GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
I– Semester

CourseTitle: **Mathematics**
(Course Code: 4300001)

Diploma program in which this course is offered	Semester in which offered
Automobile Engineering, Architecture Assistantship, Biomedical Engineering, Ceramic, Engineering, Chemical Engineering, Civil Engineering, Computer Engineering, Electrical Engineering, Electronics &Communication Engineering, Environment Engineering, Fabrication Technology, Information Technology, Instrumentation & Control Engineering, Marine Engineering, Mechanical Engineering, Mechatronics Engineering, Metallurgy Engineering, Mining Engineering, Plastic Engineering, Power Electronics Engineering, Printing Technology, Textile Designing, Textile Manufacturing Technology, Textile Processing Technology, Transportation Engineering (All branches except CACD & DM)	First

1. RATIONALE

This course of Mathematics is being introduced as a foundation which will help students in developing competency and the requisite course outcomes in most of the Diploma Engineering programs. Components of Mathematics like Algebra, Geometry, Calculus, Computer computation work as a tool to describe physical phenomena and to evaluate the merit of different possible solutions. This course is an attempt to initiate the multi-dimensional logical thinking and reasoning capabilities. It will help the students to apply the basic principles of Mathematics to solve related technology problems. The course will give the students an insight to apply and analyse the Engineering problems scientifically based on the subject of Trigonometry, Differential Calculus and Basic elements of algebra and coordinate geometry to give a comprehensive coverage at an introductory level.

2. COMPETENCY

The purpose of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

Solve broad-based technology problems using the principles of mathematics.

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with this competency are to be developed in the student to display the following COs:

a) Interpret the function graphically, numerically and analytically**.**

b) Demonstrate the ability to algebraically analyse basic functions used in Trigonometry.

c) Demonstrate the ability to Crack engineering related problems based on concepts of Vectors**.**

d) Solve basic engineering problems under given conditions of straight lines and circle.

e) Demonstrate the ability to analyze and illustrate the Functions using the concept of Limit.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
3	1	-	4	30*	70	-	-	100

(*):Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

***Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** -Practical; **C** – Credit, **CA** - Continuous Assessment; **ESE** -End Semester Examination.*

5. SUGGESTED PRACTICAL EXERCISES (During Tutorial Hours)

The following practical outcomes (PrOs) are the sub-components of the COs. *These PrOs need to be attained to achieve the Cos.*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	Solve given problems of Determinant up to order 3*3.	I	1
2	Use Open source mathematical software to demonstrate the graphs of given functions with its geometrical interpretation.	I	1
3	Use Open source mathematical software to display given logarithmic functions showing basic laws.	I	1
4	Solve the given examples based on conversion of units of Angles explaining the allied angles.	II	1
5	Crack given problems based on the concept of Compound Angles, Multiple and Submultiples angles.	II	1
6	Plot the graph of sine and cosine functions with help of Open source mathematical software and justify problems related to sum and factor formulae.	II	1
7	Use the concepts of Algebra to Solve given engineering related problems based on Magnitude of a vector.	III	1
8	Apply the concept of Dot Product to solve given engineering	III	1

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
	related problems.		
9	Explain the physical significance of the Cross Product and apply the concept to solve given engineering related problems.	III	1
10	Apply the concept of various forms of line, slope, intercept to solve simple problems.	IV	1
11	Use the concepts of equations of Parallel lines and Perpendicular lines to solve specified problems.	IV	1
12	Use the concept of Tangent and Normal to solve related engineering problems.	IV	1
13	Explain Limit of a function graphically and solve the specified problems.	V	1
14	Apply the Standard Formulae of Limit and crack the specified problems.	V	1
	Total		**14**

Note

i. *More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list.*

ii. *The following are some **sample** 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency.*

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
	Geometric Thinking: Comprehend geometric concepts to prove theorems by applying apt results to solve well defined Engineering problems.	
1.	Experiment with transformations in the plane.	30
2.	Define trigonometric ratios and solve problems involving right triangles.	30
3.	Apply theorems about circles.	40
Total		**100**

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
	Algebraic Thinking: Create, interpret, use, and analyze expressions, equations, and inequalities in a variety of contexts.	
1.	Represent, interpret, and solve variable expressions, equations, and inequalities.	60
2.	Write expressions in equivalent forms to solve problems.	40
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS AND SOFTWARE REQUIRED

These major equipment/instruments and Software required to develop PrOs are given below with broad specifications to facilitate procurement of them by the administrators/management of the institutes. This will ensure conduction of practical in all institutions across the state in proper way so that the desired skills are developed in students.

S. No.	Equipment Name with Broad Specifications	PrO.No.
1	Computer System & LCD Projector	2,3,6,10,13
2	Scientific Calculator (Display type: Natural Display Algebraic input logic: Natural V.P.A.M. Significand function: 10+2.	1,5,10

7. AFFECTIVE DOMAIN OUTCOMES

The following ***sample*** Affective Domain Outcomes (ADOs) are embedded in many of the above-mentioned COs and PrOs. More could be added to fulfill the development of this course competency.

a) Work as a leader/a team member.
b) Follow ethical practices.
c) Practice environmentally friendly methods and processes. (Environment related)

The ADOs are best developed through the laboratory/field-based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

i. 'Valuing Level' in 1st year
ii. 'Organization Level' in 2nd year.
iii. 'Characterization Level' in 3rd year.

8. UNDERPINNING THEORY

The major underpinning theory is given below based on the higher level UOs of *Revised Bloom's taxonomy* that are formulated for development of the COs and competency. If required, more such UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
Unit – I **Determinant and Function**	1a. Solve simple problems of Determinant up to order 3*3. 1b. Explain graphically the given functions. 1c. Solve simple problems using concepts of Logarithms	1.1 Determinant and its value up to 3rd order (Without properties) 1.2 Function and simple examples. 1.3 Logarithm as a function 1.4 Laws of Logarithm and related Simple examples
Unit– II **Trigonometry**	2a. Apply the concept of Compound angle, Allied angle, and Multiple angles to solve the given simple engineering problem(s) 2b. Explain the concept of Sub-Multiple and solve related problem(s). 2c. Invoke the concept of Sum and Factor formulae to solve the given simple problem(s) 2d. Investigate given simple problems using inverse Trigonometric functions.	2.1 Units of Angles (degree and radian) 2.2 Trigonometric Functions 2.3 Allied & Compound Angles, Multiple –Submultiples angles 2.4 Graph of Sine and Cosine, 2.5 Periodic Trigonometric function 2.6 Sum and factor formulae 2.7 Inverse Trigonometric function
Unit– III **Vectors**	3a. Apply the concept of algebraic operations of Vectors to solve given simple engineering problem(s) 3b. Apply the concept of Scalar and Vector product to solve specified simple problem(s) 3c. Solve problems of work done and moment of force using the concept of Vectors.	3.1 Vector, Addition, Subtraction, Magnitude and direction. 3.2 Scalar and Vector Product and it's properties 3.3 Angle between two Vectors 3.4 Applications of Scalar and Vector Product (Work Done and Moment of Force)
Unit– IV **Coordinate Geometry**	4a. Employ the equation of straight line to solve given simple problems. 4b. Apply the concept of slope and its consequences to	4.1 Straight line (Two-point form) and slope of straight line 4.2 Slope point form, Intercept form, General form of line 4.3 Condition of parallel and

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
	solve the given problems. 4c. Find the angle between two lines using the concept of Parallel and Perpendicular lines. 4d. Apply the concept of equation of circle with center and radius to solve the given problems. 4e. Solve problems related to general equation of circle based on tangent and normal.	perpendicular lines 4.4 Equations of Parallel lines and Perpendicular lines to the given lines 4.5 Angle between two lines. 4.6 Equation of circle with center and Radius. 4.7 General equation of circle. 4.8 Tangent and normal to a circle.
Unit– V **Limit**	5a. Analyse the characteristic of functions using the concept of Limit. 5b. Solve the given problems using standard formulae of Limit	5.1 Limit of a Function. 5.2 Standard formulae of Limit and related simple examples.

***Note**: The Unit Outcomes (UOs) need to be formulated at the 'Application Level' and above of Revised Bloom's Taxonomy' to accelerate the attainment of the COs and the competency.*

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Determinant and Function	9	4	7	5	16
II	Trigonometry	12	4	5	5	14
III	Vectors	7	4	6	4	14
IV	Coordinate Geometry	8	4	5	5	14
V	Limit	6	3	4	5	12
Total		42	**19**	**27**	**24**	**70**

***Legends:** R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*

***Note**: This specification table provides general guidelines to assist students for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions to assess the attainment of the UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may slightly vary from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should perform following activities in group and prepare reports of about 5 pages for each activity. They should also collect/record physical evidences for their (student's) portfolio which may be useful for their placement interviews:

a) Identify engineering problems based on real world problems relevant to content of the unit and solve these problems in the light of free tutorials available on the internet.
b) Explore the opportunity to visit Science city, ISRO or nearby Science centres.
c) Explore the opportunity to visit Mathematics Lab Virtually.
d) Prepare charts showing formulas of multiple and sub multiple trigonometric functions.
e) Use Graphing calculator to plot the graph of functions showing Engineering applications.
f) Collect set of problems based on concept of limit with real world applications and make a presentation.
g) Communicate mathematical thinking coherently and clearly to other students, peers, and others.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b) Guide student(s) in undertaking micro-projects.
c) ***'L" in section No. 4***means different types of teaching methods that are to be employed by teachers to develop the outcomes.
d) About ***20% of the topics/sub-topics*** which are relatively simpler or descriptive in nature is to be given to the students for ***self-learning***, but to be assessed using different assessment methods.
e) With respect to ***section No.10***, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
f) Explore the possibility for understanding the Biosphere through Mathematics
g) Guide students for using data manuals.

12.SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based (group of 3 to 5). However, **in the fifth and sixth semesters**, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more

COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The duration of the microproject should be about **14-16** ***(fourteen to sixteen) student engagement hours*** during the course.The students ought to submit micro-project by the end of the semester (so that they develop the industry-oriented COs).

A suggestive list of micro-projects is given here. This should relate highly with competency of the course and the COs. Similar micro-projects could be added by the concerned course teacher:

a) Draw graphs of given Functions like $2x-1, x^2, \sin x, \cos x$ etc and verify using suitable Open-source software like GeoGebra, DPLOT and GRAPH.
b) Prepare the Charts of formulae for limit, Vector, Trigonometry, Co-ordinate Geometry, and Logarithm.
c) Prepare the cardboard models based on Mathematical concepts.
d) Draw various lines, circles using GeoGebra software.
e) Prepare projects on height and distance using Trigonometry.
f) Use PHET website for simulation of Vector Algebra.
g) Prepare a presentation/seminar on any relevant topic of interdisciplinary nature.
h) Prepare a write up on the Historical path of Calculus.
i) Prepare models of graphical representation for the existence of limits of given functions.
j) Prepare charts showing formulas of multiple and sub multiple trigonometric functions and its usefulness.
k) Formulate models to describe mathematical relationships and analyze data.

13.SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Engineering Mathematics (Third edition).	Croft, Anthony	Pearson Education, New Delhi, 2014. ISBN 978-81-317-2605-1
2	A Text Book of Vector Analysis	Narayan Shanti and Mittal P.K	S. Chand Publication, ISBN 978-8121922432
3	Calculus and Analytic Geometry	G. B. Thomas, R. L. Finney	Addison Wesley, 9th Edition, 1995. ISBN 978-8174906168
4	Understanding Engineering Mathematics	John Bird	Routledge; 1st edition ISBN 978-0415662840
5	Advanced Engineering Mathematics	Krezig, Ervin	Wiley Publ., New Delhi,2014, ISBN: 978-0-470-45836-5

14.SUGGESTED LEARNING WEBSITES

a. https://www.youtube.com/channel/UCLJVrQyPYsseCf78QWCDsvA/featured
(YouTube Channel of DTEGUJ)
b. https://www.geogebra.org/?lang=en
c. https://phet.colorado.edu/
d. www.dplot.com/ - DPlot
e. www.wolfram.com/mathematica/
f. https://www.khanacademy.org/
g. www.easycalculation.com
i. www.scilab.org/ - SCI Lab
j. https://cnx.org/contents/cCXsMC7-@3.2:rOtjgdjI@5/Trigonometry
k. https://www.embibe.com/exams/real-life-applications-of-trigonometry
l. https://opentextbc.ca/calculusv1openstax/chapter/the-limit-of-a-function
m.https://www.accessengineeringlibrary.com/?implicit-login=true

15.PO-COMPETENCY-CO MAPPING

Semester I	Mathematics (Course Code: 4300001)						
	POs and PSOs						
Competency & Course Outcomes	**PO 1 Basic & Discipline specific knowledge**	**PO 2 Problem Analysis**	**PO 3 Design/ development of solutions**	**PO 4 Engineering Tools, Experimentation &Testing**	**PO 5 Engineering practices for society, sustainability & environment**	**PO 6 Project Management**	**PO 7 Life-long learning**
Competency ***Solve broad-based technology problems using the principles of mathematics.***	3	2	1	-	-	-	1
Course Outcomes CO a) Interpret the function graphically, numerically and analytically.	3	2	1	-	-	-	-
CO b) Demonstrate the ability to algebraically analyze basic functions used in Trigonometry.	3	1	1	-	-	-	1
CO c) Demonstrate the ability to Crack engineering related problems based on concepts of Vectors.	3	1	1	-	-	-	1
CO d) Solve basic engineering problems under given conditions of straight lines and circle.	3	1	-	-	-	-	-
CO e) Demonstrate the ability to analyze and illustrate the Function using the concept of Limit.	3	-	-	-	-	-	-

Legend: '**3**' for high, '**2**' for medium, **'1'** for low and **'-'** for no correlation of each CO with PO.

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

S. No.	Name and Designation	Institute	Contact No.	Email
1	Dr. N. R. Pandya I/C Principal (Retired) Head of Department	Government Polytechnic, Kheda	9099097990	nrpandyagp@gmail.com

2	Dr. N. A. Dani Sr. Lecturer	Government Polytechnic, Rajkot	9427184187	nilesh_a_d@yahoo.co.in
3	Mr. P. N. Joshi Sr. Lecturer	A.V.P.T.I, Rajkot	9924844699	pnj2004@rediffmail.com
4	Dr. J. S. Prajapati Sr. Lecturer	R.C.T.I, Ahmedabad	9426469752	jsprajapati26@gmail.com
5	Dr. Sachin J. Gajjar Lecturer	Government Polytechnic, Gandhinagar	9925362754	gjr.sachin@gmail.com
6	Dr. Nirav H. Shah Lecturer	Government Polytechnic, Jamnagar	9327632570	Nirav.hs@gmail.com

NITTTR Resource Person

S. No.	Name and Designation	Department	Contact No.	Email
1	Dr. Deepak Singh Associate Professor (Mathematics) Former Head, DAS	Department of Applied Science Education, NITTTR, Bhopal	9826991961	dsingh@nitttrbpl.ac.in

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
I– Semester

Course Title: **COMMUNICATION SKILLS IN ENGLISH**
(Course Code: 4300002)

Diploma programme in which this course is offered	Semester in which offered
ALL BRANCHES	FIRST

1. RATIONALE

Language is the most commonly used medium of self-expression in all spheres of human life – personal, social and professional. English language has become a dire need to deal successfully in the globalized and competitive market. Competency in English is need of the hour, not only for Indian industry, but also worldwide, where diploma engineers have the employable opportunity. Therefore, the basic English skills- listening, speaking, reading and writing have become almost mandatory for employability. This course intends to make the students to develop comprehension skills, improve vocabulary, use proper grammar, acquire writing skills, correspond with others and enhance skills in spoken English. Further, it is expected that each polytechnic will provide conducive environment for acquiring proficiency in communication skills among the students through English language.

2. COMPETENCY

The purpose of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Use reading, writing, speaking, listening skills to communicate effectively in English**

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with the identified competency are to be developed in the student for the achievement of the following COs:

- Use strategies to minimise barriers of effective communication.
- Construct grammatically correct sentences.
- Develop reading and listening skills in terms of fluency and comprehensibility.
- Compose different types of written communication.
- Communicate orally in a given situation with a purpose.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
2	-	2	3	30*	70	25	25	150

(*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be

taken during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

***Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **CA** - Continuous Assessment; **ESE** - End Semester Examination.*

5. SUGGESTED PRACTICAL EXERCISES

The following practical outcomes (PrOs) are the sub-components of the COs. *Some of the **PrOs** marked **'*'** are compulsory, as they are crucial for that particular CO. These PrOs need to be attained at least at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'*.

S. No.	Practical Outcomes (PrOs)	Unit No.		Approx. Hrs. required
1	Make correct sentences using tenses.	II	Any two	02
2	Compose Syntactical statements in written and Oral Communication (especially Formal Communication).	II		02
3	Make meaningful sentences using confusing words..	II		02
4	Develop listening skills through listening to recorded lectures, poems, interviews and speeches.	III		02*
5	Use antonyms and synonyms effectively in oral and written forms.	III, IV		02*
6	Use grammatically correct sentence	IV		01
7	Communicate ideas effectively and fluently in oral and written communication.	IV, V		02*
8	Apply idioms and one word substitute effectively in oral and written forms of communication.	IV, V		01
9	Articulate vowels, consonants and diphthongs correctly.	V		02*
10	Syllable and Syllable Stress	V		02
11	Speak with appropriate intonation, voice modulation, pitch, speed and volume.	V		02
12	Participate in conversations (GD /meetings etc.)	V		02*
13	Deliver the presentation effectively in the class.	V		02*
14	Communicate effectively through verbal and non-verbal means of communication.	V		02*
15	Practice online exercises for listening and reading comprehension.	V		02*
16	Perform role play and mock interview	V		02
	Total			**28**

Note

i. *More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list.*
ii. *The following are some **sample** 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency.*

Oral Communication

Each student performance will be evaluated on the basis of the sample Performance Indicators given below:

S. No.	Sample Performance Indicators for the PrOs (Oral communication)	Weightage in %
1	Pronunciation	20
2	Use of language (simple or decorated language)	20
3	Syntax (Sub-Verb Agreement, types of sentences, Modals etc.)	20
4	Use of appropriate Vocabulary	15
5	Fluency (Ease and speed of the flow of speech)	15
6	Audibility	10
Total		**100**

Written Communication

Each student performance will be evaluated on the basis of the sample Performance Indicators given below:

S.No.	Sample Performance Indicators for the PrOs (Written communication)	Weightage in %
1	Content(ideas expressed)	25
2	Use of language (Organisation of the content)	20
3	Grammar • Syntax (Sub-Verb Agreement) • Diction (choice and use of words) • Control of the basic grammatical patterns	20
4	Style • Choice of sentence structures • Use of appropriate sentence structures	20
5	Mechanics (Use of punctuations, Capitalization, paragraphing, italicizing)	15
Total		**100**

Listening skills

Each student performance will be evaluated on the basis of the sample Performance Indicators given below:

S.No.	Sample Performance Indicators for the PrOs (Listening skills)	Weightage in %
1	Enthusiasm for patient listening	15
2	Attentive listening	20
3	After listening, each student has to summarize • Accuracy of facts and figures. • Description of places and situations.	40
4	Para- phrasing of the listened texts.	25
Total		**100**

Reading Skills

Each student performance will be evaluated on the basis of the sample Performance Indicators given below:

S.No.	Sample Performance Indicators for the PrOs (Reading Skills)	Weightage in %
1	Reading correctly with clarity	30
2	Correct pronunciation	20
3	Comprehension of a vocabulary and deriving meaning of information	15
4	Reading speed	20
5	Drawing correct conclusion and valid inference	15
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS AND SOFTWARE REQUIRED

These major equipment/instruments and Software required to develop PrOs are given below with broad specifications to facilitate procurement of them by the administrators/management of the institutes. This will ensure conduction of practical in all institutions across the state in proper way so that the desired skills are developed in students.

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	Computer systems windows 7 or above with internet connectivity	All
2	Headphones with speakers	All
3	LCD Projector	All
4	Language lab software	All

7. AFFECTIVE DOMAIN OUTCOMES

The following ***sample*** Affective Domain Outcomes (ADOs) are embedded in many of the above mentioned COs and PrOs. More could be added to fulfill the development of this course competency.

a) Work well as a leader/a team member.
b) Follow ethics
c) Demonstrate human concern.

The ADOs are best developed through the laboratory/field based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy'

should gradually increase as planned below:

i. 'Valuing Level' in 1st year
ii. 'Organization Level' in 2nd year.
iii. 'Characterization Level' in 3rd year.

8. UNDERPINNING THEORY

The major underpinning theory is given below based on the UOs of *Revised Bloom's taxonomy* that are formulated for development of the COs and competency. If required, more such UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)		Topics and Sub topics
	Writing Skills	**Speaking Skills**	
Unit 1 **Theory of Communi-cation**	1a. Define the theory of communication 1b. State different types of communication. 1c. Explain barriers in communication	1d. Communicate effectively	**1.1** Concept of effective communication and communication skills **1.2** Basic communication model(S+M+C+R+F) **1.3** Types of communication **1.4** Barriers of effective communication
Unit 2 **Grammar**	2a. Identify different parts of speech and their usage in the sentence.	2f. Choose appropriate parts of speech for day to day communication.	**2.1 Parts of Speech** Noun, Pronoun, Verb, Adjective, Adverb and Interjection- Meaning and Examples (Recapitulation) Prepositions- In, into, On, At, for, Since, between, among, to, towards Connectors - If, Unless, Otherwise, Because, Therefore, Who, Which, Where, When, Why.
	2b. Apply correct verbs in the given sentence	2g. Use grammatically correct sentence in day to day communication	**2.2 Tenses** **2.2.1 Present Tense** (Simple, Continuous, Perfect, Perfect Continuous) **2.2.2 Past Tense** (Simple, Continuous, Perfect) **2.2.3 Future Tense** (Simple)
	2c. Use appropriate Modal Auxiliaries in a given expression.	2h. Choose appropriate Modals in situations where different modes of expressions are used.	**2.3 Modal Auxiliaries** (Can, Could, May, Might, Shall, Should, Will, Would, Must, Have to, Ought to)

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)		Topics and Sub topics
	Writing Skills	**Speaking Skills**	
	2d. Choose the correct verb for the given subject.	2i. Use the correct verb depending on the subject in a sentence.	**2.4 Subject- Verb Agreement**
	2e. Identify basic sentence patterns of English and form sentences in correct word order.	2j. Use correct word order in their speech.	**2.5 Basic Sentence Patterns of English** (Explanation of S, V,O,A,C) S-Subject, V-Verb, O-Object, A-Adverbial and C- Complement Four Basic Sentence Patterns • S+V • S+V+O • S+V+A • S+V+C
Unit 3 **Prose and Poetry**	3a. Realise the central idea of the literary piece. 3b. Formulate sentences using new words. 3c. Enrich vocabulary through reading. 3d. Write short as well as long answers to questions. 3e. Express ideas in English in written form effectively	3f. Explain the content of the passage/story in the class. 3g. Ask appropriate questions as well to answer them. 3h. Follow oral instructions and interpret them to others. 3i. Present topics effectively and clearly. 3j. Use dictionary, thesaurus and other reference books. 3k. Describe an object or product. 3l. Use correct pronunciation and intonation. 3m. Give instructions orally.	**3.1. Prose** The Leopard- Ruskin Bond **3.2. Short Story** After Twenty Years- O Henry **3.3. Poetry** • Stopping by Woods on Snowy Evening-Robert Frost • Where the Mind is Without Fear- Rabindranath Tagore **3.4 Language components:** Language components should be integrated with: • Passages from text book/Work book. • Unseen passages Reading with correct pronunciation.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)		Topics and Sub topics
	Writing Skills	**Speaking Skills**	
			3.5 Vocabulary Items: • Matching items (Word and its Meaning) • One-Word Substitution • Phrases and Idioms • Synonyms and Antonyms
Unit 4 **Techniques of Writing**	4a. Compose emails on given topics/ situations. 4b. Write a paragraph in words with synchronized sentence structure on the given situation / topic. 4c. Answer the questions on the given unseen passage. 4d. Summarize the given unseen passage .	4e. Face oral examinations and interviews. 4f. Grasp the main idea of any conversation and communicate accordingly.	**4.1 Email Writing** (Business) Format and Sample Enquiry, Orders and complaints Examples for Practice **4.2 Letter writing** • Types of letters, • Formats of Letters • Qualities of a good letter • Sample letters such as: - Job applications/ Cover Letter - Leave applications, Complaints, - Purchase orders, Enquiries replies etc.
Unit 5 **Mechanics of Speaking**	5a. Develop a welcome and farewell speech for the given theme/ situation. 5b. Prepare a speech for introducing a guest in the given situation. 5c. Make a weather report for the given condition .	5d. Introduce oneself with correct pronunciation, intonation, using verbal and non-verbal gestures. 5e. Speak in specified formal situations with correct pronunciation. 5f. Speak in specified informal situations with correct	**5.1 Public speaking** • Basics of Speaking • Importance of public speaking • Characteristics of good speech **5.2 Samples for Practice:** • Welcome speech • Farewell speech • Introducing oneself and another. • Discussing Weather • Disposal of E -Waste

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)		Topics and Sub topics
	Writing Skills	Speaking Skills	
		pronunciation.	• Environmental protection through non-use of Plastic • Reduction of Noise pollution by vehicles. • Conversation with the Cashier- College/ bank • Telephonic Conversations (Formal and Informal).

9. SUGGESTED SPECIFICATION TABLE FOR QUESTIONPAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A	Total Marks
I	Theory of Communication	04	03	04	03	10
II	Grammar	10	07	14	06	27
III	Prose and Poetry	09	04	07	08	19
IV	Techniques of Writing	05	03	04	07	14
V	Mechanics of Speaking	0	-	-	-	-
Total		**28**	**17**	**29**	**24**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*

Note*: This specification table provides general guidelines to assist students for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions to assess the attainment of the UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may slightly vary from above table.*

10 SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should perform following activities in group and prepare reports of about 5 pages for each activity. They should also collect/record physical evidences for their (student's) portfolio which may be useful for their placement interviews:

- The experiments should be properly designed and implemented with an attempt to develop different types of skills leading to the achievement of the competency.
- Initiating a conversation with a new comer to your college.
- Assignments using Internet. (Online Listening/Speaking/Vocabulary based exercises and uploading their score, etc. (Teacher can decide how to use various online platforms for evaluation purpose.

- Self-learning Activities using mobile apps/internet
- Discuss current affairs in English with your friends.
- Read storybooks and learn new words and sentence structures.
- Write a brief report on current environmental issues.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b) Guide student(s) in undertaking micro-projects.
c) Comprehension of passage and making presentation can given to the students for ***self-learning***, but to be assessed using different assessment methods.
d) Guide students on how to address issues on environment and sustainability using the knowledge of this course

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based (group of 3 to 5). However, **in the fifth and sixth semesters**, the number of students in the group should **not exceed three**.

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The duration of the microproject should be about **14-16 (fourteen to sixteen) student engagement hours** during the course. The students ought to submit micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. This should relate highly with competency of the course and the COs.Similar micro-projects could be added by the concerned course teacher:

a) Book review – students should read a book and then write his reviews about the book and present it in the class.
b) Presentation – Prepare a presentation regarding current problems of environment and present it in the class,
c) Mock interviews. – Interviews conducted by students and for the students.
d) Skit or role play- write the script and present it in the class
(can be asked to take topic related to environment and pollution)
e) Find out 20 new words out of a given story, write its synonym and use the word in your own sentence.
f) Draft a story according to a given picture.
g) You are in the village fair. Describe what is happening around you in present continuous tense. (Celebration of Annual Day – past tense. etc)
h) Write a paragraph about your first day in college.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Living English Structures	W. S. Allen	Pearson Education India 1992 ISBN: 9788131728499
2	Essentials of English Grammar and Composition	N. K. Aggrawal	Goyal Brothers Prakashan 2015 ISBN : 8183896162
3	English Grammar at Glance	M. Gnanamurali	S. Chand & Co. Ltd. 2010 ISBN : 9788121929042
4	Effective English	E. Suresh Kumar & Others	Pearson 2010 ISBN : 9788131731000
5	English Communication for Polytechnics	S. Chandrashekhar & Others	Orient BlackSwan 2013 ISBN : 8125037462
6	English Fluency Step 1 & 2	-	Macmillan 2010 ISBN : 9781405003650 9781405003667
7	Active English Dictionary	-	Longman 1991 ISBN : 8131707865
8	The Pronunciation of English	Daniel Jones	Cambridge: Cambridge University Press, 4th Edition 1956 ISBN : 0521093694
9	Ed. English Pronouncing Dictionary	James Hartman & et al.	Cambridge: Cambridge University Press.17th Edition 2006 ISBN : 0521680867
10	Effective Communication Skills	Kulbhushan Kumar	Khanna Publishing House, New Delhi (Revised Ed. 2018) ISBN : 9789382609940
11	Better English Pronunciation	J.D.O'Connor	Cambridge: Cambridge University Press 1982 ISBN : 0521231523
12	An English Grammar: Comprehending Principles and Rules	Lindley Murray	Franklin Classics (10 October 2018). ISBN : 0342097008
13	Examine your English	Margaret M. Maison	Orient Longman: New Delhi, 1964 ISBN : 812500176X
14	A Practice Course in English Pronunciation	J.Sethi & et al	New Delhi: Prentice Hall, 2004 ISBN : 9788120325944
15	Technical Communication: A Practical Approach.	Pfeiffer, William Sanborn and T.V.S Padmaja	Delhi: Pearson, 2007. ISBN : 9788131700884

14. SUGGESTED LEARNING WEBSITES

- https://learnenglish.britishcouncil.org
- http://www.free-english-study.com/
- http://www.english-online.org.uk/course.htm
- http://www.english-online.org.uk/
- http://www.talkenglish.com/
- http://www.learnenglish.de/
- https://www.cambridgeenglish.org/exams-and-tests/linguaskill/
- https://dictionary.cambridge.org/dictionary/english/
- https://www.oxfordlearnersdictionaries.com/definition/academic/
- https://learnenglishkids.britishcouncil.org/

15. PO-COMPETENCY-CO MAPPING

Semester I	**Communication Skills in English (Course Code: 4300002)**						
	POs						
Competency & Course Outcomes	**PO 1 Basic & Discipline specific knowledge**	**PO 2 Problem Analysis**	**PO 3 Design/ develop-ment of solutions**	**PO 4 Engineer-ing Tools, Experimen-tation & Testing**	**PO 5 Engineering practices for society, sustain-ability & environment**	**PO 6 Project Manage-ment**	**PO 7 Life-long learning**
Competency	**Use reading, writing, speaking, listening skills to communicate effectively in English**						
Course Outcomes Students will be able to: CO a). Use strategies to minimise barriers of effective communication	-	-	-	-	-	2	2
CO b) Construct grammatically correct sentences.	2	-	-	-	-	2	2
CO c) Develop reading and listening skills in terms of fluency and comprehensibility	1	-	-	-	-	-	1
CO d) Compose different types of written communication.	2	-	-	-	-	2	2
CO e) Communicate orally in a given situation with a purpose.	2	-	-	-	-	2	2

Legend: '**3'** for high, '**2**' for medium, **'1'** for low and **'-'** for no correlation of each CO with PO.

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

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GUJARAT TECHNOLOGICAL UNIVERSITY

DIPLOMA PROGRAMME

IN

ENGINEERING AND TECHNOLOGY

WORKBOOK

OF

COMMUNICATION SKILLS IN ENGLISH

IMPORTANT NOTE:

This workbook is prepared for purely academic purpose only. The authors have used various open web sources and books for content creation. The aim is to help students by providing them learning material and ample exercises for practice. This book is designed for smooth functioning of the course. The content of this text must not be used for any kind commercial purpose.

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INDEX

SECTION 1

THEORY OF COMMUNICATION

What are communication skills?

Definition:

Communication skills are the abilities you use when giving and receiving different kinds of information. Some examples include communicating new ideas, feelings or even an update on your project. Communication skills involve listening, speaking, observing and empathising. It is also helpful to understand the differences in how to communicate through face-to-face interactions, phone conversations and digital communications like email and social media.

A deep understanding of the process of communication and communication skills is essential. It is vital to the success of any individual in any business. Here we shall see some of the many types of communication.

Communication styles change from person to person. During the process of communication, a person may invoke several channels or modes or methods to convey a message. But, the process of communication doesn't only depend on the source producing or relaying information.

It also equally depends on the communication method and the manner in which the receiver understands the message. Let us first understand Basic Model Of Communication

Basic Communication Model :

The sender-message-channel-receiver (SMCR) model of communication is an expansion of the Shannon-Weaver model of communication. David Berlo created this model.

According to the Shannon-Weaver model, communication includes the following concepts: sender, encoder, channel, decoder, receiver and feedback. Furthermore, there is also concept of "noise", which affects the communication process going through the channel and makes the message more difficult to understand by the receiver. Each of those concepts are defined as follows:

Sender: the originator of message.

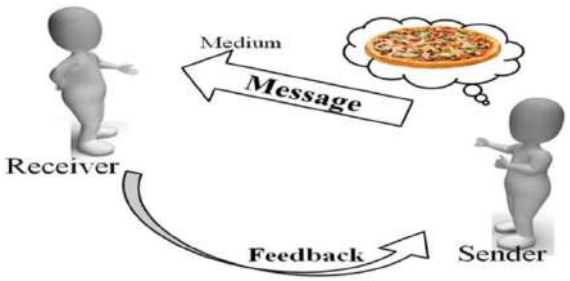
Encoder: the transmitter which converts the message into signals (the way message is changed into signals, for example sound waves).

C**hannel**: the signal carrier or medium

Decoder: the reception place of the signal which converts signals into message. Decoding is done by the receiver when he gets the message.

Receiver: the recipient of the message from the sender. He usually gives feedback to the sender in order to make sure that the message was properly received.

Noise the message, transferred through a channel, can be interrupted by external noise (for instance, conversation may be interrupted by thunder or crowd noise).
Feedback: The receiver can get an inaccurate message. This is why feedback from the receiver is important in case the message is not properly received. Furthermore, the noise can also affect the decoding of the message by the receiver.



Communication begins at a given point. The first step is the generation of information. The second step is to put this information or data into a medium for transmission towards the intended audience.

During this process, the initiator of the communication must pay extra attention to the nature of the information. The communication skills will determine the effectiveness of their communication.

Types:

On the basis of the communication channels, types of communications are:

A. Verbal

B. Non-Verbal

C. Visual

Verbal

This involves the use of language and words for the purpose of passing on the intended message. In general terms, Verbal Communication means communication in the form of spoken words only. But, in the context of types of communication, verbal communication can be in the spoken or the written form. Thus, the verbal form may be oral or written as discussed below.

- **Written Communication:** This kind of communication involves any kind of exchange of information in the written form. For example, e-mails, texts, letters, reports, SMS, posts on social media platforms, documents, handbooks, posters, flyers, etc.
- **Oral Communication:** This is the communication which employs the spoken word, either direct or indirect as a communication channel. This verbal communication could be made on a channel that passes information in only one form i.e. sound.
  You could converse either face to face, or over the phone, or via voice notes or chat rooms, etc. It all comes under the oral communication. This form of communication is an effective form.

Non-Verbal Communication

In this type of communication, messages are relayed without the transmission of words. The messages here are wordless messages. This form of communication mainly assists verbal communication. It supplements it with gestures, body language, symbols, and expressions.

Through these, one may communicate one's mood, or opinion or even show a reaction to the messages that are relaying. One's non-verbal actions often set the tone for the dialogue. You can control and guide the communication if you control and guide the non-verbal communication. Some of the modes of non-verbal communication are:

Physical Non-verbal Communication

This is the sum total of the physically observable. For instance, hand gestures, body language, facial expressions, the tone of one's voice, posture, stance, touch, gaze, and others. Several researchers have revealed that physical nonverbal communication constitutes about 55% of our daily communications.

These are subtle signals that are picked up as part of our biological wiring. For example, if you rest your head on your palms, it will mean that you are very disappointed or angry. Similarly, other subtle hints will convey your reaction to the presenter or your audience's reaction to you.

Paralanguage

This is the art of reading between the lines. The main kind of such communication is done with the tone of one's voice. This kind of communication amounts to almost 38% of all the communication that we do every day. Along with the tone of voice, the style of speaking, voice quality, stress, emotions, or intonation serves the purpose of communication. And, these aspects are not verbal.

Visual:

Visual communication is the transmission of information and ideas using symbols and imagery. It is one of three main types of communication, along with verbal communication (speaking) and non-verbal communication (tone, body language, etc.). Visual communication is believed to be the type that people rely on most, and it includes signs, graphic designs, films, typography, and countless other examples. Visual communication can be represented in the form of a graph, a map, a chart, a Vann diagram, a pie chart, a model, a table, or even multimedia like gifs, videos, and images.

Barrier To Communication:

There are many reasons why interpersonal communications may fail. In many communications, the message (what is said) may not be received exactly the way the sender intended. It is, therefore, important that the communicator seeks feedback to check that their message is clearly understood.

The skills of Active Listening, Clarification and Reflection may help but the skilled communicator also needs to be aware of the barriers to effective communication and how to avoid or overcome them.

There are many barriers to communication and these may occur at any stage in the communication process. Barriers may lead to your message becoming distorted and you therefore risk wasting both time and/or money by causing confusion and misunderstanding.

Effective communication involves overcoming these barriers and conveying a clear and concise message. Common Barriers to Effective Communication:

- The use of jargon. Over-complicated, unfamiliar and/or technical terms.
- Emotional barriers and taboos. Some people may find it difficult to express their emotions and some topics may be completely 'off-limits' or taboo. Taboo or difficult topics may include, but are not limited

to, politics, religion, disabilities (mental and physical), racism and any opinion that may be seen as unpopular.

- Lack of attention, interest, distractions, or irrelevance to the receiver. Differences in perception and viewpoint.
- Physical disabilities such as hearing problems or speech difficulties.
- Physical barriers to non-verbal communication. Not being able to see the non-verbal cues, gestures, posture and general body language can make communication less effective. Phone calls, text messages and other communication methods that rely on technology are often less effective than face-to-face communication.
- Language differences and the difficulty in understanding unfamiliar accents.
- Expectations and prejudices which may lead to false assumptions or stereotyping. People often hear what they expect to hear rather than what is actually said and jump to incorrect conclusions.
- Cultural differences. The norms of social interaction vary greatly in different cultures, as do the way in which emotions are expressed. For example, the concept of personal space varies between cultures and between different social settings.
- A skilled communicator must be aware of these barriers and try to reduce their impact by continually checking understanding and by offering appropriate feedback.

Note: MCQs of 07 Marks to be asked from this Unit in GTU Exam so practice MCQS.

Practice Questions:

1) What is communication?

a. Communication is the means by which we stay in touch with other people and know what is happening in the world around us

b. Communication is the expression of ourselves in the form of verbal discussion

c. Communication is the varying ways in which we express ourselves

d. Communication is the various mediums we use for interaction

e. Communication is talking, listening, and interacting

2) True of False: All communication is verbal

a. True

b. False

3) What is non-verbal communication?

a. Non-verbal communication is another term for using body language

b. Non-verbal communication is about exchanging information without speaking words

c. Non-verbal communication is another term for written communication

d. Non-verbal communication is for people who cannot speak or hear

4)Which of the following is NOT a form of non-verbal communication?

a. Touch

b. Facial expressions

c. Physical proximity

d. Skype

e. Sign language

5) Which of the following is an example of body language?

a. Facial expression

b. Eye contact

c. Posture

d. Gestures

e. All of the above

6) What is paralanguage?

a. Language for the disabled

b. How something is said, rather than what is said

c. What is said, rather than how it is said

d. When how something is said matches what is being said

e. When how something is said does not match what is being said

7) Factors that influence communication, may become what to effective communication?

a. Barriers

b. Obstacles

c. Enhances

d. Improvements

e. Challenges

8) How will you know if communication was successful?

a. The person smiles and gives open body language

b. The person answers

c. It has the desired outcome

d. The person is agreeable

e. The person tells you

9) What does effective communication require?

a. Purpose or reason

b. Strategy or way of communicating

c. Acknowledgement

d. Feedback

e. All of the above

10) What is efficient communication?

a. Talking quickly and using minimal words to get the point across

b. Spending the minimum amount of time and effort to get the communication message across successfully

c. Ensuring that the message is understood and being thorough enough to get the point across

d. Being able to convey a message with just body language and gestures

e. Being able to use jargon and abbreviations while still being understood

SECTION 2

GRAMMAR

Unit 1

PARTS OF SPEECH

The **part of speech** explains how a word is used in a sentence. The part of speech indicates how the word functions in meaning as well as grammatically within the sentence. An individual word can function as more than one part of speech when used in different circumstances. Understanding parts of speech is essential for determining the correct definition of a word when using the dictionary.

There are eight main parts of speech (also known as word classes): **nouns, pronouns, adjectives, verbs, adverbs, prepositions, conjunctions** and **interjection**

NOUN - (Naming word)

A noun is the name of a person, place, thing or idea.

Examples of nouns: Daniel, London, table, dog, teacher, pen, city, happiness, hope

Example sentences: **Steve** lives in **Sydney**. **Mary** uses **pen** and **paper** to write **letters**

Practice Exercise:

Apply suitable nouns.

1. …..is late today.

2. ….is very expensive these days.

3. He has a blue ….

4. They are very good friends. Their ….is example for many of us.

5. The …..addressed the gathering.

PRONOUN - (Replaces a Noun)

A pronoun is used in place of a noun or noun phrase to avoid repetition.

Examples of pronouns: I, you, we, they, he, she, it, me, us, them, him, her, this, those

Example sentences: Mary is tired. **She** wants to sleep. **I** want **her** to dance with **me**.

Practice Exercise:

Apply suitable pronouns.

1 .I know Mr. James. ….is a very good doctor.

2. Please look after my family members. ….have arrived here today only.

3. Dr. Ranjana was my professor. ….received many awards.

4. Have you seen ….book?

5. The peacock is a beautiful bird. ….feathers are colourful.

ADJECTIVE - (Describing word)

An **adjective** describes, modifies or gives more information about a noun or pronoun.

Examples: big, happy, green, young, fun, crazy, three

Example sentences: The **little** girl had a **pink** hat.

Practice Exercise:

Apply suitable adjectives.

1. I saw a …..truck on the road.
2. There are ….buildings in mega cities.
3. The garden has ……flowers.
4. My friend is wearing a ….shirt.
5. ….students get good marks.

VERB - (Action Word)

A **verb** shows an action or state of being. A verb shows what someone or something is doing.

Examples: go, speak, run, eat, play, live, walk, have, like, are, is

Example sentences: I **like** Woodward English. I **study** their charts and **play** their games.

Practice Exercise:

Apply suitable verbs.

1. Samarth …to college daily.
2. Children …in the garden.
3. We ….newspapers.
4. The manager ….the meeting.
5. I ….this temple everyday.

ADVERB - (Describes a verb)

An **adverb** describes/modifies a verb, an adjective or another adverb. It tells how, where, when, how often or to what extent. Many adverbs end in -LY

Examples: slowly, quietly, very, always, never, too, well, tomorrow, here

Example sentences: I am **usually** busy. **Yesterday**, I ate my lunch **quickly**.

Practice Exercise:

Apply suitable adverbs.

1. The boy ran …..
2. They sang the song …..

3. Rahul can play cricket …..

4. The teacher is teaching this topic …

5. We should listen to this news …..

PREPOSITION - (Shows relationship)

A **preposition** shows the relationship of a noun or pronoun to another word. They can indicate time, place, or relationship.

Examples: at, on, in, from, with, near, between, about, under

Example sentences: I left my keys **on** the table **for** you.

In, On, At, into , for, Since, between, among, to, towards

In:

Use 1: When talking about time, we use 'in' when referring to an unspecific time of the day, a month, a season or a year.

- I always brush my teeth **in** the morning.
- My birthday is **in** June.
- It's always cold **in** winter.
- My brother was born **in** 1999.

Use 2: When talking about places, 'in' is used to indicate a location or place. Here are a few examples:

- "Mumbai is **in** India.
- I am **in** my room.

ON

Use 1: The word 'on', when talking about time, is for specific dates and days.

- He was born **on** September 24th.
- I go to the gym **on** Mondays and Wednesdays.

Use 2: When talking about places, 'on' is used when we are speaking about a surface. Something is on the surface of something else.

For example:

- The papers are **on** the coffee table.
- "I left the keys **on** the counter."

AT

Use 1: When talking about time, 'at' is used for a specific time.

- I will see you **at** 8:00 pm.
- My interview is **at** 3:00 pm.

Use 2: When talking about places, ‘at’ is used to indicate a specific place.

- We are meeting **at** the cafe.
- The football game is **at** the stadium.

INTO:

Used for showing movement: entering a place, building, or vehicle

- Hundreds of athletes marched into the stadium for the opening ceremony.
- She got into her car and drove away.

FOR:

It describes duration. It means “From the start of the period to the end of the period. so it is used for suggesting period of time.

- He has been living in Ahmedabad for several months .
- Usha has worked here for 10 years.

SINCE:

It defines a point in time in the past. It means “From a point in the past until now.”

- He has been watching TV **since 7 pm**.
- Mohan had been writing a book **since 2010**

BETWEEN:

Between is usually used with **two** separate and distinct things.
For example:

- The treasure is between the palm tree and the hut.
- Our holiday house is between the mountains and the sea.

AMONG :

Among is used with separate and distinct things **more than two**. It is used to portray the idea of being in a group or in the midst of a group. For example:

- I want to live among like-minded people.
- Share these sweets among yourselves.
-

TO :

Use 1. It is used to indicate a destination or direction:

- .Does he want to come to the park with us?

Use 2. It is used to indicate time

- Her train arrives at quarter to five.

TOWARDS:

It means in the direction of somebody/something

- They were heading towards the garden.

Sample Exercise:

1. He lives --- Hyderabad.
2. He started --- six --- the morning.
3. . The child has been missing --- yesterday.
4. The mail train is due --- 3 P.M.
5. He travelled thirty kilometres --- two hours.
6. the flower pot was kept….the shelf …the room.
7.. --- last month I have seen him but once.
8. The four friends shared the food ….themselves.
9. I saw him running ….the market.
10. The boy jumped .. the river to save the child.

CONJUNCTION - (Joining word)

A conjunction joins two words, ideas, phrases or clauses together in a sentence and shows how they are connected.

Examples: and, or, but, because, so, yet, unless, since, if.

Example sentences: I was hot and exhausted but I still finished the marathon.

Connectors - ,

If, Unless, Otherwise, Because, Therefore, Who, Which, Where, When, Why.
If & Unless
It shows Condition. if + present simple+ modal verb with future meaning

- If the weather improves, we'll go for a walk.
- Rama will go if Hari goes.

Unless means something similar to 'if … not'

- We'll go to the coast tomorrow unless it rains.
- Grievances cannot be redressed unless they are known.

Otherwise:
It is used to show what the result will be if the thing or condition, mentioned before, does not occur.

- Take your umbrella, **otherwise** you will get wet.

Because:
It connects the result of something with its reason.

- She spoke quietly because she didn't want her friend to hear.

Therefore:
It indicates the cause or result of a situation.

- I studied for long hours, therefore I got very high marks from the final exams.

Who
It is used to introduce a new part of a sentence about a **person** that was mentioned before.

- Mr. Mathur, who is a professor is known to me.

Which
It is used to introduce a new part of a sentence about a **thing** that was mentioned before.

- The book which you bought yesterday is very useful.

Where

It is used to introduce a new part of a sentence about a **place** that was mentioned before.

- The place where players are staying is a five star resort.

When:

It is used to introduce a new part of a sentence about **time** that was mentioned before

- The time when you called me, I was in a meeting.

Why:

It is used to introduce a new part of a sentence about **reason** that was mentioned before

- The officer told us the reason why he was in urgency to leave.

Practice exercise:

Join the sentence groups using suitable connectors.

1. He passed the exam. He had a good teacher.
2. I do not eat meat. I do not eat eggs.
3. She is poor. She is honest.
4. I can not tell you the reason. I will not attend the function.
5. I felt ill. I went on working.
6. Rohit scored a century. India won the match.
7. The car was badly damaged in the accident. It needs repair.
8. We feel bored. We go to the movies to relieve our boredom.
9. Mohit must give in. He must also apologize. Jatin will not forgive him otherwise.
10. The children were playing hide-and-seek.. The rain came down suddenly.

INTERJECTION - (Expressive word)

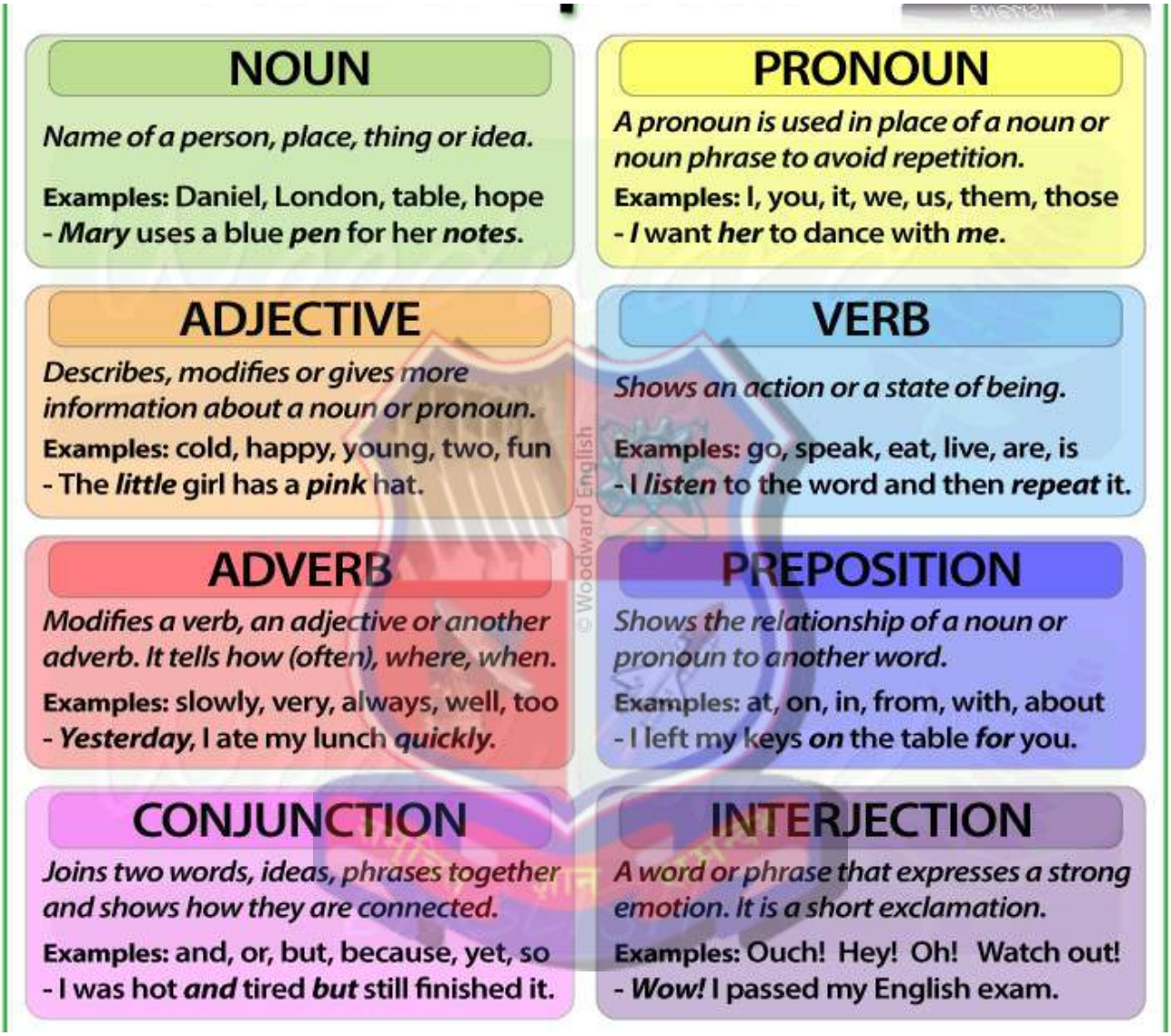
An interjection is a word or phrase that expresses a strong feeling or emotion. It is a short exclamation.

Examples: Ouch! Wow! Great! Help! Oh! Hey! Hi!

- Wow! I passed my English test.
- Great!
- Ouch! That hurts

Summary chart

Parts Of Speech



Practice Exercise:

To solve this exercise, you have to identify the noun, pronoun, verb, adverb, adjective, preposition, conjunction, interjection in the given sentences.

Tom went to market to buy books (_____).

He went to the market but (_____) did not buy new books.

I **liked** (_____) **him** (_____) better than he likes me.

A smart girl was dancing **quickly** (_____).

She (_____) eats apples in the morning daily.

When he was **sitting** (_____) on the grass, a snake bit him.

You (_____) caught him by his arm.

A **rich** (_____) lady bought a **beautiful** (_____) necklace.

Hurrah! (_____) I have passed the examination.

The cat is sitting **under** (_____) the chair.

Alas! (_____) I could not receive you.

The body of the cage is made of **iron**. (_____)

It is not **your** (_____) pen; it is hers.

There is still some milk **in** (_____) the jug.

Jimmy is **performing** (_____) his duties diligently.

The drawing made by you is **almost** (_____) perfect.

I shall not go **unless** (_____) you allow.

The road is **to** (_____) go by.

The flowers smell **sweet**. (_____)

He **frequently** (_____) goes to the beach.

UNIT 2. TENSES

In grammar, tense is a category that expresses time reference with reference to the moment of speaking. Tenses are usually manifested by the use of specific forms of verbs, particularly in their conjugation patterns. It is very essential to have knowledge of tenses for correct use of a language to establish effective communication.

There are three types of Tenses- **Present, Past and Future.**

Example:

- We watch movies every weekend. - Present Tense
- He wrote an application for that job yesterday. - Past Tense
- You will complete the project by next month. – Future Tense

Present Tense – The verb in present tense refers to the present time.

Past Tense- The verb in past tense refers to the past time.

Future Tense- The verb in future tense refers to the future time.

The tense of a verb shows not only time of action but also the state of action referred to. Each of these Tenses has four sub tenses-

1) **Simple,**
2) **Continuous,**
3) **Perfect and**
4) **Perfect Continuous Tense.**

Simple or Indefinite Tense:

Here the verb specifies the simple action, without anything being said about the completeness or incompleteness of the action.

Sub Tense	Person	Singular	Plural
Present	First person	I speak	We speak
	Second person	You speak	You speak
	Third person	He / She / It speaks	They speak
Past	First person	I Spoke	We spoke
	Second person	You spoke	You spoke
	Third person	He / She / It spoke	They spoke
Future	First person	I shall speak	We shall speak
	Second person	You will speak	You will speak
	Third person	He / She / It will speak	They will speak

Continuous/Progressive Tense:

Here the verb indicates incomplete or continuous action.

Sub Tense	Person	Singular	Plural
Present	First person	I am speaking	We are speaking
	Second person	You are speaking	You are speaking
	Third person	He / She / It is speaking	They are speaking
Past	First person	I was speaking	We were speaking

	Second person	You were speaking	You were speaking
	Third person	He / She / It was speaking	They were speaking

Perfect Tense:

Here the verb shows that the action is completed or perfect.

Sub Tense	Person	Singular	Plural
Present	First person	I have spoken	We have spoken
	Second person	You have spoken	You have spoken
	Third person	He/she/it has spoken	They have spoken
Past	First person	I had spoken	We had spoken
	Second person	You had spoken	You had spoken
	Third person	He/ she/ it had spoken	They had spoken

Perfect Continuous Tense:

Here the verb shows that the action started in past and still it is in progress.

Sub Tense	Person	Singular	Plural
Present	First person	I have been watching	We have been watching
	Second person	You have been watching	You have been watching
	Third person	He/she/it has been watching	They have been watching

USES OF TENSES :-

Present Tense [Simple Present Tense]

It is used:

i. To express a habitual action or an action happens regularly.
Examples:
- The manager gets up at five and starts work at seven
- Umesh practices the piano every day.

ii. For universal or general truth.
Examples:
- The earth turns 360º every day.
- Antarctica is covered with ice.

iii. In narrative such as sports events or demonstrations (substitute for the simple past). Examples:
- Virat catches the ball and he throws it to the wicket.
- First I put some butter in the pan and turn on the cooker.

iv. To express a future event that is part of a fixed timetable.
Examples:
- The train leaves at 03.00 pm sharp.
- The flight is at 07.00 tomorrow morning.

v. To state the facts and things in general that is always true.
Examples:
- India is a rich source of herbs.
- Gold isn't liquid at room temperature.

vi. In exclamatory sentences beginning with 'here' and 'there'.
Examples:
- There goes your trainer!
- Here comes the train you are waiting for!

vii. To introduce quotations.
Example:
- Swami Vivekananda says, "Arise, awake and do not stop until the goal is reached".

viii. Instead of the simple Future Tense in clauses of time and condition
Examples:
- I shall wait till you finish your lunch.
- If you heat water to 100 degrees, it boils.

Present Tense [Present Continuous Tense]

It is used:

i. To indicate an action that is happening at the moment of speaking.
Examples:
- I am just leaving office. I'll be home in an hour.
- Please be quiet. The children are sleeping.

ii. To indicate an action which may not happening at the time of speaking.
Examples:
- Aren't you teaching at the university now?
- At two in the afternoon, we are eating lunch.

iii. For definite future arrangements.
Examples:
- We are going to the beach at the weekend.
- I am not going to the party tonight.

iv. For habits that are not regular, but that happen very often. (an adverb like 'always', 'continuously' or 'constantly' are used)
Example:
- You are continuously losing your keys.
- She is constantly missing the train.
- Adhiraj is always smiling.

v. Verbs which refers to state rather than actions or progress, are not normally used in the continuous form in the present tense:
a) Perceptions: feel, smell, hear, taste, see
b) Emotions: want, wish, envy, fear, dislike, hate, hope, like, love regret, hope, refuse.
c) Thinking: think, suppose, believe, agree, consider, trust, remember, forget, know, understand, imagine
d) Appearing: appear, look, seem.

Present Tense [Present Perfect Tense]

It is used:

i. To indicate an action completed in the recent or immediate past (with just). Examples:
   - I have just finished my work.
   - He has just taken the medicine.

ii. To indicate a past action happened at an unspecified time.
   Examples:
   - I have been to France three times.
   - Madhuri has never travelled by train.
   - Manisha has studied two foreign languages.

iii. To show that something started in the past and has continued up until now. Examples:
   - Rashmi has been in England for six months.
   - Priya has loved chocolate since she was a little girl.

The adverb and adverbial phrases with unfinished time expressions can be used in Present Perfect such as: ever, never, once, many times, several times, before, so far, this month, this year, this week, today, already, yet, etc but not with specific past /finished time expressions such as: yesterday, one year ago, last week, when I was a child, when I lived in Japan, at that moment, that day, one day, etc.

Perfect Continuous Tense (Present Perfect Continuous Tense)

It is used

i. To express actions which started in the past and continue to the present. We often use this with 'for' and 'since'

- I've been living in London for two years.
- She's been working here since 2004.
- We've been waiting for the bus for hours.

ii. To express actions which have recently stopped and have a result, which we can often see, hear, or feel, in the present. We don't use a time word here. The action is over but the effect can be seen.

- I'm so tired, I've been studying.
- I've been running, so I'm really hot.
- It's been raining so the pavement is wet.

Past Tense [Simple Past Tense]

It is used:

i. To express the idea that an action started and finished at a specific time in the past. Examples:
   - I didn't see a play yesterday.
   - Did you have dinner last night?

ii. Sometime the specific time may not be mentioned. It can be implied by context. Example:
   - I didn’t sleep well (last night).

iii. To describe a past habit
   Examples:
   - They never went to school, they always skipped class.
   - Did you play a musical instrument when you were a kid?

Past Tense [Past Continuous Tense]-

It is used:

i. For an action going on at some time in the past.
Examples:
- Kavya was enjoying the games at funfair
- Stuti was preparing for IIT entrance exam.

ii. The past continuous and simple past are used together when a new action happened in the middle of longer action. Simple past used for later action.
Examples:
- While I was writing the email, the computer suddenly went off.
- What were you doing when I called you?

iii. It is also with 'Always', 'continuously' 'continually' or 'constantly' for persistent habit in the past.
Examples:
- She was always coming to class late
- I didn't like them because they were continuously complaining.

Past Tense [Past Perfect Tense]-

It is used:

i. To indicate a completed action before a certain point of time in the past.
Examples:
- When we arrived, the film had started.
- I had never seen such a beautiful beach before I went to Miami.

ii. To express the idea that something occurred before another action in the past. Examples:
- When I reached home, my mother had left for the office.
- I had written the letter before he arrived.

Future Tense [Simple Future Tense]-

It is used:

i. To talk about facts in the future time which we cannot control.
Examples:
- My uncle will turn forty this Sunday
- It will rain this week.

ii. To indicate an action that we think, expect, hope or believe will happen in the future. Examples:
- I think Brazil will win the World Cup.
- I'm sure you will enjoy the games.
- Probably, it will rain today.

iii. To indicate an action that we decide to do at the time of speaking
Examples:
- The task is not completed; I will complete it by evening.
- It is raining. I will take an umbrella.

Sample Exercises:

Rewrite the following sentences using correct form of verbs given in bracket.

1) When you arrive tonight, we…….. (go) out for dinner.

2) Whenever we meet, we …….. (plan) a trip.
3) The sun …….. (shine) brightly.
4) Vijay …….. (wait) for me when I arrived.
5) I promise I …….. (not/tell) him about the surprise party.
6) Shikhar Dhawan …….. (score) a century in the last match.
7) I …….. (get) hungry. Let's go and have something to eat.
8) . …….. (have) you ever …….. (visit) the U.S. before your trip in 2006?
9) Who …….. (invent) the bicycle?
10) Yesterday evening the phone …….. (ring) three times while we …….. (have) dinner.
11) When I met you last time, you …….. (think) of moving to a new flat.
12) She only understood the movie because she …….. (read) the book.
13) Can you …….. (help) me move this heavy table?
14) Hello Nitya, I …….. (not/see) you for ages. How are you?
15) We can go out now. It …….. (not/rain) any more.
16) He …….. (go) to that place every year.
17) There I…….. (notice) how important it…….. (be) to speak English nowadays.
18) And I…….. (already begin /) to read the novel.
19) If I …….. (pass) my exams successfully, I…….. (start) an apprenticeship in September.
20) While I …….. (do) the language course, I …….. (meet) lots of young people from all over the world.

UNIT 3. MODAL AUXILIARIES

An Auxiliary verb is a verb which helps or supports the main verb to form its tense, voice or mood. They are basically helping verbs and there are two types of Auxiliaries:

Primary & Modal.

[1] Primary Auxiliaries

a) Be (am, is, are ,was, were)

- I am a doctor.
- He was given a prize by the principal.
- They are doing their work.
- They were working here last year.

b) have (has, had) [Possession]

- We have a flat in Ahmedabad.
- Dr Tanna has a car.
- She had no money.

c) do (does, did) (Questions & Negative)

- What do you want from me? I don't have enough money.
- Does he go school on time?
- Did he complete his work?

[2] Modal Auxiliaries are used to express various moods and attitudes like permission, ability, duty, advice, suggestion, possibility …

SHALL

- He shall leave for Ahmedabad tomorrow. (Future)
- You shall be punished if you are late again. (Threat)
- You shall go out of the class. (Command)
- She shall have a prize. (Promise)
- Shall we have a cup of coffee?(Suggestion/ Proposal)
- Shall I carry your luggage? (to offer service)

SHOULD

- We should obey our elders. (Duty)
- We should keep promises.(Obligation)
- She should be in laboratory now. (Probability)

WILL

- He will come tomorrow. (Future)

- Will you lend me a pen, please? (Polite Request)
- I will speak to your customer care. (Threat)
- You will not go without my permission. (Command)
- I will teach you English (Promise)
- I will meet my target. (Determination)
- I will come to see you tomorrow. (Willingness)

WOULD

- Would you lend me your scooter, please? (Politeness)
- I wish you would get good marks.(Desire)
- I would like to have some coffee (likes/dislikes)
- I would rather stay at home than watching movie. (preference)

CAN

- She can speak English fluently. (Ability)
- We can walk 5 kms a day. (Capacity)
- Ramesh can come tomorrow. (Permission)
- She can be at home. (Possibility)

COULD

- I could run fast, when I was young. (Ability in Past)
- Could you help me in my assignment? (Request / Politeness)

MAY

- The guest may come. (Possibility)
- May I Come in Sir ? (Permission)
- It may rain today. (Uncertainty)
- May God bless you! (Wishes/Blessings)

MIGHT

- He might not come (Rare Possibility)
- Mayank has not come to school today. He might have missed the bus. (Possibility of Past)

MUST

- I must get the first prize. (Determination)
- He must have attended the meeting. (Certainty)
- You must pass mid semester exam. (Compulsion.)
- You must do your homework regularly. (Necessity)
- You must not speak loudly in the hospital. (Prohibition.)

Note:- have to/has to also suggests compulsion and necessity. Had to is used to show feeling of compulsion in past.

- I have to submit an assignment tomorrow.
- I had to submit the assignment yesterday though I was not much satisfied with my work.

NEED

- You need to go to a doctor.(Necessity)
- You need not study as the examination is over (absence of Necessity)

OUGHT TO

- We ought to love our neighbours. (Duty / Obligation / Desire)

Sample Exercise:

[1] Fill in the blanks with appropriate modal auxiliary:

1. On Saturdays, we …….go to school in informal dress.
2. Varun …… go for a vacation this summer.
3. When I was young, I …… swim across Ganga.
4. You ……not raise your voice.
5. I ……. to work hard to improve my performance.

[2] Fill in the blanks with appropriate modal auxiliary:

1) ……..we play football? (Permission)
2) The astrologer ….. leave the village as he lied to people. (compulsion)
3) The Indian Eleven ……. be disheartened. (Absence of Necessity)
4) ……we go to their help? (suggestion)
5) She ……come tomorrow.(Possibility)
6) ……have your book? (Permission)
7) Tomorrow ….. be a holiday. (Future)
8) Do not put off till tomorrow what you …. do today. (Ability)
9) He ….not tell a lie before me. (Desirability)
10) You …..come whenever you like. (Permission)
11) ……..god help you. (Blessing)
12) We …….honour our parents . (Moral obligation)
13) ……. You please let me have your book? (Polite request)
14) You …. Carry out government orders. (Compulsion)

15) He tried hard but … not lift it. (Past ability)
16) People …….. to vacate the village, as the flood has crossed the danger mark. (Necessity)
17) I ……borrow from this library very soon. (Ability)
18) We ……help the needy. (Desirability)
19) …….I carry your luggage? (Permission)
20) You …..not go until you finish this assignment. (Prohibition)
21) She ….. climb the hill when she was in college. (past ability)
22) ……..you teach my brother phonetics, please? (polite request)
23) I …….. read French. (ability)
24) They …..not enter the kitchen with shoes. (prohibition)
25) …….we have a cup of tea?(suggestion)
26) You ….. write assignment in this book. (permission)
27) We …… to take our umbrella as it is raining. (necessity)
28) We ….. take bath in the morning daily. (desirability)
29) Your wrist watch is almost new. You ……. Buy another one. (absence of necessity)
30) You ….. smoke at a petrol pump. It is highly inflammable. (negative obligation)
31) ……. You sweep my drawing room? (polite request)
32) No one …….. carry explosives in the train. (negative prohibition)

UNIT 4. SUBJECT VERB AGREEMENT

Subject – Verb Agreement means the harmony between the subject of the sentence and the verb. The verb always follows the subject of the sentence.

1. A finite verb must agree its subject in person and number.

Examples:

- I am reading a book.
- He is playing.
- The child is playing.
- The children are watching cartoons.

2. The Error of Proximity:

In cases where subject and verb are separated by a long phrase or a clause, the verb agrees with the real subject and not the noun or pronoun placed next to it.

Examples:

- The apples in the basket are fresh.
- The strong bond of affection between the two cousins was obvious.
- The joys one experiences in one's childhood are beyond description.

3. The Introductory '*There':*

In a sentence beginning with *there*, the verb agrees with the real subject that follows *there.*

Examples:

- There is no proof of his involvement in this case.
- There are major flaws in your argument.

4. Two or More Nouns or Pronouns joined by 'And'

(a) Subject consists of two or more nouns or pronouns joined by and- PLURAL Verb.

Examples:

- He and I were given the responsibility of the stage.
- Hard work and sincere efforts are the key to success.

(b) The nouns refer to the same person or thing –SINGULAR Verb

Examples:

- The director and producer of the movie was present there.
- Rice and curry is his favorite dish.

(c) The nouns convey the same meaning, placed together only for emphasis-Singular verb

Examples:

- The honour and the glory of my country is uppermost in my mind.
- The power and influence Gandhiji exerted over the Indian masses was really great.

5. Subject consists of two nouns or pronouns joined with as well as, together with, along with, in addition to: verb agrees with the first subject

Examples:

- Mr. Das as well as his friends has escaped unhurt.
- You as well as I are responsible for our losses.
- The captain with othe team members was given a hearty welcome.

6.Two subjects joined with not only, but also: Verb agrees with the latter subject

Example:

- Not only the principal but also the teachers have played an important role.

7. Two subjects joined with…or, neither…has .nor verb agreed with the latter subject.

Examples:

- Either you or Gaurav is responsible for the mistake.
- Neither Gaurav nor you are responsible for the mistake.

8. One subject singular and the other plural

The pattern is: **Either /Neither+ Singular sub +or/nor + Plural sub. Plural verb**

Examples:

- Either he or his parents are going to attend the marriage.
- Neither the moon nor the stars are shining today.

9. **Either, Neither, Each, Everyone, One of the -Singular Verb**

Examples:

- She does not care what either of her parents says.
- Neither of these two students has done well.
- Each of the students has to submit the assignment.
- Everyone in the family has been questioned.
- One of the books is going to win the Booker Prize.

10. None refers to amount or quality - Singular Verb

Example:

- None of the work was done.
  - **None followed by plural noun or pronoun: Verb usually plural but can be singular**

  Examples:

- None of the stories are interesting.
- None of his stories has appealed the audience.

11. Much, More, Little, Less - Singular Verb

Examples:

- Much of my anxiety is over.
- More than half of the time is over.
- Little has been achieved so far.
- Less of my time is now wasted on attending to phone calls.

12. A lot of, a great deal of, plenty of, most of, some of, refer to amount or quantity

Singular Verb Examples:

- A lot of time was wasted on preliminary enquiries.
- Plenty of help was available.
- Lots of food was distributed to the poor.

➢ **A lot of, a great deal of, plenty of, most of, some of refer to number.**

Plural Verb Examples:

- Lots of people are taking part in the marathon.
- Plenty of shops accept payments by a credit card.

Sample Exercise:

[1] Fill in the blanks:-

1. The sound of bells ……..(was, were) heard all over the neighborhood.
2. Sincere effort not more advice …. (is, are) the need of the hour.
3. Some of the work (remain, remains) to be done.
4. Either the captain or the bowler …. (is, are) at fault.
5. The teacher along with the students (have, has) gone on picnic.
6. Neither of the candidates (was, were) suitable.
7. The teacher as well as the students (was, were) present on the ground.
8. She, not you (have, has) given the right answer.

[2] Pick the right verb:-

1. His use of clauses and connectors (is/are) appalling.
2. One of the students in my class (own/owns) a motorcycle.
3. There (was/were) several; people in the adjoining room.
4. The deputy along with thirty miners (were/was) killed.
5. The pump including the motor and the hose (cost/costs) Rs. 10,000/-.
6. Either the sand or the cement (is/are) bad.
7. The chief engineer accompanied by two executive engineers (is/are) coming today.
8. Each of the boxes (weigh/weighs) 10 kgs.
9. None if the gas (has/have) been consumed.
10. Either Ram or his brother (work/works) as a manager here.
11. None of them (attends/attend) to their work these days.
12. Some of the work (remain/remains) unfinished.
13. Some of the pipes (run/runs) for several miles.
14. All the oil (has/have) been stolen.
15. All the laborers (is/are) tribals.
16. Apple pie and custard (is/are) my favourite dish.
17. Some people (dislikes, dislike) travelling by sea, as it (make, makes) them sea-sick.
18. The Thirty-Nine steps (was, were) written by John Buchan.
19. The secretary and the member (has, have) come to visit the institute today.
20. The trouble with these guys (is,are) their rustic approach.

21. A lot of good we take (is/are) wasted.
22. A large amount of money he invested (was/were) lost.
23. Some more milk (is/are) needed.
24. None of these dishes (is/are) to my taste.
25. Only a few students (is/are) likely to fail.
26. A little dust (is/are) visible.
27. A lot of money (has/have) been spent on buildings.
28. None of the children (is/are) intelligent.
29. The president and the secretary (were/was) arrested.

UNIT 5 Basic Sentence Patterns of English

Sentence: A sentence is a textual unit consisting of one or more words that are grammatically linked.

Here we will study basic four patterns of English. For better understanding of the same, We need to understand the following terms.

Subject: A *subject* is a part of a sentence that contains the person or thing performing the action (or *verb*) in a sentence. Traditionally the subject is the word or phrase which controls the verb in the clause.

- **The peon** rings the bell.

Verb: Verbs are words that express action or state of being. You have studied about them in parts of speech and tenses. They are action words in the sentence.

- He **runs** fast.

Object: An object is a noun, a noun phrase, or a pronoun that is affected by the action of a verb.

- Ram is reading **a newspaper**.

Adverbial: Adverbials are words that we use to give more information about a verb. They can be one word (angrily, here) or phrases (at home, in a few hours) and often say how, where, when or how often something happens or is done, though they can also have other uses..

- He speaks **fluently.**
- Lata ate breakfast **yesterday morning**.

Complement: Complement is the term used for a word or words that are needed to complete the meaning of an expression.

- Algebra is difficult.

The following are basic four patterns to make a meaningful sentence.

1. **S + V : Subject + Verb**

- He/ laughed.
- Dogs/ bark.
- We /enjoyed.

2. S+V+O: Subject + Verb+ Object

- We / received / the parcel.
- Many students / witnessed / the play.
- The police / arrested / the thief

3. S+V+A: Subject + Verb+ Adverbial

- The train / arrived / late
- It / rained / last night
- He / reads / slowly

4. S+V+C: Subject + Verb+ Complement

- They / are / players.
- I / am / an Indian.
- Her father / is / a doctor

Practice exercise

1. Identify the sentence pattern of given sentences.

1. They / worked / hard
2. It / was / a very pleasant talk
3. The winner was rewarded.
4. She / sings / a song
5. They / came / suddenly.
6. The class / became / noisy
7. People/ cried.
8. Her father / is / a doctor
9. I /refuse.
10. You/ are/ intelligent.

2. Form ten sentences of each sentence pattern.

SECTION 3

PROSE AND POETRY

Unit 1
The Leopard

Ruskin Bond

I first saw the leopard when I was crossing the small stream at the bottom of the hill.

The ravine was so deep that for most of the day it remained in shadow. This encouraged many birds and animals to emerge from cover during daylight hours. Few people ever passed that way: only milkmen and charcoal-burners from the surrounding villages.

As a result, the ravine had become a little haven of wildlife, one of the few natural sanctuaries left near Mussoorie, a hill- station in northern India.

Below my cottage was a forest of oak and maple and Himalayan rhododendron. A narrow path twisted its way down through the trees, over an open ridge where red sorrel grew wild, and then steeply down through a tangle of wild raspberries, creeping vines and slender bamboo.

At the bottom of the hill the path led on to a grassy verge, surrounded by wild dog roses. (It is surprising how closely the flora of the lower Himalayas, between 5,000 to 8,000 feet, resembles that of the English countryside.)

The stream ran close by the verge, tumbling over smooth pebbles, over rocks worn yellow with age, on its way to the plains and to the little Song River and finally to the sacred Ganges.

When I first discovered the stream it was early April and the wild roses were flowering—small white blossoms lying in clusters.

I walked down to the stream almost every day, after two or three hours of writing.

I had lived in cities too long, and had returned to the hills to renew myself, both physically and mentally. Once you have lived with mountains for any length of time, you belong to them, and must return again and again.

Nearly every morning, and sometimes during the day, I heard the cry of the barking deer. And in the evening, walking through the forest, I disturbed parties of pheasant. The birds went gliding down the ravine on open, motionless wings. I saw pine martens and a handsome red fox, and I recognized the footprints of a bear.

As I had not come to take anything from the forest, the birds and animals soon grew accustomed to my presence; or possibly they recognized my footsteps. After some time, my approach did not disturb them.

The langurs in the oak and rhododendron trees, who would at first go leaping through the branches at my approach, now watched me with some curiosity as they munched the tender green shoots of the oak. The young ones scuffled and wrestled like boys, while their parents groomed each other's coats, stretching themselves out on the sunlit hillside. But one evening, as I passed, I heard them chattering in the trees, and I knew I was not the cause of their excitement.

As I crossed the stream and began climbing the hill, the grunting and chattering increased, as though the langurs were trying to warn me of some hidden danger. A shower of pebbles came rattling down the steep hillside, and I looked up to see a sinewy, orange-gold leopard poised on a rock about twenty feet above me.

It was not looking towards me, but had its head thrust attentively forward, in the direction of the ravine. Yet it must have sensed my presence, because it slowly turned its head and looked down at me.

It seemed a little puzzled at my presence there; and when, to give myself courage, I clapped my hands

sharply, the leopard sprang away into the thickets, making absolutely no sound as it melted into the shadows.

I had disturbed the animal in its quest for food. But a little after I heard the quickening cry of a barking deer as it fled through the forest. The hunt was still on.

The leopard, like other members of the cat family, is nearing extinction in India,and I was surprised to find one so close to Mussoorie. Probably the deforestation that had been taking place in the surrounding hills had driven the deer into this green valley; and the leopard, naturally, had followed.

It was some weeks before I saw the leopard again, although I was often made aware of its presence. A dry, rasping cough sometimes gave it away. At times I feltalmost certain that I was being followed.

Once, when I was late getting home, and the brief twilight gave way to a dark, moonless night, I was startled by a family of porcupines running about in a clearing.I looked around nervously, and saw two bright eyes staring at me from a thicket. I stood still, my heart banging away against my ribs. Then the eyes danced away, and Irealized that they were only fireflies.

In May and June, when the hills were brown and dry, it was always cool and green near the stream, where ferns and maidenhair and long grasses continued to thrive.

Downstream I found a small pool where I could bathe, and a cave with water dripping from the roof, the water spangled gold and silver in the shafts of sunlightthat pushed through the slits in the cave roof.

'He maketh me to lie down in green pastures: he leadeth me beside the still waters.' Perhaps David had discovered a similar paradise when he wrote those words; perhaps I, too, would write good words. The hill-station's summer visitors had not discovered this haven of wild and green things. I was beginning to feel thatthe place belonged to me, that dominion was mine.

The stream had at least one other regular visitor, a spotted forktail, and though itdid not fly away at my approach it became restless if I stayed too long, and then it would move from boulder to boulder uttering a long complaining cry.

I spent an afternoon trying to discover the bird's nest, which I was certain contained young ones, because I had seen the forktail carrying grubs in her bill. The problem was that when the bird flew upstream I had difficulty in following her rapidly enough as the rocks were sharp and slippery.

Eventually I decorated myself with bracken fronds and, after slowly making my way upstream, hid myself in the hollow stump of a tree at a spot where the forktail often disappeared. I had no intention of robbing the bird: I was simply curious to seeits home.

By crouching down, I was able to command a view of a small stretch of the stream and the sides of the ravine; but I had done little to deceive the forktail, who continued to object strongly to my presence so near her home.

I summoned up my reserves of patience and sat perfectly still for about ten minutes. The forktail quietened down. Out of sight, out of mind. But where had she gone? Probably into the walls of the ravine where I felt sure, she was guarding hernest.

I decided to take her by surprise, and stood up suddenly, in time to see not the forktail on her doorstep, but the leopard bounding away with a grunt of surprise! Two urgent springs, and it had crossed the stream and plunged into the forest.

I was as astonished as the leopard, and forgot all about the forktail and her nest. Had the leopard been following me again? I decided against this possibility. Only man-eaters follow humans, and, as far as I knew, there had never been a man-eaterin the vicinity of Mussoorie.

During the monsoon the stream became a rushing torrent, bushes and small trees were swept away, and the friendly murmur of the water became a threatening boom.I did not visit the place too often, as there were leeches in the long grass.

One day I found the remains of a barking deer which had only been partly eaten. Iwondered why the

leopard had not hidden the rest of his meal, and decided that it must have been disturbed while eating.

Then, climbing the hill, I met a party of hunters resting beneath the oaks. They asked me if I had seen a leopard. I said I had not. They said they knew there was a leopard in the forest.

Leopard skins, they told me, were selling in Delhi at over 1,000 rupees each. Of course there was a ban on the export of skins, but they gave me to understand that there were ways and means. . . . I thanked them for their information and walked on,feeling uneasy and disturbed.

The hunters had seen the carcass of the deer, and they had seen the leopard's pug-marks, and they kept coming to the forest. Almost every evening I heard their guns banging away; for they were ready to fire at almost anything.

'There's a leopard about,' they always told me. 'You should carry a gun.''I don't have one,' I said.

There were fewer birds to be seen, and even the langurs had moved on. The red fox did not show itself; and the pine martens, who had become quite bold, now dashed into hiding, at my approach. The smell of one human is like the smell of anyother.

And then the rains were over and it was October; I could lie in the sun, on sweet- smelling grass, and gaze up through a pattern of oak leaves into a blinding blue heaven. And I would praise God for leaves and grass and the smell of things, the smell of mint and bruised clover, and the touch of things—the touch of grass and airand sky, the touch of the sky's blueness.

I thought no more of the men. My attitude towards them was similar to that of the denizens of the forest. These were men, unpredictable, and to be avoided if possible.

On the other side of the ravine rose Pari Tibba, Hill of the Fairies: a bleak, scrub-covered hill where no one lived.

It was said that in the previous century Englishmen had tried building their houseson the hill, but the area had always attracted lightning, due to either the hill's location or due to its mineral deposits; after several houses had been struck by lightning, the settlers had moved on to the next hill, where the town now stands.

To the hillmen it is Pari Tibba, haunted by the spirits of a pair of ill-fated loverswho perished there in a storm; to others it is known as Burnt Hill, because of its scarred and stunted trees.

One day, after crossing the stream, I climbed Pari Tibba—a stiff undertaking, because there was no path to the top and I had to scramble up a precipitous rock-facewith the help of rocks and roots that were apt to come loose in my groping hand.

But at the top was a plateau with a few pine trees, their upper branches catching the wind and humming softly. There I found the ruins of what must have been the houses of the first settlers—just a few piles of rubble, now overgrown with weeds,sorrel, dandelions and nettles.

As I walked through the roofless ruins, I was struck by the silence that surrounded me, the absence of birds and animals, the sense of complete desolation.

The silence was so absolute that it seemed to be ringing in my ears. But there wassomething else of which I was becoming increasingly aware: the strong feline odour of one of the cat family.

I paused and looked about. I was alone. There was no movement of dry leaf or loose stone. The ruins were for the most part open to the sky. Their rotting rafters had collapsed, jamming together to form a low passage like the entrance to a mine;and this dark cavern seemed to lead down into the ground.

The smell was stronger when I approached this spot, so I stopped again and waited there, wondering if I had discovered the lair of the leopard, wondering if the animal was now at rest after a night's hunt.

Perhaps he was crouching there in the dark, watching me, recognizing me,knowing me as the man who walked alone in the forest without a weapon.

I like to think that he was there, that he knew me, and that he acknowledged my visit in the

friendliest way: by ignoring me altogether.

Perhaps I had made him confident—too confident, too careless, too trusting of thehuman in his midst. I did not venture any further; I was not out of my mind. I did not seek physical contact, or even another glimpse of that beautiful sinewy body, springing from rock to rock. It was his trust I wanted, and I think he gave it to me.

But did the leopard, trusting one man, make the mistake of bestowing his trust on others? Did I, by casting out all fear—my own fear, and the leopard's protective fear —leave him defenseless?

Because next day, coming up the path from the stream, shouting and beating drums, were the hunters. They had a long bamboo pole across their shoulders; and slung from the pole, feet up, head down, was the lifeless body of the leopard, shot in the neck and in the head.

'We told you there was a leopard!' they shouted, in great good humour. 'Isn't he afine specimen?'

'Yes,' I said. 'He was a beautiful leopard.'

I walked home through the silent forest. It was very silent, almost as though thebirds and animals knew that their trust had been violated.

I remembered the lines of a poem by D. H. Lawrence; and, as I climbed the steepand lonely path to my home, the words beat out their rhythm in my mind: 'There was room in the world for a mountain lion and me.'

Glossary:

Ravine: Narrow Valley

Sanctuary: Shelter

Curiosity: Interest

Extinction: Loss

Pasture: Grazing Land

Precipitous: Steep

Denizens: A person, animal, or plant that lives or is found in a particular place

Glimpse: Sight

Ex: 1. Choose the correct option:

1. The author first saw the leopard when …
   (a) he was climbing the hill (b) it was caught by hunters (c) he was crossing the stream (d) he was going after forktail
2. When the author discovered the stream, it was month of …
   (a) May (b) June (c) February (d) April
3. The … was a regular visitor of the stream.
   (a) Forktail (b) Tiger (c) lion (d) sparrow
4. Leopared skins are sold in ….
   (a) Delhi (b) Kolkatta (c) Lucknow (d) Mumbai
5. ….. is called *Hill of Fairies*
   (a) Pari Hill (b) Angel Tibba (c) God Hill (d) Pari Tibba

Ex: 2. Answer the following questions:

1. Describe the valley where the leopard lived.
2. Why did the author return to mountains?
3. Why didn't his approach disturb the birds and animals?
4. What happened when the leopard sensed the author's presence?
5. What did the author do to find forktails's home?
6. What was the hunters' advice to the author?
7. What was the author's attitude towards men?

Suggested Speaking Skills Topics (For 30 Marks of PA in LAB)

1. Beauty of Nature
2. Cruelty towards Animals
3. Environment Conservation

UNIT 2 After Twenty Years

O'Henry

The policeman on the beat moved up the avenue impressively. The impressiveness was habitual and not for show, for spectators were few. The time was barely 10 o'clock at night, but chilly gusts of wind with a taste of rain in them had well nigh depeopled the streets.

Trying doors as he went, twirling his club with many intricate and artful movements, turning now and then to cast his watchful eye adown the pacific thoroughfare, the officer, with his stalwart form and slight swagger, made a fine picture of a guardian of the peace. The vicinity was one that kept early hours. Now and then you might see the lights of a cigar store or of an all-night lunch counter; but the majority of the doors belonged to business places that had long since been closed.

When about midway of a certain block the policeman suddenly slowed his walk. In the doorway of a darkened hardware store a man leaned, with an unlighted cigar in his mouth. As the policeman walked up to him the man spoke up quickly.

"It's all right, officer," he said, reassuringly. "I'm just waiting for a friend. It's an appointment made twenty years ago. Sounds a little funny to you, doesn't it? Well, I'll explain if you'd like to make certain it's all straight. About that long ago there used to be a restaurant where this store stands--'Big Joe' Brady's restaurant."

"Until five years ago," said the policeman. "It was torn down then."

The man in the doorway struck a match and lit his cigar. The light showed a pale, square-jawed face with keen eyes, and a little white scar near his right eyebrow. His scarfpin was a large diamond, oddly set.

"Twenty years ago to-night," said the man, "I dined here at 'Big Joe' Brady's with Jimmy Wells, my best chum, and the finest chap in the world. He and I were raised here in New York, just like two brothers, together. I was eighteen and Jimmy was twenty. The next morning I was to start for the West to make my fortune. You couldn't have dragged Jimmy out of New York; he thought it was the only place on earth. Well, we agreed that night that we would meet here again exactly twenty years from that date and time, no matter what our conditions might be or from what distance we might have to come. We figured that in twenty years each of us ought to have our destiny worked out and our fortunes made, whatever they were going to be."

"It sounds pretty interesting," said the policeman. "Rather a long time between meets, though, it seems to me. Haven't you heard from your friend since you left?"

"Well, yes, for a time we corresponded," said the other. "But after a year or two we lost track of each other. You see, the West is a pretty big proposition, and I kept hustling around over it pretty lively. But I know Jimmy will meet me here if he's alive, for he always was the truest, stanchest old chap in the world. He'll never forget. I came a thousand miles to stand in this door to-night, and it's worth it if my old partner turns up."

The waiting man pulled out a handsome watch, the lids of it set with small diamonds.

"Three minutes to ten," he announced. "It was exactly ten o'clock when we parted here at the restaurant door."

"Did pretty well out West, didn't you?" asked the policeman.

"You bet! I hope Jimmy has done half as well. He was a kind of plodder, though, good fellow as he was. I've had to compete with some of the sharpest wits going to get my pile. A man gets in a groove in New York. It takes the West to put a razor-edge on him."

The policeman twirled his club and took a step or two.
"I'll be on my way. Hope your friend comes around all right. Going to call time on him sharp?"

"I should say not!" said the other. "I'll give him half an hour at least. If Jimmy is alive on earth he'll be here by that time. So long, officer."

"Good-night, sir," said the policeman, passing on along his beat, trying doors as he went.

There was now a fine, cold drizzle falling, and the wind had risen from its uncertain puffs into a steady blow. The few foot passengers astir in that quarter hurried dismally and silently along with coat collars turned high and pocketed hands. And in the door of the hardware store the man who had come a thousand miles to fill an appointment, uncertain almost to absurdity,with the friend of his youth, smoked his cigar and waited.

About twenty minutes he waited, and then a tall man in a long overcoat, with collar turned up to his ears, hurried across from the opposite side of the street. He went directly to the waiting man.

"Is that you, Bob?" he asked, doubtfully.

"Is that you, Jimmy Wells?" cried the man in the door.

"Bless my heart!" exclaimed the new arrival, grasping both the other's hands with his own. "It's Bob, sure as fate. I was certain I'd find you here if you were still in existence. Well, well, well--twenty years is a long time. The old gone, Bob; I wish it had lasted, so we could have had another dinner there. How has the West treated you, old man?"

"Bully; it has given me everything I asked it for. You've changed lots, Jimmy. I never thought you were so tall by two or three inches."

"Oh, I grew a bit after I was twenty." "Doing

well in New York, Jimmy?"

"Moderately. I have a position in one of the city departments. Come on, Bob; we'll go around to a place I know of, and have a good long talk about old times."

The two men started up the street, arm in arm. The man from the West, his egotism enlarged by success, was beginning to outline the history of his career. The other, submerged in his overcoat, listened with interest.

At the corner stood a drug store, brilliant with electric lights. When they came into this glare each of them turned simultaneously to gaze upon the other's face.

The man from the West stopped suddenly and released his arm.

"You're not Jimmy Wells," he snapped. "Twenty years is a long time, but not long enough to change a man's nose

from a Roman to a pug."

"It sometimes changes a good man into a bad one," said the tall man. "You've been under arrest for ten minutes, 'Silky' Bob. Chicago thinks you may have dropped over our way and wires us she wants to have a chat with you. Going quietly, are you? That's sensible. Now, before we go on to the station here's a note I was asked to hand you. You may read it here at the window. It's from Patrolman Wells."

The man from the West unfolded the little piece of paper handed him. His hand was steady when he began to read, but it trembled a little by the time he had finished. The note was rather short.

"Bob: I was at the appointed place on time. When you struck the match to light your cigar I saw it was the face of the man wanted in Chicago. Somehow I couldn't do it myself, so I went around and got a plain clothes man to do the job."

JIMMY.

."

Glossary:

on the beat: usual path of a policeman on duty
avenue : road with trees on both sides
habitual : usual
intricate : complicated
chilly: very cold
gust: sudden violent rush of wind
pacific: peaceful
thoroughfare: a street much used by traffic and open at both ends
swagger: walk in a proud manner
vicinity: surroundings, neighbourhood
reassuringly: comfortingly and without any fear
torn down: pulled down, demolished
oddly: strangely
chum: close friend
chap: fellow, man
dragged out: caused to last an unnecessarily long time in
bustling around: moving around quickly
turns up: comes up, arrives
plodder: person who works slowly but earnestly
groove: way of living that becomes a habit
twirled: turned round quickly
club: heavy stick with one thick end
drizzle: rain in many fine drops
astir: in a state of excitement
dismally: gloomy
lasted: existed for more time
egotism: practice of talking about oneself
chat: friendly talk

Sample Exercises:

Ex: 1. Choose the correct option:

1. The location of the story is near ….
   (b) Dehradun (b) Mussoorie (c) Shimla (d) Dharmashala
3. Where was the man standing?
   (b) Near general store (b) near medical store (c) near bus stand (d) near hardware store
4. When was the appointment made ?
   (a) Before 20 years (b) before 15 years (c) after 20 years
   (d) before 10 years
5. The man was waiting for his _____.
   (b) wife (b) friend (c) brother (d) customer
6. The man and his friend Jimmy belong to _____ city.
   (a) New York (b) London (c) Mumbai (d) Paris
7. What was the time of appointment?
   (a) 12 o'clock (b) 11 o'clock (c) 10 o'clock (d) 9 o'clock
8. What did the tall man handed over to Bob?
   (a) A book (b) a bag (c) a chocolate (d) a note
9. Who wrote the note?
   (a) Bob (b) Jimmy (c) Vera (d) O'Henry

Ex: 2. Answer the following questions:

8. How did the policeman move up the avenue?
9. How was the weather that night?
10. What did the stranger say to the policeman?
11. What was there in place of the store at that spot twenty years ago?
12. Who was the stranger's friend?
13. Where did they take the last dinner?
14. What kind of man was his friend Jimmy?
15. What did Bob tell the man in the overcoat?
16. Was he really his friend Jimmy Wells?
17. Why was Bob under arrest?
18. Whose note was handed over to Bob in the end?

Suggested Speaking Skills Topics (For 30 Marks of PA in LAB)

1. Friendship
2. What is more important- duty or relations?
3. The choice between Right and Wrong .

UNIT 3 Stopping by Woods on a Snowy Evening

Robert Frost

Whose woods these are I think I know.
His house is in the village though;
He will not see me stopping here
To watch his woods fill up with snow.

My little horse must think it queer
To stop without a farmhouse near
Between the woods and frozen lake
The darkest evening of the year.

He gives his harness bells a shake
To ask if there is some mistake.
The only other sound's the sweep
Of easy wind and downy flake.

The woods are lovely, dark and deep,
But I have promises to keep,
And miles to go before I sleep,
And miles to go before I sleep

Glossary:

Woods : an area of land covered with thick growth of trees
Queer: beyond or deviating from the usual or expected
Farmhouse: a house attached to a farm
Frozen: turned into ice
Harness: an arrangement of leather straps fitted to a draft animal
Flake : a crystal of snow
Promise: a verbal commitment to do something in the future
Sleep : euphemisms for death

Sample Exercise:

Q.1 Where was the speaker going? What stopped him on the way?
Q.2 What according to the speaker will surprise the horse?
Q.3 What does the speaker wish to convey through the phrase "fill up with the snow"?
Q.4 What does the poet says about the owner of the woods?
Q.5 What are the sights and sounds that the poet experiences in the woods?
Q.6 What promises do you think the poet has to keep?
Q.7 What message do the last paragraph convey?
Q. 8 What is the role played by the horse in this poem?

Q. 9 Write a short note on :

(1) Description of nature

(2) Central idea of the poem

UNIT 4 Where the Mind is Without Fear

Rabindranath Tagore,

"Where the mind is without fear

and the head is held high,

where knowledge is free.

Where the world has not been broken up into fragments by narrow domestic walls.

Where words come out from the depth of truth,

where tireless striving stretches its arms toward perfection.

Where the clear stream of reason has not lost it's way

into the dreary desert sand of dead habit.

Where the mind is led forward by thee

into ever widening thought and action.

In to that heaven of freedom, my father,

LET MY COUNTRY AWAKE!"

—

Glossary:

Fragments- pieces

Head is held high- self respect

Domestic- pertaining to family.

Striving – try hard, motivated.

Tireless - without getting tired

Stream: river

Dreary: dull

Reason: intellect

Dead habit: old customs

Desert – dry area of land

Awake- to get up from sleep

Sample Exercise:

Q.1 What is meant by "mind is without fear and head is held high". Tick the correct answer.

(i) to be fearless and self respecting

(ii) to be proud of one's high position .

(iii) to stand straight and be carefree.

Q. 2. What does the poet mean by “where knowledge is free”?

Q.3. The ‘domestic walls’ are usually associated with safety, comfort and love.What is the meaning of ‘narrow domestic walls’? Choose the correct answer.

(i) small houses which make us feel cramped

(ii) ideas which are petty and narrow-minded.

iii) a house divided into rooms by walls.

Q.4. What according to the poet do people tirelessly strive towards?

Q.5. How does the poet describe the old habit?

Q.6 How does the poet describe ‘heaven of freedom’?

Q.7. Who does the poet address as ‘thee’ and my father?

Q.8 What kind of freedom does the poet desire for his country?

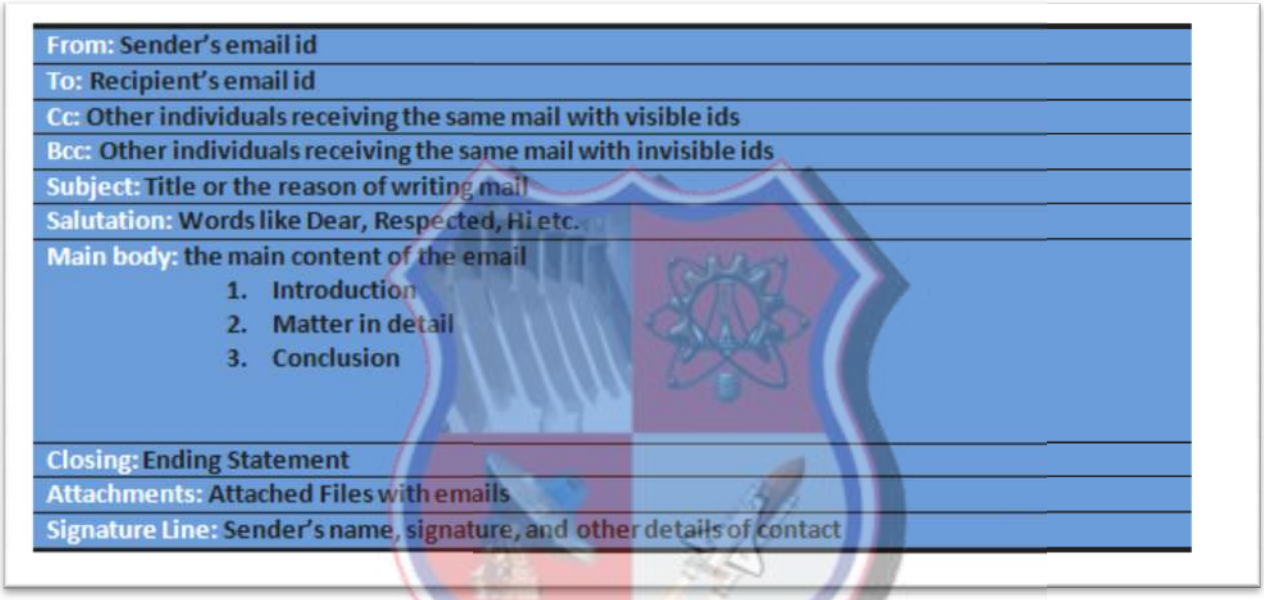
Q.9 Write a short note on the central idea of the poem.

SECTION 4

Email Writing

The email writing format is the same for each of the categories, though the choice of words and language differ depending upon the type of email. One can use friendly and casual language in informal emails. The language used in formal emails should be professional, clear, and formal.

The email writing format is



Email Format

Let us look at the important **steps to follow** when writing a formal email.

1. Subject line

Grab attention with the subject line. The first part of an email which your recipient sees is the subject of the email. If you do not put it well, you risk having your email not opened until later or at all. Here are some things to keep in mind:

- Make the subject line **specific, simple, and to the point**. For example, instead of *'The internship report you asked for'*, write, *'Internship Report, {date/week/month}'*.
- The subject line should be **short**. Ideally, your subject line should stand around six words.
- Keep the most **important and informative words in the beginning** of the subject line.
- Use **markers** like *Fwd, Reply, Urgent*, or *Notice* to further narrow down the subject. It informs your reader about the nature of your email.

Some of the examples of good subject lines in formal emails can be:

- Marketing Budget, October 2018
- List of New Freelancers
- Job Application for the Post of XYZ
- Leave Application
- Query Regarding the Missing Information in the Document
- Contract Agreement - XYZ Assignment

2. Salutation

Each email is directed towards someone. Start your formal email with addressing the recipient in a manner fitting the relationship you have with them.

For people you are unfamiliar with or do not know the names of, use '*To Whom It May Concern*' or '*Dear sir/madam*'.
For senior officials, stick to their designation or follow it with their name, for example, '*To the Manager*', '*Dear Dr. Ghosh*', or '*Dear Ms. Kapoor*'.
Among colleagues, it may be appropriate to simply precede the name with a '*Hi*'.
Do not skip the salutation and always be respectful. Never use nicknames or just surnames or first names in a formal email.

3. Body of the email

The body text is the main part of your email. It is important to follow a certain pattern when writing the body of your email.

- The **opening paragraph should set the tone and reason** for your email. Introduce yourself if you are a stranger to the person you are writing to, and jot down why you are writing to them.
- For example, you can begin with '*My name is Abc, and this email is with reference to Xyz.'* or '*This is with reference to the marketing budget as discussed in the meeting.*'
- **Elaborate on your concern, question, or response** as comprehensively as possible. Write in a way that is easy to understand, but at the same time, do not lose your point in providing unnecessary information. Say only what is required.
- The **closing of the email** should also support the nature of your email. If you are asking a question, close with something like '*Hope to have an answer from you soon*', or *'Looking forward to hearing from you soon*', and if you are addressing a question, end with '*Hope I have sufficiently answered your query/doubts.'*
- Signature
- These are the last words of your email, capable of forming a lasting impression on your reader.

- Sign off with a simple word or phrase, which conveys respect. Safe choices are *'Best regards', 'Warmly', 'Sincerely', 'Kind regards'*, or simply *'Thanks'*.
- If you are writing to someone for the first time or someone who is not an immediate colleague or senior, use your full name.

- Furnish your name with contact information. Your phone number and/or work address are enough.
- If you are writing on behalf of or as an employee of an institution, make sure to mention it along with adequate contact details
- To make your signature even more effective, you may also choose or design an attractive (but not flashy) template.

Formal Email Samples

Formal emails are sent in a whole variety of situations. While they use the same rules, they may have to be modified according to their purpose.

Now that you are familiar with the format of a formal email, let us have a look at few email samples.

Email sample 1: A request

Subject: Extension on Report Deadline

Dear Mr./Ms. {Recipient's sir name},

I am writing this to request you for an extension on the XYZ project report which is due on {date}. My mother has taken ill unexpectedly, and I must leave for home tonight. I'm afraid it will take me a week before I can return to the office and complete the report.

Kindly grant me an extension till {date} for the same. I promise to deliver the project report by then.

Sincerely,
{Your name}
{Phone number}

Sample Emails

1.Inquiry

Question: Draft an email to make an inquiry for raincoats and umbrellas from a wholesaler in Mumbai .

To: rambrellasuppliers@gmail.com

From: tirupatiagency@gmail.com

Subject: Inquiry for different varieties of raincoats and umbrellas.

Dear Sir,

We would like to buy raincoats and umbrellas (product) for the next monsoon. You are a leading manufacturer of raincoats and umbrellas. We have also visited your website and we are interested in starting business with you.

We would like to see your company catalogue which has details of all the products that you manufacture. We would like to have all the details of different models and sizes of your products we intend to sell them during the coming rainy season.

Let us know the prices of your products and the rate of discount you allow Please inform us the time you will take to deliver the goods.

We hope to receive a prompt reply to this inquiry.

Thank You

Yours sincerely,

_____(Name)

2. Reply to inquiry

Question: You have received an inquiry for raincoats and umbrellas Draft a suitable reply.

To: tirupatiagency@gmail.com

From: rambrellasuppliers@gmail.com

Subject: reply to inquiry for different varieties of raincoats and umbrellas.

Dear Sir,

We have received your mail regarding the inquiry for different raincoats and umbrellas. We appreciate your interest in our products.

We have attached our company catalogue of all our products that we manufacture and price list with this mail.

We shall allow you 30% discount on the prices of these products. We can supply your goods within 10 days of receiving the order. You have to settle the account within 15 days of receiving the goods.

Please note that we will give you 3% extra rebate if your order exceeds Rs. 500000.

We are keen on executing your order quickly and carefully.

Thank You

Yours sincerely,

_____ (Name)

3. Placing an order

Question: Place an order of Air conditioners for your newly constructed branch office.

To: kabirworld21@gmail.com

From: gujaratagro@gmail.com

Subject: order for air conditioners for new office

Dear Sir,

We have received your mail reply to our inquiry about the air conditioners .We are thankful to you for your prompt reply.

We have studied the specification of the air conditioners and have found that it is according to our need. The terms and conditions of business stated by you are suitable to us. So, we request you to supply us 15 air conditioners as shown below:

Sr.No	Type	capacity	Quantity	Unit Price	Total Price
1	Voltas AC with inverter	1.5 ton	3	35000	105000
2	Voltas AC with inverter	2.0 ton	5	52000	260000
3	Voltas AC without inverter	1..5ton	2	33000	66000
4	Voltas AC without inverter	2.0 ton	5	50000	100000
				Total	531000

Please note that the air conditioners ought to be installed before 15th May 2021 since our new office is to start functioning from 18th May 2021..

Thank You

Yours sincerely,

_____(Name)

4. Complaint: Delay in Delivery of goods

Question: You have placed an order for table and ceiling fans for coming summer season. But the order has not been executed even after one month. Draft the complaint to the supplier about delay in delivery of goods.

To: newindia@gmail.com

From: Gujaratelectronics@gmail.com

Subject: complaint for delay in delivery of fans.

Dear Sir,

We refer to our order dated 2nd April 2021 for Usha Table and Ceiling Fans. We have specially instructed you to supply them before 18th April 2021but we are sorry we have not yet received the goods.

We had ordered the goods for the coming summer season. The delay in delivery of our order has caused great loss to our business.

We, therefore , request you to supply them within 7 days of receiving the mail. If you fail to do so, we shall be compelled to cancel our order.

We look forward to your prompt and positive response..

Thank You

Yours sincerely,

_____(Name)

5. Adjustment to above Complaint.

New India Electrical Suppliers have received a complaint from Gujarat Electronics, Ahemdabad about delay in delivery of goods. Draft a suitable reply.

To: Gujaratelectronics@gmail.com

From: newindia@gmail.com

Subject: reason for delay in delivery of fans

Dear Sir,

We have received your mail regarding delay in delivery of your order for table and ceiling fans. We are sorry for the inconvenience caused to you due to this delay.

The workers and staff in our office were on strike so the administrative work was badly paralyzed . Due to this we could neither execute your order nor intimate you about the delay in delivery.

However, the strike has been called off now. We hope we shall be able to dispatch the goods with four or five days. We trust you will understand our position and cooperate.

Thank You

Yours sincerely,

_____ (Name)

Complaint: shortage in goods

Question: You have placed an order for 500 compass boxes. But the consignment had only 475 boxes. Draft a complaint to the supplier.

To: omegainstruments@gmail.com

From: swastikstationers@gmail.com

Subject: complaint for shortage in number of boxes..

Dear Sir,

We are thankful to you for executing our order no. 24/A dated 20th April 2021 for500 Camel Compass boxes. However, we are sorry to point out that the execution of the order has not been as careful as it ought to be.

Our shop assistant has opened the container of compass boxes. He has reported that there are 475 compass boxes in it instead of 500.

Please make the necessary adjustment. We are sure that you will execute our orders more carefully in future.

Thank You

Yours sincerely,

_____(Name)

Adjustment to above Complaint.

Omega Instruments have received a complaint from Swastik Stationers that he has received 475 instead of 500 ordered by him. Draft a suitable reply.

To: swastikstationers@gmail.com

From: omegainstruments@gmail.com

Subject: adjustment for remaining 25 boxes

Dear Sir,

We have received your mail on 25th May 2021. We regret to note that you have received 475 Compass Boxes instead of 500 against your order no.24/A of 20th April 2021 .

We have dispatched the remaining 25 compass boxes by Maruti Couriers. You will receive them tomorrow evening.

We request you not to judge our services by this isolated incident. We shall try to render consistently efficient services in future.

Thank You

Yours sincerely,

_____ (Name)

Complaint: damaged goods

Question: You have placed an order for 250 Flower Vases. But you found that the consignment had 23 flower vases in damaged condition. Draft a complaint to the supplier.

To : duraguardglasses@gmail.com

From: suhasininovelties@gmail.com

Subject: complaint for damaged flower vases.

Dear Sir,

We have received 250 flower vases against our order no. 76/C dated 20th June 2021. However, when our shop assistant opened the box, he found 23 vases in damaged condition.

This damage is due to the fact that you have not packed the goods in thermocoal lined boxes according to our instructions.

Please send us 23 new flower vases. Alternatively permit us to adjust their price in the settlement of the invoices.

Thank You

Yours sincerely,

_____(Name)

Adjustment to above Complaint.

Duraguard Glasses Limited have received a complaint from Suhasini Novelties that he has received 23 flower vases in damaged condition. Draft a suitable reply.

To: suhasininovelties@gmail.com

From: duraguardglasses@gmail.com

Subject: adjustment for damaged flower vases

Dear Sir,

We have received your mail on 25th July 2021. We are sorry to note that you have received 23 flower vases in damaged condition out of total 250 in the consignment against your order no.76/C of 20th June 2021 .

We accept our liability in this matter . We have enclosed a credit note for Rs. 2300 along with this mail against 23 damaged flower vases.

We regret the trouble caused to you in this transaction. We assure you to execute your orders more carefully in future.

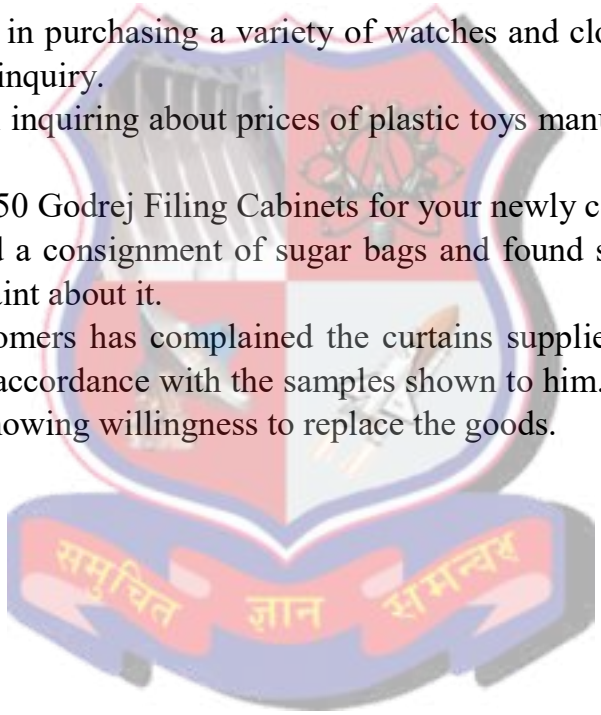
Thank You

Yours sincerely,

_____ (Name)

Exercise:

1. You have placed an order for 15 HP scanners to National Systems Limited, but received only 12 scanners. Draft an email to the supplier complaining about it.
2. Draft an email asking for the illustrated catalogue and quotation of certain electronic goods required by your firm.
3. Draft a complaint to Swagat Furnitures asking for compensation as you found some of the pieces of furniture delivered in the damaged condition.
4. The Book Store in your college requires 15 copies of Oxford Advanced Dictionary. Place an order for it.
5. The proprietor of sports goods manufacturing company has received a complaint from one of their customers regarding non-execution of his order in stipulated time. Draft a suitable reply.
6. You are interested in purchasing a variety of watches and clocks from Quartz Palace. Draft an email for inquiry.
7. You have an email inquiring about prices of plastic toys manufactured by you. Draft a reply.
8. Place an order for 50 Godrej Filing Cabinets for your newly constructed office.
9. You have received a consignment of sugar bags and found shortage in weight .Draft an email to complaint about it.
10. One of your customers has complained the curtains supplied by you are of inferior quality and not in accordance with the samples shown to him. Draft a reply expressing your regrets and showing willingness to replace the goods.



Business Letters

A **business letter** is a letter from one company to another, or between such organizations and their customers, clients, or other external parties. The overall style of letter depends on the relationship between the parties concerned. Business letters can have many types of content, for example to request direct information or action from another party, to order supplies from a supplier, to point out a mistake by the letter's recipient, to reply directly to a request, to apologize for a wrong, or to convey goodwill. A business letter is useful because it produces a permanent written record, and may be taken more seriously by the recipient than other forms of communication.

Qualities of a Good Letter:

The 7 Cs of business communication which make it are:

1. Clarity
2. Correctness
3. Conciseness
4. Courtesy
5. Concreteness
6. Consideration
7. Completeness

#1: Clarity

Practicing clarity in your communication ensures that the message is received accurately. You should know what you wish to say and how to say it. Use language that can be easily understood, and resist the temptation to include unnecessary information.

Example:

Instead of saying, “We have considered the consequences of the existing policy on the hiring strategies we employ with our human resources department and updated them accordingly,” say, “We have updated our hiring policy.”

#2: Correctness

You must communicate with correctness – correct grammar, language, data, etc. In written communication, you should proofread before sending.

Example:

“You may enter the building during opening hours but must show relevant I.D.”

Immediately, the recipient of this information has two questions:

- “What are the opening hours, and what ID is considered relevant?

Correctness in this communication is conveyed by saying, “You may enter the building during the opening hours of 9am to 5pm daily, but must show your employee identity card.”

#3: Conciseness

Never use more words than is necessary. Brevity is more easily understood, though you must avoid discourtesy. Concise messages save you and the recipient time, too. To be concise, follow these rules:

- Eliminate unnecessary words

- Use action verbs
- Remove repetition

Example:

“As a matter of fact, during the month of June, all employees must ensure that they wear appropriate clothing to ensure they stay cool while the air-conditioning is being repaired.”

Becomes:

“Indeed, during June, employees must wear appropriate clothing to stay cool while the air-conditioning is repaired.”

#4: Courtesy

Employ courtesy when communicating. This shows you respect the recipient and helps to build goodwill. You must ensure that you are sincere, thoughtful, and do not use discriminatory language.

Example:

“I don’t appreciate how your team ignores requests for collaboration from my team. The work we do is equally as important as your work. Could you make certain that your team collaborates more readily from now on?”

Such a message is unlikely to encourage a negative response. Instead, a more effective approach would be:

“I understand that your team is extremely busy and receives many requests to collaborate on project work. However, my team is working a highly urgent project with enormous mutual benefits. I would greatly appreciate if you could ask your team to collaborate more effectively with mine to move this project forward faster. If there is any help that we can provide to make this happen, please let me know.”

#5: Concreteness

Concrete communication is specific, clear, and meaningful. It avoids vagueness, uses available facts and figures to add authenticity, and builds around an active voice.

Example:

An example would be poor communication of underperformance during a one-to-one. You might say, “Your sales numbers are on the low side. They need to be improved to at least the team’s average.”

Give your employee concrete direction with evidence and an active voice:

“Your sales conversion rate is below 50%. You must improve this to the team average of 65% or higher.”

#6: Consideration

Be considerate with your messaging by putting yourself in the position of the recipient. Focus on communicating to ‘you’, considering needs and issues experienced by the recipient.

Example:

Imagine that you are unable to pay a promised bonus. How do you communicate this?

“We are unable to pay bonuses now. The business is awaiting payment from a major client. Once this payment is received, we can consider paying contractual bonuses as soon as is practicable.”

This could be better conveyed as follows:

“Unfortunately, we are not presently in the position to pay your bonus. However, as soon as our major client has settled their account, we will pay any bonuses owed to you. We’re sorry about this delay, but are sure you understand our need for positive cash flow and the long-term benefits this will deliver to you.”

#7: Completeness

Your message should be complete, delivering all the facts needed for the recipient to make an informed decision. Incomplete messages often receive poor responses.

To ensure your communication is complete, ask if it answers the what, when, why, who, where, and how.

Example:

"You haven't completed the task that I set you," is a message full of ambiguity. Instead, make sure you include all relevant facts:

"The data analysis for client ABC that I asked for on March 5 should have been completed by today. Will you have it finished this afternoon?"

Format:

A business letter must include:

1. Address

The address of the person receiving the correspondence includes a formal name, street address, city, state, and pin code.

2. Date

The date is put for any business communication.

The date is a critical piece of information documenting when the correspondence was sent.

This is important for correspondence that may be kept for future reference.

3. Subject Line

This indicates the subject of the letter so the receiver gets the idea what is the letter about.

4. Salutation

The salutation is the formal way of addressing the person.

Common salutations are *Dear* or *To Whom It May Concern*.

5. Introduction

The first few sentences of a letter are introductory.

The introduction section introduces the subject of the letter.

It is a summary in a sentence or two that explains the goal of the letter.

For example, an introduction may be something like:

I am writing today to further explore a vendor relationship with XYZ Corporation.

6. Body of the Letter

The body of the letter is where the bulk of the information is shared.

The body of the letter explains in detail all aspects of what is being communicated.

This would include detail of the information being shared.

For instance, the body may be something like this:

We understand that XYZ Corporation can provide tools for 10% less than other competitors. And, that the focus on service after the sale is amongst the best in the industry.

7. Closing

The closing of the letter summarizes what the letter was about and any next steps or action items.

This section gives the reader a heads up that the communication is coming to a close.

For instance, the closing may be something like this:

Please call me at your earliest convenience to discuss a vendor relationship and to explore if we can come to a mutually beneficial relationship. I look forward to speaking with you soon.

8. Signature

The signature section has a complimentary closing.

Examples are *Sincerely, Warmest Regards, Respectfully Yours, Very Truly Yours,* or *Cordially Yours*.

Be sure to gauge the audience when selecting a complimentary closing.

After the complimentary closing, space is left for the signature that goes above the typed name and title of the person sending the letter.

ABC Corporation
2435 West Elm Street
Small Town, USA 11223
888-987-6543

June 19, 2019 ← Date

James Smith
XYZ Corporation
Big Town, USA 21212
← Address

Dear Jim: ← Salutation

Introduction ↓

I am writing today to further explore a vendor relationship with XYZ Corporation.

Body →

We understand that XYZ Corporation can provide tools for 10% less than other competitors. And, that the focus on service after the sale is amongst the best in the industry.

Please call me at your earliest convenience to discuss a vendor relationship and to explore if we can come to a mutually beneficial relationship. ← Closing

I look forward to speaking with you soon.

Sincerely,

Jack Jones
Jack Jones
ABC Corporation
← Signature

Sample Letters

1. Order Letter

From

_____
_____
_____

Date: _____ (Date on Which Letter is Written)

To,

_____
_____
_____
_____

Subject: Order Letter

Dear Sir,

I am the purchase manager of XYZ Company and I am personally writing this letter to order goods for our site work. As we have been purchasing goods from you company since some time now, I am writing this letter to order material.

Along with this letter I am attaching the list of materials or goods that is needed. Please make sure you send it across in a week as the requirement is a bit urgent this time.

I hope there is enough stock left with you to complete this order of ours. Thanking you for your support and timely orders till date.

Thanking You,

Yours truly,

_____

Name and Signature

2. Complain letter

From

_____ (your name)
_____
_____ (your address)

Date _____ (date of writing letter)

To

_____ (name of recipient)
_____ (designation)
_____ (name of organization)
_____ (address)
_____

Dear Sir/Madam,

I purchased a ….(mention item with specifications) from your store on …(mention date) . The piece is on …. warranty (mention duration) . It was delivered on …(mention delivery date, if any), and your representative familiarized me with its operation on …(mention date), …(briefly explain the problem faced with the piece and repairs undertaken if any).

Since the piece is on warranty …, I request you to kindly …(mention how you want concerned authority to assist you). I am enclosing a copy of …(mention documents you are enclosing along with the letter). I am hoping for immediate action taken regarding this issue.

Thanking You
_____ (your name)

3. Leave Application

Sender's name and address:

Date:

Receiver's name and address:

Subject: Sick Leave application

Respected Mr. /Mrs. [Name of the recipient] (or Sir/Madam),

I am writing this application to notify you that I am suffering from severe viral infection and therefore, I need sick leave from work. I caught this infection last night and I will not be able to come to the office for at least [number of days]. As notified by my doctor, it is best that I take rest and recover properly before resuming work. The letter from the doctor is also attached for your reference.

Kindly grant me a leave for [number of days] days.

.

I hope you will understand and grant me a leave for aforementioned period. Waiting your approval.

Yours Sincerely,

[Your Name]

[Signature]

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)

I/II – Semester

Course Title: **Engineering Chemistry**

(Course Code: 4300006)

Diploma programme in which this course is offered	Semester in which offered
Electrical Engineering, Power Electronics Engineering	First
Biomedical Engineering	Second

1. RATIONALE

The background of chemistry allows engineers to get the most out of raw elements in creating fuels, drugs, new and modern materials, construction materials etc. needed in wide variety of engineering and technological applications. The in-depth comprehension of concepts and chemical reactions involved in chemistry would be applicable in solving the problems of engineering in spectrum of engineering branches like, electrical, Power Electronics Engineering, Biomedical Engineering etc.

The deep understanding of various topics/ subtopics of engineering chemistry course would enable the diploma engineers to understand and solve the various engineering problems, developments and breakthrough in engineering and technology in a very systematic and scientific way.

2. COMPETENCY

The purpose of this course is to help the student to attain the following industry identified competencies through various teaching-learning experiences:

- **Use principles of engineering chemistry to solve broadly-defined engineering problems.**

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge, and the relevant soft skills associated with this competency are to be developed in the student to display the following COs:

- Apply the principles of chemical bonding and solutions to solve various engineering problems.
- Solve engineering problems using the concepts of electrochemistry and corrosion.
- Use relevant fuels and lubricants for domestic and industrial applications.
- Select appropriate engineering materials for industrial applications.
- Choose various types of electrochemical devices for domestic and industrial applications.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
3	-	2	4	30*	70	25	25	150

(*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate the integration of COs, and the remaining 20 marks are the average of 2 tests to be taken during the semester for assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

***Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** -Practical; **C** – Credit, **CA** - Continuous Assessment; **ESE** -End Semester Examination.*

5. SUGGESTED PRACTICAL EXERCISES

The following practical outcomes (PrOs) are the subcomponents of the COs.

S. No.	Practical Outcomes (PrOs)	Unit No.		Approx. Hrs. required
1	Prepare a standard solution of oxalic acid or potassium permanganate.	I		02
2	Determine the strength of the given sodium hydroxide solution by titrating against standard oxalic acid solution using phenolphthalein indicator.	I		02
3	Standardize potassium permanganate solution by standard oxalic acid solution and estimate ferrous ions.	II	Any three	02
4	Determine pH-Values of given samples of Solution by using Universal Indicator and pH-meter.	II		02
5	Determine emf of an electrochemical cell (Daniel cell).	II		02
6	Determine electrochemical equivalent of copper metal using Faraday's first law.	II		02
7	Determine the rate of corrosion for different metals in the given solution.	III		02
8	Determine the rate of corrosion of metal in the solution of different pH.	III		02
9	Determine the calorific value of solid or liquid fuel using a bomb calorimeter.	IV		02
10	Determine the percentage of moisture content in the given sample of coal by proximate analysis.	IV		02
11	Determine the ash content of the given sample of coal by proximate analysis.	IV		02
12	Determine the viscosity of the lubricating oil using a Redwood viscometer.	V	Any three	02

S. No.	Practical Outcomes (PrOs)	Unit No.		Approx. Hrs. required
13	Determine the Acid value of the given lubricating oil.	V		02
14	Determine the Saponification value of the given lubricating oil	V		02
15	Determine flash point and fire point of the given lubricating oil using Pensky Martens/Cleveland open cup/Able's flashpoint apparatus.	V		02
16	Prepare Polystyrene and Bakelite. (Any one)	VI		02
	Total Hrs.			**28**

Note

*i. More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry-relevant skills/outcomes to match the COs. The above table is only a suggestive list.*

*ii. The following are some **sample** 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency.*

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Prepare experimental setup accurately.	10
2	Use apparatus for precise measurements.	20
3	Practice and adapt good and safe measuring techniques.	10
4	Good Record keeping of the observations accurately.	20
5	Interpret the results and their conclusion.	20
6	Prepare Report in prescribed format	10
7	Viva-Voce	10
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS AND SOFTWARE REQUIRED

These major equipment/instruments and Software required to develop PrOs are given below with broad specifications to facilitate procurement of them by the administrators/management of the institutes. This will ensure the conduction of practice in all institutions across the state in a proper way so that the desired skills are developed in students.

S. No.	Equipment Name with Broad Specifications	PrO. No.
1.	**Digital pH Meter:** Type: Microcontroller Based, Display: LED / LCD / Touch Screen, 3 digits, Calibration: up to 3 points with auto buffer, pH Range (pH): 0.00 to 14.00, +/- 0.05, Power Requirements: 230 V +/- 10, 50 Hz AC, Modes: pH mV- C, Temperature Compensation Type: Automatic,	4

S. No.	Equipment Name with Broad Specifications	PrO. No.
	Temperature Compensation Range (Degree C): 0 to 100, Temperature Accuracy (Degree C): +/- 0.3, Resolution (pH): 0.01	
2.	**Bomb Calorimeter:** Calorimeter outer container: Aluminum with rolled rim, Shape of the container: Cylindrical, Type of top cover: Removable, Calorimeter vessel: Copper, Calorimeter vessel size (Height x dia.), in mm: 100x75, Material of Stirrer: Copper, Stirrer size (Height x dia.), in mm, (min): 100 x 3.5, Stirrer with a loop at the bottom to fit inside the Calorimeter, Thermometer holder, removable: Nickel-plated brass.	9
3.	**Hot Air Oven:** Temperature is controlled by digital temperature indicator cum controller from ambient to 250°C with ± 0.1°C Accuracy. Power supply: 220/230V, 50Hz single phase, Capacity (Approx.): 50 – 100 liter, Type of Shelves: 03, Material of Inner Chambers: SS 304, Material of Outer Chamber: MS with powder coated paint, Material of Shelves: SS wire mesh.	10
4.	**Muffle Furnace:** The Furnace should be provided with a fast response temperature probe and with high-density energy-saving Ceramic Wool, Temperature Range 0-1200 °C. Muffle Size (approx.): 6" X 6" X 12", Display: LED.	11
5.	**Redwood viscometer:** Flow Range (Viscosity) in second: 20-2000, Redwood Viscometer Model No.: 01, Material: Stainless Steel, Bath Capacity (Approx.): 7 liters, Temperature Required: 95 ℃, Power supply: 220 Volt, 800 Watt, 50 Hz.	12
6.	**Pensky Martens flash point apparatus:** Voltage: 220-240V, Phase: Single phase, Power Source: Electric, Timing Range: 999.9s OR **Cleveland Open Cup apparatus:** Temperature range: Ambient to 370℃, Temp. measurement PT100 temp. sensor, Temp. scale resolution 0.1℃, Ignition source gas or electric, cooling forced air cooling, heating coil, heating 888W,220V, AC. OR **Abel's flash point apparatus:** Material: Stainless Steel, Power Source: Electric, Voltage: 115V/220-240V, 50-60 Hz, Dimensions: 230 mm x 470 mm x 470 mm (W x D x H) Temperature Range: 70 ℃, Resolution: 0.1 ℃	15
7.	**Laboratory weighing balance:** Type of Laboratory Balance: Analytical, Sensitivity (mg): 1 mg, Maximum Capacity of weighing (grams): 200 g, Shape of PAN: Circular, Power Supply: Single Phase, Display: LED.	All
8	**Hot plate with Magnetic stirrer:** Number of stirring Positions:1, Calibration: Automatic Calibration, Magnetic stirrer with a hot plate, Speed Control Accuracy of set speed	1,2,3,4,13,14

S. No.	Equipment Name with Broad Specifications	PrO. No.
	(+/-) (RPM): 5, Maximum Stirring capacity per position: 3000 ml, Top plate Material: Stainless steel.	

7. AFFECTIVE DOMAIN OUTCOMES

The following ***sample*** Affective Domain Outcomes (ADOs) are embedded in many of the above-mentioned COs and PrOs. More could be added to fulfill the development of this competency.

a) Work as a leader/a team member.
b) Follow ethical practices
c) Observe safety measures
d) Good house keeping
e) Time management
f) Practice environmentally friendly methods and processes. (Environment-related)

The ADOs are best developed through laboratory/field-based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

i. 'Valuing Level' in 1st year
ii. 'Organization Level' in 2nd year.
iii. 'Characterization Level' in 3rd year.

8. UNDERPINNING THEORY

The major underpinning theory is given below based on the higher level UOs of *Revised Bloom's taxonomy* that are formulated for development of the COs and competency.. If required, more such higher-level UOs could be included by the course teacher to focus on the attainment of COs and competency.

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
Unit – I **Atomic Structure, Chemical Bonding and Solutions**	1a. Apply the different atomic theories, models and principles for structural illustration. 1b. Explain Pauli's exclusion principle, Hund's rule and Aufbau rule with examples. 1c. Write the electronic configurations of different elements. 1d. Describe the different types of chemical bonds. 1e. Differentiate among the ionic, covalent and coordinate compounds based on the type of chemical bonding.	1.1. Atomic Structure: Concepts of orbit and orbital, Pauli's exclusion principle. 1.2. Hund's rule of maximum multiplicity, 1.3. Aufbau rule, electronic configuration of atom (up to atomic number 30) 1.4. Chemical Bonding: Concept of chemical bonding, types of chemical bonds, Ionic bond, and its characteristics (example NaCl), Covalent bond and its characteristics (example H_2, O_2, N_2, HF, NH_3, H_2O, CH_4), Coordinate covalent bond (example NH_4^+, H_3O^+), Metallic bond and its

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
	1f. Explain various properties of Materials depending upon bond formation. 1g. Prepare the solution of given concentrations (Normality, Molarity).	characteristics, Hydrogen bonding, its types, and Significance, Intermolecular force of attraction. 1.5. Molecular arrangement in solid, liquid and gases, Structure of solids - Molecular solid, Ionic solid, Network solid, and Metallic solid. 1.6. Solutions: The Idea of solute and solution, Methods to express the concentration of solution - Normality, Molarity (*M* = mole per liter), ppm, mass percentage, volume percentage, and mole fraction.
Unit – II **Concepts of Electrochemistry**	2a. Explain the theory of ionization and the factors affecting it. 2b. Describe pH value and its industrial application. 2c. Describe different types of buffer solutions and their application. 2d. Differentiate electrolyte and nonelectrolyte. 2e. Describe the construction and working of an electrochemical cell and standard hydrogen electrode (SHE) 2f. State the Nernst equation and Faraday's laws of electrolysis and its application. 2g. Use the different electrolysis process such as electro metallurgy, electroplating and electrorefining to solve wide variety of industrial problems.	2.1. Arrhenius theory of ionization. 2.2. Electronic concept of oxidation, reduction, and redox reactions. 2.3. Degree of ionization and factors affecting the degree of ionization. 2.4. Definition of pH, pH of acid, base and neutral solution, pH calculations for acid, base, and salt solutions at different concentrations, Importance of pH in various fields. 2.5. Definition of buffer solution, buffer action and types of buffer solution, Application of buffer solution. 2.6. Definition of terms: electrolytes, non-electrolytes with suitable examples, Types of electrolytes. 2.7. Construction and working of Electrochemical Cell. 2.8. Construction and working of Standard Hydrogen Electrodes (SHE). 2.9. Nernst theory of single electrode potential and Nernst equation. 2.10. Electrochemical series. 2.11. Electrolysis, Faraday's laws of electrolysis. 2.12. Industrial application of electrolysis: Electro metallurgy, electroplating, and electro refining.
Unit– III	3a. Describe the various types of corrosion.	3.1. Corrosion: Dry or Chemical corrosion: Oxidation corrosion-

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
Corrosion of metals and its prevention	3b. Identify the different factors affecting the rate of corrosion. 3c. Explain the various type of protective measures to prevent corrosion. 3d. Select relevant method to prevent metal from corrosion	mechanism, Corrosion by other gases. 3.2. Wet or Electrochemical corrosion- H_2 liberation and O_2 absorption mechanism of electrochemical corrosion. 3.3. Galvanic corrosion mechanism. 3.4. Concentration cell corrosion. 3.5. Pitting corrosion, Waterline and Crevice corrosion. 3.6. Factors affecting the rate of corrosion: Nature of the metal, Nature of surface film, Relative areas of the anodic and cathodic parts, Purity of metal, Temperature, Humidity of air, Influence of pH. 3.7. Internal and External corrosion preventive measures: Modification of environment, Modification of the properties of metal, Use of protective coatings, Anodic and cathodic protection, Modification in design and choice of material
Unit– IV **Fuels and Combustion**	4a. Classify various types of fuels. 4b. Calculate the calorific value of various fuels using Dulong's formula. 4c. Determine proximate analysis of coal for assessing its quality for domestic and industrial use. 4d. Assess the efficiency of coal by determining the calorific value of fuel. 4e. State the significance of octane and cetane number. 4f. Justify the need for alternative fuels.	4.1. Definition and Classification of fuels, Calorific values and their units. Determination of calorific value using a bomb calorimeter. 4.2. Characteristics of good fuel. 4.3. Comparison between solid, liquid, and gaseous fuels. 4.4. Theoretical calculation of HCV and LCV of fuel using Dulong's formula. 4.5. Solid fuels: Coal, Classification of coal, Proximate and ultimate analysis of coal. 4.6. Liquid fuels: Petroleum, Origin of petroleum and classification of petroleum, Refining of petroleum. 4.7. Petrol and Diesel-fuel rating (Octane and Cetane numbers), Power alcohol and Bio-diesel. 4.8. Chemical composition, Calorific values, and Applications of LPG, CNG, water gas, coal gas, producer gas, and biogas.

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
Unit– V **Lubricants**	5a. Explain terms lubricant and lubrication 5b. Describe the types of lubricants. 5c. Describe the physical and chemical properties of a lubricant. 5d. Selection of proper lubricants for engineering use. 5e. Select relevant lubricant based on their function and characteristic properties for use in different kind of machinery. 5f. Determine viscosity, flash and fire point of given lubricant for their specific use. 5g. State the biodegradable lubricants.	5.1. lubricants and Lubrication, Functions of lubricants. 5.2. Mechanism of Lubrication: Fluid lubrication, Boundary lubrication. Classification of lubricant with examples: Solid, Semi-solid, liquid and synthetic lubricants. 5.3. Physical Properties of lubricants: Viscosity and viscosity index, Flash and fire point, Cloud and pour point, Oiliness. 5.4. Chemical properties of lubricants: Saponification number, Neutralization number, Emulsification number. 5.5. Selection of lubricants for different types of Machinery like: Gears, Cutting tools, Steam turbine, Transformers. 5.6. Biodegradable lubricants
Unit– VI **Polymers, Elastomers, and Insulating Materials**	6a. Classify Polymers based on molecular structures and monomers. 6b. Differentiate thermoplastic and thermosetting polymers with examples. 6c. Explain polymerization reactions with examples. 6d. Describe the applications of thermoplastic and thermosetting polymers. 6e. Describe the application of biodegradable polymers. 6f. Explain the properties and application of synthetic rubbers. 6g. Explain the process of vulcanization of rubber. 6h. Use relevant insulating materials for engineering applications.	6.1. Definition of Monomer, Polymer and Polymerization. 6.2. Classification of Polymers based on molecular structure: Linear Polymers, branched polymers, Cross-linked polymers. 6.3. Classification of polymers based on Monomer: Homopolymer, Copolymer. 6.4. Classification of polymers based on thermal behavior: Thermoplastics and Thermosetting polymers. 6.5. Types of polymerizations: Addition and condensation polymerization 6.6. Simple reactions involved in the preparation and their properties and application of thermoplastics and thermosetting polymers: Polyethylene, Polypropylene, Polyvinyl chloride, Polytetrafluoroethylene (Teflon), Polystyrene, Polyacrylonitrile, Bakelite, Epoxy resins. 6.7. Biodegradable Polymers:

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
		Introduction, chemical composition, and application: Polyβ- hydroxybutyrate–co-β-hydroxy valerate (PHBV), Nylon-2–nylon-6. 6.8. Rubber: Natural rubber and its properties, Vulcanization of rubber, Synthetic rubber – simple reaction involved in the preparation and their properties and application: Buna-S rubber, Buna-N rubber, Neoprene rubber 6.9. Insulating Materials: Types and Properties of Insulating materials, Application of Thermal and Electrical Insulating Materials.
Unit– VII **Electrochemical Energy Sources**	7a. Describe the construction and working of various batteries. 7b. Explain the working of fuel cell. 7c. Describe the solar cells. 7d. Use the different types of fuel cells based on their mechanism and characteristics.	7.1 Batteries: An electrochemical source of energy, Types of Batteries: Primary, Secondary and Fuel batteries 7.2 Dry cell - construction and working. 7.3 Lead-acid storage cell - construction and working. 7.4 Nickel/Cadmium battery - construction and working. 7.5 Fuel cells - definition, example Hydrogen fuel cell, and biochemical fuel cell, Characteristics of fuel cells, Solar Cells.

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Atomic Structure, Chemical Bonding, and Solutions	06	03	03	02	08
II	Concepts of Electrochemistry	07	02	06	04	12
III	Corrosion of metals and its prevention	05	02	04	02	08
IV	Fuels and Combustion	07	03	05	04	12
V	Lubricants	05	02	04	02	08

VI	Polymers, Elastomers, and Insulating Materials	07	03	06	05	14
VII	Electrochemical Energy Sources	05	02	04	02	08
Total		**42**	**17**	**32**	**21**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*

Note*: This specification table provides general guidelines to assist students for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions to assess the attainment of the UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may slightly vary from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, the following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct the following activities in group and prepare small reports of about 5 pages for each activity. They should also collect/record physical evidence such as photographs/videos of the activities for their (student's) portfolio which will be useful for their placement interviews:

a) Prepare a PowerPoint presentation or animation showing different types of chemical bonds and atomic structures.
b) Prepare a model of an atom with the help of a ball and stick or of any other items.
c) pH Calculations for acid, base, and salt solutions at different concentrations.
d) Preparation of a table showing the different methods used for prevention of corrosion.
e) Solve simple problems on hardness calculation.
f) Market survey of different lubricating oil and compare their physical and chemical properties.
g) Library survey regarding polymers, synthetic rubber, and adhesives used in different industries.
h) Collect different polymers and prepare the chart/ PowerPoint based on their type, properties, and uses.
i) Market survey of different batteries and differentiate primary and secondary batteries.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses (***MOOCs***) may be used to teach various topics/subtopics.
b) Guide student(s) in undertaking micro-projects/activities.
c) Different types of teaching methods i.e. video demonstration, activity-based learning, case study, m-learning need to be employed by teachers to develop the outcomes.

d) **Some *of the topics/sub-topics*** which are relatively simpler or descriptive are to be given to the students for ***self-learning*** but to be assessed using different assessment methods.
e) Teachers need to ensure to create opportunities and provisions for ***co-curricular*** activities.
f) Guide students to address issues on environment and sustainability with reference to using the knowledge of this course.
g) OERs, Vlab, and Olabs may be used to teach for the teaching of different concepts.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her at the beginning of the semester. In the first four semesters, the micro-project are group-based (group of 3 to 5). However, **in the fifth and sixth semesters**, the number of students in the group should ***not exceed three.***

The micro-project could be industry application-based, internet-based, workshop-based, laboratory-based, or field-based. Each micro-project should encompass two or more COs which are the integration of PrOs, UOs, and ADOs. Each student will have to maintain a dated work diary consisting of individual contributions in the project work and give a seminar presentation of it before submission. The duration of the micro-project should be about **14-16 *(fourteen to sixteen) student engagement hours*** during the course e. The students ought to submit micro-project by the end of the semester (so that they develop industry-oriented COs).

A suggestive list of micro-projects is given here. This should relate highly to the competency of the course and the COs. Similar micro-projects could be added by the concerned course teacher:

a) Prepare a PowerPoint animation that can explain the structure of an atom.
b) Prepare a chart of the modern periodic table which gives information about the atomic number and mass number of different elements.
c) Prepare common salt crystals from NaCl solution
d) Prepare a chart representing compounds and solutions which affect human life positively and negatively.
e) Prepare a model of an atom with the help of a ball and stick or of any other items.
f) Form three groups of students in the class. Consider a hypothetical situation of exchanging/ sharing/giving of different items/belongings and demonstrate the type of ionic, covalent, and co-ordinate bonding amongst the students in a simulated situation. Present your findings.
g) Model of electronic configurations for different atoms (Z=30)
h) Prepare a model to demonstrate the application of electrolysis cells.
i) Collect three metallic strips of Al, Cu, Fe, strips, Place them in different acidic and alkaline solutions of the same concentration. Observe and record the loss in weight of metals due to an acidicand alkaline environment. Discuss the findings with your teacher and colleagues.
j) Classify the surrounding corrosion into dry corrosion and wet corrosion.
k) Collect different samples of utensils reinforced materials, iron, copper, brass, bronze, and other alloys. Place them in an open environment under tin shade. Observe the corrosive properties overa period of four weeks. Record your observations. Discuss the findings with your teacher andcolleagues.
l) Collect samples of petrol, kerosene oil, diesel, any edible oil, coconut oil. Find out the

flash point and fire point, cloud and pour point, and viscosity of the same. Compare the properties and justify their use in relevant applications.

m) Depending on the type of machinery, the load applied, speed of the machine, heat generated, etc, select the appropriate lubricant which can be applied to the machinery. Discuss with your teachers and colleagues and present the same.

n) Make a table showing the availability of natural rubber in India and show places on the India map.

o) Collect different polymers and prepare the chart/ PowerPoint based on their type,properties, and uses.

p) Collect fuel samples from different sources and prepare a chart showing their calorific values and uses.

q) Mapping of energy resources in India.

r) Collection of data of various electrochemical cells-batteries used in equipment and devices and available in the market.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with the place, year and ISBN
1	Engineering Chemistry	Jain & Jain	Dhanpat Rai Publishing Co.(P) Ltd., New Delhi, 2015, ISBN: 93-521-6000-2
2	A Textbook of Engineering Chemistry	Dr. S. S. Dara & Dr. S. S. Umare	S. Chand & Co.(P) Ltd., New Delhi, 2014, ISBN:81-219-0359-9
3	Textbook of Chemistry for Class XI & XII (Part-I & II)	NCERT	NCERT, New Delhi, 2017-18, Class-XI, ISBN: 81-7450-494-X (part-I), 81-7450-535-O (part-II), Class-XII, ISBN: 81-7450-648-9 (part-I), 81-7450-716-7 (part-II)
4	Engineering Chemistry	Shikha Agarwal	Cambridge Uni. Press, New Delhi, 2019, ISBN: 978-1-108-72444-9
5	Understanding Chemistry	C.N.R. Rao	World scientific publishing Co., 2009, ISBN: 9789812836045
6	Engineering Chemistry	Dr. Vikram, S.	Wiley India Pvt. Ltd., New Delhi, 2013, ISBN: 9788126543342
7	Applied Chemistry Laboratory Practices, Vol. I & II	Dr. G.H. Hunger & Prof. A.N. Pathak.	NITTTR, Chandigarh, Publication, 2013-14
8	Chemistry for Engineers	Rajesh Agnihotri	Wiley India Pvt. Ltd., 2014, ISBN: 9788126550784
9	Fundamental of Electrochemistry	V. S. Bagotsky	Wiley International N. J.,2005, ISBN: 9780471700586

14. SUGGESTED LEARNING WEBSITES

a) http://www.chemguide.co.uk/atommenu.html

b) https://www.visionlearning.com

c) http://www.chem1.com

d) http://www.em-ea.org
e) https://ncert.nic.in
f) www.onlinelibrary.wiley.com
g) www.rsc.org
h) www.chemcollective.org
i) www.wqa.org
j) https://docslib.org/insulation-materials-science-and-application
k) http://www.olabs.edu.in/
l) http://chemcollective.org/activities/type_page/1
m) http://www.presentingscience.com/vac/corrosion/index.htm
n) https://vlab.amrita.edu/index.php?sub=2&brch=190

15. PO-COMPETENCY-CO MAPPING

Semester I/II	Engineering Chemistry (Course Code: 4300006)						
	POs						
Competency & Course Outcomes	PO 1 Basic & Discipline-specific knowledge	PO 2 Problem Analysis	PO 3 Design/ development of solutions	PO 4 Engineering Tools, Experimentation &Testing	PO 5 Engineering practices for society, sustainability & environment	PO 6 Project Management	PO 7 Life-long learning
Competency **Use principles of engineering chemistry to solve broadly-defined engineering problems.**	3	2	2	1	1	1	1
Course Outcomes CO1: Apply the principles of chemical bonding and solutions to solve various engineering problems.	3	1	-	1	-	-	1
CO2: Solve engineering problems using the concepts of electrochemistry and corrosion.	3	1	-	1	1	-	1
CO3: Use relevant fuels and lubricants for domestic and industrial applications.	3	1	1	1	1	-	1
CO4: Select appropriate engineering materials for industrial application.	3	1	-	1	1	1	1
CO5: Choose various types of electrochemical devices for domestic and industrial applications.	3	1	-	1	1	1	1

Legend: '**3'** for high, '**2**' for medium, **'1'** for low and **'-'** for no correlation of each CO with PO.

16 COURSE CURRICULUM DEVELOPMENT COMMITTEE

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GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
1st Semester

Course Title: Basics of Information and Communication Technology (ICT)
(Course Code: 4300010)

Diploma programme in which this course is offered	Semester in which offered
Electronics & Communication Engineering, Electrical Engineering, Civil Engineering	First

1. RATIONALE

In this era of the 21st century, information and communication technology (ICT) is used in every walk of life. Today, the potential of ICT is extensively used in scientific, business, industrial and educational areas. This course envisages developing basic skill sets in the use of Information and Communication Technology. It will provide the student hands-on experience on different application software used for office automation and improve day-to-day problem-solving skills using online resources for creating business documents, data analysis, and graphical representations. It will also enable the student to use Internet services for different communication.

2. COMPETENCY

The purpose of this course is to help the student to attain the following industry identified competency through various teaching learning experiences.

- **Develop basic skills in ICT for creating professional documents, analyzing data, preparing multimedia presentations, and using internet services.**

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with the identified competency are to be developed in the student for the achievement of the following COs:

a) Classify various computer hardware, peripherals, and software for various purposes.
b) Prepare professional documents, analyzing data, creating a presentation
c) Use computer Networks for data and device sharing.
d) Use Internet services for various applications.
e) Create a webpage using HTML

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
0	-	4	2	0	0	25*	25	50

(*): For this practical only course, 25 marks under the practical CA has two components i.e. the assessment of micro-project, which will be done out of 10 marks and the remaining 15 marks are for the assessment of practical. This is designed to facilitate attainment of COs holistically, as there is no theory ESE.
***Legends: L**-Lecture ; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical;*
***C** – Credit, **CA** - Continuous Assessment; **ESE** - End Semester Examination.*

5. SUGGESTED PRACTICAL EXERCISES

The following practical outcomes (PrOs) are the sub-components of the COs. *These PrOs need to be attained to achieve the COs.*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Identify various parts of computer systems & peripherals.	I	02
2	Install Windows/linux Operating System.	I	04
3	Use various tools / utilities available in accessories of Windows/Linux OS.	I	04
4	Install printer, scanner, web cam, projector with the computer system.	I	02
5	Create a text document incorporating different formatting features, inserting images and tables as per given sample	II	02
6	Create a text document setting page layout features, backgrounds, shapes and smart arts as per given sample.	II	02
7	Use mail merge feature for sending invitation letter for expert lecture to 10 industries.	II	04
8	Create spreadsheet, analyse data using formulas and functions and present it through charts.	II	04
9	Create Pay bills/ Pay slips/ Electricity bills/student mark sheets using spreadsheet and take a print out.	II	04
10	Create a professional presentation incorporating various formatting features, inserting media and action buttons.	II	04
11	Prepare & test Ethernet LAN Cable for connecting computers & peripherals using PING command.	III	04
12	Connect two Computers/laptops and transfer/share data using Bluetooth/Wifi/cable.	III	04
13	Connect a Remote Desktop and share data using any remote login method.	III	02
14	Create an E-Mail account for sending and receiving mail.	IV	02
15	Create an online form for registration of students (for any activity) and download its response.	IV	04
16	Organize an online video meeting inviting 10 students.	IV	02
17	Develop HTML/Web page using various formatting tags as per given sample.	V	06
	Total		**56**

Note

i. *More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list.*
ii. *Care must be taken in assigning and assessing study report as it is a first year study report. Study report, data collection and analysis report must be assigned in a group. Teacher has to discuss about type of data (which and why) before group start their market survey.*

*The following are some **sample** 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency.*

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Lab Records	05
2	Question answer or Writing steps exercise	20
3	Executing of exercise	40
4	Printout/ Result	20
5	Viva voice	15
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

These major equipment with broad specifications for the PrOs is a guide to procure them by the administrators, so uniformity for conducting practical can be maintained across the state.

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	Computer with basic configuration and Internet Facility	All
2	Word Processing Software	All
3	Data Analysis Software	All
4	Presentation Software	All
5	Anti Virus Software	All
6	Window/ Linux as operating system	All
7	Gujarati Indic	ALL

7. AFFECTIVE DOMAIN OUTCOMES

The following ***sample*** Affective Domain Outcomes (ADOs) are embedded in many of the above-mentioned COs and PrOs. More could be added to fulfil the development of this course competency.

a) Follow safety practices.
b) Practice good housekeeping.
c) Demonstrate working as a leader/a team member.

d) Maintain tools and equipment
e) Follow ethical practices.

The ADOs are best developed through the laboratory/field-based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

i. 'Valuing Level' in 1st year
ii. 'Organization Level' in 2nd year.
iii. 'Characterization Level' in 3rd year.

8. UNDERPINNING THEORY

The major underpinning theory is given below based on the higher level UOs of *Revised Bloom's taxonomy* that are formulated for development of the COs and competency. If required, more such UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
Unit – I **Basics of Computer Systems**	1a. Explain functions of CPU ,ALU and memory unit of a computer system 1b. Write the steps to install Windows and Linux operating Systems in virtual box	1.1 Computer system block diagram, Concept of Hardware and Software 1.2 CPU, Control Unit, Arithmetic logic Unit(ALU), Memory Unit, Power Unit and Interfacing Ports. 1.3 Input Output unit: Monitor, keyboard, External Hard disk, Mouse Printers, Plotters, Scanner, Projectors, Webcam, Mic, etc. 1.4 Operating system concepts, purpose and functions 1.5 Operations of Windows and Linux 1.5.1 Installation on PC / virtual box 1.5.2 Configuration 1.5.3 Files and Folder Operation 1.5.4 Basic Terminal Commands 1.5.5 Installation of various Application Software
Unit – II **Documentations**	2a. Write steps for text formatting, page Setup features, checking spelling and grammar, with header and footer for a Word Document 2b. Write steps for inserting graphics/clipart, Shapes and Table in a Word Document 2c. Write steps to mail merge documents for inviting students 2d. Write steps for creating a excel	**Using Text Processing** 2.1 Basics of Font type, size, colour, Effects and other text formatting features 2.2 Page settings and margins including header and footer in word document. 2.3 Spelling and Grammatical checks 2.4 Table and its options, Inserting rows or columns, merging and splitting cells, Arithmetic Calculations in a Table.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
	worksheet and representing in the form of chart. 2e. Write steps to setup page as per given layout and print an excel sheet 2f. Write steps for creating presentation and apply basic formatting features using Spreadsheet. 2g. Write steps to insert objects ,clips, video, audio, with special effects and hyperlink in a multimedia presentation. 2h. Write steps for installing Indic IME Gujarati for creating a document.	2.5 Working with pictures, Drawings and WordArt 2.6 Mail merge **Using Spreadsheet** 2.7 Introduction to data, Cell address, Excel Data Types, formatting, number, text and date Concept of hyperlink in Worksheet 2.8 Understanding formulas, Operators and Common spreadsheet functions 2.9 Types of graphics : Word art, auto shapes ,Images ,charts 2.10 Concept of print area, margins, header, footer and other page setup options 2.11 Overview of Spreadsheets and how to create Spreadsheets **Using Professional Presentation** 2.12 Creating new Slides, Working with text boxes, fonts, tables, Layouts, themes, effects, background and Colours 2.13 Selecting, deleting, moving, copying, resizing and arranging objects. 2.14 Working with drawing tools, Applying shape or picture styles, Applying object borders, object fill, object effects, clip art collection and modifying clip art 2.15 Embed a video, Link to a video, Size a video, Video playback options. 2.16 Configuring a sound playback, Assigning sound to an object, Adding a digital music sound track, Transition effects and timings **Using Gujarati IME** 2.17 Installation of Guajarati IME Software 2.18 How to change language English to Gujarati 2.19 Introduction about the Gujarati keyboards 2.20 Introduction about the Gujarati

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
		IME and create Documents in Gujarati
Unit– III **Computer Networks and Data Sharing**	3a. State the advantages of Computer Network in your lab 3b. Create a layout of computer network topology in the lab 3c. Analyse network specifications(Devices,Cables & Connectors) ,IP addressing scheme of Computer Network of your lab 3d. Write steps of various remote login techniques 3e. Write steps of various Data Transfer Techniques	3.1 Basics of Computer Networks 3.1.1 Needs 3.1.2 Types 3.1.3 Topologies 3.1.4 Components 3.2 Network Cables and Connectors 3.3 Overview of Network Devices 3.4 IP Addresses Basics 3.5 Computer and Peripheral sharing in LAN 3.6 Remote Login 3.6.1 Remote Desktop 3.6.2 Telnet 3.6.3 FTP 3.7 Data Transfer or sharing 3.7.1 Using LAN 3.7.2 Bluetooth 3.7.3 Wi-Fi 3.7.3 Modems
Unit– IV **Internet Services**	4a. Use various internet applications. 4b. Create Online form for data collection. 4c. Write various methods to secure your personal computer	4.1 Internet 4.2 Web Browser and Browsing Websites 4.3 Search engines 4.4 WWW and URL 4.5 E-mail 4.6 Video-Conferencing/online Meet 4.7 Online Games 4.8 E-Commerce 4.9 Forums 4.10 Online Data Management 4.10.1 Online Quiz 4.10.2 Online Forms 4.10.3 Online Assignment. 4.11 Cyber security 4.11.1 Threats in Internet : Virus, Malware 4.11.2 Preventing Tools : Antivirus, Firewall
Unit-V **Designing of Web pages, Blogs and Websites**	5a. Write structure of a HTML page 5b. Write formatting tags as per the sample given page. 5c. Write tags to insert a table in a HTML page	**Working with HTML** 5.1 Structure of HTML Page 5.2 Inserting formatting tags for Text 5.3 Font color, size, style, Alignment 5.4 Margin with body tag, background and text colour

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
	5d. Write tags to insert image in a HTML page	5.5 Ordered and unordered lists 5.6 **Tables** – basic structure, Using TD, TR, TH tags, use of basic elements in table : border, cell padding, cell spacing, width, caption, align, bg color 5.7 **Images in web page**: inserting and formatting of images using SRC, border, Vspace, Hspace, align, ALT, height, width and background in HTML page

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
		Not Applicable				

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should perform following activities in group and prepare reports of about 5 pages for each activity. They should also collect/record physical evidences for their (student's) portfolio which may be useful for their placement interviews:

a) Undertake micro-projects in team/individually.
b) Encourage Students for creating and designing forms related to Departmental work.
c) Encourage students to participate in the Microsoft-Office Specialist World Championship.
d) Students are encouraged to register themselves in various MOOCs such as: Swayam, edx, Coursera, Udemy etc to further enhance their learning.
e) Undertake a market survey of different Version like new and improved desktop apps, as well as mobile apps and a web-based alternative for both Windows and Mac users.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Guide student(s) in undertaking micro-projects.
b) Diagnosing Essential Missed Learning concepts that will help for students to improve their performance.
c) Guide Students to do Personalized learning so that students can understand the course material at his or her pace.
d) Encourage students to do Group learning by sharing so that learning can be enhanced.

e) About ***20% of the topics/sub-topics*** which are relatively simpler or descriptive in nature is to be given to the students for ***self-learning***, but to be assessed using different assessment methods.
Guide students on addressing the issues on environment and sustainability using the knowledge of this course

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based (group of 3 to 5). However, **in the fifth and sixth semesters**, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The duration of the microproject should be about **14-16** ***(fourteen to sixteen) student engagement hours*** during the course. The students ought to submit micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. This has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher:

MICRO PROJECT 1: Prepare the following text documents

1. Prepare your Resume as per the given sample
2. Draft a letter addressed to the principal getting permission to avail leave.\
3. Develop a handout for Unit-1 of 10-pages with the table of content (INDEX).

MIICRO PROJECT 2: / Prepare the following spreadsheets.

1. Prepare a Timetable for your current semester.
2. Prepare a Mark sheet with grades for your final examination as per the given sample.

MICRO PROJECT 3: Prepare 15-20 slides presentation having Department and Institute Information.

MICRO PROJECT 4: Develop a webpage for your department as per the given sample.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Computer Course	R Taxali	Tata McGraw Hills. New Delhi.
2	World Wide Web design with HTML	Xavier	Tata McGraw Hills. New Delhi.
3	INFORMATION TECHNOLOGY	Dennis P. Curtin, Kim Foley, Kunal Sen, Cathy Morin	Tata McGraw Hills. New Delhi.
4	Fundamentals of	V. Rajaraman	PHI; 5th edition (1 December 2011)

S. No.	Title of Book	Author	Publication with place, year and ISBN
	Computers		
5	Data communication and networking	Behrouz A Forouzan	Tata McGraw Hills. New Delhi.

14. SOFTWARE/LEARNING WEBSITES

a) www.tutorialspoint.com
b) www.wix.com
c) www.blogger.com
d) www.forms.google.com

15. PO-COMPETENCY-CO MAPPING

Semester-I	Basics of Information and Communication Technology (ICT) (Course Code: 4300010)						
	POs						
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design/ develop-ment of solutions	PO 4 Engineering Tools, Experimen-tation &Testing	PO 5 Engineering practices for society, sustainability & environment	PO 6 Project Manage-ment	PO 7 Life-long learning
Competency ***Use Fundamentals of Computer in various engineering applications***							
Course Outcomes CO a) Classify various computer hardware, peripherals and software for various purposes	3	3	2	3	2	2	2
CO b) Prepare professional documents, analyzing data, creating presentation	2	1	2	1	-	2	1
CO c) Use computer Networks for data and device sharing.	3	2	2	3	1	2	3
CO d) Use Internet	3	2	2	2	1	2	3

Semester-I	Basics of Information and Communication Technology (ICT) (Course Code: 4300010)						
	POs						
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design/ develop-ment of solutions	PO 4 Engineering Tools, Experimen-tation &Testing	PO 5 Engineering practices for society, sustainability & environment	PO 6 Project Manage-ment	PO 7 Life-long learning
services for various applications.							
CO e) Create webpage using HTML.	3	2	2	1	1	2	3

Legend: '**3'** for high, '**2**' for medium, **'1'** for low and **'-'** for no correlation of each CO with PO.

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

S. No.	Name and Designation	Institute	Contact No.	Email
1	Mr. N. M. Rindani	AVPTI, Rajkot	9898533198	nmrindani@gmail.com
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4	Mr. M. R. Panchal	G.G.P., Ahmedabad	9723340568	panchalmihir031@gmail.com

NITTTR Resource Persons

S. No.	Name and Designation	Department	Contact No.	Email
1	Dr. M.A.Rizvi Associate Professor	Department of Computer Science Engineering Education	0755-2661600	marizvi@nitttrbpl.ac.in
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GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
I & II – Semester

Course Title: **Sports and Yoga**
(Course Code: 4300015)

Diploma programme in which this course is offered	Semester in which offered
Civil, Environment, Automobile, Fabrication, Marine, Mechanical, Electrical, Electronics and Communication, Metallurgy, Plastics, Bio Medical, Instrumentation and Control, Power Electronics, Computer, Information Technology, CACDDM, Ceramics, Printing, Textile Design, Textile Manufacturing, Textile Processing	First
Architectural Assistantship, Mining, Chemical, Mechatronics	Second

1. RATIONALE

Physical activity is vital to the holistic development of students, fostering their physical, social and emotional health. Sports and Yoga are essential part of our life for good health and peace of mind. Yoga is considered itself as a sport which plays through your own physical ability. Yoga provides you all the benefits that you are willing to have from generic sports like badminton, football, cricket, etc. Yoga is the application of physical postures, control of breath, purification and relaxation of mind / body and spiritual principles aimed at bringing greater unity and balance to the mind and body. The use of breathing techniques known as *Pranayama* enables a person to focus on breath and helps to calm and still the mind and cultivate concentration ability. *Pranayama* can also help to energise and revitalize the body.

2. COMPETENCY

The purpose of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Apply sports and yoga activities to keep the body physically and mentally fit.**

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with the identified competency are to be developed in the student for the following Course Outcomes (COs) achievement:

a) Practice physical activities and yoga for strength, flexibility and relaxation.
b) Use techniques for increasing concentration and decreasing anxiety for stronger academic performance.
c) Perform yoga exercises in various combination and forms.
d) Improve personal fitness through participation in sports and yoga activities.
e) Follow sound nutritional practices for maintaining good health and physical performance.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
0	0	2	0	0	0	25	0	0

This is designed to facilitate attainment of COs holistically, as there is no examination.

***Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** -Practical; **C** – Credit, **CA** - Continuous Assessment; **ESE** -End Semester Examination.*

5. SUGGESTED PRACTICAL EXERCISES

The following practical outcomes (PrOs) are the sub-components of the COs. *Some of the **PrOs** marked **'*'** are compulsory, as they are crucial for that particular CO at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'*.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1.	Perform following Yoga Asanas under the guidance of yoga trainer :- • Surya Namaskar (Sun Salutation) • Tadasana (Mountain pose) • Vrikshasana (Tree pose) • Vajrasan (Hand under foot pose) • Pada-hastasana (Hand under foot pose) • Ushtrasana (Camel pose) • Dhanurashana.(Bow Pose) • Bhjangasana (Snake pose) • Halasana (Plough pose) • Shavasana/Yoga Nidra • Bhastrikai Pranayam • Kapalbhati Pranayam • Anulom Vilom Pranayam • Bhramari Pranayam	III	12*
2.	Participate in any sports activities of your choice : • Indoor sports/games (Badminton, Chess, Carrom, Table Tennis) • Outdoor sports/games (Cricket, Kabaddi, , Volley ball, Basketball, Football, Hockey)	IV	14
3.	Prepare report on any sports events including associated rules, playground specification, rules for judgement, etc.)	IV	02*
	Total		**28**

Note

*i. More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list.*

*ii. The following are some **sample** 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency.*

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
	-Not applicable-	Nil

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specifications for the PrOs is a guide to procure them by the administrators to usher in uniformity of practicals in all institutions across the state.

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	Yoga Mats/ Blankets Straps Blocks Bolsters Chairs Meditation cushions Eye pillows (tissues or washable cloth to cover them) Mat cleaning wipes Strong floorings Temperature control, fans, portable heaters (if needed) Chime, bells, or gong (for bringing people out of corpse pose, or silent meditation) Essential oil diffuser Yoga CD's CD player Lighting system that allows for dimming Effective sound system Salt lamp – they purify air and look lovely Sandbags	1
2	Sports and games accessories as per the decision of college.	2

7. AFFECTIVE DOMAIN OUTCOMES

The following ***sample*** Affective Domain Outcomes (ADOs) are embedded in many of the above-mentioned COs and PrOs. More could be added to fulfill the development of this course competency.

a) Follow safe practices.
b) Practice good housekeeping.
c) Demonstrate working as a leader/a team member.
d) Maintain tools/accessories/ equipment.
e) Follow ethical practices.

The ADOs are best developed through the laboratory/field-based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

i. 'Valuing Level' in 1st year
ii. 'Organization Level' in 2nd year.
iii. 'Characterization Level' in 3rd year.

8. UNDERPINNING THEORY

The major underpinning theory is given below based on the higher level UOs of *Revised Bloom's taxonomy* that are formulated for development of the COs and competency. If required, more such UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
Unit – I **Introduction to Physical fitness**	1a. Explain importance of physical education. 1b. Describe importance of Physical Fitness & Wellness 1c. Explain the components of physical fitness. 1d. Demonstrate healthy life style. 1e. Prevent health threats by changing life style.	1.1 Aims & Objectives of Physical Education 1.2 Changing trends in Physical Education 1.3 Meaning & Importance of Physical Fitness & Wellness 1.4 Components of Physical fitness 1.5 Components of health related fitness 1.6 Components of wellness 1.7 Preventing health threats through lifestyle change 1.8 Concept of positive lifestyle
Unit – II **Fundamentals of Anatomy & Physiology in sports & yoga**	2a. Explain importance of anatomy and physiology. 2b. Describe effects of exercise in various body systems. 2c. Describe concept of correct posture. 2e. Explain corrective measures for posture deformities.	2.1 Anatomy, physiology and its importance. 2.2 Effect of exercise on various body system i.e. circulatory system, respiratory system, neuro- muscular system 2.3 Concept and advantages of correct posture. 2.4 Posture deformities and corrective measures.
Unit– III **Yoga & Pranayama**	3.1 Explain importance of yoga. 3.2 Perform various pranayama for increasing concentration. 3.3 Use meditation and other relaxation techniques for improving concentration.	3.1 Meaning & Importance of Yoga Asanas, Pranayama & Meditation 3.2 Yoga & related Asanas - Sukhasana, Tadasana, Padmasana & Shashankasana 3.3 Relaxation techniques for improving concentration - Yog-Nidra

Unit– IV **Sports/ games**	4.1 Describe various warming exercises. 4.2 Select any game/sports of your choice. 4.3 Explain latest rules of any game/sports. 4.4 Describe specifications of play fields and related sports equipment.	4.1 Warming up and limbering down exercises 4.2 Tournaments- Knock out, League/ Round Robin & combination 4.3 Following sub topics related to any one Game/Sport of choice of student out of: Badminton, Chess, Carrom, Table Tennis, Cricket, Kabaddi, , Volley ball, Basketball, Football, Hockey, etc. 4.4 History of the Game/Sport. 4.5 Latest General Rules of the Game/Sport. 4.6 Specifications of Play Fields and Related Sports Equipment. 4.7 Effect of anxiety & fear on sports performance.

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching/ Practical Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction to Physical fitness	**- Not Applicable -**				
II	Fundamentals of Anatomy & Physiology in sports & yoga					
III	Yoga & Pranayama					
IV	Sports/games					
Total						

Legends: *R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should perform following activities in group and prepare reports of about 5 pages for each activity. They should also collect/record physical evidences for their (student's) portfolio which may be useful for their placement interviews:

a) Prepare a list of specifications for various tools/equipment/machines used in gymnasium/indoor sports complex.
b) Undertake a market survey of local dealers for procurement of sports items/ equipment/machines.
c) Visit the sports shop and collect all relevant information about any sport item and submit the detailed report.
d) Download video clips showing correct practices for yogasanas, pranayam and any sports/games.
e) Prepare a chart showing different types of yogasanas.
f) Prepare a chart showing different types of pranayams.

g) Prepare a chart showing the field details of any sports/games.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b) About ***20% of the topics/sub-topics*** which are relatively simpler or descriptive in nature is to be given to the students for ***self-learning***, but to be assessed using different assessment methods.
c) With respect to ***section No.10***, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
f) Arrange visit to nearby yoga centre and sports complex and use of videos/animations for understanding various steps , processes related to the activities .

12. SUGGESTED MICRO-PROJECTS

- Not Applicable -

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Modern Trends and Physical Education class 11 & class 12	Ajmer Singh	Kalyani Publication, New Delhi ISBN : 9789327264319
2	Light on Yoga	B.K.S. Iyengar	Thomson's Publication, New Delhi ISBN: 8172235011
3	Health and Physical Education	V.K.Sharma	NCERT Books; Class11,12 Saraswati House Publication, New Delhi
4.	Yoga and Stress Management	Acharya Yatendra	Fingerprint Publishing ISBN: 938905303X
5.	Patanjali Yoga Sutras	Swami Vivekanand	Fingerprint Publishing ISBN: 9389567351
6.	Pranayam Rahasya	Ramdev	Patanjali-Divya Prakashan,Haridwar ISBN: 978-8189235017
7.	Yoga its Philosophy & Practice	Ramdev	Divya Prakashan, Haridwar

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14. SOFTWARE/LEARNING WEBSITES

- https://youtu.be/dAqQqmaI9vY
- https://youtu.be/c8hjhRqIwHE
- https://youtu.be/MrR04m1zoJ8
- https://youtu.be/P-jwGj7YqNM

- https://youtu.be/3p4r_ad2Y7g
- https://youtu.be/mndOlVCwFss
- https://youtu.be/J68MR3dBzto

15. PO-COMPETENCY-CO MAPPING

Semester-I & II	Sports & Yoga (Course Code: 4300015)						
	POs						
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design/ develop-ment of solutions	PO 4 Engineering Tools, Experimen-tation &Testing	PO 5 Engineering practices for society, sustain-ability & environ-ment	PO 6 Project Manage-ment	PO 7 Life-long learning
Competency	Apply sports and yoga activities to keep the body physically and mentally fit.						
Course Outcomes CO a) Practice Physical activities and yoga for strength, flexibility, and relaxation.	2	-	-	-	1	-	2
CO b) Use techniques for increasing concentration and decreasing anxiety for stronger academic performance.	3	-	-	-	1	-	2
CO c) Perform yoga exercises in various combination and forms.	2	-	-	-	1	-	2
CO d) Improve personal fitness through participation in sports and yoga activities.	2	-	-	-	1	-	2
CO e) Follow sound nutritional practices for maintaining good health and physical performance.	3	-	-	-	1	-	2

*Legend: '**3**' for high, '**2**' for medium, '**1**' for low and '**-**' for no correlation of each CO with PO.*

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

S. No.	Name and Designation	Institute	Contact No.	Email
1.				
2.				
3.				

NITTTR Resource Persons

S. No.	Name and Designation	Department	Contact No.	Email
1.	Prof. M.C.Paliwal, Associate Professor	Civil Engg. Education	9407271980	mcpaliwal@nitttrbpl.ac.in
2.	Dr. K.K. Jain, Professor	Mech. Engg. Education	9425017472	kkjain@nitttrbpl.ac.in

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
Semester – I & II

Course Title: **Basics of Mechanical Engineering**
(Course Code: 4300017)

Diploma Programme in which this course is offered	Semester in which offered
Electrical	First
Civil, Environment, Mining, Metallurgy, Plastics	Second

1. RATIONALE

Now a days as an advancement of technology interdisciplinary knowledge is must for the engineering diploma holders. An engineering diploma holder expected to look after many activities at work place, which may be of interdisciplinary. Knowledge other than own discipline plays important role in the development of individual as well as society. This course mainly encompasses the major areas of mechanical engineering which are being used by engineering diploma holders and are required to perform tasks such as selection of hand tools, power tools, welding, cutting, manufacturing processes, diesel generator sets, refrigeration and air conditioning, hydro-pneumatic devices/equipment, and material handling equipment used for various purposes. Such skills can be developed by knowing the basic principles of mechanical engineering. The motive of this subject is to enhance the knowledge & skill level in the interdisciplinary area. This course is designed in such a way that practical performed in this course will develop these basic skills to perform well in industry as well as in field work.

2. COMPETENCY

The purpose of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Apply basic principles of mechanical engineering in various engineering applications.**

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with the identified competency are to be developed in the student for the achievement of the following COs:

a) Use relevant mechanical power and hand tools in real life applications.
b) Select relevant power transmission mode in simple engineering situation.
c) Use relevant manufacturing process for various components.
d) Identify different components of various thermal systems.
e) Identify various hydro-pneumatic devices/equipment.
f) Use material handling equipment for given situations.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
0	2	2	3	-	-	25*	25	50

(*): Out of 25 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 15 marks is the average of 2 tests to be taken during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

Legends: ***L****-Lecture;* ***T*** *– Tutorial/Teacher Guided Theory Practice;* ***P*** *- Practical;* ***C*** *– Credit,* ***CA*** *- Continuous Assessment;* ***ESE*** *- End Semester Examination.*

5. SUGGESTED PRACTICAL EXERCISES

The following practical outcomes (PrOs) are the sub-components of the COs. *Some of the* ***PrOs*** *marked* ***'*'*** *are compulsory, as they are crucial for that particular CO at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'.*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	Use different hand, power tools and pipe fitting tools for the given application	I	02*
2	Make simple pipe layouts using pipes and pipe fittings as per given drawing.	I	02
3	Assemble/dismantle given power transmission setup.	II	02*
4	Fix different transmission elements between two parallel shaft systems (Bike, Cycle, Washing Machine, etc.)	II	02
5	Assemble/dismantle different brakes, clutches and couplings.	II	02*
6	Produce a plain or taper turning job as per given drawing.	III	02
7	Prepare a job using arc and gas welding operation.	III	02
8	Perform soldering/brazing operation on the given job.	III	02*
9	Prepare a wooden joint as per the given drawing	III	02
10	Prepare a simple sheet metal product such as (Funnel or Box)	III	02*
11	Attach/detach different mountings and accessories on steam boiler model.	IV	02*
12	Assemble/dismantle impulse turbine model.	IV	02
13	Assemble/dismantle reaction turbine model.	IV	02
14	Assemble/dismantle two stroke and four stroke petrol engine (Any one).	IV	02*
15	Assemble/dismantle two stroke and four stroke diesel engine (Any one).	IV	02
16	Determine properties of air (Dry bulb temperature, Wet bulb temperature, Humidity).	IV	02
17	Assemble/dismantle centrifugal and reciprocating pump. (Any one)	V	02*
18	Assemble/dismantle water turbines models.	V	02
19	Assemble/dismantle centrifugal, reciprocating and screw	V	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
	compressor model.(Any one)		
20	Design and assemble a pneumatic circuit that extends and retracts a single acting (spring return) and double acting cylinder on a given training kit.	V	02
21	Design and assemble a hydraulic circuit that extends and retracts a single acting (spring return) and double acting cylinder on a given training kit.	V	02*
22	Identify different material handling equipment.	VI	02
	Minimum 14 Practical Exercises #		**28Hrs**

Note

i. (#)Minimum 14 (fourteen) practical have to be performed which is equal to 28 hours and it should be a proper mix of practical which cover all the units.

*ii. More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list of practical.*

*iii. The following are some **sample** 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency.*

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Preparation of experimental set up.	20
2	Observation and recording.	20
3	Interpretation of result and conclusion.	20
4	Answer to sample questions.	10
5	Safety measures and good housekeeping.	10
6	Submission of report in time and attendance.	20
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

These major equipment with broad specifications for the PrOs is a guide to procure them by the administrators to usher in uniformity of practical's in all institutions across the state.

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	Plumbing tools- Coupling, Elbow, Bends, Tee, Plug, Cap, Nipple, Union, Reducer, Cross, Flanges.	For Demo in Tutorial class for Unit-I
2	Hand tools- Different spanners (Wrench), Pliers, Screw drives, Chisel, Hand hacksaw, Hammers.	1
3	Power tools- Portable Drilling and grinding machine, Electric power saw, portable electric cutter, electric demolition hammer, power screw driver.	1

S. No.	Equipment Name with Broad Specifications	PrO. No.
4	Plastic Pipes and Metal pipes of different diameters and connectors, different types of pipe fittings, different types of pipe joints.	2
5	Pipe wrench, pipe vice, hacksaw , plumb bob, dies, pipe cutter, files and rasps	2
6	Working models of different belts in different arrangement.	3, 4
7	Working models of belt drives, chain and sprocket, various gear drives.	3, 4
8	Working and cut section models of various types of brake assemblies.	3, 4, 5
9	Models (Wooden/Plastic/Metallic) of various clutch (suitable for dismantling)	5
10	Models (Wooden/Plastic/Metallic) of various coupling.(suitable for dismantling)	5
11	Center lathe machine(length between centers:1200mm)	6
12	Arc Welding machine welding current 20-400A.	7
13	Arc welding tools-electrode holder, cable connector, cable lugs, earthing clamp, wire brush.	7
14	Oxygen and acetylene gas welding and cutting kit with cylinders and regulators.	7
15	Gas welding tools- welding torch, welding tip, spark lighters.	7
16	Brazing and soldering kit. (Brazing kit with suitable silver and copper brazing alloy rods for ¼ '' to 7/8'' tubes- cu to cu, cu to steel, cu to brass and appropriate flux.)	8
17	Wood working tools- carpentry vice 150mm, marking and measuring tools, saws, claw hammer, mallet, chisel, squares.	9
18	Sheet metal material - Black iron, Galvanized iron, Stainless steel , Copper, Aluminum, Tin plate	10
19	Hand tools for sheet metal work - Trammers, Wire Gauge, Snips, Hammers, Stakes, Steel Metal Joints.	10
20	Models/cut section (Wooden/Plastic/Metallic) of fire and water tube boilers.	11
21	Models (Wooden/Plastic/Metallic) of different mountings and accessories for boilers.	11
22	Models/cut section (Wooden/Plastic/Metallic) of impulse and reaction turbine (suitable for dismantling)	12, 13
23	Model/cut section (Wooden/Plastic/Metallic) of two stroke and four stroke petrol engine (suitable for dismantling)	14
24	Model/cut section (Wooden/Plastic/Metallic) of two stroke and four stroke diesel engine (suitable for dismantling)	15
25	Sling psychomotor and thermometer.(Digital temperature and humidity measurement, temperature range of -25° C to 60° C or higher)	16

S. No.	Equipment Name with Broad Specifications	PrO. No.
26	Centrifugal pump (suitable for dismantling)	17
27	Reciprocating pump. (suitable for dismantling)	17
28	Model/cut section (Wooden/Plastic/Metallic) Pelton wheel, Francis and Kaplan turbine. (suitable for dismantling)	18
29	Centrifugal compressor (suitable for dismantling)	19
30	Reciprocating compressor (suitable for dismantling)	19
31	Screw compressor(suitable for dismantling)	19
32	Hydraulic and Pneumatic trainer	20, 21
33	Working models of material handling equipment	22

7. AFFECTIVE DOMAIN OUTCOMES

The following ***sample*** Affective Domain Outcomes (ADOs) are embedded in many of the above mentioned COs and PrOs. More could be added to fulfill the development of this course competency.

a) Work as a leader/a team member.
b) Maintain tools and equipment.
c) Follow safety Practices.
d) Practice good housekeeping.
e) Follow ethical practices.
f) Practice energy conservation.

The ADOs are best developed through the laboratory/field based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

i. 'Valuing Level' in 1st year
ii. 'Organization Level' in 2nd year.
iii. 'Characterization Level' in 3rd year.

8. UNDERPINNING THEORY

The major underpinning theory is given below based on the higher level UOs of *Revised Bloom's taxonomy* that are formulated for development of the COs and competency. If required, more such UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
Unit – I **Basic Mechanical Tools and Components**	1a. Describe the significance of mechanical engineering in daily routine. 1b. Describe the procedure to Identify mechanical tools in general use. 1c. Select pipe and pipe fitting tools.	1.1. Introduction of mechanical engineering. 1.2. Use of mechanical engineering a. In day to day life. b. Interdisciplinary use 1.3. Items in general use- identification criteria, major types, specifications and uses:

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
	1d. Use of different hand and power tools. 1e. Describe the significance of Industry 4.0 in 21st century	such as bolts, nuts, washers, bearings, valves, bushes, springs, levers, rivets, keys, o' rings, oil seals, shafts, axles. 1.4. Pipes and pipe fittings- Types, specifications and uses. 1.5. Hand and power tools a. Types, specifications and uses of spanners (such as fix, ring, box, pipe, Allen, adjustable). b. Types, specifications and uses of hand tools (such as, Pliers, Screw drives, Chisel, Hand hacksaw, Hammers). c. Types, specifications and uses of power tools (Portable Drilling and grinding machine, Electric power saw, portable electric cutter, electric demolition hammer, power screw driver) 1.6. Industry 4.0, Fourth Industrial Revolution, Industry 4.0 Technologies
Unit – II **Power Transmission**	2a. Identify different mode of power transmission. 2b. Select suitable power transmission mode for given application. 2c. Identify the different types of Brake, Clutch and Coupling. 2d. Explain with sketches construction and working of given brake, clutch and coupling.	2.1. Power transmission: a. Importance. b. Modes (belt drives, rope drives, chain drives and gear trains). c. Types of belt and belt drive. d. Types of gear and gear train. e. Applications. 2.2. Brakes, Clutch and Coupling. a. Classification. b. Construction and working. c. Application.
Unit– III **Machine Tools and Manufacturing Processes**	3a. Identify basic machine tools. 3b. State operation performed on different machine tools. 3c. Explain concept of different metal joining processes. 3d. Describe the procedure for casting of given object. 3e. Explain concept of various	3.1. Basic machine tools. a. Introduction to lathe, drill, milling and grinding machines. b. Types of operations / jobs which can be performed on machine tools listed above. 3.2. Metal Joining Processes.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
	metal forming processes.	3.2.1. Welding. a. Types. b. Working setup of arc and gas welding. c. Precautions and safety during arc and gas welding. 3.2.2. Brazing and Soldering. d. General set up. e. Applications. 3.3. Foundry. a. Concept. b. Process of casting a component. c. Applications. 3.4. Basic metal forming processes Bending, rolling, forging and extrusion – concept and its application
Unit– IV **Thermal systems**	4a. Explain steam formation process. 4b. Explain working of the given boiler. 4c. Describe the function of different mounting and accessories.	4.1. Steam generation. a. Steam formation process. 4.2. Boilers. a. Introduction. b. Classification. c. Construction and working of Cochran, Lancashire, and Babcock and Wilcox boiler. d. Functioning of different mountings and accessories.
	4d. Explain working of a given steam turbine. 4e. Identify the components of given type of IC Engine. 4f. Explain working of two stroke and four stroke petrol and diesel engine with sketches. 4g. State effect of air pollution due to IC engine.	4.3. Prime movers. a. Definition. b. Classifications. 4.4. Steam turbine -working and applications. 4.5. Internal combustion engines. a. Introduction. b. Classification. 4.6. Construction and Working of two stroke and four stroke petrol engine. 4.7. Construction and Working of two stroke and four stroke diesel engine. 4.8. Air pollution due to IC engines.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
	4h. Identify the component of refrigeration and air conditioning systems. 4i. Differentiate refrigeration and air conditioning systems. 4j. Suggest the solution for energy saving in the given simple situation.	4.9. Refrigeration. a. Definition. b. Major components of refrigeration systems. c. Ton of refrigeration. d. Applications. 4.10. Air Conditioning. a. Definition. b. Properties of air. c. Types of air conditioning systems. (Window, Package, Central air conditioning system) 4.11. Methods of energy conservation in refrigeration and air conditioning systems.
Unit– V **Hydraulic and Pneumatic Devices**	5a. Explain different fluid properties. 5b. Describe construction, working and application of centrifugal and reciprocating pumps. 5c. Explain working and application of water turbines and air compressors. 5d. Describe working and application of other pneumatic/ hydro-pneumatic equipment.	5.1. Concept of theory of fluid flow. 5.2. General properties of fluids. 5.3. Pump. a. Working principle. b. Types. c. Construction and Working of centrifugal and reciprocating pumps. 5.4. Water turbines: a. Working principle. b. Types. c. Application. 5.5. Air compressor. a. Working principle. b. Types. c. Application. 5.6. Other hydraulic/pneumatic/ hydro-pneumatic equipment. a. Principle of working- hydraulic lift, hydraulic pump, hydraulic power pack, hydraulic jack. b. Application.
Unit– VI **Material Handling Devices**	6a. Identify different material handling equipment. 6b. Describe the procedure for selecting relevant material handling equipment.	6.1. Need of material handling. 6.2. Types, principle of working and applications of material handling equipment. a. Hoisting equipment. b. Conveying equipment.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
		c. Surface & overhead equipment. d. Earth moving machineries. e. Construction machineries. 6.3. Criteria for selection of material handling equipment.

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Tutorial Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Basic Mechanical Tools and Components	03	NOT APPLICABLE			
II	Power Transmission	03				
III	Machine Tools and Manufacturing Processes	06				
IV	Thermal Systems	10				
V	Hydraulic and Pneumatic Devices	04				
VI	Material Handling Devices	02				
Total		**28**				

Legends: R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should perform following activities in group and prepare reports of about 5 pages for each activity. They should also collect/record physical evidences for their (student's) portfolio which may be useful for their placement interviews:

a) Student will visit the respective discipline industry / site and will prepare the list of mechanical engineering related equipment/machineries used by that industry / site.
b) Prepare a seminar on casting Processes.
c) Prepare a power point presentation on metal forming process.
d) Prepare a list of household items which are made by joining processes.
e) Prepare a chart on construction and working of various boilers.
f) Visit a nearby automobile workshop and collect parts of IC engine from scrap.
g) Prepare property table for different types of refrigerants/alternate fuels.
h) Collect videos, animation showing working of various hydro/pneumatic devices.
i) Visit a nearby industry and prepare a report on different types of material handling equipments.
j) Students will visit the industry and collect the specification and features of different water turbine and submit the report.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b) Guide student(s) in undertaking micro-projects.
c) ***'L' in section No. 4*** means different types of teaching methods that are to be employed by teachers to develop the outcomes.
d) About ***20% of the topics/sub-topics*** which are relatively simpler or descriptive in nature is to be given to the students for ***self-learning***, but to be assessed using different assessment methods.
e) With respect to ***section No.10***, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
f) Guide students on how to address issues on environment and sustainability

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-projects are group-based (group of 3 to 5). However, **in the fifth and sixth semesters**, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The duration of the microproject should be about **14-16** ***(fourteen to sixteen) student engagement hours*** during the course. The students ought to submit micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. This has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher:

a) **Gear**: Build model of different gears from cardboard.
b) **Boilers**: Build model of different mountings with suitable material.
c) **IC Engine**: Build model of IC Engine parts from cardboard.
d) **Casting**: Prepare cast product with wax material.
e) **Pump:** Collect leaflets of pump from market, analyze and compare specifications.
f) **Material Handling Equipment:** Collect information on different material handling equipment used in power plant/ construction site/Mining industries/Process industries/heavy manufacturing industries/ship building industries/aircraft industries from the internet.
g) **Air conditioning and Refrigeration Controls :** Make models of controls demonstrating their functions at least 3 under guidance of instructor/teacher in lab/ workshop.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Theory of machine	R S Khurmi & J K Gupta	Eurasia Publishing House (Pvt.) Ltd. New Delhi,2020 ISBN: 9788121925242
2	Elements of workshop Technology (Vol. 1,2)	S.K. Hajra chaudhary A.K. Hajra chaudhary	Media promoters & publishers Pvt.Ltd. Mumbai,2010 ISBN:9788185099156
3	Fluid mechanics and hydraulic machines	R.K.Bansal	Laxmi publication Pvt.Ltd. New Delhi,2018 ISBN: 9788131808153
4	Material Handling equipment	N.Rundenko	Central Books Ltd,1970, ISBN: 978-0714702858
5	Thermal Engineering	R.K.Rajput	Laxmi Publication Pvt.Ltd. New Delhi,2018 ISBN:9788131808047
6	A Textbook of thermal Engineering	R. S. Khurmi & J. K. Gupta	S.chand Limited, New Delhi,2020, ISBN:9788121925730
7	Basic Mechanical Engineering	Pravin Kumar	Pearson Education ,India, 2018 ISBN: 9789386873293
8	Basic Mechanical Engineering	S. C. Sharma & M.P. Poonia	Khanna Publishing,2018 ISBN:9789386173331

14. SOFTWARE/LEARNING WEBSITES

- http:/nptel.iitm.ac.in/
- https://www.khanacademy.org/
- http://learnerstv.in/
- https://www.youtube.com/watch?v=DGST2NvATKI (Basic Mechanical tools)
- https://www.youtube.com/watch?v=eRfTZpEmnys&t=6s (Hand Tools)
- https://www.youtube.com/watch?v=RdipnvBPOKU (Power Tools)
- https://www.youtube.com/watch?v=r3f7klDFwrU (Gears)
- https://www.youtube.com/watch?v=EdiuTT7xzZg&t=144s (Power Transmission Mode)
- https://www.youtube.com/watch?v=MYhe3KSKKiU (Operations of lathe machine)
- https://www.youtube.com/watch?v=Nao_mLIh5dk (Welding)
- https://www.youtube.com/watch?v=EIBDp6U8bHo (Foundry)
- https://www.youtube.com/watch?v=Um_g8sQ_p3Y (Manufacturing Processes)
- https://www.youtube.com/watch?v=dVBoZ4PfZmE (Boiler)
- https://www.youtube.com/watch?v=_ui143hJCK4 (IC Engine Parts)
- https://www.youtube.com/watch?v=Pu7g3uIG6Zo&t=18s (Four stroke Engine Working)
- https://www.youtube.com/watch?v=h5wQoA15OnQ (Refrigeration)
- https://www.youtube.com/watch?v=gVLhrLTF878 (Air Conditioning)
- https://www.youtube.com/watch?v=BaEHVpKc-1Q (Pump)
- https://www.youtube.com/watch?v=7uI7G8csJSM (Pump)

- https://www.youtube.com/watch?v=VoUtTjtA5vE (Compressor)
- https://www.youtube.com/watch?v=M08LCcVAuUY (Material Handling equipment)

15. PO-COMPETENCY-CO MAPPING

Semester I & II	Basics of Mechanical Engineering (Course Code: 4300017)						
	POs						
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design/ development of solutions	PO 4 Engineering Tools, Experimentation &Testing	PO 5 Engineering practices for society, sustainability & environment	PO 6 Project Management	PO 7 Life-long learning
Competency	**Apply basic principles of mechanical engineering in various engineering applications.**						
Course Outcomes							
CO a) Use relevant mechanical power and hand tools in real life applications.	3	1	1	3	2	1	3
CO b) Select relevant power transmission mode in simple engineering situation.	3	2	1	1	2	1	2
CO c) Use relevant manufacturing process for various components.	2	1	3	2	2	2	2
CO d) Identify different components of various thermal systems.	3	2	1	1	2	1	2
CO e) Identify various hydro-pneumatic devices/ equipment.	2	2	1	2	1	2	2
CO f) Use material handling equipment for given situations.	2	2	2	2	2	1	3

*Legend: '**3**' for high, '**2**' for medium, '**1**' for low and '**-**' for no correlation of each CO with PO.*

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

S. No.	Name and Designation	Institute	Contact No.	Email
1	Mr. C.R. Vyas, Lecturer, Mechanical Engineering Department	Dr. Jivraj N Mehta Government Polytechnic, Amreli	7698567447	chiragvyas064@yahoo.com
2	Mr. M.N. Dodiya, Lecturer, Mechanical Engineering Department	Dr. Jivraj N Mehta Government Polytechnic, Amreli	9265006549	monikdodiya@gmail.com
3	Dr. H.R. Sapramer, HOD, Mechanical Engineering Department	Dr. Jivraj N Mehta Government Polytechnic, Amreli	9426587197	merhamir@gmail.com

NITTTR Resource Persons

S. No.	Name and Designation	Department	Contact No.	Email
1	Dr. Vandana Somkuwar, Associate Professor	Mechanical Engineering Education	0755-2661600	vsomkuwar@nitttrbpl.ac.in
2	Dr. Sanjay Alan Rocha, Professor	Mechanical Engineering Education	0832-2411326	asrocha@nitttrbpl.ac.in

Induction Program for Diploma Engineering

Preamble:

As suggested in Model Curriculum of Diploma by AICTE, all students will have to undergo a mandatory induction program as part of their Diploma Programme Curriculum right at the start of the first year. The duration of the induction program will be of two weeks (12 Working Days) wherein students will undergo a wide variety of activities without actually starting with their usual classes. Normal classes will start only after the induction program is over.

This will help build confidence among the new students, instill a sense of connect and appreciation towards their institution, provide them with the comfortable environment to adjust and pick up friendship with other students, facilitate them to get to know important functionaries and faculty members of the institution, equip them with human and social values.

The Induction Program will help the new students in building social character, leadership qualities, self-confidence, creativity and appreciation for mankind and nature at large. In nutshell, the induction program is envisaged to give the new students the broader foundational experience for the life- long success.

The new students, in the process, will get to learn about various processes and procedures in place in the institution, facilities and best practices, student activities, and the culture & values prevailing in the institution. The Program is also expected to be used for rectifying some critical lacunas, for example, Communication Skills in English for those students who have deficiency in it. Such students can be identified by conducting diagnostic tests and special Proficiency Modules can be conducted for them.

The mentor-mentee groups of the students are formed with each group comprising small number of students and being associated with a faculty mentor. Then the different activities start with a healthy daily routine.

Scheme:

Sr No	Phase and Activities Heads	Weightage	Hours
1.	**Initial Phase**	**1 day (6 Hrs)**	**6**
2	**Regular Phase**	**10 Days**	**60**
a)	Physical activity	14 Hours	14
b)	Creative Arts & Culture	10 Hours	10
c)	Mentoring & Universal Human Values	8 Hours	8
d)	Literary Activity	6 Hours	6
e)	Proficiency Modules	6 Hours	6
f)	Lectures & Workshop by Eminent People	3 Hours: 3 Expert Lectures, One per Week	3
g)	Visits to local Areas or Industry	1 Day	10
h)	Co & Extra-curricular Activities in the institute	3 Hours	3
3	**Closing Phase (Feedback & Report)**	**1 Day (6 Hrs)**	**6**
	Total	**72 Hours/ 12 Days**	**72**

Phases, Modules, Activities and Guidelines:

The activity during Induction Program would have an Initial Phase, a Regular Phase and a Closing Phase. The initial and closing phases would be one day each. The following is the guidelines indicating the possible activities under each phase of the Induction Program.

Initial Phase (First Day)-6 Hrs.

Following are the activities to be carried on the first day:

- Orientation Programme
- Know your Department/Institute
- Know your university
- Know hostel and other amenities
- Information about Student Diary and Induction Program

Regular Phase (10 Days)-60 Hrs.

The Regular Phase consists of 8 days; each day is of 6 hours. It may cover any/ all the 8 different activity modules. For each module, the objectives, suggested activities and guidelines are provided herewith. Institute can form their time table according to local situation and priorities or use additional relevant activities in additional in suggested activities for each of the phases.

Module Name	Objectives	Suggested Activities
1. **Physical Activity (14 hours)**	1. Improve bone health 2. Improve cardio respiratory and muscular fitness 3. Understand the anatomy, basic biomechanical principles and terminology. 4. Examine the effect of nutrition, rest and other lifestyle factors that contribute to the better health.	1. Running/Jogging 2. Brisk Walk 3. Cycling 4. Heavy yard work 5. Swimming 6. Yoga/Pranayama 7. Aerobics 8. Outdoor Sports/Indoor Games(In addition to cricket, Volleyball, Badminton, Chess, Carom, Table Tennis, Other games like Critical Thinking, Math skill developing Games, Memory Games can be included.) 9. Calculate Body mass index of each students and explain their fitness level fromit. 10. Tree Plantation 11. Gardening

Guidelines:

- Half an hour Yoga/Pranayama followed by physical activities including various games.
- Refer this link for Yoga/Pranayama https://yoga.ayush.gov.in/public/assets/front/pdf/CYPEnglishBooklet.pdf

Module Name	Objectives	Suggested Activities
2. **Creative Arts & Culture (10 hours)**	1. Develop creativity and imagination through a range of complexactivities. 2. Improve the student's ability to control materials, tools and techniques. 3. Develop increasing confidence in the use of visual and tactile elements and materials.	1. Make a model of any physical object related to Engineering Design 2. Crafting 3. Painting 4. Sculpture 5. Pottery 6. Music 7. Dance

Guidelines:

- Use any activities leading to creative thing and practice.
- Show the video demonstrating the creative ideas and thinking.
- Show the video demonstrating phenomenon performance using innovation in different areas of humanity and social science.
- Demonstrate the story of leaders with the context of how with their creative vision, with all odds they achieved success.

Module Name	Objectives	Suggested Activities
3. **Mentoring & Universal Human Values (08 hours)**	1. Impart universal human values in students. 2. Enable students to live in harmony within themselves, with family, with society and the nature 3. Initiate the process of self-exploration and self-investigation within themselves about their understanding of happiness.	1. Mentoring for creating a learning relationship 2. Showing Motivational Movies. 3. Social Activities like visit of orphanage,old age home, blind people association, Apang Manav Mandal etc. 4. Swachchhata Mission Activities. 5. Awareness regarding environmental issues and remedies. 6. Spread awareness about blood donation, organ donation, precaution to avoid malaria in monsoon etc. 7. Discuss autobiography of legendary persons who practiced universal human values in their life and work. 8. Conduct universal human values group discussions.

Guidelines:

- Use the materials and activities covered in the FDP on Induction Program held at GTU organized by AICTE.
- The faculties trained from institute will take leadership role to rollout it at institute level.

Module Name	Objectives	Suggested Activities
4. **Literary Activity (06 hours)**	1. Inculcate the habit of active (or interactive) consumption of the best content available in literature. 2. Develop thinking skills. 3. Improve reading abilities and attitude.	1. Digital literacy and use of Internet 2. Basic Mathematics for Solving Real World Problems 3. Use of Scientific Calculator in Engineering 4. General Knowledge Quiz Competition 5. Vedic Mathematics 6. Reading/writing/speaking/listening 7. Debating/Elocution 8. Enacting a play 9. Book review 10. Digital India Portal 11. Vernacular Literature

Guidelines:

- Use the video lectures to literate students in different skills needed for day-to-day life and need.
- Motivate students to create the nature of inquiry and reading habits.
- Arrange the various competitions like Elocution, Essay writing, Storytelling, Bookreviews etc.
- Writing the review of the well-known books, movies etc. and sharing.

Module Name	Objectives	Suggested Activities
5. **Proficiency Modules (06 hours)**	1. Determining English proficiency level of students and mentoring accordingly. 2. Learn the mining vocabulary, idioms, and expressions and Understand their meanings in context. 3. Develop ability to write a paragraph about general topics by using the English language correctly. 4. Realize the importance of English language as a global business language.	1. Activity by Faculty from Communication Skills/ English from Science & Humanities/ General Departments 2. English general diagnostic test to Determine student's English proficiencylevel. 3. Mentoring students to improve in English proficiency according to his/her proficiency level based on test.

Guidelines:

- An MCQ test of **30 Marks / 30 minutes** should be conducted covering basic grammar andvocabulary.
- Group the students in three groups based on test result in three proficiency levels:
  - Unsatisfactory
  - Satisfactory
  - Good
- Following activities are to be used to uplift proficiency levels of students.
  - Motivational movies, documentary
  - Language games
  - Essay/story writing
  - Ice breaking games.
- Separate set of activities from suggested list should be used for different groups.
- Groups requiring Mentoring may be identified and informed to respective departments for their development in future
- Groups who can lead can also be identified and informed to respective departments for their development in future

Module Name	Objectives	Suggested Activities
6. **Lectures & Workshop by Eminent people (03 hours)**	1. Motivation through knowing experience of successful person / Alumni. 2. Meet and interact with eminent personalities of different fields.	1. To conduct lecture by eminent people. 2. Interaction with leaders, experts, entrepreneurs, contributors and successful personalities / alumni.

Guidelines:

- 3 expert lectures each of 1 hour for every discipline. It should be arranged at department level or Common for institute. If multiple disciplines are to be combined in an expert lecture then it may be arranged in both the weeks so as to accommodate all branches.
- External expert should be invited.
- Expert can be from academic, industry, research organization, social organization etc.
- An individual successful person in any of the field can be invited.
- The aspect to be addressed may be social / economical / engineering / entrepreneurship/ spiritual/ humanity science.

Module Name	Objectives	Suggested Activities
7. **Visit to LocalArea and Industry (1 Full day- 10 Hrs.)**	1. To familiarize students with the local area. 2. Sensitize with the different aspects of the life including social services and heritage	1. A full day visit covering at least 2 or 3 places. 2. List of possible places A. Centre of excellence B. Elite Academic Institutes C. Research institute D. Hospitals E. Industry visit F. Heritage places

Guideline and References:

- Institute can arrange visit to public, social or specifies places to give insight of the activities and overall socio-economic contribution of such places.
- The uniqueness or impact of such visits should be highlighted.

Module Name	Objectives	Suggested Activities
8. **Co & Extra Curricular Activities in the institute (03 hours)**	1. Introduce the student about innovation in different fields 2. Make students aware about innovative and modern practices and products in their own branch 3. Create awareness about support available for start-up and innovation	1. Lectures by Convener/ senior members of Gymkhana Committee. 2. Showing videos demonstrating Gymkhana Activity / Talent hunt/ Performances. 3. Introducing NSS Activity 4. Awareness regarding SSIP Scheme of Government of Gujarat 5. Awareness about Government initiatives in areas of innovations and supports for start- up, Incubation, Entrepreneurship etc.

Guideline:

- Video lectures of Gymkhana Activity / Talent hunt/ Performances
- Video lectures from leaders and innovators.
- TeDx Talks.
- Government Policy documents for different schemes.

Closing Phase (Last Day)

The closing phase is the last day of the Induction Program and covering conclusion andsummary of the Induction Program.

- **Conclusion and summary:**
- Guiding students for preparation of student report about Induction Program.
- Instruct students regarding submission and examination of the Induction Program.
- Address by HODs/Senior faculties regarding branch/discipline and career option in respective branch.

- Introduce about the engineering and its importance in life and their responsibilitiestowards the society.

General Regulations:

a) Every student has to maintain a daily diary. Format of the diary is already given.
b) After completion of the Induction program student has to prepare a report based onactivities performed during the Induction program. Diary will be attached as Appendix in Report.
c) 75% Attendance is required during Induction Program.
d) This program will be noncredit subject but it will reflect in 1st Semester Mark sheet as PASS or FAIL.
e) Institute should appoint a mentor for a group of 20 to 30 students. Mentor can take help of senior students.
f) If student gets admission transfer in other college during Induction Program the diary will be continued from previous college to new college.
g) If student gets admission in middle of the Induction Program or student gets admission after Induction Program, it is responsibility of the institute to fulfill the criteria of the Induction Program.
h) If student fails in the Induction program the student has to clear the same during subsequent Semester

Evaluation Pattern:

1. Induction Program is Mandatory course for each branch of Engineering.
2. It is mandatory for each student to clear Induction Program with PASS grade.
3. Grades for Induction Program are either PASS or FAIL and have no credits. Evaluation for Induction Program is based on the Induction Program Report prepared by a student from Student diary and student will be declared PASS or FAIL.
4. Student has to submit the Induction Program Report at the end of first semester dully approved by Mentor and HOD.
5. Evaluation of Induction Program will be done along with first Semester Term-Work Submission.
6. The evaluation is carried out by Internal Examiner from institute itself. The entry on the GTU portal will be PASS or FAIL, not marks.
7. The students who will FAIL have to reappear again after every 6 months as remedial exam.

Guidelines for Program Report:

1) Report should have minimum 15 pages.
2) Report must have One Photograph per Activity.
3) Report consists of Certificate, Index and Diary as Appendix.
4) Report should be dully signed by Mentor and HOD.
5) Index will have following sequence:

[A] The Suggestive List of activities is as mentioned below:

- ✓ Physical Activity
- ✓ Creative Arts and Culture
- ✓ Mentoring & Universal Human Values
- ✓ Familiarization with the institution, Dept. /Branch
- ✓ Literary Activity
- ✓ Proficiency Modules
- ✓ Lectures & Workshops by Eminent People
- ✓ Visits in Local Area
- ✓ Extra-Curricular Activities in the institution
- ✓ Feedback and Report on the Program

Induction Program Schedule (Suggestive only)

Note: It is presumed that the first year students are so divided into two major groups that the number of students in each group is almost equal with some branches forming part of Group-I while the rest of the branches being part of Group-II. Grouping can also be done at discipline/ department level.

The detailed suggestive program is as under:

Arrival to Hostel/ Accommodation			
Time	**Activity**	**Students' Group**	**Venue**
Whole day	Students arrive - Hostel allotment	I & II	Respective Hostels / Accommodation
DAY 1- Initial Phase- Reporting at 10.00 am in the respective Departments			
10.30 am – 12.00	Mentor-mentee groups - Introduction with-in group. ● Orientation Programme ● Know your Department/Institute ● Know your university ● Know hostel and other amenities	I	Suitable Venue as per number of mentor-mentee groups
	Screening of Institute Documentary Movie; video clips of various functions and events	II	Conference/Seminar Hall
12.00 – 01.30 pm	Mentor-mentee groups - Introduction with- in group. ● Orientation Programme ● Know your Department/Institute ● Know your university ● Know hostel and other amenities	II	Suitable Venue as per number of mentor-mentee groups
	Screening of Institute Documentary Movie; video clips of various functions and events	I	Conference/Seminar Hall
1.30 pm – 2.00 pm	Lunch	I & II	Respective Departments/ Hostels/ Mess/ canteens
2.00 pm – 5.00 pm	Institute Excursion	I & II	Around the Campus
DAY 2 to 10- Regular Phase -Timings can be changed for Physical / other Activities as per local requirements			
10.30 am – 12.00	Events from [A] are to be scheduled as per guidelines and local convenience i.e. Various activities from Regular Phase like Physical Activity Creative Arts and Culture Mentoring & Universal Human Values Familiarization with the institution, Dept. /Branch Literary Activity Proficiency Modules Lectures & Workshops by Eminent People Visits in Local Area Extra-Curricular Activities in the institution Feedback and Report on the Program	I II	Suitable Indoor/ Outdoor Venue in respective Departments as per number of mentor-mentee groups or Conference / Seminar Hall

12.00 – 01.30 pm	Events from [A] are to be scheduled as per guidelines and local convenience	II I	Suitable Indoor/ Outdoor Venue in respective Departments as pernumber of mentor-mentee groups or Conference / Seminar Hall
1.30 pm – 2.00 pm	Lunch	I & II	Respective Departments/ Hostels/ Mess/ canteens
2.00 pm – 5.00 pm	Events from [A] are to be scheduled as per guidelines and local convenience	I II	Suitable Indoor/ Outdoor Venue in respective Departments as pernumber of mentor-mentee groups or Conference / Seminar Hall
DAY 11- Visits to local Areas or Industry/ Any 1 DAY from above			
DAY 12- Closing Phase (Feedback & Report)			
10.30 am – 12.00	• Guiding students for preparation of student report about Induction Program. • Instruct students regarding submission and examination of the Induction Program.	I	Suitable Indoor/ Outdoor Venue in respective Departments as pernumber of mentor-mentee groups or Conference / Seminar Hall
	• Address by HODs/Senior faculties regarding branch/discipline and career option in respective branch. • Introduce about the engineering and its importance in life and their responsibilities towards the society.	II	
12.00 – 01.30 pm	• Address by HODs/Senior faculties regarding branch/discipline and career option in respective branch. • Introduce about the engineering and its importance in life and their responsibilities towards the society.	II	Suitable Indoor/ Outdoor Venue in respective Departments as pernumber of mentor-mentee groups or Conference / Seminar Hall
	• Guiding students for preparation of student report about Induction Program. • Instruct students regarding submission and examination of the Induction Program.	I	
1.30 pm – 2.00 pm	Lunch	I & II	Respective Departments/ Hostels/ Mess/ canteens
2.00 pm – 5.00 pm	Talent Show and Valedictory Function Principal's Address	I & II	Suitable Indoor/ Outdoor Venue in respective Departments as pernumber of mentor-mentee groups or Conference / Seminar Hall

Note:

1) Total duration of the Induction Program is two weeks i.e. 12 working days with Saturdays being working and Sundays off.
2) Sundays can be utilized for screening some Patriotic / Socially Significant Movies/ home viewing.
3) Faculty mentors would be required to obtain the feedback cum suggestions of the students of their respective groups about the Induction programme on the last day.

4) Coordinators can be assigned for various activities during the induction programme.

The suggestive template is as under:

S. No.	Name of the activity	Coordinators
1.	Visits to different departments and around the campus	HoDs
2.	Physical/Sports activities in the Sports Ground (Morning as well as Evening)	In charge of Physical Education / Sports/ Gymkhana Activity
3.	Creative Arts / Technical Workshops. Lecture Sessions or Films on Universal Human Values / Cultural / Talent hunt Activities / Performances by Classical or folk artists. Talent Show and Valedictory Function.	In charge of Technical / Cultural activities/ Gymkhana Activity
4.	Presentation cum Interactive Session with Eminent Alumni / Eminent Speaker	Training & Placement In charge of Department
5.	Universal Human Values	Suitable Faculty members
6.	Proficiency Module (English)	Faculty of English language
7.	Local Visits	Hostel Wardens / Discipline in –charge, 1Sr. & 1 Jr. Faculty
8.	Wake up call/Hostel related activities and Arrangements at Valedictory Function	Chief Wardens (Boys/Girls) Gymkhana Members

- **Schedule of local visits can be tabulated as under:**

Dates	Sections
…	…
…	…
…	…

- **Note:**

1) The faculty mentors of the respective mentor-mentee groups / sections will accompany the students on local visits.
2) The Institute buses, if there, may be made available for the purpose each day or some other/ local arrangements may be made.
3) Attendance of the students' needs to be taken at the time of departure and return.

GTU BoS Resource Persons

Sr. No.	Name and Designation	Institute	Contact No.	Email
1	Shri U. V. Buch- BoS Member and Subject in-charge (EC)	G P Ahmedabad	9825346922	uvbuch@gmail.com

NB: The format of diary to be maintained will be as per Annexure-I

Annexure-I

Induction Program for Diploma Engineering

Format of Diary

Enrolment/Roll No: _____

Name of Student: _____

Dates from :_____ to _____			
Day	**Activities Done**	**Learning Outcomes**	**Remarks**
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
Signature of the Student			
Evaluation: PASS/ FAIL			
Signature with Date of Mentor			**Signature of HoD**

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
I – Semester

Course Title: **D.C. Circuits**
(Course Code: 4310901)

Diploma programme in which this course is offered	Semester in which offered
Electrical Engineering	First

1. RATIONALE

Students of diploma electrical engineering need to have a thorough understanding of fundamental concepts and principles of DC Circuits to determine various electrical engineering parameters. Diploma students undertaking this course are expected to apply the fundamentals of DC circuits to analyse the different electrical and electronics engineering circuits, advance course like electrical machines and drives and also develop skills required to meet the expectations of the industry.

2. COMPETENCY

The purpose of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Solve basic circuit problems using circuit laws and network theorems.**

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with the identified competency are to be developed in the student for the achievement of the following COs:

a) Solve simple electrical circuits using basic circuit laws.
b) Solve simple electric circuits using different network solution techniques/analysis.
c) Solve simple electrical circuits using network theorems.
d) Interpret the working of capacitor based on electrostatic principle.
e) Interpret the working of inductor based on electromagnetic principle.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
3	1	2	5	30*	70	25	25	150

(*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

***Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **CA** - Continuous Assessment; **ESE** - End Semester Examination.*

5. SUGGESTED PRACTICAL EXERCISES

The following practical outcomes (PrOs) are the sub-components of the COs. *Some of the **PrOs** marked **'*'** are compulsory, as they are crucial for that particular CO at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'*.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	Identify resistor, inductor and capacitor.	1,4,5	2
2	Demonstrate various types of resistors	1	2
3	Calculate the temperature coefficient of the given resistor.	1	2
4	Verify Ohm's law in the given electric circuit	1	2*
5	Verify Kirchhoff's current law in the given electric circuit	1	2*
6	Verify Kirchhoff's voltage law in the given electric circuit	1	2*
7	Measure voltage, current and resistance in the given DC circuit.	1	2
8	Find equivalent resistance for series connection.	2	2
9	Find equivalent resistance for parallel connection.	2	2
10	Verify Superposition theorem and determine the current and voltage in each branch of the given circuit.	3	2*
11	Verify the Thevenin's theorem and determine the voltage and current in the given branch of the circuit.	3	2*
12	Verify the Norton's Theorem and determine the voltage and current in the given branch of the circuit.	3	2*
13	Verify Maximum Power Transfer Theorem and determine value of load resistance for maximum power transfer in the given electrical circuit.	3	2*
14	Connect given capacitors in series, parallel, series-parallel and determine the total equivalent value of capacitance.	4	2
15	Measure charging and discharging time of capacitor in the given circuit and verify the same with RC time constant.	4	2
16	Test different types of capacitors.	4	2*
17	Connect batteries in series and in parallel to the given load and check the resultant voltage and current at load terminals.	4	2
18	Test different types of inductors.	5	2*
19	Measure inductance of the given choke coil using LCR meter.	5	2
20	Demonstrate Faraday's law of electromagnetic induction.	5	2
	Minimum 14 Practical Exercises		**28 Hrs.**

Note

i. *More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list.*

ii. *The following are some **sample** 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency.*

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Prepare of experimental setup.	20
2	Operate the equipment setup or circuit.	20
3	Follow safe practices.	10
4	Record observations correctly.	20
5	Interpret the result and conclude.	30
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

This major equipment with broad specifications for the PrOs is a guide to procure them by the administrators to usher in uniformity of practicals in all institutions across the state.

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	Variable DC source, Dual channel (0-30 V, 0-2 A, digital display)	3 -15, 20
2	DC Ammeter (0-2 A, Analog)	3 -15, 17, 20
3	DC Voltmeter(0-30 V or 0-50 V, Analog)	3-15, 17
4	Digital Multimeter (3-1/2 display, max reading 1999m hand held)	3-15, 17
5	Stop Watch	15
6	Thermometer (lab thermometer, degree Celsius /Fahrenheit, non-contact type)	3
7	Rheostat (0-200 Ohm, 0-2 A, linear, slider type)	2,3,7
8	Bread board (2 Power, 2 ground rails, 2 circuit areas, contact points > 200, Volt > 15 V, Current > 1 A)	4,5,6,8,9,10,11, 12,13,14
9	Resistors of various range	2
10	Capacitors of various range	16
11	Inductors of various range	18
12	Variable POT: Single turn (rotation upto 270 degrees , multi turn, Dual gang POT)	11,12,13
13	LCR meter – Diplay-3.5 Digits, Count-1999, Inductance range-1mh-10 H or suitable, Inductance accuracy-+/- 5%, Capacitor range- 1nF – 1000 micro F, Capacitance accuracy-+/- 5 %, Resistance accuracy-+/- 1 %, Auxiliary-Test leads, batteries and manual.	19
14	Batteries (1.5 V to 12 V, cylindrical, rectangular, chargeable / non-rechargeable, Size A, AA, C, D, E etc.)	17

7. AFFECTIVE DOMAIN OUTCOMES

The following ***sample*** Affective Domain Outcomes (ADOs) are embedded in many of the above mentioned COs and PrOs. More could be added to fulfil the development of this course competency.

a) Work as a leader/a team member.
b) Follow safety practices while using electrical appliances.
c) Practice environmental friendly methods and processes. (Environment related)

The ADOs are best developed through the laboratory/field based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

i. 'Valuing Level' in 1st year
ii. 'Organization Level' in 2nd year.
iii. 'Characterization Level' in 3rd year.

8. UNDERPINNING THEORY

The major underpinning theory is given below based on the higher level UOs of *Revised Bloom's taxonomy* that are formulated for development of the COs and competency. If required, more such UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
Unit – I Fundamental concepts of D.C. Circuits	1a. Explain the properties of the commonly used electrical engineering materials. 1b. Classify different types of resistors. 1c. Explain the effect of temperature on resistance. 1d. Determine voltage, current and resistance in electrical circuit using Ohm's law. 1e. Apply Kirchhoff's Voltage and Current Law to determine voltage, current and power in the given resistive circuit. 1f. Calculate work, power and energy in given electrical circuit. 1g. Use Joule's Law of heating to compute the amount of heat produced due to current flow in a conductor. 1h. State the impact of using electrical source over the other energy sources on the environment	1.1 Electric Potential, EMF, Current, Power and Energy 1.2 Conductor, Semiconductor and insulator-properties and applications 1.3 Resistor, Inductor and Capacitor 1.4 Resistor-Properties and Practical applications, Classification based on ohmic value and material, Effect of temperature on resistance and temperature coefficient of resistance 1.5 Conductance, conductivity, current density 1.6 Ohm's law: Applications and limitations 1.7 Kirchhoff's voltage law and Kirchhoff's current law 1.8 Joule's law of heating, applications 1.9 Power and energy, unit conversion from mechanical to electrical and vice-versa

		1.10 Impact of using electrical source over the other energy sources on the environment.
Unit – II Network solution techniques	2a. Determine the equivalent resistance of given series, parallel connections. 2b. Apply source transformation techniques to simplify electrical circuits. 2c. Apply Mesh analysis and Nodal analysis to calculate voltage, current and power in given resistive circuits. 2d. Apply the principle of duality to electrical networks	2.1 Node, branch, loop, mesh; open, closed and short circuit 2.2 Series and Parallel connections of resistors and equivalent resistance 2.3 Source transformation techniques 2.4 Mesh analysis 2.5 Nodal Analysis 2.6 Duality in electrical networks.
Unit– III Network Theorems	3a. Differentiate given types of electrical circuits with examples. 3b. Apply superposition theorem to calculate current and voltage in any branch of circuit with two or more sources. 3c. Apply Thevenin's theorem to simplify a given electrical network and compute current and voltage in branch under consideration. 3d. Apply Norton's theorem to simplify a given electrical network and compute current and voltage at a branch under consideration. 3e. Apply Maximum Power Transfer theorem to calculate load resistance for maximum power transfer. 3f. Convert resistive 'T (star)' network to 'pi (delta)' network and vice versa.	3.1 Types of electric circuits - Active and Passive, Linear & Nonlinear, unilateral and bilateral circuit 3.2 Superposition theorem, equivalent circuit 3.3 Thevenin's theorem, equivalent circuit 3.4 Norton's theorem, equivalent circuit 3.5 Maximum Power Transfer theorem 3.6 'T' to 'Pi' network conversion (star-delta transformation) and 'Pi' to 'T' network conversion (delta-star transformation),
Unit– IV Capacitors and its Applications	4a. Explain the working of a capacitor 4b. Identify the factors affecting the capacitance 4c. State applications and types of capacitors 4d. Calculate the capacitance, charging and discharging time, energy stored in capacitors in electrical circuits 4e. Classify the types of batteries & connect it in series & parallel.	4.1 Capacitor- Function, types, applications, Capacitance, Capacitive reactance, Factors affecting capacitance 4.2 Behaviour of capacitors in DC circuits, Charging and discharging of Capacitor, RC time constant, Energy stored in Capacitor 4.3 Series and parallel

	4f. Describe in brief, the recycling as well as disposal processes of old capacitors and batteries.	combination of capacitors 4.4 Capacitance of parallel plate capacitor and Spherical capacitor 4.5 Batteries, ratings, types and their comparison, 4.6 Identification of weak battery in series and parallel combination 4.7 Recycling, disposal of old capacitors and batteries safely
Unit– V Magnetism and Electromagnetism	5a. Compare magnetic circuit with electric circuit. 5b. Apply laws of electromagnetism to determine direction of flux, magnetic force, induced emf, flux density and field strength. 5c. State Faraday's laws of electromagnetic induction, Flemings right- and left-hand rule and Lenz's law. 5d. Compute equivalent inductance in various series-parallel combinations. 5e. State applications of the given type of inductor. 5f. Calculate the energy stored in the given inductor.	5.1 Flux, Flux density (B), Magnetic field intensity (H), M.M.F, magnetic lines of force, permeability, hysteresis loop, reluctance, leakage factor, B-H Curve 5.2 Comparison of magnetic and electric circuit 5.3 Electromagnetism, Electromagnetic field around a current carrying conductor 5.4 Faraday's Laws of electromagnetic Induction, Fleming's right- and left-hand rule, Lenz's Law 5.5 Induced EMF, Self(static and dynamically induced emf) and mutually induced emf and their applications. 5.6 Self and mutual inductance, Inductive reactance, Coefficient of self and mutual inductance. 5.7 Inductance in series and parallel 5.8 Inductors- Function, types, construction and applications 5.9 Energy stored in an inductor

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A	Total Marks
I	Fundamental concepts of DC Circuits	10	5	5	5	15
II	Network Solutions Techniques	7	4	5	6	15

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A	Total Marks
III	Network Theorems	8	4	5	6	15
IV	Capacitors and its applications	7	4	2	4	10
V	Magnetism and Electromagnetism	10	6	4	5	15
Total		**42**	**23**	**21**	**26**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*

Note*: This specification table provides general guidelines to assist students for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions to assess the attainment of the UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may slightly vary from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should perform following activities in group and prepare reports of about 5 pages for each activity. They should also collect/record physical evidences for their (student's) portfolio which may be useful for their placement interviews:

a) Prepare specification of electrical and electronic components.
b) Give seminar on resistors, Inductors and Capacitors, function, types and applications.
c) Undertake a market survey of different electrical and electronic components.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b) Guide student(s) in undertaking micro-projects.
c) ***'L' in section No. 4*** means different types of teaching methods that are to be employed by teachers to develop the outcomes.
d) About ***20% of the topics/sub-topics*** which are relatively simpler or descriptive in nature is to be given to the students for ***self-learning***, but to be assessed using different assessment methods.
e) With respect to ***section No.10***, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
f) Guide students on how to address issues on environment and sustainability
g) Guide students for using data manuals.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be

individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The duration of the microproject should be about **14-16** ***(fourteen to sixteen) student engagement hours*** during the course. The students ought to submit micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. This has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher:

a) Electromagnetism: Build a basic model to demonstrate Fleming's right and left hand rules.

b) Build a simple electric model to demonstrate mutually induced emf

c) Build a small heater (room, water etc.)

d) Make demonstrable models of various types of resistors, capacitors, inductors, their types, application based on types and ratings etc.

e) DC Source and application: Use toy motor and batteries to make any moving toy.

f) Flashing neon bulb using RC timer circuit. (Or any application using RC timer circuit).

g) Disposal of old capacitors and batteries – Compile a report on handling recycling and disposal of old capacitors and batteries with figures, tables and comparative charts and strategies used and suggested.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Electrical Technology Vol-1	Theraja, B. L.	S. Chand & Co. Ltd., 23 edition or latest edition, ISBN-10: 8121924405
2	Basic Electrical Engineering	Sahdev RItu	Khanna Publications, 2018 edition, ISBN: 9789386173492
3	Basic Electrical Engineering	Rao, Uma. K.	Pearson Education, India, 2012 or latest edition, ISBN: 9788131766026,
4	Basic Electrical Engineering	Ananda Murthy, R. S	Pearson Education, India,2011 or latest edition: ISBN: 9788131754276
5	Basic Electrical Engineering	Mehta V. K.	S. Chand & Company (PVT) LTD., 1988 or Latest edition, ISBN: 9788121908719
6	Introduction to Electrical Engineering	Partha Kumar Ganguly	PHI Learning Private Limited, 2014 or latest edition Print Book ISBN: 9788120348097; eBook ISBN : 9789354433719

14. SOFTWARE/LEARNING WEBSITES

a. www.nptel.iitm.ac.in
b. www.khanacademy.org
c. https://phet.colorado.edu/
d. https://ndl.iitkgp.ac.in
e. www.electrical4u.com
f. www.vlab.co.in

15. PO-COMPETENCY-CO MAPPING

Semester I	DC Circuits (Course Code: 4310901)						
	POs						
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design/ development of solutions	PO 4 Engineering Tools, Experimentation &Testing	PO 5 Engineering practices for society, sustainability & environment	PO 6 Project Management	PO 7 Life-long learning
Competency	Solve basic circuit problems using circuit laws and network theorems.						
Course Outcome CO a) Solve simple electrical circuits using basic circuit laws.	3	2	2	3	2	1	2
CO b) Solve simple electric circuits using different network solution techniques/analysis.	3	2	2	3	-	1	2
CO c) Solve simple electrical circuits using network theorems.	3	2	2	3	-	1	2
CO d) Interpret the working of capacitor based on electrostatic principle.	3	1	1	2	2	1	2
CO e) Interpret the working of inductor based on electromagnetic principle.	3	1	1	2	-	1	2

Legend: '**3**' for high, '**2**' for medium, '**1**' for low and '**-**' for no correlation of each CO with PO.

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

S. No.	Name and Designation	Institute	Contact No.	Email
1	H. B. Kapadiya Lecturer	Government Polytechnic, Ahmedabad	9427600807	hbkapadia@gpahmedabad.ac.in
2	M.H. Kumar Lecturer	Government Polytechnic, Ahmedabad	9924826791	Mksingh.gpa@gmail.com

3	S. N. Doshi Lecturer	Government Polytechnic, Himatnagar	9724433844	sndoshi1980@gmail.com
4	Dipa J. Kapupara Lecturer	A. V. Parekh Technical Institute, Rajkot	9409111405	dipakapupara.ee@gmail.com

GTU Resource Persons

NITTTR Resource Persons

S. No.	Name and Designation	Department	Contact No.	Email
1	Dr. C. S. Rajeshwari, Professor	Electrical & Electronics Engineering Education	9340068700	csrajeshwari@nitttrbpl.ac.in
2	Dr. A.S. Walkey, Associate Professor	Electrical & Electronics Engineering Education	8989792155	aswalkey@nitttrbpl.ac.in

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
I – Semester

Course Title: **Environment and Sustainability**
(Course Code: 4300003)

Diploma programme in which this course is offered	Semester in which offered
Chemical, Mechatronics, Computer	First
Civil, Environment, Mining, Architectural Assistantship, Mechanical, Automobile, Marine, Metallurgy, Fabrication, Electrical, Electronics and Communication, Instrumentation and Control, Bio Medical, Power Electronics, IT, Textile Manufacturing, Textile Processing, Textile Design, Printing, Plastics, Ceramics, CACDDM , Computer Science and Engineering.	Second

1. RATIONALE

For a country to progress, sustainable development is one of the key factors. Environment conservation and hazard management is of much importance to every citizen of India. Considerable amount of energy is being wasted. Energy saved is energy produced. Environmental pollution is on the rise due to rampant industrial mismanagement and indiscipline. Renewable energy is one of the answers to the energy crisis and also to reduce environmental pollution. Therefore this course has been designed to develop a general awareness of these and related issues so that the every student will start acting as a responsible citizen to make the country and the world a better place to live in.

2. COMPETENCY

The purpose of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Adopt the sustainable practices to resolve the environment related issues.**

3. COURSE OUTCOMES (Cos)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with this competency are to be developed in the student to display the following COs:

a) Adopt relevant ecofriendly product in the given situation to protect ecosystem
b) use relevant method of pollution reduction in the given situation
c) Use of renewable resources of energy for sustainable development
d) Use the relevant techniques in given context to reduce impact due to climate change
Use relevant laws and policies for developing the sustainable environmental development

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T/2+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
3	0	0	3	30*	70	0	0	100

(*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.
Legends: ***L****-Lecture;* ***T*** *– Tutorial/Teacher Guided Theory Practice;* ***P*** *- Practical;* ***C*** *– Credit,* ***CA*** *- Continuous Assessment;* ***ESE*** *- End Semester Examination.*

5. SUGGESTED PRACTICAL EXERCISES – Not Applicable

The following practical outcomes (PrOs) that are the sub-components of the COs. *Some of the* ***PrOs*** *marked* ***'*'*** *are compulsory, as they are crucial for that particular CO at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'.*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
	Total		**44**

Note

i. *More* ***Practical Exercises*** *can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list.*
ii. *The following are some* ***sample*** *'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed* ***Practical Exercises*** *of this course required which are embedded in the COs and ultimately the competency..*

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Prepare of experimental setup	20
2	Operate the equipment setup or circuit	20
3	Follow safe practices measures	10
4	Record observations correctly	20
5	Interpret the result and conclude	30
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED – (Not Applicable)

These major equipment with broad specifications for the PrOs is a guide to procure them by the administrators to usher in uniformity of practicals in all institutions across the state.

S. No.	Equipment Name with Broad Specifications	PrO. No.
1		

7. AFFECTIVE DOMAIN OUTCOMES

The following ***sample*** Affective Domain Outcomes (ADOs) are embedded in many of the above mentioned COs and PrOs. More could be added to fulfil the development of this competency.

a) Work as a leader/a team member.
b) Follow ethical practices.
c) Practice environmental friendly methods and processes. (Environment related)

The ADOs are best developed through the laboratory/field based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

i. 'Valuing Level' in 1st year
ii. 'Organization Level' in 2nd year.
iii. 'Characterization Level' in 3rd year.

8. UNDERPINNING THEORY

Only the major Underpinning Theory is formulated as higher level UOs of *Revised Bloom's taxonomy* in order development of the COs and competency is not missed out by the students and teachers. If required, more such higher level UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at Application and above level)	Topics and Sub-topics
Unit – I Ecosystem	1a. Explain the Structure with components of the given Ecosystem 1b. Explain Carbon, Nitrogen, Sulphur and phosphorus cycle for the given ecosystem. 1c. Justify the need to conserve the given Ecosystem on the w.r.t. following points: • carrying capacity of earth • Biomes, • Ecologically sensitive area 1d. Explain the term biodiversity with its importance. 1e. Illustrate the importance of IUCN red list in environmental engineering. 1f. Calculate global ecological overshoot and virtual water requirement of given natural and man-made materials.	1.1 Structure and components of ecosystem 1.2 Types of Ecosystem, changes in ecosystem 1.3 Various natural cycles like carbon, Nitrogen, Sulphur, Phosphorus 1.4 Ecosystem conservation, carrying capacity of earth, Biomes in India, (ESA) Ecologically sensitive areas 1.5 Bio diversity, its need and importance, International Union for Conservation of Nature (IUCN) red list 1.6 Concept of Ecological foot print, virtual water, global ecological overshoot
Unit – II Pollution and its types	2a. Explain the term, "pollution and pollutant" in the given situation. 2b. Classify the air pollution on the basis of its source 2c. Use relevant equipment to control given type of air pollution.	2.1. Definition of pollution and pollutant 2.2. Air pollution, classification and its sources 2.3. Air pollution control Equipments 2.4. Water pollution, pollution parameters like BOD,COD, pH, Total suspended solids, Turbidity, Total Solids 2.5. Waste water treatment like primary,

Unit	Unit Outcomes (UOs) (4 to 6 UOs at Application and above level)	Topics and Sub-topics
	2d. Explain relevant techniques of treatment to deal with given type of water pollution. 2e. Apply relevant techniques of Solid waste management based on its characteristics. 2f. Explain drawbacks of noise pollution in given situation. 2g. Describe the environmental degradation due to Plastic waste and E- waste	secondary and tertiary 2.6. Solid waste generation, sources and characteristics of Muncipal solid waste 2.7. Collection and disposal of Muncipal waste and Hazardous waste 2.8. Noise pollution- its effects, sources and measurement 2.9. Plastic waste and its hazard 2.10. E waste and its hazard
Unit– III Renewable sources of energy	3a. Justify the need of renewable energy adopting relevant energy policy in given situation. 3b. Explain the working of the solar thermal and PV systems with sketch in given situation. 3c. Justify the need of Advanced collector, Solar Pond, Solar water heater, Solar dryer in the given system. 3d. Emphasize the importance of wind power in India 3e. Select the relevant type of wind turbines in the given situation. 3f. Identify the relevant types of Sources of biomass energy. 3g. Draw the neat labelled diagram of simple biogas plant to explain its working. 3h. Identify the sources of the energy generation for the given situation.	3.1 Need of Renewable energy and energy policy 3.2 Solar energy: National solar mission 3.3 Features of solar thermal and PV systems Advanced collector, Solar Pond, Solar water heater, Solar dryer, polycrystalline, monocrystalline and thin film PV systems 3.4 Wind Energy: Growth of wind power in India 3.5 Types of wind turbines – Vertical axis wind turbines (VAWT) and horizontal axis wind turbines (HAWT) 3.6 Types of HAWTs – drag and lift types 3.7 Biomass: Overview of biomass as energy source. Thermal characteristics of biomass as fuel 3.8 Anaerobic digestion, Biogas production mechanism, utilization and storage. 3.9 New energy sources: Geothermal energy, Ocean energy sources, Tidal energy conversion, Hydrogen energy
Unit– IV Climate Change	4a. Explain the term, “climate change” in context of environment. 4b. Describe the ill effects of Global warming due to various causes arising in the given situation. 4c. Explain the term, “greenhouse effect” with its causes. 4d. Relate the impact of Ozone depletion in climate change due to its causes.	4.2 Definition of climate change 4.3 Global warming-causes, effect, process 4.4 Greenhouse effect 4.5 Ozone depletion 4.6 Factors affecting climate change 4.7 Impact and mitigation 4.8 Climate change management

Unit	Unit Outcomes (UOs) (4 to 6 UOs at Application and above level)	Topics and Sub-topics
	4.1 Identify Factors affecting climate change in given locality. 4e. Justify the need of relevant Climate change management system to reduce the impact of climate change in the given context.	
Unit– V Environmental legislation and sustainable practices	5.a Use relevant policy or law in relation with environment in given situation 5.b Relate the relevant provision of given act in given situation. 5.c Explain the necessity of the Environmental management system in given situation. 5.d Use the principle of Rain water harvesting in the given situation. 5.e Justify the necessity of Green building in India. 5.f. Adopt the relevant rating system for energy calculation for the given building. 5.f Explain the terms, "Cradle to cradle concept" and "Life cycle analysis" 5.g Emphasize the importance of Carbon credit system in India. 5.h Explain the importance of 5R concept.	5.1 Environmental policies in India 5.2 Air act, water act, Environment protection act, wild life protection act, Forest conservation act, Biodiversity act 5.3 Environmental management system: ISO 14000, definition and benefits 5.4 Rain water harvesting 5.5 Green building and rating system in India 5.6 Cradle to cradle concept and Life cycle analysis 5.7 Green label 5.8 Carbon credit system its advantages and disadvantages 5.9 Concept of 5R(Refuse, Reduce, Reuse, Repurpose, Recycle) 5.10 Eco tourism: advantages and disadvantages

***Note**: The UOs need to be formulated at the 'Application Level' and above of Revised Bloom's Taxonomy' to accelerate the attainment of the COs and the competency.*

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A	Total Marks
I	Ecosystem	08	6	6	2	14
II	Pollution and its types	10	4	6	6	16
III	Renewable sources of energy	10	4	6	6	16
IV	Climate Change	08	4	6	4	14

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A	Total Marks
V	Environmental legislation and sustainable practices	06	5	3	2	10
Total		**42**	**12**	**28**	**30**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*
Note*: This specification table provides general guidelines to assist student for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions assess the attainment of the UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary slightly from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a) Prepare specification of some renewable sources of energy.
b) Undertake micro-projects in teams
c) Give seminar on any relevant topic.
d) Undertake a market survey of different green materials.
e) Prepare showcase portfolios.
f) Prepare report on various issues related to environment and sustainable development
g) Publish a research paper on themes related to environment and sustainable development.
h) Compare the pollution (water, air and noise) data of various cities with standard values as laid by pollution control board.
i) Undertake some small mini projects on various issues related to environment and sustainable development.
j) Submit a report on visit to an energy park
k) Prepare power point on clean and green technologies
l) Submit a report on visit to garbage disposal system in your city/town.
m) Submit a report on analysis of the life cycle of any one or two eco-friendly product/s.
n) Calculate ecological footprint using various calculator available on web with a report recommending ways and means to reduce ecological footprint.
o) Give seminar on relevant topic.
p) Undertake micro-projects.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b) Guide student(s) in undertaking micro-projects.
c) ***'L' in section No. 4*** means different types of teaching methods that are to be employed by teachers to develop the outcomes.

d) About ***20% of the topics/sub-topics*** which are relatively simpler or descriptive in nature is to be given to the students for ***self-learning***, but to be assessed using different assessment methods.
e) With respect to ***section No.10***, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
f) Guide students on how to address issues on environment and sustainability
g) Guide students for using data manuals.
h) Guide students for using data manuals.
i) Arrange visit to nearby industries and workshops for understanding various sources of pollution.
j) Use video/animation films to explain various processes related to environment and sustainable development
k) Use different instructional strategies in classroom teaching.
l) Write the report on properties of various eco-friendly construction materials like Stone, aggregate of different sizes, timber, lime, bitumen, Bricks, tiles, precast concrete products, Water proofing material, Termite proofing material, Thermal insulating material, plaster of Paris, paints, distemper, and varnishes.
m) Display various technical brochures of recent projects/themes related to environment and sustainable development
n) Visit the Pollution control board office and its various projects to demonstrate the various practices adopted for control of Pollution

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be ***individually*** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** during the course. The student ought to submit micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. This has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher:

a) **Natural cycles**: Build a Chart showing different natural cycles like Carbon, Nitrogen,Sulphur and phosphorus cycle.)
b) **Solar Energy:** Build a model of Solar water heater/Solar cooker
c) **Wind energy:** Build a model of wind mill
d) **Best out of waste**: Build useful items from waste materials like used plastic bottles, discarded pens etc.

e) Compare the pollution (water, air and noise) data of various cities with standard values as laid by pollution control board.
f) Surf different websites related environment and sustainable development, Pollution control.
g) Prepare energy audit report of any residential building.
h) Collect relevant information about the software used in pollution control.
o) Visit to ongoing project and study various aspects related to environment and sustainable development

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Renewable Energy Technologies: A Practical Guide for Beginners	Solanki, Chetan Singh	PHI Learning, New Delhi, 2010 Print Book ISBN: 9788120334342 eBook ISBN: 9789354437151
2	Ecology and Control of the Natural Environment	Izrael,Y.A.	Kluwer Academic Publisher eBook ISBN: 978-94-011-3390-6 Softcover ISBN: 978-94-010-5499-7
3	Green Technologies and Environmental Sustainability	Singh, Ritu, Kumar, Sanjeev	Springer International Publishing, 2017 eBook ISBN 978-3-319-50654-8
4	Environmental Noise Pollution and Its Control	G.R. Chhatwal, M. Satake, M.C. Mehra, Mohan Katyal, T. Katyal, T. Nagahiro	Anmol Publications, New Delhi ISBN: 8170411378 ISBN: 8170411378
5	Wind Power Plants and Project Development	Earnest, Joshua & Wizelius, Tore	PHI Learning, New Delhi, 2011 ISBN-10: 8120351274 ISBN-13: 978-8120351271
6	Renewable Energy Sources and Emerging Technologies	Kothari, D.P. Singal, K.C., Ranjan, Rakesh	PHI Learning, New Delhi, 2009 ISBN-13 - 978-8120344709
7	Environmental Studies	Anandita Basak	Pearson Publications ISBN 8131785688, 9788131785683 ISBN: 9788131721186, 8131721183
8	Environmental Science and Engineering	Aloka Debi	University Press ISBN: 9788173718113 ISBN-10: 8173716080 ISBN-13: 978-8173716089
9	Coping With Natural Hazards: Indian Context	K. S. Valadia	Orient Longman ISBN-10: 8125027351 ISBN-13: 978-8125027355
10	Introduction to Engineering and Environment	Edward S. Rubin	Mc Graw Hill Publications ISBN-10 : 0071181857 ISBN-13 : 978-0071181853

14. SOFTWARE/LEARNING WEBSITES

a) www.nptel.iitm.ac.in
b) www.khanacademy
c) http://www1.eere.energy.gov/wind/wind_animation.html
d) http://www.nrel.gov/learning/re_solar.html
e) http://www.nrel.gov/learning/re_biomass.html
f) http://www.mnre.gov.in/schemes/grid-connected/biomass-powercogen/
g) http://www.epa.gov/climatestudents/
h) http://www.climatecentral.org
i) http://www.envis.nic.in/
j) https://www.overshootday.org/
k) http://www.footprintcalculator.org/
l) https://www.carbonfootprint.com/calculator.aspx

15. PO-COMPETENCY-CO MAPPING

Semester II	Environment and Sustainability (Course Code: .....)								
	POs and PSOs								
Competency & Course Outcomes	**PO 1** Basic & Discipline specific knowledge	**PO 2** Problem Analysis	**PO 3** Design/ development of solutions	**PO 4** Engineering Tools, Experimentation &Testing	**PO 5** Engineering practices for society, sustainability & environment	**PO 6** Project Management	**PO 7** Life-long learning	**PSO 1** Environmental planning & deisgn	**PSO 2** Execution & Maintenance
Competency - Adopt the sustainable practices to resolve the environment related issues									
a. Adopt relevant ecofriendly product in the given situation to protect ecosystem	2	1	1	-	2	1	1	2	2
b. use relevant method of pollution reduction in the given situation	2	2	1	1	2	-	2	2	2
c. Use of renewable resources of energy for sustainable development	2	2	2	1	2	2	1	2	2
d. Use the relevant techniques in given context to reduce impact due to climate change	2	2	2	1	2	1	2	2	2
e. Use relevant laws and policies for developing the sustainable environmental development	2	2	2	1	1	1	1	2	2

Legend: '**3**' for high, '**2**' for medium, '**1**' for low or '**-**' for the relevant correlation of each competency, CO, with PO/ PSO

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

S. No.	Name and Designation	Institute	Contact No.	Email
1	Dr. Jayesh Shah	Ass. Dean GTU, Pacific School of Engineering, Surat	9825436342	jayesh.shah.23021971 @gmail.com
2	Mrs. Jini Sunil	Shri K.J. Polytechnic, Bharuch	9601880636	jinivt@rediffmail.com

NITTTR Resource Persons

S. No	Name and Designation	Dept.	Contact No.	Email
1	Dr. V.D.Patil, Associate Professor, DCEEE	DCEEE	9422346736	vdpatil@nitttrbpl.ac.in
2	Prof. M.C.Paliwal, Associate Professor, DCEEE	DCEEE	9407271980	mcpaliwal@nitttrbpl.ac.in

0GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)

I &II – Semester

Course Title: **Physics**

(Course Code: 4300005)

Diploma programme in which this course is offered	Semester in which offered
Biomedical Engineering, Electronics and Communication Engineering, Instrumentation & Control, Printing Technology	First
Computer Engineering, Electrical Engineering, Information Technology, Power Electronics	Second

1. RATIONALE

Physics is branch of science mainly deals with interaction of energy and matter and considered as the mother of all engineering disciplines. Diploma engineers (technologists) have to deal with various materials while using/ maintaining machines. More over the basic knowledge of principles of physics helps diploma students to lay foundations of core engineering courses. The laws and principles of physics, formulae and knowledge of physical phenomena and physical properties provides a means of estimating the behavior of things before we design and observe them. This course of physics has been designed as per program requirements to help students to study the relevant core engineering courses. The complicated derivations have been avoided and micro projects are introduced. This course will help the diploma engineers to use/apply the basic concepts and principles of physics solve well designed engineering problems and comprehend different technology-based applications.

2. COMPETENCY

The purpose of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Use principles of physics to solve broadly defined engineering problems.**

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with this competency are to be developed in the student to display the following COs:

a) Use relevant instruments with precision to measure the dimension of given physical quantities in various engineering situations.
b) Apply the concepts of electrostatics and capacitance for engineering applications.
c) Apply the basic concepts of heat transfer and thermometric properties to provide solutions for various engineering problems.
d) Use the concept of waves and sound waves for various engineering applications involving wave dynamics.
e) Use the concepts of LASER and Fiber optics for various engineering applications.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
3	-	2	4	30*	70	25	25	150

(*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

***Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **CA** - Continuous Assessment; **ESE** - End Semester Examination.*

5. SUGGESTED PRACTICAL EXERCISES

The following practical outcomes (PrOs) that are the sub-components of the COs. *Some of the **PrOs** marked **'*'** are compulsory, as they are crucial for that particular CO. These PrOs need to be attained at least at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'*.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	Use Vernier calipers to measure the dimensions of a given object.	I	02*
2	Use micrometer screw gauge to measure diameter of a given wire and determine volume of a given metallic piece.	I	02
3	Use a parallel plate capacitor to investigate the dependence of capacitance of a parallel plate capacitor on various factors.	II	02*
4	Use principles of series and parallel combinations of capacitance in solving various electrical circuits.	II	02
5	Use different types of thermometers to measure temperature of a hot bath and convert it into different scales.	III	02*
6	Use Searle's method to measure the coefficient of thermal conductivity of a given metallic rod.	III	02
7	Use Searle's method to determine the coefficient of linear expansion of the given metallic rod.	III	02
8	Use sonometer to find the frequency of given tuning fork.	IV	02*
9	Use resonance tube to determine velocity of sound in air at room temperature.	IV	02
10	Determine the refractive index of given semi-circular glass block using TIR.	V	02*
11	Determine refractive index of liquid by concave mirror.	V	02
12	Determine the value of the numerical aperture (NA) of given optical fibre.	V	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
13	Use ultrasonic interferometer to determine the velocity of ultrasonic waves in different liquids.	V	02
14	Use electrical vibrator to find the frequency of AC mains.	V	02
	Total		28

Note

*i. More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list.*

*ii. The following are some **sample** 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency.*

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Prepare of experimental setup	20
2	Operate the equipment setup or circuit	20
3	Follow safe practices measures	10
4	Record observations correctly	20
5	Interpret the result and conclude	30
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS AND SOFTWARE REQUIRED

These major equipment/instruments and Software required to develop PrOs are given below with broad specifications to facilitate procurement of them by the administrators/management of the institutes. This will ensure conduction of practical in all institutions across the state in proper way so that the desired skills are developed in students.

Sr. No.	Equipment Name with Broad Specifications	PrO. No.
1	Vernier caliper analog - least count- 0.02 mm	1
2	Micrometer screw gauge analog (0-25 mm) – least count 0.01mm	2
3	Parallel plate capacitor (variable plate distance and area)	3
4	Digital capacitance meter	3, 4
5	Hot water bath	5
6	Mercury filled glass thermometer 0-110 °C, Mercury filled glass thermometer 0-250 °C., digital food thermometer, bimetallic thermometer.	5

Sr. No.	Equipment Name with Broad Specifications	PrO. No.
7	Clamp with stand.	5
8	Searle's thermal conductivity apparatus - made up of pure copper and outer boxes are of wooden polished material, 04 thermometers, steam boiler, measuring cylinder, constant water level tank, pinch cork, stop watch (1/100 s), rubber tube.	6
9	Linear expansion apparatus, steam generator, rubber tubing, metal rods of aluminum, iron, copper, brass, and steel.	7
10	A Sonometer with a tuning fork set and two sharp edge wedges and a weight box.	8
11	Resonance tube apparatus, tuning forks of different frequencies, rubber pad, thermometer	9
12	Semi-circular glass block	10
13	Laser light pen	10
14	A concave mirror, stand, pointer	11
15	Complete set up to determine numerical aperture (NA) of optical fiber with LASER source.	12
16	Hot plate (1800 W)	6, 7
17	Ultrasonic interferometer - gold plated quartz crystal, operating voltage - 220 Volt, display - analog, frequency - 2MHz with position control	13
18	Electrical Vibrator, uniform cord, weight pan, weight box, pulley, meter scale, sensitive balance	14

7. AFFECTIVE DOMAIN OUTCOMES

The following ***sample*** Affective Domain Outcomes (ADOs) are embedded in many of the above-mentioned COs and PrOs. More could be added to fulfil the development of this competency.

a) Work as a leader/a team member.
b) Follow ethical practices.
c) Follow safe practices
d) Handle equipment carefully
e) Practice energy saving processes.
f) Practice environmentally friendly methods and processes. (Environment related)

The ADOs are best developed through the laboratory/field-based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

i. 'Valuing Level' in 1st year
ii. 'Organization Level' in 2nd year.
iii. 'Characterization Level' in 3rd year.

8. UNDERPINNING THEORY

The major underpinning theory is given below based on the higher level UOs of *Revised Bloom's taxonomy* that are formulated for development of the COs and competency. If required, more such higher level UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
Unit – I: **Units and Measurements**	1.a Explain physical quantities and their units. 1.b Convert unit of a given physical quantity in one system of units into another systems of units. 1.c Explain methods to measure the dimensions of given object by using relevant instruments. 1.d Estimate errors in the measurement. 1.e Apply the concept of least count, errors and significant figures to solve the given problems.	1.1 Measurement and units in engineering and science 1.2 Physical quantities; fundamental and derived quantities, 1.3 Systems of units: CGS, MKS and SI, definition of units (only for information and not to be asked in examination), Interconversion of units MKS to CGS and vice versa, requirements of standard unit, 1.4 Vernier caliper, Micrometer screw gauge 1.5 Accuracy, precision and error, estimation of errors - absolute error, relative error and percentage error, error propagation, significant figures
Unit – II: **Electrostatics**	2.a Explain Coulomb's inverse square law and apply it on system of charges. 2.b Explain an electric field, electric flux, electric potential and potential difference. 2.c Explain the concepts of a capacitor, capacitance and working of parallel plate capacitor. 2.d Apply the concept of series and parallel combination of capacitors to solve problems in electrical circuits.	2.1 Charge, unit of charge, Coulomb's law 2.2 Electric field, electric field lines and its properties 2.3 Electric flux, electric potential and potential difference (point charge only) 2.4 Capacitor and its capacitance. $(C = Q/V)$, Working of the parallel capacitor, formula $\left(C = \varepsilon_0 \frac{A}{d}\right)$, types of capacitors: Plane, spherical & cylindrical (Information only) 2.5 Equivalent capacitance of capacitors in series and in parallel combinations. 2.6 Effect of dielectric material on the capacitance of parallel plate capacitor. (No Derivation)
Unit – III: **Heat and**	3.a Distinguish between Heat and Temperature. 3.b Explain modes of heat	3.1 Heat and Temperature 3.2 Modes of Heat transfer: Conduction, Convection and

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
Thermometry	transmission. 3.c Explain various temperature scales and conversion between them. 3.d Explain Heat Capacity and Specific Heat. 3.e Explain types of thermometers and their uses. 3.f Apply the concept of co-efficient of thermal conductivity to solve engineering problems. 3.g Explain expansion in solids and coefficient of linear expansions in solids.	Radiation 3.3 Temperature measurement scales: Kelvin, Celsius and Fahrenheit and interconversion between them 3.4 Heat Capacity and Specific Heat 3.5 Types of thermometers (Mercury thermometer, Bimetallic thermometer, Platinum resistance thermometer, Pyrometer) and their uses 3.6 Coefficient of thermal conductivity and its engineering applications 3.7 Expansion of solids, coefficient of linear expansion
Unit – IV: **Wave motion and its applications**	4.a Explain wave and wave motion with example. 4.b Distinguish between longitudinal and transverse waves. 4.c Explain frequency, periodic time, amplitude, wave length and wave velocity. 4.d Explain sound waves, light waves and their properties 4.e Explain amplitude, phase, phase difference and wave equation. 4.f Explain principle of superposition of waves, interference and beat formation. 4.g Explain ultrasonic waves, production and their properties. 4.h Explain engineering and medical applications of ultrasonic waves.	4.1 Waves, wave motion, and types of waves: longitudinal and transverse waves 4.2 Frequency, periodic time, amplitude, wave length and wave velocity and their relationship 4.3 Properties of sound and light waves 4.4 phase, phase difference and various terms of wave equation ($y = Asin(\omega t + \varphi)$) [NO equations of velocity and acceleration] 4.5 Superposition of waves, Interference: constructive and destructive interference , condition for stationary interference pattern, beat formation 4.6 Ultrasonic waves, production of ultrasonic waves – magnetostriction and piezoelectric method, their properties, applications of ultrasonic waves in the field of engineering and medical
Unit – V: **Optics and Modern Physics**	5.a Apply Snell's law to calculate refractive index of given medium 5.b Explain the phenomenon of total internal reflection 5.c Explain LASER and it's in	5.1 Refraction, refractive index and Snell's law 5.2 Total internal reflection, critical angle and necessary conditions for total internal reflection 5.3 Application of total internal

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
	engineering and medical applications. 5.d Explain construction and working principle of step index and graded index optical fibers. 5.e Comprehend engineering and medical applications of optical fiber.	reflection in optical fire 5.4 LASER, characteristics of LASER, differences between LASER and ordinary light 5.5 Applications of LASER in engineering and medical field. 5.6 Optical fiber and light propagation through optical fiber, acceptance angle and numerical aperture 5.7 Step index and graded index 5.8 Applications of optical fiber in engineering and medical. 5.9 Advantages of optical fiber over coaxial cable.

***Note**: The UOs need to be formulated at the 'Applcation Level' and above of Revised Bloom's Taxonomy' to accelerate the attainment of the COs and the competency.*

- 'Definition of units' is only for information and not to be asked in examination.
- Students can be introduced to system of units other than SI, MKS, CGS unit systems.
- Application level based numerical should be given at the time of instruction and assessment in each unit.
- Only scalar treatment is to be given to Coulomb's law (No Vector Treatment)
- Concept of electric potential and potential difference is constrained to Point charge only.
- Types of capacitors: parallel plate, spherical & cylindrical are for information point of view only.
- Types of Optical Fiber: Step index and Graded index (Only Single mode)

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Units and Measurements	8	4	4	5	13
II	Electrostatics	8	4	4	5	13
III	Heat and Thermometry	8	2	5	6	13
IV	Wave motion and its applications	9	4	6	5	15
V	Optics and Modern Physics	9	4	7	5	16
Total		42	**18**	**26**	**26**	**70**

***Legends:** R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*

***Note**: This specification table provides general guidelines to assist student for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions to assess the attainment of the UOs. The actual distribution of marks at*

different taxonomy levels (of R, U and A) in the question paper may slightly vary from above table.

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare small reports of about 5 pages for each activity. They should also collect/record physical evidences such as photographs/videos of the activities for their (student's) portfolio which will be useful for their placement interviews:

a) Prepare model to demonstrate concepts of physics
b) Undertake micro-projects in teams
c) Give seminar on any relevant topic.
d) Measure physical quantities using smart phone.
e) Prepare showcase portfolios.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses (MOOCs) may be used to teach various topics/sub topics.
b) Guide student(s) in undertaking micro-projects.
c) ***'L' in section No. 4*** means different types of teaching methods that are to be employed by teachers to develop the outcomes.
d) About ***20% of the topics/sub-topics*** which are relatively simpler or descriptive in nature is to be given to the students for ***self-learning***, but to be assessed using different assessment methods.
e) With respect to ***section No.10***, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
f) Guide students on how to address issues on environment and sustainability using the knowledge of this course

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based (group of 3 to 5). However, **in the fifth and sixth semesters**, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The duration of the microproject should be about **14-16** ***(fourteen to sixteen) student engagement hours*** during the course.The students ought to submit micro-project by the end of the semester (so that they develop the industry-oriented COs).

A suggestive list of micro-projects is given here. This should relate highly with competency of the course and the COs. Similar micro-projects could be added by the concerned course teacher:

a) Measurement: Measure physical quantities using smart phone applications.
b) Prepare proto type Vernier calipers of given least count.
c) Arduino**:** Physical quantities such as Voltage, Magnetic field, Temperature, Light, Sound and distance can be measured with the help of low-cost sensors and Arduino.
d) Paper Capacitor: Aluminum foil and tissue paper can be used to make cylindrical capacitor.
e) Variable capacitor: Two copper cylinders and plastic pipe can be used to make variable capacitor.
f) Sugar and bending of light: prepare a solution of sugar and water to demonstrate bending of light (using semiconductor LASER).
g) Fiber optics: prepare an optical fiber cable using transparent flexible plastic tube, laser and water to demonstrate the property of optical fiber cable.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	SEARS and ZEMANSKY'S University Physics with modern Physics	Hugh D. Young & Roger A. Freedman	Person Publication 14th Edition, USA, ISBN 10: 0-321-97361-5; ISBN 13: 978-0-321-97361-0 (Student edition)
2	Physics for Scientists and Engineers with Modern Physics	John W. Jewett & Raymond A. Serway	CENGAGE Learning, 2010, Boston, 10th edition, ISBN-10: 1337553298
3	University Physics (Volume I, II & III) (Open-source Material)	William Moebs, Samuel J. Ling & Jeff Sanny	OPENSTAX, 2016, Houston, Texas ISBN-13: 1-947172-20-4
4	PHYSICS for SCIENTISTS & ENGINEERS with Modern Physics	Douglas C. Giancoli	Pearson, 2015, 7th edition, Delhi, ISBN-13: 978-1292057125
5	Principles of Physics	Jearl Ealker, David Halliday, Robert Resnick	Wiley India, 2015, Navi Mumbai 10th edition, ISBN-13: 978-8126552566
6	Physics in Daily Life With illustrations	L.J.F. Hermans & Wiebke Drenckhan	EDP Sciences, 2012, France ISBN: 978-2-7598-0705-5
7	Introductory Physics: Building Models to Describe Our World (Open-Source Material)	Ryan Martin, Emma Neary, Joshua Rinaldo & Olivia Woodman	Creative Commons license, 2019, GitHub
8	Concept of Physics (volume I & II)	H.C. Verma	Bharati Bhavan Publishers, 2017, 1st edition, New Delhi, ISSBN-13: 978-8177091878

S. No.	Title of Book	Author	Publication with place, year and ISBN
9	Introduction to Fiber optics	Ajoy Ghatak & K. Thyagarajan	Cambridge University Press India Pvt. Ltd., New Delhi, ISBN: 9780521577854

14. SUGGESTED LEARNING WEBSITES

a) www.williamson-labs.com
b) www.cadsoft.io
c) www.nptel.iitm.ac.in
d) www.khanacademy
e) www.olabs.edu.in
f) www.vlab.co.in
g) www.vlabs.iitb.ac.in
h) www.vlab.amrita.edu
i) www.praxilabs.com
j) www.compadre.org/osp/
k) www.datasheetcafe.com

15. PO-COMPETENCY-CO MAPPING

Semester I/II	Physics (Course Code: 4300005)						
	POs						
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design/ development of solutions	PO 4 Engineering Tools, Experimentation &Testing	PO 5 Engineering practices for society, sustainability & environment	PO 6 Project Management	PO 7 Life-long learning
Competency ***Use Principles of Physics to solve broadly defined engineering problems*.**	3	1	1	2	1	-	1
Course Outcomes CO a) Use relevant instruments with precision to measure the dimension of given physical quantities in various engineering situations.	3	1	1	2	-	-	1
CO b) Apply the concepts of electrostatics and capacitance for engineering applications	3	1	1	2	-	-	1
CO c) Apply the basic concepts of heat transfer and thermometric properties to provide solutions for various engineering problems.	3	1	1	2	1	-	1
CO d) Use the concept of waves and sound waves for various engineering applications involving wave -dynamics.	3	1	1	2	1	-	1
CO e) Use the concepts of LASER and Fiber optics for various engineering applications.	3	-	1	2	1	-	1

Legend: '**3'** for high, '**2**' for medium, **'1'** for low or **'-'** for no correlation with CO and PO

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

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5	Late Dr. Gaurang S. Patel Lecturer in Physics	Dr. S. & S. S. Ghandhy College of Engineering & Technology, Surat	9909986859	goru16686@gmail.com

NITTTR Resource Person

S. No.	Name and Designation	Department	Contact No.	Email
1	Dr Hussain Jeevakhan Assistant Professor	Department of Applied science and education	0755-261600*360	hjeevakhan@nitttrbpl.ac.in

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
I – Semester

Course Title: **Basic Engineering Drawing and Graphics**
(Course Code: 4300013)

Diploma programme in which this course is offered	Semester in which offered
Civil, Environment, Mining, Metallurgy, Plastics, Mechatronics, Textile Manufacturing, Textile Processing, Printing, Ceramics	First
Chemical Engineering, Electrical Engineering	Second

1. RATIONALE

Engineering drawing is a way of communication for engineers. It is a graphical language that essential for communicating design ideas and technical information to engineers in industry and other professionals throughout the design process. The purpose of an engineering drawing is to clearly and accurately capture all geometric features of a product or component so that a manufacturer or engineer can produce the required item. This course aims at development of fundamental understanding and application of engineering drawing so as to develop the ability to prepare, read and interpret drawings correctly and make aware of drafting practices, symbols, codes, norms and standards generally used in industries. It covers knowledge & application of drawing instruments & also familiarizes the learner about codified symbols and principles of technical drawing as per BIS (Bureau of Indian Standards): "SP 46:2003" standards. The course also intended to develop the sense of drawing sequence and imagination in the students and to use computer aided software to create engineering branch specific 2D entities.

2. COMPETENCY

The purpose of this course is to help the student to attain the following industry identified competency through various teaching learning experiences.

- **Prepare engineering drawings using prevailing drawing standards, drafting instruments and computer aided drafting software.**

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with this competency are to be developed in the student to display the following COs:

a) Use scales, drawing standards and drafting instruments as per BIS codes.
b) Construct polygons, circles and lines with different geometric conditions.
c) Construct engineering curves as per given dimensions.
d) Draw the projection of points, lines and planes under different conditions.
e) Draw orthographic views from isometric views of simple objects and vice versa.
f) Use computer aided drafting software to draw 2D and 3D entities.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T/2+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
2	-	4	4	30*	70	25	25	150

(*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

***Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **CA** - Continuous Assessment; **ESE** - End Semester Examination.*

5. SUGGESTED PRACTICAL EXERCISES

The following practical outcomes (PrOs) are the sub-components of the COs. *These PrOs need to be attained to achieve COs.*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	**Use of Drawing Instruments:** Draw following as per I.S. 1a. Draw different types of lines. 1b. Draw simple 2D entities and demonstrate the use of different types of dimensioning methods. 1c. Illustrate dimensioning of circle, arc, angle, square bar, hexagonal bar, cylinder & sphere through figures. 1d. Draw 1st and 3rd angle orthographic projection symbols. 1e. Draw a typical Title block. 1f. Draw simple objects using reduced and enlarge scales.	I,II,III	08
2	**Geometric Construction:** 2a. Draw set of lines with different conditions (Four problems). 2b. Draw circle and arcs with different geometric conditions and constraints (Four problems). 2c. Draw polygons by general methods (Triangle, square, pentagon, hexagon, heptagon) (Three problems). 2d. Draw polygons by special methods (Pentagon, hexagon and heptagon) (Three problems).	IV	08
3	**Engineering Curves (Conic Sections):** 3a. Construct ellipse using concentric circle method, four center method, arc of circle method, rectangle method, oblong method and eccentricity method. (Any three methods) 3b. Construct parabola using rectangular method, parallelogram method, tangent method and eccentricity method. (Any two methods) 3c. Construct hyperbola using rectangular method, oblique method and eccentricity method. (Any two methods)	V	04

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
4	**Projections of Points and Lines:** 4a. Draw projection of points (For 10 various conditions). 4b. Draw projection of lines with different conditions (Five problems).	VI	04
5	**Projections of Planes:** Draw projections of different planar entities with different conditions. (Triangle, square/rectangular, pentagonal, hexagonal and circular – One for each) (Five problems).	VI	04
6	**Orthographic Projections:** Draw Orthographic projections of different objects (three views of each object) (Four problems).	VII	08
7	**Isometric Projections:** Draw isometric drawing from given orthographic views (Four problems).	VIII	08
8	Draw basic 2D entities like: Rectangle, Rhombus, Polygon, Circles, Arcs, circular and rectangular array, blocks using AutoCAD (Print out should be a part of progressive assessment)	IX	02
9	Draw two complex branch specific components in 2D using AutoCAD (Print out should be a part of progressive assessment)	IX	02
10	Draw 6-7 engineering branch specific components (Minimum two should be based on real industrial components selected by student as student activity and approved by teacher) using AutoCAD. Also take print outs of the same.	IX	08
	Total		**56**

Note

i. *Note: The teacher should demonstrate -*
   - *Use of drawing instruments.*
   - *Planning and layout of drawing sheet as per IS code.*
   - *Scaling technique.*

ii. *More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list.*

iii. *The following are some **sample** 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency.*

iv. *Teachers should encourage students for optimum use of drawing sheet space. Further, instruct them to use both sides of a drawing sheet. For example, draw sheet number 2 on back side of sheet number 1, 4 on back of 3, and likewise.*

v. *First angle orthographic projection and IS codes (*Engineering Drawing Practices for School and Colleges SP 46:2003*) should be followed wherever applicable.*

vi. *The dimensions of line, axes, distances, angle, side of polygon, diameter, etc. must be varied for each student in batch so that each student will have same problems, but with different dimensions.*

vii. *The sketchbook should contain data related to all problems, solutions of all problems and student activities performed. Students' activities are compulsory to be performed.*

viii. *A hand out containing applicable standards from IS codes including title block as per IS standard should be given to each student by concerned teacher.*

ix. *For 25 marks Practical Marks ESE, students are to be assessed for competencies achieved. Students are to be given data for practical ESE to prepare drawings.*

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Drawing planning and layout (for optimum use of drawing sheet)	10
2	Use of appropriate instruments, lines, dimensioning & annotations	20
3	Completing given practice problems	30
4	Accuracy of drawing	10
4	Neatness of drawing	10
5	Timely submission of completed drawing sheet	10
6	Answering viva voce questions	10
Total		**100**

Note: Use above sample assessment scheme for practical exercises 1 to 7.

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Developing/ using Institute Template	20
2	Selecting relevant set up parameters	05
3	Creating given drawing using relevant Commands.	40
4	Dimensioning the given drawing and writing text using blocks and layers effectively.	15
5	Answer to sample questions	10
6	Submission of digital drawing file/plot in time	10
	Total	**100**

Note: Use above sample assessment scheme for practical exercises 8 to 10.

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

These major equipment with broad specifications for the PrOs is a guide to procure them by the administrators to usher in uniformity of practicals in all institutions across the state.

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	Drawing instruments for class room teaching (Large Size).	1 to 7
2	Models of various objects (Mechanical, Electrical, Civil etc.).	3 to 7
3	Set of various drawings being used by industries/developed by experienced teachers.	1 to 7
4	Drawing Board (B2) & Mini Drafter.	1 to 7
5	Other Instruments: T-Square, Set square (45˚ and 30˚-60˚), Roller Scale, Protector, Drawing Compass, Dividers, Drawing Pencils	1 to 7

S. No.	Equipment Name with Broad Specifications	PrO. No.
	(Clutch Pencil with H & 2H Lead), Lead Box (H & 2H – 0.5 or 0.7 mm) Circle Master, French Curves, Stencils (8-6-4 mm, All in One), Eraser, Drawing sheets, Drawing Pins/Clips, Sheet Container and Drawing instrument box.	
6	Interactive board with LCD overhead projector	All
7	CAD Workstation: i7, 2 GB RAM, 320 GB HDD, 17" Screen, 1 GHz. (Minimum requirement)	8 to 10
8	Plotter: Print resolution Up to 1200 x 600 dpi, 16 MB Memory	8 to 10
9	Licensed latest network version of AutoCAD software	8 to 10

7. AFFECTIVE DOMAIN OUTCOMES

The following ***sample*** Affective Domain Outcomes (ADOs) are embedded in many of the above mentioned COs and PrOs. More could be added to fulfill the development of this course competency.

a) Work as a leader/a team member.
b) Follow safety practices. Particularly don't use razor or blade to sharpen the pencils.
c) Follow ethical practices.
d) Maintain cleanliness.
e) Practice environmental friendly methods and processes. (Environment related)
f) Shutdown the CAD workstation if not in use.

The ADOs are best developed through the laboratory/field based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

i. 'Valuing Level' in 1st year
ii. 'Organization Level' in 2nd year.
iii. 'Characterization Level' in 3rd year.

8. UNDERPINNING THEORY

The major underpinning theory is given below based on the higher level UOs of Revised Bloom's taxonomy that are formulated for development of the COs and competency. If required, more such UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
Unit – I **Engineering Drawing Aids**	1a. Use drawing instruments and materials effectively.	1.1 Drawing instruments and materials. a) Instruments-types, specifications, method to use them and applications. b) Pencils-grades, papers-grades, applications, types of points and applications. c) Other materials-types and applications.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
Unit – II **Planning Layout and Scaling of Drawing**	2a. Follow and apply standard practice as per B.I.S. for planning and layout. 2b. Choose appropriate scale factor for the drawing as per the given situation with justification.	2.1. I.S. cods for planning and layout. 2.2. Scaling technique used in drawing: a) Plain Scale b) Diagonal Scale
Unit– III **Lines, Lettering and Dimension-ing**	3a. Write annotations on the given drawing where ever necessary. 3b. Choose appropriate line and dimensioning style for the given Geometrical entity.	3.1 Different types of lines. 3.2 Lettering. 3.3 Dimensioning methods. a) Aligned method. b) Unilateral with chain, parallel, progressive and combined dimensioning.
Unit– IV **Geometric Construc-tion**	4a. Draw polygons, circles and lines with the given geometric conditions.	4.1 Geometric construction related with line. 4.2 Geometric construction related with angle. 4.3 Geometric construction related with circle & arc. 4.4 Construct polygons: a) Hexagon: Using drawing tools. b) Polygon (Triangle, square, pentagon, hexagon and heptagon) by general method. c) Polygon (Pentagon, hexagon and heptagon) by special method.
Unit– V **Engineering Curves**	5a. Draw engineering curves with proficiency as per given dimensions.	5.1 Conic sections. a) Concept and understanding of focus, directrix, vertex and eccentricity and drawing of conic sections. b) Using various methods, understand construction and application of : • Ellipse. • Parabola. • Hyperbola.
Unit– VI **Projection of Points,**	6a. Draw the projection of points, lines and planes with different conditions in first angle projection.	6.1 Concept of quadrant. 6.2 Reference planes, orthographic projections. 6.3 1st angle and 3rd angle projection

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
Lines and Planes	6b. Find out true shape and size of an inclined line or plane.	and their symbols. 6.4 Projection of points. 6.5 Projection of lines – determination of true length and inclinations for following cases. a) Line parallel to one or both the plane. b) Line perpendicular to one of the planes. c) Line inclined to one plane and parallel to another. d) Line inclined to both the planes. 6.6 Projection of Planes. a) Type of planes. b) Projections of planar object parallel to one of the reference planes. c) Projections of planar object inclined to one reference plane and perpendicular to another. d) Projections of planar object inclined to both reference planes. **Note:** Planar objects like Triangle, Square / rectangle, pentagon, hexagon and circle shape should be considered.
Unit– VII **Ortho-graphic Projection**	7a. Draw the orthographic views of objects containing lines, circles and arc geometry. 7b. Interpret given orthographic views to imagine the shape of the component.	7.1 Types of projections-orthographic, perspective, isometric and oblique: concept and applications. 7.2 Various term associated with orthographic projections. a) Theory of projection. b) Methods of projection. c) Orthographic projection. d) Planes of projection. 7.3 Conversion of simple pictorial views into Orthographic views. Illustrative problems on orthographic projection. 7.4 B.I.S. code of practice. **Note:** Problem should be restricted up to three views Front view/Elevation, Top view/Plan and Side views only. Use First

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
		Angle Method only.
Unit– VIII **Isometric Projection**	8a. Draw the isometric view from orthographic views of object/s containing lines, circles, arcs and slant surfaces.	8.1 Isometric axis, lines and planes. 8.2 Isometric scales. 8.3 Isometric view and isometric drawing. 8.4 Difference between isometric projection and isometric drawing. 8.5 Illustrative problems limited to objects Containing lines, circles and arcs shape only.
Unit– IX **Computer Aided Drafting using AutoCAD**	9a. Draw basic 2D entities using AutoCAD software. 9b. Prepare 2D drawing of simple engineering components using AutoCAD software. 9c. Printing of digital drawings using Printer/plotter.	9.1 Basic knowledge of computer hardware, software and System requirement, understanding the interface. 9.2 AutoCAD main window elements: Title bar, standard tool bar, menu bar, object properties tool bar, draw tool bar, modify toolbar, cursor cross hair, command window, status bar, drawing area, UCS icon. 9.3 File features: New file, Saving the file, Opening an existing drawing file, Creating Templates, Quit. 9.4 Setting up new drawing, Units, Limits. Using Grid, Snap, Ortho, Object Snap. 9.5 Methods of Specifying points: Absolute coordinates, Relative Cartesian & Polar coordinates. 9.6 Draw basic entities like Line, Circle, Arc, Polygon, Ellipse, Rectangle, Multiline, Poly Line. 9.7 Modify and edit commands like trim, delete, copy, offset, array, block, layers. 9.8 Dimensioning: Linear, Horizontal, Vertical, Aligned, Rotated, Baseline, Continuous, Diameter, Radius, Angular Dimensions. 9.9 Editing dimensions. 9.10 Text: Single line Text, Multiline text 9.11 Print/plot settings.

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Engineering drawing aids	0	0	0	2	2
II	Planning, layout and scaling of drawing	0	2	0	3	5
III	Lines, lettering and dimensioning	0	0	2	0	2
IV	Geometric construction	3	0	3	7	10
V	Engineering curves	3	1	0	5	6
VI	Projection of points, lines and planes	8	3	0	14	17
VII	Orthographic projections	6	0	0	12	12
VIII	Isometric projections	5	0	2	8	10
IX	Computer Aided Drafting using AutoCAD	3	1	0	5	6
Total		**28**	**7**	**7**	**56**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*

Note*: This specification table provides general guidelines to assist students for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions to assess the attainment of the UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may slightly vary from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related **co-curricular** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should perform following activities in group and prepare reports of about 5 pages for each activity. They should also collect/record physical evidences for their (student's) portfolio which may be useful for their placement interviews:

a) Solve all problems for all sheets number 1 to 7 in sketch book (with complete data and dimensions).
b) Take one circular shape (i.e. tyre). Assume one point on circumference and mark it. Roll that shape on flat and circular surface. Observe the path of point and correlate the same with respective engineering curve.
c) Take two simple objects in your vicinity and sketch 3D isometric of them. Also draw 2D orthographic projections of them (all views). Try to clearly and accurately capture all the geometric features present in the selected objects. Also draw the same using AutoCAD software.
d) Download soft copy of technical drawing of any engineering products. Read and interpret this drawing (e.g. Car, Cutting tools, gears, bearings etc.).
e) Collect the orthographic views from your facilitator, at least three objects with few missing lines. The student will try to imagine the corresponding objects, complete the views and draw these views in sketch book.
f) Create an institute template with institute logo using AutoCAD software.

g) Explain at least one problem for construction and method of drawing in sheet to all batch colleagues. Teacher will assign the problem of particular sheet to be explained to each batch student.
h) Each student will assess at least one sheet of other students (May be a group of 5-6 students identified by teacher can be taken) and will note down the mistakes committed by them. Student will also guide the students for correcting the mistakes, if any.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b) Guide student(s) in undertaking micro-projects.
c) ***'L' in section No. 4*** means different types of teaching methods that is to be employed by teachers to develop the outcomes.
d) About ***20% of the topics/sub-topics*** which are relatively simpler or descriptive in nature is to be given to the students for ***self-learning***, but to be assessed using different assessment methods.
e) With respect to ***section No.10***, teachers should create opportunities and provisions for ***co-curricular activities***.
f) Guide students for using BIS "SP 46:2003" standard

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based (group of 3 to 5). However, **in the fifth and sixth semesters**, the number of students in the group should **not exceed three**.

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The duration of the microproject should be about **14-16 (fourteen to sixteen) student engagement hours** during the course. The students ought to submit micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. This has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher:

a) Creating Digital Portfolio: Students should Observe and **c**ollect photographs and images of industrial/domestic components/items which contain or their functioning create shapes/features like polygon, ellipse, parabola, hyperbola.
b) Technology in education: Refer websites related to use of virtual drawing instruments and environment like https://www.triumphcloud.com/, https://www.mathspad.co.uk/. Practice few problems using the virtual drawing instruments.
c) **Model Making:** Students should Build 3D model of various object as per shape and dimension from thermocol, hardboard scrap, wooden scrap, plastic or metal scrap.

d) **World of work connect:** Students should collect Production drawings, Building Drawings, Layouts from nearby workshops/industries/builders/contractors and try to
- redraw types of lines used
- redraw lettering styles used
- list BIS code referred
- list the symbols/annotations/dimensioning used
- list the type of scales used. Compare the size of component on drawing sheet with actual component.
- Redraw the 2D entities using AutoCAD software.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Engineering Drawing	N.D. Bhatt	Charotar Publishing House;Anand, 2014. ISBN : 9789380358963
2	Textbook of Engineering Drawing	P.J. Shah	S.Chand, New Delhi. 2013 ISBN : 9788121941822
3	Textbook of Engineering Drawing	R K Dhawan	S.Chand, New Delhi. 2013 ISBN : 9789352837373
4	Engineering Drawing	M.B. Shah, B.C. Rana	Pearsons. 2009 ISBN: 9788131759714
5	Engineering Drawing	Basant Agrawal, C. M. Agrawal	McGraw-Hill, 2019 ISBN : 9789353167448
6	Engineering Drawing Practices for School and Colleges SP 46:2003	Bureau of Indian Standards	Bureau of Indian Standards, Government of India, Third Reprint, October 1998; ISBN: 81-7061-091-2
7	Machine Design Includes AutoCAD	Ajeet Singh	Second Edition, Tata McGraw Hill Education Private Limited, New Delhi, 2018
8	AutoCAD 2020: A Problem-Solving Approach, Basic and Intermediate	Sham Tickoo	26th Edition, CADCIM Technologies, 2019
9	AutoCAD 2013, Command Reference Guide	Autodesk Inc.	Autodesk Inc.
10	AutoCAD User Guide	Autodesk	Autodesk Press, USA, 2015
11	Autodesk knowledge network, tutorials, documentation, downloads, troubleshooting articles: https://knowledge.autodesk.com/support	Autodesk Inc.	Autodesk Inc.

14. SOFTWARE/LEARNING WEBSITES

a) https://www.youtube.com/results?search_query=engineering+drawing
b) https://www.youtube.com/c/MechanicalEnggSubjectsGTU/playlists

c) https://youtu.be/MT1T31GtGpg
d) https://youtu.be/WEwkepkv6mg
e) https://youtu.be/trJQIvatIpI
f) https://nptel.ac.in/courses/112/103/112103019
g) https://nptel.ac.in/courses/112/105/112105294
h) https://en.wikipedia.org/wiki/Engineering_drawing
i) https://www.slideshare.net/search/slideshow?searchfrom=header&q=engineering+drawing
j) https://www.scribd.com/search?content_type=tops&page=1&query=engineering%20drawing&content_types=tops,books,audiobooks,summaries,articles,documents,sheet_music,podcasts
k) http://www.cognifront.com/tools.php
https://www.youtube.com/watch?v=bmAlJAMndwM
l) https://www.youtube.com/watch?v=904_RPjGJg4
m) https://www.youtube.com/watch?v=jzlDouas0Wc
n) https://www.youtube.com/watch?v=VuHdV38fyjc
o) https://www.youtube.com/watch?v=iOzlIJge_G0
p) https://www.youtube.com/watch?v=-l0iRdH3MbA
q) https://www.youtube.com/watch?v=vI5xhCD5mXQ
r) https://www.youtube.com/watch?v=GDrD9nEZ9LY

15. PO-COMPETENCY-CO MAPPING

Semester I & II	Basic Engineering Drawing and Graphics (Course Code: 4300013)						
	POs						
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design/ development of solutions	PO 4 Engineering Tools, Experimentation &Testing	PO 5 Engineering practices for society, sustainability & environment	PO 6 Project Management	PO 7 Life-long learning
Competency	*Prepare engineering drawings using prevailing drawing standards and drafting instruments.*						
Course Outcomes CO a) Use scales, drawing standards and drafting instruments as per BIS codes.	3	1	2	3	-	-	2
CO b) Construct polygons, circles and lines with different geometric conditions	3	-	3	2	2	-	2
CO c) Construct engineering curves as per given dimensions	3	-	3	2	2	-	2
CO d) Draw the projection of points, lines and planes under different conditions.	3	-	3	2	2	-	2
CO e) Draw orthographic views from isometric views of simple objects and vice versa .	3	2	3	2	2	2	2
CO f) Use computer aided drafting software to draw 2D and 3D entities.	3	-	3	3	-	2	2

Legend: '**3'** for high, '**2**' for medium, **'1'** for low and **'-'** for no correlation of each CO with PO.

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

S. No.	Name and Designation	Institute	Contact No.	Email
1	Mr. M.D.Naraniya, Lecturer in Mech. Engg.	Government Polytechnic, Jamnagar	9726716135	naraniya98 @gmail.com
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3	Dr. S.S. Sonigra, Lecturer in Mech. Engg.	Government Polytechnic, Rajkot	9427322129	sssonigra @gmail.com
4	Dr. H.R. Sapramer HOD, Mechanical Engg.	Dr. J.N.Mehta Polytechnic, Amreli	9426587197	merhamir @gmail.com

NITTTR Resource Persons

S. No.	Name and Designation	Department	Contact No.	Email
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2	Dr. K.K. Jain, Professor	Mechanical Engineering Education	9425017472	kkjain@nitttrbpl.ac.in

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
Semester -II

Course Title: Indian Constitution
(Course Code: 4300016)

Diploma programmes in which this course is offered	Semester in which offered
Auto Mobile, Bio Medical, Power Electronics, Plastic, Computer, IT, Chemical, Civil, Electrical, Electronics and Communication. Environmental, Information Technology, Instrumentation and Control,Marine,Mechanical,Mechatronics,Mettalurgy,Mining,Textile Processing Technology, Textile Manufacturing Technology, Architectural Assistantship, CADCAM, Ceramic, Fabrication Technology, Printing Technology, Textile Designing	Second

1. RATIONALE

This course will survey the basic structure and operative dimensions of Indian Constitution. It will explore various aspects of the Indian political and legal system from a historical perspective highlighting the various events that led to the making of the Indian Constitution. It will also socio-political equations. The various challenges faced by the constitution and the corresponding coping mechanisms would also be discussed. Broadly, the students would be exposed to the working of various institutions, offices and political debates ensuing from the operation of the Indian constitution in the last five decades.

2. COMPETENCY

Thepurpose of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Follow policies, processes, duties, rights and federal structure of Indian constitution as responsible citizens and engineer of the country.**

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with the identified competency are to be developed in the student for the achievement of the following COs:

a) List salient features and characteristics of the constitution of India.
b) Follow fundamental responsibilities, privileges, rights and duties as responsible citizen and engineer of the country.
c) Differentiate between state and central administrative setup of the country.
d) Explain major constitutional amendment procedures and emergency provisions in the country
e) Explain judicial setup and electoral process of the country.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
2	-	-	0	-	-	50*	-	50

(*): the marks distribution total internal assessment 50 marks

5. SUGGESTED PRACTICAL EXERCISES -Not applicable

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED-Not applicable

7. AFFECTIVE DOMAIN OUTCOMES

The following ***sample***Affective Domain Outcomes (ADOs) are embedded in many of the above mentioned COs andPrOs.More could be added to fulfil the development of this course t competency.

a) Work as a leader/a team member.
b) Follow constitutional duties and responsibilities
c) Follow ethical practices.
d) Practice environmental friendly methods and processes.

The ADOs are best developed through the laboratory/field based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

i. 'Valuing Level' in 1st year
ii. 'Organization Level' in 2nd year.
iii. 'Characterization Level' in 3rd year.

8. UNDERPINNING THEORY

The major underpinning theory is given below based on the higher level UOs of *Revised Bloom's taxonomy* that are formulated for development of the COs and competency. If required, more such higher level UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
Unit – I Constitution and Preamble	1a. Explain the meaningof preamble of the constitution. 1b. List the salient features of constitution. 1c. List the characteristics of constitution.	1.1 Meaning of the constitution of India 1.2 Historical perspective of the Constitution of India 1.3 Salient features and characteristics of the Constitution of India 1.4 Preamble to the Constitution of India

Unit – II Fundamental Rights and Directive Principles	2a. Enlist the fundamental rights. 2b. Identify fundamental duties. 2c. Follow fundamental responsibilities as an engineer. 2d. Differentiate between fundamental rights and directive principles. 2e. Identify fundamental duties and responsibilities applicable to a practicing engineer.	2.1 Fundamental Rights under Part-III (Details of exercise of rights and Limitations) 2.2 Fundamental duties and their significance 2.3 Relevance of Directive Principles of State Policy under part-IV.
Unit– III Federal Structure	3a. Draw the structure of governance in India. 3b. Differentiate between state and central administrative setup of the country.	3.1 Federal structure and distribution of legislative and financial powers between the Union and the States 3.2 Union Executive-President, Prime minister, Parliament and the Supreme Court of India, 3.3 State Executive - Governor, Chief Minister, State Legislator, and high Court 3.4 Local Administration - District Administration, Municipal Corporation, Zila Panchayat
Unit– IV Governance and Amendments	4a. Enlist the constitutional amendments 4b. Infer the purposes of various amendments.	4.1 Amendment of the Constitutional Powers and Procedure 4.2 Major Constitutional Amendment procedure - 42nd, 44th, 74th, 76th, 86th and 91st. 4.3Emergency provisions
Unit– V Judicial System and Election Commission&National Green Tribunal	5a. Perform judicial review for societal welfare 5b. Abide by the judicial provisions. 5c. Adopt the electoral procedures with respect to citizenship. 5d. Abide by greening laws 5e. Identify the topics/subtopics in a given engineering corse where greening laws are affecting significantly.	5.1 The Indian Judicial System 5.2 Judicial Review 5.3 Election Commission 5.4 National Green Tribunal

9. SUGGESTED SPECIFICATION TABLE FOR QUESTIONPAPER DESIGN

Unit	Unit Title	Teachin	Distribution of Theory Marks

No.		g Hours	R Level	U Level	A Level	Total Marks
I	Constitution and Preamble	04	04	04	0	08
II	Fundamental Rights and Directive Principles	08	03	02	10	15
III	Federal Structure	07	02	03	06	11
IV	Governance and Amendments	05	02	02	04	08
V	Judicial System and Election Commission	04	02	02	04	08
Total		**28**	**13**	**13**	**24**	**50**

Legends: *R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*

Note*: This specification table provides general guidelines to assist student for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions to assess the attainment of theUOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may varyslightly from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course. Students should conduct following activities in group and prepare reports of about 5 pages for each activity. They also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a) Prepare a report on Mock court hearing
b) Visit to courts
c) Arrange Mock Parliament.
d) Visit to Local Bodies
e) Visit to Courts.
f) Visit to Legal Service Authority
g) Design games and simulation
h) Group discussions on current print articles
i) Prepare college/posters on current constitutional issues.
j) Learning through cases

- **A.K. Gopalan Case (1950):weblink** *https://indiankanoon.org/doc/1857950/*
- **Shankari Prasad Case (1951):weblink***https://indiankanoon.org/doc/1706770/*
- Berubari Union case (1960) :weblinkhttps://indiankanoon.org/doc/1120103/
- Golaknath case (1967) :weblinkhttps://indiankanoon.org/doc/120358/
- Kesavananda Bharati case(1973):weblinkhttps://indiankanoon.org/doc/257876/
- Indira Nehru Gandhi v. Raj Narain case (1975):weblinkhttps://indiankanoon.org/doc/936707/
- Maneka Gandhi case (1978):weblink https://indiankanoon.org/doc/1766147/
- Minerva Mills case (1980): weblink https://indiankanoon.org/doc/1939993/
- Indra Sawhney and Union of India (1992):weblinkhttps://indiankanoon.org/doc/1969682/
- Samatha and State of Andhra Pradesh (1997): weblink https://indiankanoon.org/doc/1969682/

- Aruna Shanbaug Case (2011) : weblinkhttps://indiankanoon.org/doc/235821/
- Justice K.S.Puttaswamy(Retd) ... vs Union Of India And Ors.: Right To Privacy (2017)weblinkhttps://indiankanoon.org/doc/1857950/
- L Chandra Kumar Case (1997):weblink https://indiankanoon.org/doc/1152518/
- Habeas Corpus Case (1976): weblink https://indiankanoon.org/doc/1735815/
- Romesh Thapar Case (1950): weblink https://indiankanoon.org/doc/456839/
- M.C. Mehta And Anr vs Union of India &Ors on 20 December, 1986 Bhpal Gas Tragedy:weblinkhttps://indiankanoon.org/doc/1486949/
- M.C. Mehta vs Union Of India &Ors on 30 December, 1996 Taj Mahal:weblink https://indiankanoon.org/doc/1964392/
- M.C. Mehta vs Union Of India on 15 November, 2019 Delhi Pollution: weblink ttps://indiankanoon.org/doc/174204561/
- Samit Mehta v. Union of India &Ors.;National Green weblink:https://www.casemine.com/judgement/in/5b17d5604a932678010063da

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b) Guide student(s) in undertaking micro-projects.
c) ***'L' in section No. 4***means different types of teaching methods that are to be employed by teachers to develop the outcomes.
d) About ***20% of the topics/sub-topics*** which are relatively simpler or descriptive in nature is to be given to the students for ***self-learning***, but to be assessedusing different assessment methods.
e) With respect to ***section No.10***, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
f) Guide students on how to address issues on environment and sustainability.

12. SUGGESTED MICRO-PROJECTS

- Not Applicable

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	The Constitution of India	P.M. Bakshi	Universal Law Publishing, New Delhi 15th edition, 2018, ISBN: 9386515105
2	Introduction to Indian Constitution	D.D. Basu	Lexis Nexis Publisher, New Delhi, 2015, ISBN:935143446X
3	Introduction to Constitution of India	B. K. Sharma	PHI, New Delhi, 6th edition, 2011, ISBN:8120344197
4	The Constitution of India	B.L. Fadia	Sahitya Bhawan, Agra, 2017, ISBN:8193413768

S. No.	Title of Book	Author	Publication with place, year and ISBN
5	Ethics and Politics of the Indian Constitution	Rajeev Bhargava	Oxford University Press, New Delhi, 2008, ISBN:0198063555
6	The Constitutional Law of India	Durga Das Basu	LexisNexis Butterworths Wadhwa, Nagpur 978-81-8038-426-4
7	Indian Constitution	Avtar Singh	Central Law Publication, Prayagraj. Uttar Pradesh 2019. 978-9386456861
8	The Constitution of India	NaushirwanJhabwala	C. Jamnadas&Company. Ahmedabad. 2016.978-9789364572

14. SOFTWARE/LEARNING WEBSITES

a) http://www.legislative.gov.in/constitution-of-india
b) https://en.wikipedia.org/wiki/Constitution_of_India
c) https://www.india.gov.in/my-government/constitution-india
d) https://eci.gov.in/about/about-eci/the-setup-r1/
e) https://www.toppr.com/guides/civics/the-indian-constitution/the-constitution-of-india
f) https://main.sci.gov.in/constitution
g) https://nios.ac.in/media/documents/srsec317newE/317EL8.pdf
h) https://legalaffairs.gov.in/sites/default/files/chapter%203.pdf
i) https://www.concourt.am/armenian/legal_resources/world_constitutions/constit/india/india--e.htm
j) https://constitutionnet.org/vl/item/basic-structure-indian-constitution

15. PO-COMPETENCY-CO MAPPING

1	Indian Constitution (Course Code: 4300016)						
	POs and PSOs						
Competency and Course Outcomes	**PO 1 Basic and Discipline specific knowledge**	**PO 2 Problem Analysis**	**PO 3 Design/ development of solutions**	**PO 4 Engineering Tools, Experimentation andTesting**	**PO 5 Engineering practices for society, sustainability and environment**	**PO 6 Project Management**	**PO 7 Life-long learning**
Competency ***Follow policies, processes, duties, rights and federal structure of Indian constitution as responsible citizens***							

and engineer of the country.							
Course Outcomes CO a) List salient features and characteristics of the constitution of India.	-	1	1	-	2	1	2
CO b) Follow fundamental responsibilities, privileges, rights and duties as responsible citizen and engineer of the country.	-	1	1	-	2	1	2
CO c) Differentiate between state and central administrative setup of the country.	-	1	1	-	2	1	2
CO d) Explain major constitutional amendment procedures and emergency provisions in the country.	-	1	1	-	2	1	2
CO e) Explain judicial setup and electoral process of the country.	-	1	1	-	2	1	2

*Legend: '**3**' for high, '**2**' for medium, **'1'** for low and **'-'** for no correlation of each CO with PO.*

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

S. No.	Name and Designation	Institute	Contact No.	Email
1	Dr PeenaThanky Lecturer [English] BOS Member	RCTechnical Institute, Ahmedabad	94094 11256	drpeena@gmail.com

2	Dr. Yatharth Vaidya Lecturer [English] BOS Member	Government Polytechnic, Rajkot	8980291650	yatharthvaidya@gmail.com
3	Dr J U Nanavaty Expert	Formal principal Sheth M N Law college Patan.	9898115448	junanavaty@gmail.com

NITTTR Resource Persons

S. No.	Name and Designation	Department	Contact No.	Email
1	Dr. Roli Pradhan, Assistant Professor	Department of Management Education	09893205011	rpradhan@nitttrbpl.ac.in

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
I – Semester

Course Title: **Basics of Civil Engineering**
(Course Code: 4310001)

Diploma programme in which this course is offered	Semester in which offered
Mechanical, Automobile, Marine, Fabrication	First
Electrical	Second

1. RATIONALE

Now a days Industrial activities/ task to be performed by allied programs such as Automobile, Marine, Fabrication are complex in nature and involves integration of activities of core programs which are Mechanical, Electrical and Civil. Thus, they are expected to look after many activities at work place, which may be interdisciplinary, for example he/ she has to interpret and execute the task as per the drawing, select suitable material, adopt/ suggest appropriate construction activity which requires the knowledge of civil engineering. Therefore he/she is supposed to be exposed to basics of civil engineering. This course mainly encompasses the major and general areas of civil engineering considering environmental aspects; knowledge of which is required by them.

2. COMPETENCY

The purpose of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **To apply the basic principles of civil engineering to solve broadly defined engineering problems.**

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with this competency are to be developed in the student to display the following COs:

a) Prepare drawing from field Survey data using Chain, Tape, Compass and /or Dumpy level.
b) Select suitable building material and construction technique.
c) Interpret various building drawing and Services.
d) Follow traffic control aids.
e) Use green and ecofriendly building technology.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T/2+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
-	2	2	3	0	0	25*	25	50

(*):For this practical only course, 25 marks under the practical CA has two components i.e. the assessment of micro-project, which will be done out of 10 marks and the remaining 15

marks are for the assessment of practical. This is designed to facilitate attainment of COs holistically, as there is no theory ESE.

***Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **CA** - Continuous Assessment; **ESE** - End Semester Examination.*

5. SUGGESTED PRACTICAL EXERCISES

The following practical outcomes (PrOs) are the sub-components of the COs. *Some of the **PrOs** marked **'*'** are compulsory, as they are crucial for that particular CO at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'.*

S. No.	Practical Outcomes (PrOs)	Unit No.		Approx. Hrs. required
1	Record linear and angular measurements in horizontal plane using chain, tape and compass	1		02*
2	Prepare drawing using Chain, Tape and Compass Survey Data	1		04*
3	Record measurements in vertical plane using dumpy Level.	1		02*
4	Prepare contour map using leveling data.	1		02*
5	Prepare a report on market survey of construction materials	2		04*
6	Draw a sketch of wall section showing all building components.	2	Any three	02
7	Draw Sketches of different brick masonry bonds.	2		02
8	Prepare a chart of Standards of potable water.	2		02
9	Conduct field tests on Cement.	2		02
10	Conduct field tests on Bricks.	2		02
11	Prepare a cost estimate for the given drawing.	2		02
12	Draw Utility plans of a given building (Electricals, drainage)	3	Any three	02
13	Draw Sketches of different types of Foundations	3		02
14	Draw Sketches of plumbing fixtures.	3		02
15	Prepare list of abbreviation related to civil engineering drawing.	3		02
16	Prepare drawing of symbols related to Civil engineering drawing.	3		02
17	Draw Sketches of different Traffic Signs, Road Markings and Signals.	4		02
18	Prepare a report on ecofriendly materials.	5	Any one	02
19	Draw a typical sketch of rain water harvesting.	5		02
	Total			**28**

Note

*i. More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list.*

*ii. The following are some **sample** 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency..*

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
For PrOs 1 to 4		
1	Operation and handling of instruments	30
2	Observations and recording	20
3	Interpretation of result and plotting and submitting	10
4	Answer the questions	20
5	Follow safe practices measures	20
Total		**100**

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
For PrOs 5 to 19		
1	Initiative of work allotted	30
2	Neatness in work done and work place	20
3	Submission of report in time	10
4	Answer the question	20
5	Follow safe practices measures	20
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specifications for the PrOs is a guide to procure them by the administrators to usher in uniformity of practicals in all institutions across the state.

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	**Measuring Chain** (20m and 30m). The length of each linked is 200 mm. each meter is provided with circular brass ring & each five meter length is provided with brass tallies of requisite shapes each chain should be provided with 10 numbers of M.S. Arrows of 4 mm diameter bar and 40 cm. Height .As per IS 1492-1970	1,2
2	**Metallic Tape:** 30 Meter, consists of 12 to 15 mm wide Low High Accuracy 5mm + 10ppm 1mm + 1ppm Range 1 km 5 km Cost $10,000 $40,000 Data Storage none 7500 pts. Magnification 10X 30X Run-time 3 hrs. 6 hrs. . strip of either Yarn coating or linen or cloth / or plastic coating. having very fine brass or copper or bronze wires. Woven into it to prevent it from elongation and twisting Graduated in metric system. Each meter length is divided into decimeter and centimeters. It is available in various length. 30 meter length is in common use. The tape is available in a leather / suitable cover with a winding device. The Zero end of the tape is provided with a metal ring. 10 meters 15 meters 20 meters 30 meters 50 meters	1,2
3	**Ranging Rods:** Circular / Octagonal Ranging Rods preferably circular with 3 to 5 cm diameter made up of either seasoned solid bamboo stick or	1,2

S. No.	Equipment Name with Broad Specifications	PrO. No.
	metal conduit pipe of length 2 to 3 meters, with conical metallic shoe fitted at bottom & fully painted with 20 cm. long colour bands of either of the following combinations. Salient Features a) Black & White - size 2 meters b) Red & White - size 3 meters	
4	**Prismatic Compass:** consisting of brass or aluminum circular box with a diameter of 100/125 millimeter. Aluminum circle consists of a needle graduated to 30 min. (0. 50)	2
5	**Dumpy Level:** image erect, magnification 24x, length of telescope 300 mm, objective aperture 40 mm, stadia radio 02:40:00 am ,field of view 1° 30' ,resolution 0.01 cm at 100 mt plate, bubble size 12mm x 87.5 mm, sensitivity 45°/2 mm, circle diameter 75 mm(magnetic), circle graduation 1 div=1°	3,4
6	**Leveling Staff:** Made of Aluminium body Telescopic in 3 PCS, 4 meter in length packed in canvas cover, graduated in meters, dm, cm, and mm with background and black strips. 5 mm thick with suitable locking arrangement Made of Aluminium body / Metallic Body folding in 2 PCS, 4 meter in length graduated in meters, dm, cm and mm. with white background and black strips. 5mm thick with suitable folding & locking arrangement. Improved soap with pattern is made of best quality well seasoned teak wood, Telescopic in three pieces, brass fitting and glued, thus greatly increasing its strength, stability and durability, Accurately machine divided and engraved to read 5 mm. painted and polished. Size 4 meters. Long Size 5 meters. Long Size 6 meters Long.	3,4

7. AFFECTIVE DOMAIN OUTCOMES

The following ***sample*** Affective Domain Outcomes (ADOs) are embedded in many of the above mentioned COs and PrOs. More could be added to fulfil the development of this course competency.

a) Work as a leader/a team member.
b) Follow ethical practices.
c) Practice of environmental friendly methods and processes.

The ADOs are best developed through the laboratory/field based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

i. 'Valuing Level' in 1st year
ii. 'Organization Level' in 2nd year.
iii. 'Characterization Level' in 3rd year.

8. UNDERPINNING THEORY

The major underpinning theory is given below based on the UOs of *Revised Bloom's taxonomy* that are formulated for development of the COs and competency. If required, more such UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
Unit – I Surveying and levelling	1a. Use surveying tools and instruments for field survey. 1b. Determine horizontal distances by chaining. 1c. Compute horizontal angles using prismatic compass. 1d. Calculate difference in levels using dumpy level. 1e. Prepare contour map of a given area.	1.1 Importance and types of Surveying & leveling 1.2 Principals of surveying. 1.3 Instrument/tools used for surveying and levelling. 1.4 Chaining and Ranging 1.5 Recording of measurements in field book. 1.6 Functions of different part of Prismatic compass 1.7 Setting and operations of compass 1.8 Methods of finding included angles from bearings 1.9 Basic terminology related to levelling 1.10 Functions of different part of Dumpy level 1.11 Different types of levelling staff 1.12 Setting of Dumpy Level 1.13 Methods of finding out the RL in level book by HI method and Rise & Fall Method with necessary check 1.14 Contour – use, characteristics 1.15 Preparations of contour sheets/ plan using survey data.
Unit – II Building Material and Construc-tion Technology	2a. Select different types of construction materials as per requirements. 2b. Test given construction materials on field for quality control. 2c. Classify various types of foundations. 2d. Explain various types of bonds in brick masonry. 2e. Estimate the cost of given simple construction works.	2.1. Common construction materials such as cement, brick, sand, aggregate, steel and water. 2.2. Properties of each materials & their acceptable standards. 2.3. Types of bricks, cement and aggregate 2.4. Field tests on bricks, cement 2.5. Functions of various components of buildings. 2.6. Classification and Types of foundations.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
		2.7. Bonds in brick masonry. 2.8. Estimations and costing for simple structure (only the material cost)
Unit– III **Building Drawing and Building Services.**	3a. Interpret various types of drawings used in civil engineering. 3b. Explain building bylaws and principles of planning. 3c. Describe basics of building services. 3d. Classify various types of building services. 3e. Apply various types of services as per need of building.	3.1 Types of building drawings 3.2 Abbreviation, conventions & symbols in civil drawing for • Electric fittings • Water supply and sanitary fittings. • Material for constructions • Surveying 3.3 Building byelaws and principles of planning of residential building. 3.4 Planning of a simple residential building. 3.5 Objective and uses of building services. 3.6 Applications of services for different types of building. 3.7 Classification of building services 3.8 Types of services 3.1 Electrical 3.2 Water Supply 3.3 Drainage 3.4 Circulation 3.5 Fire Safety
Unit– IV **Basics of Transpor-tation Engineering**	4a. Explain role of transportation. 4b. Explain various modes of transportation. 4c. Explain importance of traffic signs. 4d. Explain traffic control aids.	4.1 Role of transportation in national development. 4.2 Modes of Transportation. 4.3 Introduction to road traffic and traffic control aids.
Unit– V **Green and ecofriendly Technology**	5a. Use green and ecofriendly building technology. 5b. Explain rain water harvesting. 5c. Explain various types of green building materials. 5d. Explain components of green buildings.	5.1 Rain water harvesting for buildings. 5.2 Concept of GREEN buildings 5.3 Components of GREEN building.

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A	Total Marks
I	Surveying and levelling	6	NOT APPLICABLE as no theory exam at the end of semester.			
II	Building Material and Construction Technology	8				
III	Building Drawing and Building Services.	8				
IV	Basics of Transportation Engineering	3				
V	Green and ecofriendly Technology	3				
Total		**28**				

Legends: *R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a) Prepare specification of surveying devices.
b) Prepare specification of various building materials by market survey.
c) Submit a report of construction work going on at site.
d) Prepare drawing of line plan of a house.
e) Prepare drawing of various services provided in a house.
f) Prepare power point on various construction stages.
g) Submit a report on traffic system in your city/town.
h) Submit a report on traffic control aids in your city/town.
i) Calculate traffic intensity in peak hours in a busy road in your city/town.
j) Give seminar on relevant topic.
k) Prepare a report of rainwater harvesting.
l) Prepare a report on green building construction.
m) Prepare showcase portfolios.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b) Guide student(s) in undertaking micro-projects.
c) ***'L' in section No. 4*** means different types of teaching methods that are to be employed by teachers to develop the outcomes.
d) About ***20% of the topics/sub-topics*** which are relatively simpler or descriptive in nature is to be given to the students for ***self-learning***, but to be assessed using different assessment methods.
e) With respect to ***section No.10***, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.

f) Guide students on how to address issues on environ and sustainability

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based (group of 3 to 5). However, **in the fifth and sixth semesters**, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The duration of the microproject should be about **14-16** ***(fourteen to sixteen) student engagement hours*** during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. This has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher:

a) Prepare a layout plan of an existing building of campus.
b) Comparison of test results obtain from different sources of drinking water with potable water standards (minimum 5 samples)
c) Prepare Report on Justifying traffic signs on particular section of roads.
d) Prepare a suggestive report on upgrading existing building into green building as per IGBC/GRIHA standards.
e) Rain water Harvesting System.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Surveying and Levelling	T.P.Kanetkar and S.V.Kulkarni	Pune Vidyarthi Griha Prakashan, ISBN13-9782508807185
2	Surveying Volume 1	B.C.Punamia, Ashokkumar Jain Arunkumar Jain,	Laxmi Publication ISBN-13: 978-8170088530
3	Engineering Material	S.C.Rangwala	Charotar Publishing House ISBN13 9788185594965
4	Building Construction	S.C.Rangwala	Charotar Publishing House ISBN13-9789385039041
5	Building Construction	Shushilkumar	Standard Publications-Delhi, 2008 ISBN 13: 9788186308868
6	Building Construction	Bindra and Arora	Dhanpat Rai & Co. ISBN-13-9788189928803
7	Traffic Engineering	L.R.Kadiyali	KHANNA PUBLISHERS ISBN-13-9788174092205
8	Water Supply and Sanitary Engineering	G. S. Birdi and J. S. Birdi	Dhanpat Rai Publishing Company (p) Ltd ISBN-13- 9788187433798
9	Building Drawing with an Integrated Approach to	CM Kale, MG Shah, SY Patki	McGraw Hill Education ISBN-13-9780071077873

S. No.	Title of Book	Author	Publication with place, year and ISBN
	Built Environment		
10	A text book on Green Building	Guttila Yugantha Jaysinghe Shehani Sharadha Maheepala	LAP Lamberd Academic Publishing ISBN13-9786138389187
11	Green building Guidence :The ultimate guide for IGBC	Karthik Karuppu	Notion Press.com ISBN-13 978-1684667291

14. SOFTWARE/LEARNING WEBSITES

a) www.nptel.iitm.ac.in

b) www.surveyofindia .gov.in

c) www.igbc.in

d) www.grihaindia.org

15. PO-COMPETENCY-CO MAPPING

	Basics of Civil Engineering (Course Code: 4310001)						
	POs						
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design/ development of solutions	PO 4 Engineering Tools, Experimentation &Testing	PO 5 Engineering practices for society, sustainability & environment	PO 6 Project Management	PO 7 Life-long learning
Competency **To supervise the simple civil engineering tasks related to own branch's integrated tasks.**							
Course Outcomes CO a) Prepare drawing from field Survey data using Chain, Tape, Compass and /or Dumpy level.	3	2	-	3	-	2	1
CO b) Select suitable building material and construction technique.	3	-	-	2	1	-	1
CO c) Interpret various building drawing and Services.	2	-	-	-	-	-	-
CO d) Follow traffic control aids.	2	-	-	-	-	-	1
CO e) Use green and ecofriendly building technology	1	1	-	-	2	-	1

Legend: '**3'** for high, '**2**' for medium, **'1'** for low and **'-'** for no correlation of each CO with PO

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

S. No.	Name and Designation	Institute	Contact No.	Email
1	Shri Umesh.N.Pattani	Govt.Poly.,Ahmedabad	079-26301285	unpat1969@gmail.com
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3	Smt. Margee Milisia	Shri. K.J.Polytechnic, Bharuch	0264-2246402	margee.milisia@gmail.com
4	Shri Munaf Jagdu	Govt.Poly.,Ahmedabad	079-26301285	mjagadu@gmail.com
5	Shri Darshan V Patel	Govt.Poly., Himatnagar	02772-229285	darshan.2228@gmail.com

NITTTR Resource Persons

S. No.	Name and Designation	Department	Contact No.	Email
1	Prof. M.C.Paliwal, Associate Professor	Civil Engineering	0755-2661602	mcpaliwal@nitttrbpl.ac.in
2	Prof. A.K.Jain, Professor	Civil Engineering	0755-2661600	akjain@nitttrbpl.ac.in

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
Semester -II

Course Title: **Engineering Mathematics**
(Course Code: 4320002)

Diploma programmes in which this course is offered	Semester in which offered
Biomedical Engineering, Computer Engineering, Electrical Engineering, Electronics & Communication Engineering, Environment Engineering, Information Technology, Instrumentation & Control Engineering, Power Electronics Engineering, Computer Science & Engineering	Second

1. RATIONALE

This course is an extension of the course based on Mathematics of first semester namely Engineering Mathematics. The course is designed to inculcate its applications in relevant branch of engineering and technology using the techniques of Differentiation, Integration, Differential equations, Matrix theory and Complex numbers. Calculus is a branch of Mathematics that calculates how matter, particles and heavenly bodies actually move. With calculus, we can find how the changing conditions of a system affect us, we can control a system. Derivatives are useful to find maxima and minima of the function, velocity and acceleration and also useful for many engineering optimization problems. Definite integrals are a powerful tool to help us realize and model the world around us. Differential equations are widely applied to model natural phenomena, engineering systems and many other situations. Matrix analysis is a valuable tool used in nearly all the engineering sciences. Complex numbers, is one of the most elegant and interesting topics in mathematics. Complex numbers, their algebra and geometry has always been an important tool to crack thousands of the problems based on Pure and Applied Mathematics. In fact, some properties are easier in complex than real variables. DeMoivre's Theorem is one of the most important and useful theorems which connects complex numbers and trigonometry and also helpful for obtaining relationships between trigonometric functions of multiple angles. This course further develops the skills and understanding of mathematical concepts which underpin the investigative tools used for modeling and analysis in a wide range of applications in engineering.

2. COMPETENCY

The purpose of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Solve broad-based technology problems using the principles of engineering mathematics.**

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with the identified competency are to be developed in the student for the achievement of the following COs:

a) Demonstrate the ability to Crack engineering related problems based on Matrices.
b) Demonstrate the ability to solve engineering related problems based on applications of differentiation.
c) Demonstrate the ability to solve engineering related problems based on applications of integration.
d) Develop the ability to apply differential equations to significant applied problems.
e) Represent complex numbers algebraically and geometrically for solving engineering related problems.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
3	1	-	4	30*	70	-	-	100

(*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

***Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** -Practical; **C** – Credit, **CA** - Continuous Assessment; **ESE** -End Semester Examination.*

5. SUGGESTED PRACTICAL/TUTORIALS EXERCISES (During Tutorial Hours)

The following practical outcomes (PrOs)/Tutorials are the sub-components of the COs. *Some of the **PrOs/Tutorials** marked **'*'** (in approx. Hrs column) are compulsory, as they are crucial for that particular CO at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'.*

S. No.	Practical Outcomes (PrOs)/Tutorials	Unit No.	Approx. Hrs. required
1	Solve simple problems using the concept of algebraic operations of matrices.	I	1
2	Use the concept of adjoint of a matrix to find the inverse of a matrix.	I	1
3	Solve system of linear equations using matrices. Use suitable software to demonstrate the geometric meaning of solution of system of linear equations.	I	1
4	Solve examples related to 1st rule of derivative, working rules.	II	1
5	Solve examples of derivative related to Chain Rule, Implicit functions.	II	1
6	Solve the examples derivative of Parametric functions and second order derivative of simple functions.	II	1

S. No.	Practical Outcomes (PrOs)/Tutorials	Unit No.	Approx. Hrs. required
7	Use concept of derivative to solve the problems related to velocity, acceleration and Maxima-Minima of given simple functions. Use suitable graphical software to visualize the concept of maxima-minima of function.	II	1
8	Solve examples of integration using working rules, standard forms of integration and method of substitution.	III	1
9	Use the concept of integration by parts to solve related problems. Solve problems related to definite integral using properties.	III	1
10	Apply the concept of definite integration to find area and volume.	III	1
11	Solve problems of the order, degree of differential equations and Variable Separable method.	IV	1
12	Apply the concept of linear differential equations to solve given differential equation. Explain the various applications of differential equations in engineering and real life.	IV	1
13	Solve problems related to algebraic operations of complex numbers, conjugate, modulus and inverse of given complex number.	V	1
14	Solve problems related to polar form of a complex number, argument of complex number, De Moivre's Theorem and square root of a given complex number.	V	1
			14 Hrs.

Note

*i. More **Practical Exercises/Tutorials** can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list.*

*ii. The following are some **sample** 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises/Tutorials** of this course required which are embedded in the COs and ultimately the competency.*

S. No.	Sample Performance Indicators for the PrOs/Tutorials	Weightage in %
	Geometric Thinking: Comprehend geometric concepts to prove theorems by applying apt results to solve well defined Engineering problems.	
1	Solve problems based on derivative/integration and interpret geometrically the obtained solution.	40
2	Solve problems involving area and volume through integrals and interpret geometrically.	20
3	Perform basic operations of complex numbers geometrically.	30
4	Interpret the result and conclude.	10
Total		**100**

S. No.	Sample Performance Indicators for the PrOs/Tutorials	Weightage in %
S. No.	Sample Performance Indicators for the PrOs/Tutorials	Weightage in %
	Algebraic Thinking: Create, interpret, use, and analyze expressions, equations, and inequalities in a variety of contexts.	
1	Represent, interpret, and solve variable expressions, equations, and inequalities.	60
2	Write expressions in equivalent forms to solve problems.	20
3	Interpret the result and conclude.	20
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

This major equipment with broad specifications for the PrOs is a guide to procure them by the administrators to usher in uniformity of practicals in all institutions across the state.

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	Computer System & LCD Projector	3,5,6,10,12,13
2	Scientific Calculator (Display type: Natural Display Algebraic input logic: Natural V.P.A.M. Significant function: 10+2.	5,9,11

7. AFFECTIVE DOMAIN OUTCOMES

The following ***sample*** Affective Domain Outcomes (ADOs) are embedded in many of the above-mentioned COs and PrOs. More could be added to fulfill the development of this competency.

a) Work as a leader/a team member.
b) Follow ethical practices.
c) Realize importance of green Mathematics.

The ADOs are best developed through the laboratory/field-based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

i. 'Valuing Level' in 1st year
ii. 'Organization Level' in 2nd year.
iii. 'Characterization Level' in 3rd year.

8. UNDERPINNING THEORY

The major underpinning theory is given below based on the higher level UOs of *Revised Bloom's taxonomy* that are formulated for development of the COs and competency. If required, more such higher level UOs could be included by the course teacher
to focus on attainment of COs and competency.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
Unit – I **Matrices**	1a. Solve simple problems using the concept of algebraic operations of matrices. 1b. Apply the concept of adjoint of a matrix to find the inverse of a matrix. 1c. Investigate the solution of system of linear equations using matrices.	1.1 Concept of Matrix 1.2 Types of Matrices 1.3 Addition, Subtraction and multiplication by scalar of matrices 1.4 Product of two matrices 1.5 Adjoint and Inverse of a matrix of order 2X2 and 3X3. 1.6 Solution of Simultaneous linear equations of two variables.
Unit – II **Differentiation and its Applications**	2a. Apply the working rules and standard forms of differentiation to find the derivative of simple functions. 2b. Invoke the concept of Chain Rule to find the derivative of simple functions. 2c. Find the derivative of Implicit and Parametric functions. 2d. Apply the standard forms and rules of derivative to find the second order derivative of simple functions. 2e. Apply the concept and rules of derivative to solve the problems related to velocity, acceleration and Maxima-Minima of given simple functions.	2.1. Concept and Definition of Differentiation 2.2. Working rules: Sum, Product, Division 2.3. Chain Rule 2.4. Derivative of Implicit functions 2.5. Derivative of Parametric functions 2.6. Logarithmic Differentiation 2.7. Successive Differentiation up to second order 2.8. Applications: Velocity, Acceleration, Maxima & Minima of given simple functions.
Unit– III **Integration and its Applications**	3a. Apply the working rules and standard forms of integration to find the integral of simple functions. 3b. Find the integral of simple functions using the method of substitution and integration by parts. 3c. Solve problems related to definite integral using properties. 3d. Apply the rules and standard forms of integration to solve the problems related to area and volume.	3.1 Concept and Definition of Integration. 3.2 Working rules and Integral of standard functions. 3.3 Method of substitution. 3.4 Integration by parts. 3.5 Definite Integral and its properties. 3.6 Applications: Area and volume. (Simple problems)
Unit– IV	4a. Find the order and degree of differential equations.	4.1 Concept and Definition, Order and Degree of differential equation.

Differential Equations	4b. Solve Differential Equations related to Variable Separable method. 4c. Solve given linear differential equations	4.2 Solution of DE of first degree and first order by Variable Separable method. 4.3 Solution of linear Differential equation.
Unit– V **Complex Numbers**	5a. Convert the complex form into a+ib form using algebraic operations of complex numbers. 5b. Find conjugate, modulus and inverse of a given complex number. 5c. Convert the given complex number into polar form using the concept of modulus and argument. 5d. Use De Moivre's Theorem to simplify mathematical expressions. 5e. Find the square root of a given complex number and cube root of unity.	5.1 Concept of Complex number. 5.2 Algebra of Complex numbers. 5.3 Conjugate, Modulus and inverse of Complex numbers. 5.4 Argument and Polar form of a Complex number. 5.5 De Moivre's Theorem and related simple examples. 5.6 Square root of a Complex number and cube root of unity.

9. SUGGESTED SPECIFICATION TABLE FOR QUESTIONPAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Matrices	09	4	6	6	16
II	Differentiation and its Applications	10	4	6	6	16
III	Integration and its Applications	10	4	4	6	14
IV	Differential Equations	06	2	4	6	12
V	Complex Numbers	07	2	6	4	12
Total		**42**	**16**	**26**	**28**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*

Note*: This specification table provides general guidelines to assist student for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions assess the attainment of theUOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may varyslightly from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare

reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a) Identify engineering problems based on real world problems relevant to content of the unit and solve these problems in the light of free tutorials available on the internet.
b) Explore the opportunity to visit Science city, ISRO or nearby Science centers.
c) Explore the opportunity to visit Mathematics Lab Virtually.
d) Prepare charts showing formulas of differentiation.
e) Prepare charts showing formulas of integrations.
f) Use Graphing calculator to plot the graph of solutions explaining Engineering applications.
g) Communicate mathematical thinking coherently and clearly to other students, peers, and others.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b) Guide student(s) in undertaking micro-projects.
c) ***'L' in section No. 4***means different types of teaching methods that are to be employed by teachers to develop the outcomes.
d) About ***20% of the topics/sub-topics*** which are relatively simpler or descriptive in nature is to be given to the students for ***self-learning***, but to be assessedusing different assessment methods.
e) With respect to ***section No.10***, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
f) Explore the possibility for understanding the Biosphere through Mathematics.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based (group of 3 to 5). However, **in the fifth and sixth semesters**, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The duration of the microproject should be about **14**-**16** ***(fourteen to sixteen) student engagement hours*** during the course. The students ought to submit micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. This has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher:

a) **Charts:** Prepare the Charts of formulae for Matrix, Differentiation, Integration, Complex Numbers.
b) **Charts:** Compare last weather conditions with current weather to predict future weather through chart.
c) **Models:** Prepare the cardboard models based on real world applications of derivatives.

d) **Presentation/Seminar:** Prepare a presentation/seminar on any relevant topic of interdisciplinary nature.
e) **History of Mathematics**: Prepare a write up on the Historical path of Calculus.
f) **Solution of system of linear equations:** Form the system of linear equations up to three variables for the given electrical circuit using matrices and solve it.
g) **Maxima and Minima:** Find a real-world problem related to finding area/volume, form the corresponding function and find maxima/minima. For example, maximize the volume of a box made of a rectangle tin sheet by cutting off squares of same size from each corner and folding up.
h) Slope of tangent: Find the slope of tangent for the given curves at a given point using derivative and verify using suitable software.
i) Area/Volume: Find the area of a given closed regain or volume of revolution for a given function using integration and verify using suitable software.
j) Solution of Differential equation: Form differential equations for real-world problems and plot the graph using suitable software with geometrical interpretation.
k) Geometrical representation of complex numbers: Formulate the geometrical representation of addition, subtraction, multiplication, etc. and explain using suitable software.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Elementary Engineering Mathematics	B. S. Grewal	Khanna Publishers,15th Edition. ISBN: 978-81-7409-257-1
2	Engineering Mathematics (Third edition).	Croft, Anthony	Pearson Education, New Delhi, 2014. ISBN 978-81-317-2605-1
3	Calculus and Its Applications	Marvin L. Bittinger David J. Ellenbogen Scott A. Surgent	Addison-Wesley 10th Edition ISBN-13: 978-0-321-69433-1
4	Calculus and Analytic Geometry	G. B. Thomas, R. L. Finney	Addison Wesley, 9th Edition, 1995. ISBN 978-8174906168
5	Understanding Engineering Mathematics	John Bird	Routledge; 1st edition ISBN 978-0415662840
6	Advanced Engineering Mathematics	Krezig, Ervin	Wiley Publ., New Delhi,2014, ISBN: 978-0-470-45836-5

14. SOFTWARE/LEARNING WEBSITES

a) https://www.youtube.com/channel/UCLJVrQyPYsseCf78QWCDsvA/featured (YouTube Channel of DTEGUJ)
b) https://www.geogebra.org/?lang=en

c) https://nios.ac.in/online-course-material/sr-secondary-courses/mathematics-(311).aspx
d) www.dplot.com/ - DPlot
e) www.wolfram.com/mathematica/
f) www.easycalculation.com
g) www.scilab.org/ - SCI Lab
h) https://ncert.nic.in/textbook.php (NCERT Textbooks of Mathematics 11th and 12th Science)
i) https://www.desmos.com/

15. PO-COMPETENCY-CO MAPPING

Semester II	Engineering Mathematics (Course Code:4320002)						
	POs						
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design/ development of solutions	PO 4 Engineering Tools, Experimentation &Testing	PO 5 Engineering practices for society, sustainability & environment	PO 6 Project Management	PO 7 Life-long learning
Competency .	Solve broad-based technology problems using the principles of Engineering mathematics.						
Course Outcomes CO a) Demonstrate the ability to Crack engineering related problems based on Matrices	3	1	-	-	-	-	1
CO b) Demonstrate the ability to solve engineering related problems based on applications of differentiation	3	1	1	-	-	-	1
CO c) Demonstrate the ability to solve engineering related problems based on applications of integration	3	1	1	-	-	-	-
CO d)Develop the ability to apply differential equations to	3	1	1	-	-	-	1

significant applied problems							
CO e) Represent complex numbers algebraically and geometrically for solving engineering related problems	3	1	-	-	-	-	-

*Legend: '**3**' for high, '**2**' for medium, **'1'** for low and **'-'** for no correlation of each CO with PO.*

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

S. No.	Name and Designation	Institute	Contact No.	Email
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NITTTR Resource Persons

S. No.	Name and Designation	Department	Contact No.	Email
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GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
Semester-II

Course Title: A. C. Circuits
(Course Code: 4320901)

Diploma programmer in which this course is offered	Semester in which offered
Electrical Engineering	Second

1. RATIONALE

Most of electrical power generation, transmission, distribution and utilization are in the form of alternating current. Therefore it is essential for students of diploma electrical engineering to know fundamental concepts and principles of AC circuits to solve electrical circuits. This course is not only a prerequisite to learn the advanced electrical courses but also diploma students undertaking this course are expected to apply the principle of ac circuits to troubleshoot electrical circuits in industries/power system. This is one of the most important core engineering courses for electrical technocrats and hence students should try to develop mastery over fundamental concepts and principle of AC Circuits for effective working as an electrical engineer.

2. COMPETENCY

The purpose of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Apply the principles of AC circuits to maintain electrical system.**

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with the identified competency are to be developed in the student for the achievement of the following COs:

- ***a)*** Interpret various terminologies, waveform and vector representation of alternating quantities.
- ***b)*** Apply principles of A.C. series circuits to solve electrical circuits.
- ***c)*** Apply principles of A.C. parallel circuits to solve electrical circuits.
- ***d)*** Apply principles of three phase circuits to solve electrical circuits.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
3	1	2	5	30*	70	25	25	150

(*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be

taken during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

***Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **CA** - Continuous Assessment; **ESE** - End Semester Examination.*

5. SUGGESTED PRACTICAL EXERCISES

The following practical outcomes (PrOs) are the sub-components of the Course Outcomes (Cos). Some of the **PrOs** marked **'*'** are compulsory, as they are crucial for that particular CO at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'.

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Demonstrate waveforms of alternating quantities using CRO and function generator.	I	2
2	Use CRO to measure Peak value, RMS value, Time period and frequency of alternating quantity.	I	2*
3	Measure voltage, current, and power through pure resistor.	II	2
4	Measure inductance and internal resistance of choke coil.	II	2
5	Measure voltage, current, power and power factor in an RL A.C. series circuit.	II	4*
6	Measure voltage, current, power and power factor in an RC A.C. series circuit.	II	2*
7	Measure voltage, current, power and power factor in an RLC A.C. series circuit.	II	4
8	Measure resonance frequency and resonant impedance in RLC series circuit.	II	2
9	Measure voltage, current, power and power factor in an RL A.C. parallel circuit.	III	4*
10	Measure voltage, current, power and power factor in an RC A.C. parallel circuit.	III	2*
11	Measure voltage, current, power and power factor in an RLC A.C. parallel circuit.	III	4
12	Verify line & phase voltage and line & phase current relation for three phase star connection.	IV	2*
13	Verify line & phase voltage and line & phase current relation for three phase delta connection.	IV	2*
14	Test relation between power consumption in three phase star and delta connected load.	IV	2
	Minimum 10 Practical Exercises		28

Note

i. *More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list.*
ii. *The following are some **sample** 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises**of this course required which are embedded in the COs and ultimately the competency.*

Sr. No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Prepare experimental setup	20
2	Operate the equipment setup or circuit	20
3	Follow safe practices.	10
4	Record observations correctly	20
5	Interpret the result and conclude	30
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

This major equipment with broad specifications for the PrOs is a guide to procure them by the administrators to user in uniformity of practical's in all institutions across the state.

Sr.No.	Equipment Name with Broad Specifications	PrO. No.
1	Single phase variac: 10A, Output 0-270V AC for Input of 230V 50Hz AC	3 to 11
2	Single phase choke coil :230V, 50Hz, 2KVAR	4,5,7,9,11
3	Single phase capacitor bank: 230V, 50Hz, 2KVAR	6,7,10,11
4	Three phase variac : 20A, Output 0-415V for Input of 415V 50Hz AC	12 to 14
4	Single phase resistive load bank : 230V, 2KWOR Lamp loads	3 to 11
5.	Three phase lamp loads suitable for making three phase star and delta connection	12, 13
6.	CRO	1,2
7.	Function Generator	1,2
8.	Ammeter:0-1A/0-5A/0-10A	3 to 14
9.	Voltmeter:0-50V/0-150V/0-300V/0-500V	3 to 14

Sr.No.	Equipment Name with Broad Specifications	PrO. No.
10.	Wattmeter:0-1000W(5/10A,300/600V)	3,5,6,7 9,10,11,14

7. AFFECTIVE DOMAIN OUTCOMES

The following ***sample*** Affective Domain Outcomes (ADOs) are embedded in many of the above-mentioned COs and PrOs. More could be added to fulfill the development of this course competency.

a) Work as a leader/a team member(while doing a micro-project)
b) Follow safety practices while using AC supply and electrical equipments.
c) Work as a group member (while performing experiments and taking readings)
d) Practice environmental friendly methods and processes. (Environmentrelated)

The ADOs are best developed through the laboratory/field based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

i. 'Valuing Level' in 1st year
ii. 'Organization Level' in 2nd year.
iii. 'Characterization Level' in 3rd year.

8. UNDERPINNING THEORY

The major underpinning theory is given below based on the higher level UOs of *Revised Bloom's taxonomy* that are formulated for development of the COs and competency. If required, more such UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
Unit 1 A C Fundamentals	1a.Explain generation of alternating EMF. 1b.Define various terms regarding alternating quantity. 1c.Derive equation for RMS and average value of sinusoidal waveform. 1d.Interpret phase difference between ac quantities with necessary wave-forms 1e.Explain the vector representation and mathematical operations of alternating vector quantities	1.1 Principle of generation of alternating voltage 1.2Cycle, Time period, Frequency, Amplitude, Instantaneous value, Average value, R.M.S. value, Form factor, Peak Factor Phase and Phase difference 1.3 Vector representation of alternating quantities 1.4Addition,subtraction, multiplication and division of alternating quantity 1.5Numerical based on AC fundamentals

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
	1f. Solve numerical based on AC fundamentals	
Unit-II Single Phase AC Series Circuits	2a Compare the behavior of AC voltage, current, power and power factor through pure resistance, pure inductance and pure capacitance with waveforms and vector diagrams. 2b.Compare behavior of AC voltage, current, power and power factor through RL, RC and RLC series circuit with waveforms and vector diagrams. 2c.Explain resonance in RLC series circuit with graphical representation 2d.Explain the concept of active power, reactive power and power factor with power triangle 2e.Explain the concept of Lagging, leading and unity power factor with waveform and vector diagram 2f.Explain Causes & disadvantages of low power factor and advantages of improving power factor. 2g. Solve numerical based on single phase AC series and circuits and series resonance.	2.1 Waveform, vector diagram and expression of voltage, current and power in pure: Resistance, Inductance, Capacitance 2.2 AC through RL, RC, RLC series circuits. 2.3 Resonant condition and frequency in RLC series circuit 2.4 Active, reactive and apparent power with examples. 2.5 lagging, leading and unity power factor 2.6 Causes & disadvantages of low power factor and advantages of improvement in power factor 2.7 Numerical based on AC series circuits and series resonance
Unit-III Single Phase AC Parallel Circuits	3a.Decribe various methods of solving AC parallel circuits. 3b.Explain resonance in RLC parallel circuit. 3c.Solve numerical based on single phase AC parallel circuits and parallel resonance	3.1 Phasor (Vector) method for solving AC parallel circuits. 3.2 Admittance method for solving AC parallel circuits. 3.3 Complex algebra method for solving AC parallel circuits. 3.3 Resonant frequency and resonance condition in parallel AC circuits 3.4 Numerical based on AC parallel

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
		circuits and parallel resonance.
Unit-IV Three Phase Circuits	4a.Differentiate between single and three phase circuits. 4b.Explain generation of three phase alternating voltage. 4c.Distinguish between line and phase voltage, line and phase currents in 3- phase AC circuits 4d.Describe three phase star and delta connection with phasor diagrams 4e.Solve numerical based on three phase AC circuits	4.1 Comparison between Single and three phase systems 4.2 Principle of generation of three phase alternating voltage. 4.3 Line and phase voltage, line and phase current 4.4 Three-phase star connection 4.5 Three phase delta connection 4.6 Numerical based on three phase circuits

9. SUGGESTED SPECIFICATION TABLE FOR QUESTIONPAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	A C Fundamentals	12	6	6	6	18
II	Single phase AC Series Circuits	14	8	8	8	24
III	Single phase AC Parallel Circuits	08	4	6	4	14
IV	Three Phase Circuits	08	4	5	5	14
Total		42	22	25	23	70

Legends: *R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*

Note*: This specification table provides general guidelines to assist students for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions to assess the attainment of the UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may slightly vary from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course. Students should perform following activities in group (or individual) and prepare reports of about 5 pages for each activity. They should also collect/record physical evidences for their (student's) portfolio which may be useful for their placement interviews:

a) Present seminar on various topics from course content
b) Solve numerical given in tutorials.

The tutorials can be given unit wise. The Student should be encouraged to get their tutorial assessed by the concerned teacher progressively during the term and at the end of the term the whole work should be submitted to the concerned teacher.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b) Guide student(s) in undertaking micro-projects.
c) ***'L' in section No. 4***means different types of teaching methods that are to be employed by teachers to develop the outcomes.
d) Show animation/ video related to course content.
e) Tutorial hours should be used to develop the ability in students to solve numerical related to AC fundamentals and AC circuits.
f) Co-relating the importance of content of this course with other courses/ practical applications. (e.g. importance of a content in course or whole course related to A.C. Machines, Transmission and Distribution of Electrical Power, Energy Conservation Switchgear and Protection etc. and in practical industrial &/ domestic applications.
g) Students learn Engineering Mathematics as a separate course in 2nd Semester and knowledge of some topics /concepts of this course is necessary and extremely helpful to learn various topics of A.C. Circuits. So, students should be encouraged at the beginning of the term and periodically during term by the concerned faculties of A.C. Circuits to learn Engineering Mathematics with more interest and also co-relate the content of AC Circuits with Mathematics and Engineering Mathematics.
h) Introduce E-waste recycling technology among the students.
i) Guide students on how to address issues on environment and sustainability

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-projects are group-based (group of 3 to 5). However, **in the fifth and sixth semesters**, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The duration of the micro project should be about **14-16** ***(fourteen to sixteen) student engagement hours*** during the course. The students ought to submit micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. This has to match the competency and the COs.Similar micro-projects could be added by the concerned course teacher:

a) Build model to demonstrate generation of alternating EMF.
b) Build model of various types of AC Series circuits.
c) Build model of various types AC Parallel circuits.
d) Build lamp loads in three phase star connection.
e) Build lamp Loads in three phase delta connection.

f) Prepare chart of generation of alternating voltage.
g) Prepare chart for phase difference between alternating quantities
h) Prepare chart of waveforms and vector diagram of voltage, current and power in purely resistive, inductive and capacitive circuits.
i) Prepare chart of graphical representation of series and parallel resonance
j) Prepare chart of waveforms and vector diagram of three phase voltage.
k) Prepare chart for three phase star and delta connection with current and voltage relations.

13. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1	A text book of Electrical Technology Volume-I (Basic Electrical Engineering)	B. L. Theraja & A.K. Theraja	S. Chand and Co., New Delhi, 23 edition or Latest edition (ISBN : 9788121924405)
2	Principles of Electrical Engineering	B. R. Gupta	S. K. Kataria & Sons, New Delhi, Latest edition (ISBN-9788121901031)
3	Fundamentals of Electrical Engineering	Tarlok Singh	S. K. Katariav & Sons, New Delhi, Latest edition(ISBN: 9789350140680)
4	Basic Electrical Engineering	K. Uma Rao and A. Jayalakshmi	Pearson Education, New Delhi Latest Edition(ISBN: 9789385909283)
5	Basic Electrical and Electronics Engineering	Ravish. R. Singh	Tata McGraw Hill EducationPvt.Ltd., New Delhi 2018 edition or Latest edition (ISBN-978007026092)
6	Fundamentals of Electrical Engineering and Electronics	S.K. Sahdev	Dhanpatrai & Co., New Delhi Latest edition(ISBN: 978877002027)
7	Principles of Electrical Engineering and Electronics	V.K. Mehta Rohit Mehta	S. Chand and Co., New Delhi (ISBN : 9789352837199)
8	Elements of Electrical Engineering	U.A. Patel	Atul Prakashan, Ahmedabad 2010 edition or latest edition

14. SOFTWARE/LEARNING WEBSITES

WEBSITES

- https://nptel.ac.in/courses/108/105/108105112/
- https://nptel.ac.in/courses/108/105/108105053/
- https://lectures.gtu.ac.in/(related to course content)
- https://circuitglobe.com/

- https://www.*electronics*-tutorials.ws/accircuits
- https://www.electrical4u.com/electrical-engineering-articles/basic-electrical/
- https://www.electricaltechnology.org/
- www.vlab.co.in
- www.khanacademy.org
- https://ndl.iitkgp.ac.

15. PO-COMPETENCY-CO MAPPING:

Semester I	A C Circuits (Course Code:4320901)						
	POs						
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design/ development of solution	PO4 Engineerig Tools, Experimen-tation&Testing	PO 5 Engineering practices for society, sustainability & environment	PO 6 Project Manage-ment	PO 7 Life-long learning
Competency	**Apply the principles of AC circuits to maintain in electrical system.**						
Course Outcomes CO1 Interpret various terminologies, waveform and vector representation of alternating quantities.	3	3	-	2	-	-	-
CO2 Apply principles of A.C. series circuits to solve electrical circuits.	3	3	2	2	-	-	-
CO3 Apply principles of A.C. parallel circuits to solve electrical circuits	3	3	2	2	-	-	-
CO4 Apply principles of three phase circuits to solve electrical circuits.	3	3	2	2	-	-	-

*Legend: '**3**' for high, '**2**' for medium, '**1**' for low and '**-**' for no correlation of each CO with PO.*

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

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GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
Semester-III

Course Title: Summer Internship-I
(Course Code: 4330001)

Diploma programme in which this course is offered	Semester in which offered
All Branches of Diploma Engineering(Except Automobile, Bio Medical, ICT, Power)	Third

1. RATIONALE

Idea of Embedded Internships- AICTE has made 7-10 weeks summer internships mandatory in the new curriculum which will equip the students with practical understanding and training about industry practices in a suitable industry or organization. To make education holistic, sports, physical activities, values and ethics have been embedded in the curriculum.

We must agree that all Branches of Diploma Engineering are changing rapidly. New technologies are adding fast which effects can be seen in our society. Summer internship is a good option by which students to get flavor of such emerging technology and familiar with industry environment to identify scope and focus of their career development opportunities. Main objective of summer internship is hand-on practice to expose students for thinking about professional career by observing, understanding working mechanism of ongoing work of industry and to obtain various types of skills throughout internship program.

This two week mandatory internship is to equip the students with practical knowledge and provide them exposure to real time industrial environments. Further, in these internships, the option is provided to do internship in Government Agencies/ skill centers/ social sector/ Govt. initiated social schemes/ NGOs etc. The duration of internship will be two weeks. It will be after completion of 2nd Semester and before the commencement of Semester 3rd. Any options from following can be chosen by the students:

1. **Offline internship in industry** - Student is supposed to produce joining letter for starting and relieving letter once the internship is over in case of Offline internship in any industry.
2. **Online internships –** Student can select from any of approved /supported / recommended by the All India Council of Technical education for Internship (like Internshala/ NEAT/ Gujarat Knowledge Society Initiative etc.) or Approved by the state government or University approved
3. **A Mini Project** - On some suitable topic related to respective branch. It can be small fabrication / experimental results/ simulations/ Application development / Design and / or Analysis of System(s) etc. depending on the branch of the student. Preferably a single student should carry out a mini-project.

2. COMPETENCY

The purpose of this course is to help the student to attain flavor of the following industry identified competency through summer internship experiences:

- **Develop multiple types of skills such as planning, communication, collaboration, decision making / Problem solving and management skills along with selected technical knowledge.**

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with the identified competency are to be developed in the student for the achievement of the following COs:

a) Learn and adopt the engineer's role and responsibilities with ethics.
b) Get exposure to the industrial environment for professional activities.
c) Get possible opportunities to learn, understand and sharpen the technical skills required for technical advancement.
d) Develop managerial skills required for professional career.
e) Attain skill for writing technical report and prepare poster for presentation.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
0	0	0	1	0	0	25	25	50

1. **Offline internship in industry:** CA will be carried out based on submitted progress card by Industry resource person and ESE / Assessment will be carried out by institute resources person.
2. **Online internships:** CA will be carried out based on submitted certificate and ESE/ Assessment will be carried out by institute resources person.
3. **A Mini Project:** CA will be carried out based on project work by institute resources person.

Legends: ***L****-Lecture;* ***T*** *– Tutorial/Teacher Guided Theory Practice;* ***P*** *-Practical;* ***C*** *– Credit,* ***CA*** *- Continuous Assessment;* ***ESE*** *-End Semester Examination.*

List of Documents to be prepared for Submission:

- Detail report duly signed and approved by the internal/external mentor
- Presentation softcopy approved by the internal/external mentor
- Poster of summer internship activities approved by the internal/external mentor.

Sample forms for Registration and Evaluation of Summer Internship-I –SI-I are given below:

1) Both forms are mandatory to be filled at the commencement and completion of SI respectively.
2) It is mandatory to file and map SI-I Registration and Evaluation with respective forms of SI-II (Later in Semester 5) so that students get enough exposure of industry / technology. (Mapping doesn't mean same industry/ company/ project-it can be independent/ different also.)
3) Mapping will be done to ease CA and ESE Evaluations.
4) A Seminar / Webinar can be arranged so that students coming from different industry / institute / project background can share experiences and learnings to their peers / all students of the same department.
5) Attached formats for Registration, Completion and Evaluation are suggestive. But, adhering to these formats is anticipated.

Summer Internship-I Registration Form

Note: Students needs to submit this registration form after finalizing mode of internship.

Student Details												
Enrollment Number												
Student Name												
Student Details	Mobile Number :											
	Email Address:											
Branch												
Code of the Institute	Name of the Institute											
Mentor Details (Institute)	Name:											
	Designation:											
	Mobile No:											
	Email Address:											
Industry Details	Name:											
	Address:											
	Email:											
	Phone:											
	Website:											
Mentor Details (Industry)	Name:											
	Designation:											
	Mobile No:											
	Email Address											
Mode of Internship Carried Out	Online / Offline/ Mini Project											
Title of the Project/ Internship carried out												
Nature of Work Carried Out	Web Design / Application development (Web / Mobile), Experimental results/ simulations/ Analysis of System(s) etc… Other please Specify_____											

Student Signature Faculty Signature

Summer Internship-I -Suggested Letter for Completion

[Company or Institute letter head]

No: Date

TO WHOM SO EVER IT MAY CONCERN

This is to certify that, Mr. /Mrs._____

Enrollment No._____ Student of_____

Has successfully completed a two week Internship in the field of_____

From the date:_____ to date:_____.

[90% Attendance is mandatory for completion of Internship]

During the period of his/her summer internship program with us, He / She were exposed to following different processes and were found sincere and hardworking.

1. _____

2. _____

3. _____

4._____

Mentor Signature **Head of Department**

Stamp Stamp

Summer Internship-I -Evaluation Rubrics for Institute

Evaluation Rubrics (Institute)

Enrollment No: _____ Branch: _____

Name of the Students: _____

Date of Evaluation: _____

Internal Evaluation – 25 Marks PA(I) **(To be carried out by the mentor in consultation with Industry) Minimum Passing Marks: 13**					
Parameter	**Excellent**	**Good**	**Average**	**Not up the level of Satisfaction**	**Obtained Marks**
Mark range	**4-5**	**3-4**	**2-3**	**Below 2**	
Knowledge acquisition in specific domain. **5 marks**					
Skill and attitude attainment in specific domain. **5 marks**					
Feedback and suggestions given are incorporated? **5 marks**					
Quality of the prepared report and poster. **5 marks**					
Quality of the presentation. **5 marks**					
Total Marks Obtained Out of 25 PA(I)					

Signature: _____ Institute Resource Examiner Name: _____

Suggested Evaluation Rubrics for Industry

Evaluation Rubrics (Industry)

Enrollment No: _____ Branch: _____

Name of the Students: _____

Date of Evaluation: _____

External Evaluation – 25 Marks ESE(V) **(To be carried out by the Industry Supervisor) Minimum Passing Marks: 13**					
Parameter	**Excellent**	**Good**	**Average**	**Not up the level of Satisfaction**	Obtained Marks
Mark range	**4-5**	**3-4**	**2-3**	**Below 2**	
Student regularity during the Internship period and proactive ness/responsiveness towards the given tasks (**5 Marks)**					
Work Plan, Execution and quality of work in forms of Outcome achieved (**5 Marks)**					
Engineering Tools and Techniques (**5 Marks)**					
Quality of poster design and presentation (**5 Marks)**					
Quality of the report and Skill **(5 Marks)**					
Total Marks Obtained Out of 25 ESE(V)					

Signature: _____ Industry resource/ Examiner Name: _____

Common Note:

1) For Summer Internship / Projects / Seminar etc. Evaluation is based on work done, quality of report, performance in viva-voce, presentation etc. The internal / external assessment is based on the student's performance in viva-voce /work record respectively.
2) In case Industry Supervisor is not available / Institute Mentor/ Faculty can fill up both.

5. AFFECTIVE DOMAIN OUTCOMES

The following affective Domain Outcomes (ADOs) are embedded in many of the above mentioned COs. More could be added to fulfill the development of this course competency.

a) Work as a leader/a team member as role of Engineer.
b) Practice environmentally friendly methods and processes.
Follow safety precautions and ethical practices.

6. SUGGESTED STUDENT ACTIVITIES

Following are the suggested student-related curricular, **co-curricular** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should perform following activities and prepare reports and give presentation in front of students and faculty members. They should also collect/record physical evidences for their (student's) portfolio which may be useful for their placement interviews:

a) Perform various tasks given by industry resources person during offline internship.
b) Perform various tasks given during online internship.
c) Perform various task required to complete mini project work under guidance of faculty member.
d) Summer Internship program Interns are required to give a presentation before review committee consisting of a group of academic staff members.
e) The review committee gives feedback and suggests possible improvements in the work.
f) At the end of the program all the Summer Internship program Interns make a poster presentation of the work carried out. The poster presentation is open to the public. It is also evaluated by faculty members.
g) A completion certificate will be issued to all Summer Internship program Interns only after the completion of internship tenure.

7. SOFTWARE / LEARNING WEBSITES

An internship is a short term work program usually offered to students by companies and institutes who require staff for assistance at junior levels. Thus for the students undergoing internship a professional learning experience is provided to benefit them in their skills as well as career. It will brush existing skills and provide exposure to new skills. Generally it is provided ay entry level in the industry.

Here is a suggestive list for reference only.

- https://www.internshala.com
- https://swayam.gov.in
- https://nptel.ac.in/
- https://neat.aicte-india.org/
- https://www.edx.org/
- https://www.coursera.org/
- https://www.udemy.com/
- https://www.linkedIn.com
- https://www.stumags.com
- https://www.letsintern.com
- https://www.internship.com
- https://www.glassdoor.com

8. PO-COMPETENCY-CO MAPPING

Semester III	Summer Internship (Course Code:4330001)						
	POs						
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design/ development of solutions	PO 4 Engineering Tools, Experimentation & Testing	PO 5 Engineering practices for society, sustainability & environment	PO 6 Project Management	PO 7 Life-long learning
Competency	**Use principles of basic electronics to maintain various electronics circuits And equipment**						
CO1) Learn and adopt the engineer's role and responsibilities with ethics.	2	1	1	1	1	1	1
CO2) Get exposure to the industrial environment for professional activities.	1	1	1	1	1	1	1
CO3) Get possible opportunities to learn understand and sharpen the technical skills required for technical advancement.	2	1	2	2	1	1	1
CO4) Develop managerial skills required for professional career.	1	1	2	1	1	1	1
CO5) Attain skill for writing technical report and prepare poster for presentation.	1	1	-	1	1	1	1

*Legend: '**3**' for high, '**2**' for medium, '**1**' for low and '**-**' for no correlation of each CO with PO.*

9. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Sr. No.	Name and Designation	Institute	Contact No.	Email
1	Jiger P. Acharya	GP, Ahmedabad	9429462026	jigeracharya@gmail.com
2	Alpeshkumar R. Thaker	GP, Ahmedabad	9879709675	alpeshrthaker@gmail.com
3	Umang D. Shah	GP, Ahmedabad	9427686364	umang.shah111gp@gmail

BoS Resource Persons

Sr. No.	Name and Designation	Institute	Contact No.	Email
1	Shri U. V. Buch- BoS Member and Subject in-charge (EC)	G P Ahmedabad	9825346992	uvbuch@gmail.com

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
Semester-III

Course Title: D. C. Machines and Transformer
(Course Code: 4330901)

Diploma programmer in which this course is offered	Semester in which offered
Electrical Engineering	Third

1. RATIONALE

The electrical engineering applications in industries use small and large electric motors in some crucial application systems. This course will enable the students to develop skills to select, operate, and maintain various types of D.C. machines and transformers. Practical features of the course will make the students capable of performing various tests on these machines. This course will also make the students familiar with the working and applications of Single-phase transformer and D.C. Machines.

2. COMPETENCY

The purpose of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Maintain various types of D.C. machines and single-phase transformers safely.**

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with the identified competency are to be developed in the student for the achievement of the following COs:

a) Distinguish types of D.C. Generators.
b) Distinguish types of D.C. Motors.
c) Interpret constructional and operational features of different types of single-phase transformers.
d) Undertake performance test of single-phase transformers.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
4	0	4	6	30*	70	50	50	200

(*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

***Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **CA** - Continuous Assessment; **ESE** - End Semester Examination.*

5. SUGGESTED PRACTICAL EXERCISES

The following practical outcomes (PrOs) are the sub-components of the Course Outcomes (Cos). Some of the **PrOs** marked **'*'** are compulsory, as they are crucial for that particular CO at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'.

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Identify various parts of D.C. machine	I	2
2	Perform test on D.C. shunt generator to find out Magnetization characteristic.	I	4*
3	Maintain constant voltage of D.C. generator at different load conditions	I	4*
4	Test the performance of a separately excited D.C. shunt generator	I	4
5	Test the performance of D.C. series generator	I	4
6	Test the performance of D.C. compound machine	I	4
7	Connect three point and four-point starters for D.C. motor.	II	4
8	Control the speed of D.C. series motor.	II	4
9	Control the speed of D.C. shunt motor by armature and field control.	II	4*
10	Perform Hopkinson test on D.C. Machine.	II	6
11	Perform field test on D.C. Series Motor.	II	6
12	Perform Brake test on D.C. Motor.	II	6
13	Perform Swinburne's test of D.C. machine.	II	6
14	Reverse direction of various D.C. Motors.	II	4*
15	Study construction of BLD.C. motor and it's parts.	II	2*
16	Perform parallel operation on two single phase transformers.	IV	4*
17	Perform direct load test on single phase transformer.	IV	4*
18	Perform Sumpner's test on single phase transformer.	IV	6
19	Perform polarity test on single phase transformer.	IV	4*
20	Perform open circuit and short circuit test of single-phase transformer.	IV	6*
21	Troubleshoot of D.C. Machine.	II	4
22	Troubleshoot of single-phase transformer.	III	4
			56 Hrs

Note

i. *More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list.*
ii. *The following are some **sample** 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency.*

Sr. No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Prepare experimental setup	20
2	Operate the equipment setup or circuit	20
3	Follow safe practices.	20
4	Record observations correctly	20
5	Interpret the result and conclude	20
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

This major equipment with broad specifications for the PrOs is a guide to procure them by the administrators to user in uniformity of practical's in all institutions across the state.

Sr.No.	Equipment Name with Broad Specifications	PrO. No.
1	D.C. supply, 250 Volt, 25 Amp.	2 to 14
2	D.C. series, shunt, and compound machine (up to 230 V, 5 HP)	2 to 14
3	Single-phase transformer (1-2 KVA, 230/115 V) at least 02 nos.	16 to 20
4	Single-phase auto transformer- 0 to 270 V, 15 Amp.	16 to 20
5	Cut section of D.C. Machine	1
6	Lamp load (10-20 A)	3,4,5,6,17

7. AFFECTIVE DOMAIN OUTCOMES

The following ***sample*** Affective Domain Outcomes (ADOs) are embedded in many of the above-mentioned COs and PrOs. More could be added to fulfill the development of this course competency.

a) Work as a leader/a team member (while doing a micro-project)
b) Follow safety practices while using D.C. and AC supply and electrical equipment.
c) Work as a group member (while performing experiments and taking readings)
d) Practice environmentally friendly methods and processes. (Environment related)

The ADOs are best developed through the laboratory/field-based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

i. 'Valuing Level' in 1st year
ii. 'Organization Level' in 2nd year.
iii. 'Characterization Level' in 3rd year.

8. UNDERPINNING THEORY

The major underpinning theory is given below based on the higher level UOs of *Revised Bloom's taxonomy* that are formulated for development of the COs and competency. If required, more such UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
Unit 1 D.C. Generator	1a. Describe material used for various parts of D.C. machine & its function and working of DC generator. 1b. Derive emf equation of D.C. generator. 1c. Distinguish between lap and wave winding. 1d. Differentiate between shunt, series and compound generator. 1e. Compare performance characteristic of different types of D.C. Generators. 1f. Explain armature reaction and commutation 1g. Solve numerical based on emf equation, voltage regulation and efficiency of DC generator.	1.1 Energy conversion principle. 1.2 Construction of D.C. machine. 1.3 Working principle of D.C. generator (single loop generator, action of commutator) 1.4 EMF equation of D.C. generator. 1.5 Armature winding terminology and its types. 1.6 Dummy coils, Equalizer rings. 1.7 Types of D.C. generators. 1.8 Characteristics of various types of D.C. generators. 1.9 Armature reaction and Commutation. 1.10 Power stage and Losses in D.C. machines 1.11 Voltage regulation, Efficiency and condition for maximum efficiency. 1.12 Applications of various types of D.C. generator.
Unit-II D.C. Motors	2a. Explain working of D.C. motor 2b. Derive torque equation of D.C. motor. 2c. Justify the need of D.C. motor starter 2d. Explain working of D.C. motor starter 2e. Classify different types of D.C. motors 2f. Compare performance of different types of D.C. motors 2g. Explain the speed control of D.C. motor 2h. Calculate the losses and	2.1 Working principle of D.C. Motor. 2.2 Significance of the Back EMF. 2.3 Torque in D.C. Motor (armature torque, shaft torque, BHP) and Numerical. 2.4 D.C. motor starter (necessity, two-point, three point and four-point starter) 2.5 Types of D.C. motors and its characteristics and Numerical. 2.6 Speed control of D.C. motor 2.7 Electronic speed control, reversal of rotation.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
	efficiency 2i. State the need of Brake test, Swinburne's test and field test. 2j. List the applications of various types of D.C. motors 2k. Explain working of BLD.C. Motor.	2.8 Power stages, Losses, and Efficiency of D.C. Motor and Numerical. 2.9 Testing of D.C. Machines. (Brake test, Swinburne's test, Hopkinson test, field test) 2.10 Applications of D.C. Motors. 2.11 Specifications of D.C. Machines. 2.12 Brushless D.C. Motor (construction and working)
Unit-III Single Phase Transformer	3a. Explain the working of a single-phase transformer with sketches 3b. Derive EMF equation of transformer and transformation ratio 3c. Differentiate between core and shell type transformer with sketches. 3d. State the materials used for the different parts of the transformer 3eExplain the performance of the transformer on no load, resistive, inductive, and capacitive loads with phasor diagrams 3f. Explain various losses in transformer. 3g. Derive expression for efficiency and the condition for maximum efficiency of a single-phase transformer 3h. Describe working of an autotransformer with sketches.	3.1 Construction and working principle of Transformer. 3.2 Material used for core, winding and insulations) 3.3 EMF equation and transformation ratio and Numerical. 3.4 No load and on load phasor diagram. 3.5 Equivalent circuit of transformer (equivalent resistance and reactance) and Numerical. 3.6 Losses of transformer, separation of core loss components and Numerical. 3.7 Efficiency of single-phase transformer and condition for maximum efficiency and Numerical. 3.8 Voltage regulation, application of transformer. 3.9 Auto transformer (construction and working) 3.10Saving of copper in auto transformer.
Unit-IV Testing of single-phase transformer	4a. State the need for conducting different types of tests on single phase transformers. 4b. Describe the steps for conducting various test of single phase transformer. 4c. Describe the need and conditions for parallel operation of transformers	4.1 Direct load test 4.2 OC and SC test 4.3 Back-to-Back test 4.4 Need of parallel operation 4.5 Conditions of parallel operation in single phase transformer. 4.6 Parallel operation and load sharing of single-phase transformer

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
		4.7 Numerical.

9. SUGGESTED SPECIFICATION TABLE FOR QUESTIONPAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	D.C. Generator	16	6	8	6	20
II	D.C. Motor	16	6	8	6	20
III	Single-phase Transformer	16	6	8	6	20
IV	Testing of Single-phase Transformer	08	2	4	4	10
Total		**56**	**20**	**28**	**22**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*
Note*: This specification table provides general guidelines to assist students for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions to assess the attainment of the UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may slightly vary from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course. Students should perform following activities in group (or individual) and prepare reports of about 5 pages for each activity. They should also collect/record physical evidence for their (student's) portfolio which may be useful for their placement interviews:

a) Present seminar on various topics from course content
b) Prepare nameplate of D.C. machines and single-phase transformer.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses (***MOOCs***) may be used to teach various topics/subtopics.
b) Guide student(s) in undertaking micro-projects.
c) ***'L' in section No. 4***means different types of teaching methods that are to be employed by teachers to develop the outcomes.
d) Show animation/ video related to course content.
e) Co-relating the importance of content of this course with other courses/ practical applications. (e.g. importance of a content in course or whole course related to A.C. Machines, Transmission and Distribution of Electrical Power, Energy Conservation Switchgear and Protection etc. and in practical industrial &/ domestic applications.
f) Introduce E-waste recycling technology among the students.
g) Guide students on how to address issues on environment and sustainability

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-projects are group-based (group of 3 to 5). However, **in the fifth and sixth semesters**, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The duration of the micro project should be about **12-14** ***(fourteen to sixteen) student engagement hours*** during the course. The students ought to submit micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. This has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher:

a) Prepare chart showing different material used for various parts of D.C. machines.
b) Collect specification from different manufacturers of D.C. machines and prepare market survey report.
c) Collect specification from different manufacturers of single-phase transformer and prepare market survey report.
d) Prepare simple model of single-phase transformer.
e) Prepare chart of industrial applications of various types of D.C. motor and generator.
f) Prepare chart of application single-phase transformer and auto transformer.
g) Prepare report on power saving in BLD.C. motor.
h) Prepare model of Lap and Wave winding of D.C. Machines.

13. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1	A textbook of Electrical Technology Volume-II	B. L. Theraja & A.K. Theraja	S. Chand and Co., New Delhi, 23 edition or Latest edition (ISBN : 9788121924405)
2	Principle of Electrical Machines	V.K.Mehta, Rohit Mehta	S.Chand and Co. Ltd, New Delhi ISBN: 9788121930888
3	Electrical Machines	S.K.Bhattacharya	McGraw Hill Education. New Delhi ISBN:9789332902855
4	Electrical Machinery	Dr. P.S.Bimbhra	Khanna Publication. New Delhi ISBN: 9788174091734
5	Electrical Machine-I	Gupta, J. B.	S. K. Kataria & Sons, New Delhi, ISBN : 9350140551

14. SOFTWARE/LEARNING WEBSITES

WEBSITES

- https://archive.nptel.ac.in/courses/108/105/108105155/
- https://www.electrical4u.com/electrical-engineering-articles/transformer/
- https://electrical4u.in/D.C.-machines/
- https://lectures.gtu.ac.in/
- https://circuitglobe.com/
- https://www.electricaltechnology.org/
- www.vlab.co.in
- www.khanacademy.org

15. PO-COMPETENCY-CO MAPPING:

Semester I	D.C. Machines and Transformer (Course Code:4330901)						
	POs						
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design / develo	PO4 Engineering Tools, Experimen-	PO 5 Engineering practices for society, sustainability	PO 6 Project Manage-ment	PO 7 Life-long learning

			pment of solution	tation & Testing	& environment		
Competency	**Maintain various types of D.C. machines and single-phase transformers safely.**						
Course Outcomes CO1 Distinguish types of D.C. Generators.	3	3	1	3	2	-	-
CO2 Distinguish types of D.C. Motors.	3	3	1	3	2	-	-
CO3 Interpret constructional and operational features of different types of single-phase transformers.	3	3	1	-	-	-	-
CO4 Undertake performance test of single-phase transformers.	3	-	-	3	-	-	-

*Legend: '**3**' for high, '**2**' for medium, '**1**' for low and '**-**' for no correlation of each CO with PO.*

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

S. No.	Name and Designation	Institute	Contact No.	Email
1.	Ravi J. Dattani Lecturer Electrical Engg.	G.P. Jamnagar	9016593517	rjdele@gmail.com
2.	Jayesh L.Chandpa Lecturer Electrical Engg.	G.P. Jamnagar	8866970001	jlc.elect@gmail.com

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
Semester-III

Course Title: Electrical Instrumentation
(Course Code: 4330902)

Diploma programmer in which this course is offered	Semester in which offered
Electrical Engineering	Third

1. RATIONALE

Precise measurement of the quantities such as voltage, current, power, temperature, pressure etc. is essential to operate and maintain the electrical machines and systems effectively and efficiently. Transducers and instruments are the devices which are used to measure such parameters. The electrical diploma engineer should therefore be competent to use, calibrate and maintain different types of electrical instrumentation systems and transducers used in the industry and power systems. This demands a better understanding of the construction, material used and principle of operation of various types of measuring instruments. This course is therefore designed to meet these needs and hence it is a core course for any electrical engineer.

2. COMPETENCY

The purpose of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Use relevant measuring instrument in different electrical applications.**

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with the identified competency are to be developed in the student for the achievement of the following COs:

- ***a)*** Interpret different terms related to measurement and instrumentation
- ***b)*** Measure circuit parameters using potentiometers and DC and AC bridges.
- ***c)*** Use electromechanical instruments for measurement of electrical quantities.
- ***d)*** Calibrate ammeter, voltmeter, wattmeter and energy meter as per IS.
- ***e)*** Use transducers to measure various non-electrical quantities.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
4	0	2	5	30*	70	25	25	150

(*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

***Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **CA** - Continuous Assessment; **ESE** - End Semester Examination.*

5. SUGGESTED PRACTICAL EXERCISES

The following practical outcomes (PrOs) are the sub-components of the Course Outcomes (Cos). Some of the **PrOs** marked **'*'** are compulsory, as they are crucial for that particular CO at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'.

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Identify measuring instruments on the basis of symbols on dial, type, accuracy, class, position and scale.	I	2*
2	Measure medium resistance using Wheatstone bridge.	II	2*
3	Measure low resistance using Kelvin's double bridge.	II	2*
4	Measure inductance by using Universal Impedance bridge.	II	2*
5	Measure capacitance by using Universal Impedance bridge.	II	2
6	Measure insulation resistance of winding insulation by using Megger.	II	2*
7	Measure earth resistance by using earth tester.	II	2
8	Measure power drawn by three phase load using two wattmeter method.	III	2*
9	Measure different electrical parameters using clip on meter.	III	2*
10	Test phase sequence of three phase AC supply using phase sequence indicator.	III	2
11	Measure maximum demand using Maximum demand meter.	III	2
12	Use Tri-vector meter for measuring kW, kVAr and kVA of a power line.	III	2
13	Extend the range of ammeter and voltmeter by using CT and PT.	III	4
14	Calibrate Ammeter (MI/MC) as per IS.	IV	2*
15	Calibrate Voltmeter (MI/MC) as per IS.	IV	2*
16	Calibrate Single phase energy meter as per IS.	IV	2*
17	Calibrate single phase wattmeter using standard voltmeter and ammeter.	IV	2
18	Calibrate power factor meter as per IS.	IV	2
19	Measure Linear displacement using LVDT.	V	2*
20	Use Thermocouple to control the temperature of a furnace/machine.	V	2
21	Measure speed using inductive pick-up transducer.	V	2
22	Use Strain gauge to measure strain.	V	2*
	Minimum 14 Practical Exercises		28

Note

*i. More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list.*

*ii. The following are some **sample** 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency.*

Sr. No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Prepare experimental setup	20
2	Operate the equipment setup or circuit	20
3	Follow safe practices.	10
4	Record observations correctly	20
5	Interpret the result and conclude	30
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

This major equipment with broad specifications for the PrOs is a guide to procure them by the administrators to user in uniformity of practical's in all institutions across the state.

Sr. No.	Equipment Name with Broad Specifications	PrO.No.
1	Wheatstone bridge (Measuring Range- 1.000Ω to 10.00MΩ)	2
2	Kelvin's double bridge (0.2 Micro - Ohms to 11 ohms)	3
3	Universal Impedance bridge (Basic accuracy- 0.3%)	4,5
4	Megger (dc voltage generated 500 V, 1000 V)	6
5	Earth tester	7
6	Two element wattmeter 0-1000W(5/10A,300/600V)	1,8,17
7	Clip on meter :Analog and digital meters with latest specifications	9
8	Phase sequence indicator: Analog and digital meters with latest specifications	10
9	Maximum demand meter	11
10	Tri vector meter	12
11	Current transformer and Potential transformer	13
12	Ammeter MI/MC (0-1 A, 0-5 A, 0-10 A)	1,13,14,17
13	Voltmeter MI/MC (0-50 V,0-150 V,0-300 V,0-500 V)	1,13,14,17
14	Energy meter : 1Ø and 3Ø analog and digital meters with latest specifications	16
15	Power factor meter : Analog and digital meters with latest specifications	18
16	LVDT : +12V D.C. at 50mA D.C .regulated Power Supply	19
17	Thermocouple	20
18	Inductive pick-up transducer	21
19	Strain gauge: +12V D.C. at 50mA I.C. regulated Power Supply	22

7. AFFECTIVE DOMAIN OUTCOMES

The following ***sample*** Affective Domain Outcomes (ADOs) are embedded in many of the above-mentioned COs and PrOs. More could be added to fulfill the development of this course competency.

a) Work as a leader/a team member(while doing a micro-project)
b) Follow safety practices while using AC supply and electrical equipments.
c) Work as a group member (while performing experiments and taking readings)
d) Practice environmental friendly methods and processes. (Environment related)

The ADOs are best developed through the laboratory/field based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

i. 'Valuing Level' in 1st year
ii. 'Organization Level' in 2nd year.
iii. 'Characterization Level' in 3rd year.

8. UNDERPINNING THEORY

The major underpinning theory is given below based on the higher level UOs of *Revised Bloom's taxonomy* that are formulated for development of the COs and competency. If required, more such UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
Unit – I Fundamentals of measurement & instrumentation	1a.Differentiate between direct and indirect measurement 1b.Discriminate between Indicating, integrating and recording, absolute and secondary instrument 1c.Differentiate between deflecting, controlling and damping torques 1d.Explain different terms related to measurement 1e.Differentiate between different types of errors with examples	1.1 Methods of measurement -Direct and indirect methods 1.2 Types of Instruments - Indicating, integrating and recording, absolute and secondary instrument 1.3 Deflecting, Controlling and damping torques 1.4 Range, true value, indicated value, correction, sensitivity, repeatability, reproducibility, precision, Accuracy, significant figure, etc. 1.5 Types and sources of error : gross error, systematic error , random error
Unit – II Potentiometers and Bridges	2a.Explain the working of the DC potentiometer. 2b.Differentiate between different types of potentiometers 2c.Classify different types of resistances	2.1 Construction and working of DC potentiometer, and its applications 2.2 Dial type and Crompton type.. 2.3 Low, medium, and high resistance 2.4 Kelvin's double bridge, 2.5 Medium resistance by Wheatstone

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
	2d. Explain the procedure to measure low resistance by Kelvin's double bridge with sketches 2e. Explain the procedure to measure medium resistances by Wheatstone's bridge and other methods with sketches. 2f. Justify the need of a Megger. 2g. Justify the need of a earth tester. 2h. Select an A.C. bridge to determine Inductance and capacitance.	bridge, Ammeter-voltmeter method, Ohmmeter. 2.6 High resistance by Mugger 2.7 Earth resistance by Earth tester. 2.8 Measurement of inductance and capacitance by Universal impedance bridge, A.C. bridge - Maxwell, Anderson, Hays, DeSauty's and Wien's bridge. (no phasor diagram)
Unit – III Electromechanical Instruments	3a. List the common errors in various electromechanical measuring instruments. 3b. Differentiate between moving iron and PMMC instruments 3c. Distinguish between electrodynamometer type and induction type meters. 3d. Describe the working of a hot wire instruments 3e. Select different types of electro-mechanical instruments for different kinds of measurement. 3f. Illustrate the use of shunt and multipliers for range extension of ammeters and voltmeters 3g. Illustrate the use of Current Transformer and Potential Transformer for range extension of meters	3.1 Common errors in electromechanical instruments 3.2 Moving iron instruments: Ammeter, voltmeter, Frequency meter, 3.3 PMMC instruments: ammeter, voltmeter, Vibration galvanometer. 3.4 Electrodynamometer type meter: ammeter, voltmeter, wattmeter, power factor meter. 3.5 Induction type Energy meter (single phase, three phase) 3.6 Hot wire type instruments 3.7 Tri vector meter, Maximum demand meter, Phase sequence indicator, Solid state energy meter, Clip on meter 3.8 Extension of range using shunt, multipliers and derive equation for them. 3.9 Extension of range of meters using instrument transformer like CT and PT
Unit – IV Calibration and Testing	4a. Justify the necessity of calibration 4b. State the procedure to calibrate various electrical instruments	4.1 Calibration and its importance 4.2 Calibration of ammeter, voltmeter and wattmeter and single phase energy meter(along with adjustments) as per IS

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
Unit – V **Transducers**	5a.State the basic requirements of transducers 5b. Classify different types of transducers 5c. Describe working principle of different types of electrical transducers. 5d. Describe working principle of different types of electro optical transducers. 5e.Explain the Incident caused by Transducer failure. 5f.Justify possibilities and improvements after the failure.	5.1 Basic requirements of transducers. 5.2 Classification based on : Transduction phenomenon, type of application, types of input and output signal, electrical principle involved. 5.3 Resistive Transducers, Inductive Transducers: LVDT, RVDT, Capacitive Transducers, Piezoelectric Transducers, Strain Gauge Transducers (unbonded and bonded), Thermocouple, RTD, Thermistor and semiconductor sensors 5.4 Opto-electronic devices: Photo emissive cells, Photoconductive cells, Photodiode, Photo transistor, Photovoltaic cells, Photo optic transducer. 5.5 Transducer failure which caused massive industrial / equipment damages and environmental damages.

9. SUGGESTED SPECIFICATION TABLE FOR QUESTIONPAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Fundamentals of measurement and instrumentation	06	04	04	01	**09**
II	Potentiometers and Bridges	12	04	07	05	**16**
III	Electromechanical Instruments	16	07	08	05	**20**
IV	Calibration and Testing	04	01	02	01	**04**
V	Transducers	18	06	07	08	**21**
Total		**56**	**22**	**28**	**20**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*

Note*: This specification table provides general guidelines to assist students for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions to assess the attainment of the UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may slightly vary from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the

various outcomes in this course. Students should perform following activities in group (or individual) and prepare reports of about 5 pages for each activity. They should also collect/record physical evidences for their (student's) portfolio which may be useful for their placement interviews:

a) Present chart showing real-life examples indicating various types of electrical measuring equipment.
b) Prepare PowerPoint presentation for different types of electromechanical instruments.
c) Solve numerical related to Bridges.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b) Guide student(s) in undertaking micro-projects.
c) ***'L' in section No. 4*** means different types of teaching methods that are to be employed by teachers to develop the outcomes.
d) Show animation/ video to explain concepts, facts and applications related to electrical measuring instruments.
e) In respect of section no.10, teachers need to ensure to create opportunities and provisions for such co-curricular activities. (Use remaining practical hours).
f) Co-relating the importance of content of this course with other courses/ practical applications. (e.g. importance of a content in course or whole course related to A.C. Machines, Transmission and Distribution of Electrical Power, Energy Conservation Switchgear and Protection etc. and in practical industrial &/ domestic applications.)
g) Introduce E-waste recycling technology among the students.
h) Guide students on how to address issues on environment and sustainability

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-projects are group-based (group of 3 to 5). However, **in the fifth and sixth semesters**, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The duration of the micro project should be about **14-16** ***(fourteen to sixteen) student engagement hours*** during the course. The students ought to submit micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. This has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher:

a) Prepare a report on various measuring instruments used in Instrumentation laboratory.
b) Build a model to extend the range of ammeter with the help of shunt resistor.

c) Build a model to extend the range of voltmeter with the help of high resistor (multiplier).
d) Build a model of phase sequence indicator.
e) Prepare a report on transducers or sensors used in automation and robotics.
f) Design an instrument to generate electricity using piezoelectric device.
g) Case studies on transducer failure and its implications.
h) Make a case study on any industrial accident.
i) Prepare charts that spread awareness on environmental effect due to industrial accidents.
j) Compile the reports of past industrial/massive accidents, their causes, effect and strategies used and suggestion to prevent such incidents and present the same in seminar.
k) Prepare a chart that classifies recycling process for electronic waste and plastics.

13. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1	A text book of Electrical Technology Volume-I (Basic Electrical Engineering)	B. L. Theraja& A.K. Theraja	S. Chand and Co., New Delhi, 23 edition or Latest edition (ISBN : 9788121924405)
2	Principles of Electrical Engineering	B. R. Gupta	S. K. Kataria& Sons, New Delhi, Latest edition (ISBN-9788121901031)
3	Fundamentals of Electrical Engineering	Tarlok Singh	S. K. Katariav& Sons, New Delhi, Latest edition(ISBN: 9789350140680)
4	Basic Electrical Engineering	K. Uma Rao and A. Jayalakshmi	Pearson Education, New Delhi Latest Edition(ISBN: 9789385909283)
5	Basic Electrical and Electronics Engineering	Ravish. R. Singh	Tata McGraw Hill EducationPvt.Ltd., New Delhi 2018 edition or Latest edition (ISBN-978007026092)
6	Fundamentals of Electrical Engineering and Electronics	S.K. Sahdev	Dhanpatrai& Co., New Delhi Latest edition(ISBN: 978877002027)
7	Principles of Electrical Engineering and Electronics	V.K. Mehta Rohit Mehta	S. Chand and Co., New Delhi (ISBN : 9789352837199)

14. SOFTWARE/LEARNING WEBSITES

WEBSITES

- https://nptel.ac.in/courses/108105153
- https://nptel.ac.in/courses/108105064
- https://lectures.gtu.ac.in/listview.aspx?br=09&course=DI

- https://circuitglobe.com/category/electrical-terms/electrical-instrumentation
- https://www.electrical4u.com/electrical-engineering-articles/measurement/
- https://www.electricaltechnology.org/
- https://vp-dei.vlabs.ac.in/Dreamweaver/measurement.html

15. PO-COMPETENCY-CO MAPPING:

Semester III	Electrical Instrumentation (Course Code:4330902)						
	POs						
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design/ development of solution	PO4 Engineering Tools, Experimen-tation &Testing	PO 5 Engineering practices for society, sustainability & environment	PO 6 Project Manage-ment	PO 7 Life-long learning
Competency	**Use relevant measuring instrument in different electrical applications.**						
Course Outcomes CO1 Interpret different terms related to measurement and instrumentation	3	-	-	2	-	-	-
CO2 Measure circuit parameters using potentiometers and DC and AC bridges.	2	2	2	3	-	-	-
CO3 Use electromechanical instruments for measurement of electrical quantities.	2	-	-	3	-	-	-
CO4 Calibrate ammeter, voltmeter, wattmeter and energy meter as per IS.	3	2	2	3	-	-	-
CO5 Use transducers to measure various non electrical quantities.	2	2	2	3	2	-	-

*Legend: '**3**' for high, '**2**' for medium, '**1**' for low and '**-**' for no correlation of each CO with PO.*

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

S. No.	Name and Designation	Institute	Contact No.	Email
1.	Mayur D. Muchhadiya Lecturer Electrical Engg.	G P Junagadh	9638167122	muchhadiyamd@gmail.com
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GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
Semester-III

Course Title: Electrical Power Generation and Transmission
(Course Code: 4330903)

Diploma programmer in which this course is offered	Semester in which offered
Electrical Engineering	Third

1. RATIONALE

Generation of Electric Power is most important activity in power system. With growing demand for electric power, it has become more necessary to generate electric power more efficiently. It is possible with advanced technology. This course deals in detail about generation of electric power using thermal (coal) hydro and nuclear sources. These types of power plants need highly skilled technocrats who are capable of operating and maintaining various equipment and auxiliaries to generate uninterrupted power.

The bulk electrical power is generated at power plants which are quite away from load center, transmitted to different load center by transmission system and then supplied to consumers through distribution system. This course deals in detail with elements & performance of overhead transmission line and HVDC transmission systems. The skilled technocrats are required to operate and maintain power transmission system so that uninterrupted electrical power supply is made available at consumer end. Essential efforts are made in this course to develop basic skills required to maintain power generation and transmission system.

2. COMPETENCY

The purpose of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Operate and maintain various types of electrical power generating plants and transmission systems.**

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with the identified competency are to be developed in the student for the achievement of the following COs:

a) Supervise functioning of Thermal power plant, Hydro power plant and Nuclear power plant.
b) Solve problems related to load curve and load duration curve.
c) Apply mechanical and electrical design aspects of various types of conductor, support and insulator to maintain overhead line.
d) Analyze performance of transmission line.

e) Differentiate various types of HVDC transmission system.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
4	0	2	6	30*	70	25	25	150

(*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

***Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **CA** - Continuous Assessment; **ESE** - End Semester Examination.*

5. SUGGESTED PRACTICAL EXERCISES

The following practical outcomes (PrOs) are the sub-components of the Course Outcomes (Cos). Some of the **PrOs** marked **'*'** are compulsory, as they are crucial for that particular CO at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'.

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Sketch and interpret the schematic diagram of thermal power station (T.P.S.) and its main cycles.	I	4*
2	Prepare technical report of visit to a nearby T.P.S.	I	2
3	Sketch and interpret the various schemes of hydro power plant(H.P.S.)	I	2*
4	Prepare technical report of visit to a nearby H.P.S.	I	2
5	Sketch and interpret the schematic diagram of nuclear power station (N.P.S.)	I	2*
6	Prepare and interpret load curve for given data/data collected from nearby power station	II	4*
7	Demonstrate various types of conductors used in overhead transmission lines.	III	2*
8	Demonstrate different types of line supports employed in transmission system and distribution system.	III	4*
9	Demonstrate different types of insulators used in overhead transmission and distribution system	III	4*
10	Calculate sag in overhead transmission line for given data.	III	2
11	Determine string efficiency of suspension type insulator for given data.	III	2

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
12	Determine voltage regulation and transmission efficiency of short transmission line.	IV	4
13	Determine voltage regulation and transmission efficiency of medium transmission line.	IV	4
14	Prepare technical report on load dispatch center.	IV	2*
15	Prepare report on HVDC transmission systems.	V	2*
	Minimum 10 Practical Exercises		28

Note

*i. More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list.*

*ii. The following are some **sample** 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency.*

Sr. No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Understanding of concepts	20
2	Explanation of conclusion	20
3	Student attitude towards learning	20
4	Quality of term work	20
5	Timely completion of term work	20
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

This major equipment with broad specifications for the PrOs is a guide to procure them by the administrators to user in uniformity of practical's in all institutions across the state.

Sr. No.	Equipment Name with Broad Specifications	PrO. No.
1	Demonstration piece of ACSR conductors, Bundle Conductor etc	7
2	Demonstration piece of Pin insulator, Disc of suspension insulator, Shackle insulator, Silicon rubber insulator	9
3	Transmission line trainer kit	12,13

7. AFFECTIVE DOMAIN OUTCOMES

The following ***sample*** Affective Domain Outcomes (ADOs) are embedded in many of the above-mentioned COs and PrOs. More could be added to fulfill the development of this course competency.

a) Work as a leader/a team member(while doing a micro-project)
b) Follow safety practices while usingElectrical supply and electrical equipment.
c) Practice environmental friendly methods and processes. (Environment related)

The ADOs are best developed through the laboratory/field based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

i. 'Valuing Level' in 1st year
ii. 'Organization Level' in 2nd year.
iii. 'Characterization Level' in 3rd year.

8. UNDERPINNING THEORY

The major underpinning theory is given below based on the higher level UOs of *Revised Bloom's taxonomy* that are formulated for development of the COs and competency. If required, more such UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
Unit -I Generation of Electrical Power	1a. Explain energy conversion process in thermal, hydro and nuclear power plant. 1b. Identify appropriate site for thermal, hydro and nuclear power plant. 1c. Describe schematic diagram, major equipment, accessories used in thermal, hydro and nuclear power station. 1d. State the critical safe practices, and precautions to be followed while operation and maintenance of thermal, hydro and nuclear power plant.	1.1 Energy conversion process of thermal, hydro and nuclear power plant 1.2 Factors of site selection for thermal, hydro and nuclear power plant 1.3 Schematic diagram of thermal, hydro and nuclear power plant. 1.4 Schematic diagram of different cycles of thermal power plant. 1.5 Major equipment, accessories used in thermal power plant. 1.6 Classification of hydro power plant 1.7 Different schemes and elements of Hydro Power Plant 1.8 Nuclear fission, nuclear fusion and chain reaction 1.9 Nuclear reactor and fuels used 1.10 Nuclear waste in its disposal 1.11 Advantages and disadvantages of thermal, hydro and nuclear power plant. 1.12 Safe practices, environmental effect and precautions for thermal, hydro and nuclear

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
		power plant 1.13 Major thermal, hydro and nuclear power plant of Gujarat-state
Unit-II Variable Load on Power Station	2a. Distinguish between load curve and load duration curve. 2b. Differentiate between base load and peak load power plants. 2c. Solve numerical related to load curve and load duration curve.	2.1 Types of loads 2.2 Types and importance of load curve 2.3 Terms and factors regarding load curve 2.4 Load duration curve 2.5 Base load and peak load power plants
Unit-III Elements of Overhead Transmission Lines	3a. Compare features of different transmission systems. 3b. State effect of system voltage and load power factor 3c. Differentiate features of various types of line conductors, line supports and line insulators. 3d. Explain voltage distribution across string of suspension insulator and method of improving string efficiency. 3g Describe factors to be considered while erecting lines and factors affecting sag of lines. 3h Solve numerical based on string efficiency and sag.	3.1 Single line diagram of typical power supply system. 3.2 Classification of transmission lines 3.3 Comparison between AC & DC and overhead & underground system. 3.4 Effect of system voltage and load power factor and Selection of voltage of transmission. 3.5 Line Conductors: requirements, materials & types of conductors for overhead lines, types of ACSR conductors and features of optical fiber ground wire. 3.6 Line Supports: requirements & types of line supports and classification of transmissions line towers Line 3.7 Line Insulators: requirements, materials, types & failure of line insulators and features of silicon rubber insulators. 3.8 String efficiency and methods of improving string efficiency. 3.9 Sag calculation , spacing between conductors and ground clearance
Unit-IV Performance of Transmission Lines	4a. Explain effect of line parameters (constants) and their representation in short & medium transmission line. 4b. Differentiate the features of	4.1 Transmission line parameters: effect and representation of line parameters 4.2 Transposition of line conductors 4.3 Classification of transmission lines 4.4 Skin effect, proximity effect,

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
	short, medium and long transmission lines. 4c.Discriminate between skin effect, proximity effect, Ferranti effect and corona effect. 4d.Explain effect of load power factor on performance of short transmissions lines. 4e.Differentiate various methods of determining performance of medium transmissions lines. 4f.Describes importance and functions of LDC. 4g.Solve numerical based on line parameters and performance of short & medium transmission lines.	ferranti effect and corona effects 4.5 Voltage regulation and transmission efficiency 4.6 Performances of short transmission lines. 4.7 Performances of medium transmission lines 4.8 Load dispatch center; grid system in India and it's hierarchy
Unit-IV HVDC Transmission System	5a.State need for EHV transmission. 5b.Compare features of HVAC and HVDC transmission system. 5c.Explain concepts and types of HVDC transmission system. 5d. State application of HVDC transmission system.	5.1 Requirements of EHV transmission system. 5.2 Advantage and limitations of EHV AC transmission system 5.3 Single diagram of HVDC transmission 5.4 Types of HVDC transmission systems 5.5 Merits, demerits and application of HVDC transmission system 5.6 Comparison between HVDC and HVAC transmission systems

9. SUGGESTED SPECIFICATION TABLE FOR QUESTIONPAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Generation of Electrical Power	24	8	14	6	28
II	Variable load on Power Station	04	2	2	4	08
III	Elements of Overhead	14	4	6	4	14

	Transmission System					
IV	Performance of Transmission System	10	4	4	4	12
V	HVDC Transmission System	04	2	4	2	08
Total		56	20	30	20	70

Legends: *R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*
Note*: This specification table provides general guidelines to assist students for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions to assess the attainment of the UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may slightly vary from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course. Students should perform following activities in group (or individual) and prepare reports of about 5 pages for each activity. They should also collect/record physical evidences for their (student's) portfolio which may be useful for their placement interviews:

a) Present seminar on various topics from course content
b) Present seminar on recent technologies used for power generation and transmission
c) Solve numerical problems regarding course contents.

The student should be encouraged to get their work assessed by the concerned teacher progressively during the term and at the end of the term the whole work should be submitted to the concerned teacher.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b) Guide student(s) in undertaking micro-projects.
c) ***'L' in section No. 4***means different types of teaching methods that are to be employed by teachers to develop the outcomes.
d) Show animation/ video related to course content.
e) Visit to a nearby power plant and load dispatch center.
f) Co-relating the importance of content of this course with other courses and practical applications.
g) Introduce methods to reduce pollution in Thermal power plant.
h) Introduce E-waste recycling technology among the students.
i) Guide students on how to address issues on environment and sustainability.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-projects are group-based (group of 3 to 5). However, **in the fifth and sixth semesters**, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The duration of the micro project should be about **14-16** ***(fourteen to sixteen) student engagement hours*** during the course. The students ought to submit micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. This has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher:

a) Build model to demonstrate layout of Thermal Power Plant.
b) Build working model to demonstrate working or Hydro Power Plant.
c) Prepare charts of various cycles of Thermal Power Plant.
d) Prepare charts of various schemes of Hydro Power Plant.
e) Prepare chart of schematic diagram of Nuclear Power Plant.
f) Prepare chart of single line diagram of Electrical power system.
g) Prepare chart of various types of line insulators,
h) Prepare chart of various types of line conductors.
i) Prepare chart of various types of line supports.
j) Prepare chart of various types of HVDC systems.
k) Prepare chart of representation of line parameters of medium transmission line.
l) Prepare chart of equivalent circuit and vector diagram of short transmission line.
m) Prepare a report on various power plants in Gujarat by collecting data from internet.
n) Prepare a report on disasters occurred in Thermal, Hydro or Nuclear Power Plant.

13. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1	Principles of Power system	Mehta, V.K.	S. Chand & Co., New Delhi, 2020 ISBN: 978-8121924962
2	Power plant Engineering	Nag, P K	Tata McGraw Hill, New Delhi, 2011 ISBN:978-0-07-064815-9
3	Electrical Power Systems	Uppal S.L.	Khanna publication, New Delhi, 2011 ISBN:978-8174092380
4	Generation and Utilization of Electrical Energy	S. Sivanagaraju	Pearson, New Delhi, 2011 ISBN:978-81-317-33325
5	A course in Power Systems	J.B.Gupta	S K Kataria & sons,2013 ISBN:978-9350143735

6	Electrical Power Systems	C.L.Wadhwa	New Age, New Delhi, sixth edition ISBN:978-8122424683
7	A Textbook on Power System Engineering	P.V. Gupta, M.L. Soni, U.S. Bhatnagar, A. Chakrabarti	Dhanpat Rai & Co., New Delhi, Latest edition

14. SOFTWARE/LEARNING WEBSITES

- https://nptel.ac.in/courses/108/105/108105112/
- https://nptel.ac.in/courses/108/105/108105053/
- https://lectures.gtu.ac.in/(related to course content)
- https://www.electrical4u.com/electrical-engineering-articles/basic-electrical/
- https://www.electricaltechnology.org/
- www.vlab.co.in
- www.khanacademy.org
- https://ndl.iitkgp.ac
- http:www.nhpcindia.com/hydro-technology.htm
- http://www.mnre.gov.in/
- http://www.ntpc.co.in/index.php?option=com_content&view=article&id=64&Itemid=34&lang=en
- https://www.youtube.com/user/EnergyShouldBe

15. PO-COMPETENCY-CO MAPPING:

Semester III	Electrical Power Generation and Transmission (Course Code: 4330903)						
	POs						
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design/ development of solution	PO4 Engineering Tools, Experimentation &Testing	PO 5 Engineering practices for society, sustainability & environment	PO 6 Project Management	PO 7 Life-long learning
Competency	Operate and maintain various types of Electrical power generating plants and transmission systems.						
Course Outcomes CO1 Supervise functioning of Thermal power plant, Hydro power plant and Nuclear power plant.	3	2	2	--	2	--	--
CO2 Solve problems related to load curve and load duration curve.	2	3	--	--	--	--	--
CO3 Apply mechanical and electrical design aspects of various types of conductors, supports and insulators to	3	3	2	--	--	--	--

maintain overhead lines.							
CO4 Analyze performance of transmission lines	3	3	2	--	--	--	--
CO4 Differentiate various types of HVDC transmission systems	3	2	--	--	--	--	--

*Legend: '**3**' for high, '**2**' for medium, **'1'** for low and **'-'** for no correlation of each CO with PO.*

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

S. No.	Name and Designation	Institute	Contact No.	Email
1.	Shailesh M. Kanani Lecturer Electrical Engg.	AVPTI, Rajkot	9904651807	smkanani2013@gmail.com
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GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
Semester-III

Course Title: Fundamentals of Electronics
(Course Code: 4330904)

Diploma programmer in which this course is offered	Semester in which offered
Electrical Engineering	Third

1. RATIONALE

Electrical engineer must have knowledge about electronics devices because now a days in industry many electronics components are used, So to meet industrial demands this course discuss about fundamental concepts and principles of basic electronics and aims at providing construction, working and applications of various types of semiconductor and optoelectronic devices, working of transistor in various configuration; which are used in electronics circuits. This course is developed in such a way that, students will be able to apply the knowledge to solve broad electronic engineering problems.

2. COMPETENCY

The purpose of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Maintain electronic circuits comprising of distinct electronic components.**

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with the identified competency are to be developed in the student for the achievement of the following COs:

a) Use P-N junction diode for various rectifier circuits.
b) Apply knowledge of transistor in amplifier circuits.
c) Use the different types of oscillator.
d) Identify the behavior of semiconductor and opto electronic devices.
e) Test the performance of regulated power supply.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
4	0	2	5	30*	70	25	25	50

(*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken

during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

***Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **CA** - Continuous Assessment; **ESE** - End Semester Examination.*

5. SUGGESTED PRACTICAL EXERCISES

The following practical outcomes (PrOs) are the sub-components of the Course Outcomes (Cos). Some of the **PrOs** marked **'*'** are compulsory, as they are crucial for that particular CO at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'.

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Test characteristics of PN junction diode.	I	2*
2	Test characteristics of Half wave rectifier using CRO	I	2
3	Test characteristics of full wave centre tapped & bridge rectifier using CRO	I	2*
4	Compare output waveform of different Filters using CRO	I	2
5	Test the performance characteristics of CB transistor amplifier.	II	2*
6	Test the performance characteristics of CE transistor amplifier.	II	2*
7	To Test/Build transistor as a switch.	II	2
8	Testing of transistor using multi meter.	II	2
9	Test Hartley oscillator using CRO.	III	2*
10	Test Colpitts oscillator using CRO.	III	2
11	Test characteristic of zener diode.	IV	2
12	Test MOSFET amplifier.	IV	2
13	Derive characteristics of SCR.	IV	2*
14	Derive characteristics of UJT.	IV	2*
15	Display various alphanumeric characters on Seven segment LED Display.	IV	2
16	Test characteristics of LDR.	IV	2
17	Test Zener diode as voltage regulator.	V	2*
18	Build voltage regulator using 78xx and 79xx and measure the dropout voltage for the given voltage regulator.	V	2
19	Test the performance of SMPS.	V	2
20	Trouble shoot given DC regulated power supply.	V	2

	Minimum 14 Practical Exercises		28

Note

*f) More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list.*

*g) The following are some **sample** 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency.*

Sr. No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Prepare experimental setup	20
2	Operate the equipment setup or circuit	20
3	Follow safe practices.	10
4	Record observations correctly	20
5	Interpret the result and conclude	30
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

This major equipment with broad specifications for the PrOs is a guide to procure them by the administrators to user in uniformity of practical's in all institutions across the state.

Sr.No.	Equipment Name with Broad Specifications	PrO. No.
1	Regulated power supply: Dual DC , 0-30V/1A & 5V /1A with resolution of 10mV , 2mA	1-18
2	Digital Storage Oscilloscope : 300 MHZ Bandwidth , 2GSa/s maximum real time sampling rate refresh rate upto 2000 wfams/s , RS232 & USB connectivity	2,3,4,9,10
3	C.R.O.: 30 MHz Bandwidth, 2 channels, 20 ns sampling time.	2,3,4,9,10
4	Function generator: 10 HZ to 10MHZ , 10 Vpp , rise & fall time =20ns, manual / external triggering	2,3,4,9
5	Digital Multimeter: 51/2 digits resolutions with all basics measurement facility like DC Voltage: 200 mV ~ 1000 V, DC Current: 200 µA ~ 10 A, AC Voltage: True-RMS, 200 mV ~ 750 V, AC Current: True-RMS, 20 mA ~ 10 A, 2-Wire, 4-Wire	1-18

	Resistance: 200 Ω ~ 100 MΩ, Capacitance Measurement: 2 nF ~ 10000µF, Frequency Measurement: 20 Hz ~ 1 MHz etc., 0.015% DC Voltage Accuracy.	
6	DC Ammeter(0-50mA, 0-500 µA)	1-18
7	DC Voltmeter (0-30V, 0-10V)	1-18

7. AFFECTIVE DOMAIN OUTCOMES

The following ***sample*** Affective Domain Outcomes (ADOs) are embedded in many of the above-mentioned COs and PrOs. More could be added to fulfill the development of this course competency.

a) Work as a leader/a team member(while doing a micro-project)
b) Follow ethical practices.
c) Work as a group member (while performing experiments and taking readings)
d) Practice environmental friendly methods and processes. (Environment related)

The ADOs are best developed through the laboratory/field based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

I. 'Valuing Level' in 1st year
II. 'Organization Level' in 2nd year.
III. 'Characterization Level' in 3rd year.

8. UNDERPINNING THEORY

The major underpinning theory is given below based on the higher level UOs of *Revised Bloom's taxonomy* that are formulated for development of the COs and competency. If required, more such UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
Unit-I **Basics of semiconductor and its applications**	**1a.** Explain properties of Semiconductor **1b**.Distinguish between intrinsic and extrinsic semiconductor materials **1c**. Describe working of PN junction diodes. **1d.**Describethe working of half and full wave bridge rectifier along with sketches. **1e.**Justify the need for different types of filters.	**1.1** Semiconductor properties and bonds in semiconductor **1.2** Intrinsic and extrinsic semiconductor materials: P type, N type semiconductors. **1.3** P-N junction diode. **1.4** Applications - Diode as rectifier, half wave, full wave and bridge wave rectifier. **1.5** Need of Filters **1.6** C, L, LC, π filters.

	1f. Differentiate between C, L, LC and π filters	
Unit– II **Transistor and amplifiers**	**2a**.Describe PNP and NPN transistors **2b**. Compare the working of CB, CE and CC transistors. **2c.**Describe the load line and biasing methods of the transistor. **2d.** Justify the need of voltage amplifier. **2e.** Select the voltage amplifier for a particular application. **2f.**Transistor as a switch	2.1 PNP and NPN transistors, conduction through transistor Leakage current, relationship between α and β. 2.2 Transistor configuration & Characteristics for CB, CE, CC. 2.3 Load line and biasing methods of Transistor. 2.4 Transistor as an amplifier : CE Amplifier. 2.5 Cascade amplifiers. 2.6 Transistor as a Switch: Working and application.
Unit– III **Oscillators**	**3a.** Explain the working of different types of oscillators with relevant sketches **3b.** Select oscillator for different frequency generation	3.1Working principle of oscillators 3.2 Different types of oscillators: Hartley oscillator, Colpitts oscillator, Phase-Shift Oscillator, Wien Bridge Oscillator, Crystal Oscillator
Unit– IV semiconductor and optoelectronic devices	**4a.** Describe working of the Zener diode, FET,MOSFET, DIAC , TRIAC ,UJT,TRIAC and SCR **4b.** Describe working of the Photo diode, photo transistor, LDR, Photovoltaic Cell, LCD, Light Emitting Diode (LED) and opto coupler, with symbols. **4c.**Explain seven segment LED display	4.1 Zener diode, FET,MOSFET, DIAC , TRIAC ,UJT and SCR 4.2 Photo diode, photo transistor, LDR, Photovoltaic Cell, LCD, LED and opto coupler. 4.3 Seven Segment LED display
Unit– V **Regulated Power supply**	**5a.** Justify the need of IC **5b.** Explain the need of Power Supply. **5c.** Explain parameters of the regulator and the need of regulated DC power supply. **5d.**Explain the working of different types of voltage regulator circuits **5e.** Explain working of SMPS. **5f.**Explain the working of UPS.	5.1 Need of IC 5.2 Difficulties with unregulated power supply. Need to have Regulated Power Supply. 5.3 Regulated power supply (module level), Shunt voltage regulator (module level). 5.4 Transistorized series voltage regulator(basic and with feedback, without derivation) 5.5 3-Terminal Fixed/variable voltage regulator IC: 78xx, 79xx, LM317

		5.6 Switch mode power supply (SMPS). 5.7 Uninterruptible Power Supply (UPS) types and application for critical load.

9. SUGGESTED SPECIFICATION TABLE FOR QUESTIONPAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Basics of semiconductor and its applications	12	4	7	5	16
II	Transistor and amplifiers	14	5	6	7	18
III	Oscillators	08	4	3	3	10
IV	Semiconductor and opto electronic devices	12	6	4	4	14
V	Regulated Power Supply	10	4	4	4	12
Total		56	23	24	23	70

Legends: *R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*
Note*: This specification table provides general guidelines to assist students for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions to assess the attainment of the UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may slightly vary from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course. Students should perform following activities in group (or individual) and prepare reports of about 5 pages for each activity. They should also collect/record physical evidences for their (student's) portfolio which may be useful for their placement interviews:

a) Present seminar on various topics from course content
b) Test different semiconductor devices using multimeter.
c) Prepare a chart on different configuration of transistor.
d) Undertake micro-projects in teams.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b) Guide student(s) in undertaking micro-projects.
c) ***'L' in section No. 4***means different types of teaching methods that are to be employed by teachers to develop the outcomes.
d) Show animation/ video related to course content.
e) Some of the topics/sub-topics which are relatively simpler or descriptive are to be given to the students for self-learning but to be assessed using different assessment methods.
f) Many electronics projects can be made using semiconductor and optoelectronic devices which are covered in syllabus, so encourage students to make such projects.
g) Guide students on how to address issues on environment and sustainability

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-projects are group-based (group of 3 to 5). However, **in the fifth and sixth semesters**, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The duration of the micro project should be about **14-16** ***(fourteen to sixteen) student engagement hours*** during the course. The students ought to submit micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. This has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher:

a) Build circuit of half wave rectifier without filter on bread board/General purpose PCB.
b) Build circuit of half wave rectifier with filter on bread board/General purpose PCB.
c) Build circuit of Full wave rectifier without filter on bread board/General purpose PCB.
d) Build circuit of Full wave rectifier with filter on bread board/General purpose PCB.
e) Prepare chart of comparison of CB, CE and CC transistors.
f) Prepare chart of different methods of cascading amplifiers.
g) Prepare chart of amplifier with positive feedback as oscillator and explain "Barkhausen criterion"

h) Make a flasher circuit using diac and triac.
i) Make a circuit of Burglar alarm using LDR.

13. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1	Electronics Fundamental and application	Chattopadhyay ,D.	New Age International Publishers 2011
2	Electronics Principles	Malvino, Albert	TMH, New Delhi 2012
3	Principle of Electronics	Mehta, V.K.	S.Chand, New Delhi 2012
4	Basic Electronics and linear circuits	Bhargava, N.N.	TMH, New Delhi 2012
5	Basic Electronics and linear circuits	Kulshreshtha,D.C . Gupta, S.C.	TTTI, Chandigarh 2007
6	Fundamentals of Electronics	Thomas F. Schubert	I K International Publishing House, 2017
7	Electronic devices and circuit	Robert Boylestad	PHI, New Delhi 2012
8	Electronics devices and circuits	J.B.Gupta	S.K.kataria& Sons, 2013
9	Electrical and ElectronicsEngineering	SK Bhattacharya	Pearson Education, New Delhi, 2011
10	Electronic Principles	SK Sahdev	DhanpatRai & Co., New Delhi, 2022
11	Semi conductor opto electronic devices	Pallab bhattacharya	Prentice-Hall of India Pvt.Ltd 2017

14. SOFTWARE/LEARNING WEBSITES

WEBSITES

- https://circuitmaker.com/
- https://www.pspice.com/
- https://www.electronics-tutorials.ws/
- Electronics work bench
- https://www.allaboutcircuits.com/
- Electronicsclub.info

15. PO-COMPETENCY-CO MAPPING:

Semester III	Fundamental Of Electronics(Course Code:4330904)						
	POs						
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design/ development of solution	PO4 Engineerig Tools, Experimen-tation&Testing	PO 5 Engineering practices for society, sustainability & environment	PO 6 Project Manage-ment	PO 7 Life-long learning
Competency	**Apply the basic concepts of distinct electronic components to build and trouble shoots various electronic circuits.**						
Course Outcomes CO1 Use P-N junction diode for various rectifier circuits	3	3	2	3	-	1	1
CO2 Apply knowledge of transistor in amplifier circuits.	3	3	3	3	-	1	2
CO3 Use the different types of oscillator.	3	1	1	-	-	-	-
CO4 Identify the behavior of semiconductor and opto electronic devices.	3	2	2	2	1	-	-

CO5 Test the performance of regulated power supply.	3	3	3	2	-	2	2

*Legend: '**3'** for high, '**2**' for medium, **'1'** for low and **'-'** for no correlation of each CO with PO.*

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

S. No.	Name and Designation	Institute	Contact No.	Email
1.	Nimish R. Suchak Lecturer Electrical Engg.	GP, Jamnagar	9228526725	suchak.nimish@rediffmail.com
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GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
Semester-III

Course Title: Electrical Engineering Workshop Practice
(Course Code: 4330905)

Diploma programmer in which this course is offered	Semester in which offered
Electrical Engineering	Third

1. RATIONALE

Electrical engineering diploma holders are expected to handle various electrical tools and measuring instruments in the Electrical workshop. They have to perform work related to Safety devices, Earthing, measurement of various electrical parameters and solder and de-solder the electronic components and test the circuits in the workshop. They are also expected to test the contacts of contactor and push buttons, internal wiring of fan and tube lights using appropriate tools and measuring instruments in an industry. This course helps to develop skills to select and use appropriate tools, safety devices and measuring instruments.

2. COMPETENCY

The purpose of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Identification and Use of various electrical Tools, instruments and safety devices.**

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with the identified competency are to be developed in the student for the achievement of the following COs:

1. Use Various Electrical Tools and Measuring Instruments.
2. Select different types of wires, Cables and Switches.
3. Solder different electrical and electronics components using of appropriate tools.
4. Follow safe practices to prevent accidents/ hazards to personnel and environment.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
0	0	2	1	00	00	50	50	100

(*): For this practical only course, 25 marks under the practical CA have two components i.e. the assessment of micro-project, which will be done out of 10 marks and the remaining 15

marks are for the assessment of practical. This is designed to facilitate attainment of COs holistically, as there is no theory ESE.
***Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** -Practical; **C** – Credit, **CA** - Continuous Assessment; **ESE** -End Semester Examination.*

5. SUGGESTED PRACTICAL EXERCISES

Following practical outcomes (PrOs) are the sub-components of the Course Outcomes (Cos). Some of the **PrOs** marked **'*'** are compulsory, as they are crucial for that particular CO at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'.

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Identify and Use of various tools used in electrical workshop.	1	2*
2	Identify symbols used in Electrical circuit diagram.	1	2
3	Use Digital meters like Multimeter, Clamp on meter and Digital tachometer for measuring various parameters.	1	2
4	Use Analogy meters like Ammeter, Voltmeter, and Wattmeter for measuring various electrical parameters.	1	2
5	Measure output voltage of the given single phase auto transformer.	1	2
6	Demonstrate different types of switches, plugs and sockets.	2	2*
7	Test the tube light wiring appropriate tools.	2	2
8	Test the fan wiring using appropriate tools.	2	2*
9	Test NO and NC contacts of contactor and push button. Operation of three phase contactor with Auxiliary Contact.	2	2*
10	Demonstrate installation of lugs and gland on the cable.	2	2
11	Identify different type of faults in a cable using Meggar and Test lamp.	2	2*
12	Identify various types of resistors, inductors and capacitors, diodes and LEDs.	3	2
13	Measure the size of different wires using standard wire gauge and micrometer.	3	2
14	Demonstrate breadboard utilization for making electronics circuits.	3	2
15	Solder various electrical and electronics components on PCB.	3	2*
16	Find out value of Resistance using color code and verify it with Multimeter.	3	2
17	Demonstrate the different types of earthing including chemical earthing.	4	2

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
18	Study of electrical hazard and its effect, Precaution, and cure.	4	2
19	Study of Artificial respiration and first aid exercise to learn about safety procedures.	4	2
20	Study about IE safety rules.	4	2*
21	Demonstrate the protective devices like Fuse, MCB and ELCB.	4	2*
22	Study about recycle cables and electrical/electronic waste.	2	2
	Minimum 14 Practical Exercises		**28**

Note

i. *More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list.*
ii. *Care must be taken in assigning and assessing study report as it is a first year study report. Study report, data collection and analysis report must be assigned in a group. Teacher has to discuss about type of data (which and why) before group start their market survey.*

The following are some **sample** 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency.

Sr.No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Diagrams/Sketches/Tables	20
2	Experimental procedure and conduction by following safety practices.	30
3	conceptual clarity	30
4	Time bound completion, team work & ethical values	20
Total		**100**

6. EQUIPMENT/ INSTRUMENTS REQUIRED :

These equipments with broad specifications for the PrOs is a guide to procure them by the administrators to user in uniformity of practical's in all institutions across the state.

Sr. No.	Equipment Name
1	Various Electrical Tools like pliers, wire stripper, cramping tools, etc.

Sr. No.	Equipment Name
2	Various electrical measuring instruments such as Digital and analog Multimeter, Ammeter, Voltmeter, Wattmeter, Clamp on Meter, Megger, Digital Tachometer, tong tester etc.
3	Various Domestic appliances like fan, tube light, electrical iron etc.
4.	Electrical wires and Cables, Lugs, Gland, tags, switches, socket, Contactor, Push button, etc.
5.	Electrical safety devices for Protection such as Fuse, MCB, ELCB, earthing rods.
6.	Electrical and electronics Component like Resistor, Inductor, Capacitor, LEDs etc.
7.	Soldering Kit.
8.	Various safety devices used for first aid and electrical hazards.
9.	Various electrical powers supplying equipment like variac, dc power supply.

8. UNDERPINNING THEORY

The major underpinning theory is given below based on the higher level UOs of *Revised Bloom's taxonomy* that are formulated for development of the COs and competency. If required, more such UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
Unit-I **Electrical Tools & Measuring Instruments**	**1a**.Use of Various electrical tools. **1b**. Measure electrical parameters using measuring instruments.	Pliers, Nose Plier, Cutter, Screw Driver, Test Lamp, Series Lamp etc. Voltmeter, Ammeter, Wattmeter, multimeter, Digital Tachometer, Clamp on Meter, Meggar.
Unit– II **Switches and Cable**	**2a**. Identify different type of cables, switches, plugs, sockets. **2b**. Test NO-NC contacts of contactor and Push buttons. **2c.** Trouble shooting of internal wiring of fan and tube light.	Different types of Cables, Lugs, Glands, Cable Joint, Tags, Recycle of Cables, Different Types of Switches, Plugs and Sockets, Basics of Contactor and Push Button, Internal circuit connection of Fan and Tube light, Recycle of cables.
Unit– III	**3a**. Identify different type Resistors, Inductors and Capacitors	Different types of Resistor, Inductor capacitors and LED, Color Coding of Resistors,

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
Resistor, Inductor and Capacitor	**3b**. Test different types of LED. **3c**. Soldering electrical and electronics components on PCB	Soldering Practices, Recycle of Electronics components
Unit– IV **Earthing and Electrical safety devices**	**4a**. Select safety devices for various types of protections. **4b**. Aware about the safety Rules to prevent accidents and hazards.	Need Of Earthing, Basics of Pipe Earthing, Plate earthing and Chemical Earthing, Safety devices Like Fuse, MCB, MCCB, ELCB etc. Electrical safety Rules, I.E. Rules for Electrical Safety and Hazards

9. SUGGESTED SPECIFICATION TABLE FOR QUESTIONPAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Electrical tools and Measuring Instruments.	**Not Applicable**				
II	Switches and Cables.					
III	Resistor, Inductor and Capacitor					
IV	Earthing and Electrical Safety devices.					

Legends: *R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should perform following activities in group (max.3-4 students) and prepare reports for each activity. They should also collect/record physical evidences for their (student's) portfolio which may be useful for their placement interviews.

a) Undertake a market survey of different Switches and cables.
b) Conduct Mock drill of Electric shock and respiration.
c) Arrange group discussion on
d) Seminar/Presentation on following topics:
    i. Electrical I.E. Safety rules.
    ii. Electrical Protective devices.
    iii. Electrical tools

iv. Different types of wires and cables.
v. Different types of earthing etc.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b) Guide student(s) in undertaking micro-projects.
c) ***'L' in section No. 4***means different types of teaching methods that are to be employed by teachers to develop the outcomes.
d) About ***20% of the topics/sub-topics*** which are relatively simpler or descriptive in nature is to be given to the students for ***self-learning***, but to be assessed using different assessment methods.
e) With respect to ***section No.10***, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
f) Introduce E-waste recycling technology among the students.
g) Guide students for reading data sheets.

12. SUGGESTED MICRO-PROJECTS :

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-projects are group-based (group of 3 to 4). However, **in the fifth and sixth semesters**, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission.. The students ought to submit micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. This has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher:

1) Prepare Extension board using few sockets and switches.
2) Prepare a board of different types of wires or cables.
3) Prepare a board of different types of Switches and sockets.
4) Make a PCB circuit using electronic components.
5) Prepare a board of different types of lugs and glands.
6) Prepare board of different protective devices with specification.
7) Make a simple control circuit using contactor and push button.

13. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication
1	Electronic Components and Materials	Joshi Madhuri	Shroff Publishers & Distributors private ltd.
2	Electrical Wiring, Estimating and Costing	S. L. Uppal & G. C. Garg	Khanna Publication
3	Electrical Measurements And Measuring Instruments.	Rajput R.K.	S Chand
4	Electrical Workshop	R. P. Singh	I.K. International Publishing House Pvt. Ltd.,
5	Handbook of Electrical Engineering	S.L. Bhatia	Khanna Publication
6	Electrical Engineering Drawing I & II	Singh, S. K. Surjit	Kataria & Sons
7	Handbook of Electrical Design Details	Neil Sclater, John E. Traister	Mc Graw hill
8	Text book of Applied Electronics	Sedha R.S	S. Chand
9	Electrical engineering materials & semiconductor devices	Gupta, J.B. ,& Gupta, Renu	S.K. Kataria& sons
10	Electrical Engineering Materials	G. K. Mithal	Khanna Publication

14. SOFTWARE/LEARNING WEBSITES

- https://www.electronics-tutorials.ws/resistor/res_1.html (for Resistor)
- https://nptel.ac.in (for online courses and video of all engineering branches)
- https://www.electricaltechnology.org/2019/07/mcb-mccb-elcb-rcb-rcd-rccb-rcbo.html (for MCB, ELCB,RCCB)
- https://uk.rs-online.com/web/generalDisplay.html?id=ideas-and-advice/cable-glands-guide (for cable Gland installation guideline)
- www.electrical4u.net/basic-accessories/electrical-cable-lugs-crimping-procedure-for-beginner/ (For cable lug)
- https://electrialstandards.blogspot.com/2015/11/circuit-diagram-of-ceiling-fan-fault.html (For Trouble shoot of fan)

- https://www.electrical4u.com/wiring-diagram-for-a-single-tube-light-circuit/ (for trouble shoot of tube light)
- https://electricalgang.com/chemical-earthing (For Chemical earthing)
- https://cpcb.nic.in/uploads/Projects/E-Waste/e-waste_amendment_notification_06.04.2018.pdf(For E-waste Recycle guidelines)
- https://cpcb.nic.in/displaypdf.php?id=RS1XYXN0ZS9FLVdhc3RlTV9SdWxlc18yMDE2LnBkZg==(For E-waste Recycle guidelines)
- https://www.meity.gov.in/writereaddata/files/1035e_eng.pdf(For E-waste Recycle guidelines)
- https://www.meity.gov.in/content/gazettes(For E-waste Recycle guidelines)

Semester 2	**Electrical Engineering Workshop and Practice (Course Code: 4320902)**						
	POs						
Competency & Course Outcomes	**PO 1 Basic &Discipline specific knowledge**	**PO 2 Problem Analysis**	**PO3 Design/ development of solutions**	**PO 4 Engineering Tools, Experimentation &Testing**	**PO 5 Engineering practices for society, sustainability & environment**	**PO 6 Project Management**	**PO 7 Life-long learning**
Competency	Identification and Use of basic electrical instruments and devices.						
CO 1Use Various Electrical Tools and Measuring Instruments.	3	-	-	3	-	2	2
CO 2Select different types of wires, Cables and Switches.	3	2	2	2	2	-	2
CO 3Solder different electrical and electronics components using of appropriate tools.	3	-	-	2	-	-	-
CO 4 Follow safe practices to prevent accidents/ hazards to personnel and environment.	3		-		3	2	2

*Legend: '**3**' for high, '**2**' for medium, '**1**' for low and '**-**' for no correlation of each CO with PO.*

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

Sr. No	Name	Institute	Contact No.	Email
1.	Prof. R. J. Dattani	G. P. Jamnagar	9016593517	rjdele@gmail.com
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3.	Prof. F.M.Patel	G.P.Ahmedabad	9879161235	patelfalu12@gmail.com
4.	Prof. D.J.Kapupara	AVPTI Rajkot	9409111405	dipakapupara.ee@gmail.com

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)
Semester – IV

Course Title: Contributor Personality Development
(Course Code: 4340002)

Diploma programme in which this course is offered	Semester in which offered
All branches of Diploma Engineering	4th Semester

Type of course: Work-Personality Development

For Year: Pre-final year for all Diploma programs

Rationale: The Contributor Program aims to accomplish the following outcomes in the lives of students–

- Improve the employability of students by giving them the right work ethic and thinking that employers are looking for.
- Build their I-Can attitude and self-confidence for their career.
- Improve their ability to engage positively to handle the challenges in career and workplaces.
- Build long-term and sustainable view of success and career that will help them make sustainable choices in a volatile and changing world of work.
- Widen their choices of career and success, so that they are able to open up more opportunities for themselves and take up unconventional career pathways.
- Awaken their aspiration to develop as Contributors in their organizations and society.

The program is focused on building foundational career values and the self-esteem of students to contribute in today's world of work.

The Contributor Program syllabus has been evolved and fine-tuned over several years, to –

a) address the changing needs and contemporary challenges being faced by industry and what employers today are looking for in the people they hire.
b) working extensively with universities and students and an appreciation of their challenges and concerns.
c) guided by the higher ideas and principles of Practical Vedanta in work.

OVERALL TEACHING AND EXAMINATION SCHEME
FOR ALL DIPLOMA COURSES

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
2	0	0	2	30	70	25	25	150

L- Lecture; T- Tutorial/ Teacher Guided Student Activity; P- Practical; C- Credit; ESE- End Semester Examination; PA- Progressive Assessment

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
-	**30**	**30**	**10**	-	-

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note:
It is the responsibility of the institute heads that marks for PA of theory & ESE and PA of practical for each student are entered online into the GTU Portal at the end of each semester within the dates specified by GTU.

Note:
1. This subject is compulsory.
2. It will carry 2 credits.

COURSE FORMAT

Class Sessions:

- Students will have to attend 3 hours of discovery-based sessions, to build new models of thinking & capacities for every module. [i.e., total 18 hours of classroom sessions in the semester]
- They will work closely with their peers to discuss and understand these new models of thinking.
- Their learning will be facilitated by trained college faculty.
- They also go through standard end-of-module, live assessments in class via a Student App, for continuous assessment of learning, which will be used for the progressive assessment component.

Project work:

- Students will have to complete projects as part of Practical work. They have one project corresponding to each module. These projects help them apply contributor thinking into their careers and life. These also help them build their confidence to communicate, ability to do systematic research and present their thinking effectively.
- For the successful completion of projects:
    - Students will be given orientation to the project and systematic guidelines on how to conduct the project by their trained college faculty in a project orientation session.
    - The projects will be done in teams and will require research. It may also need field work.
    - Student teams present their projects in the classroom in project presentation sessions.

COURSE CONTENT:

MODULE		WHAT IS COVERED	Total Hrs.
1	Part 1: Developing self-efficacy and basic inner strength	**Who is a Contributor?** Students build a vision of who they can become as a 'Contributor' in their career. They gain clarity on expectations from the future workforce, and importance of being a contributor. This enables students to transform their expectation of themselves in their career and future work.	3 hrs Lab Sessions (discovery-based facilitator led)

2		**The 'creator approach' to life & challenges** In a "caged approach", we see the career environment as full of difficulties and hurdles. We feel powerless or blame our circumstances for not having many opportunities. This makes us fearful of uncertainty and makes us settle for jobs where we remain mediocre. In this topic, students discover the "creator approach" to challenges and situations. This helps them take ownership & responsibility to shape destiny, build a new future, find answers to challenges; and stop being complainers.	Same as above
3		**Develop yourself to succeed: The I CAN Approach** Students learn to develop an "I CAN" attitude to everything. This is the base that helps them develop a Growth Identity & builds their self-esteem step by step; making them ready to deal with the dynamic demands of the future workplace.	Same as above
4	Part 2: Building ability to make more effective career choices	**Achieving Sustainable Success in their career** Students discover how to achieve sustainable or lasting success, by making themselves success worthy. Where their focus shifts to building one's "engine of success" rather than being focused on chasing the "fruits of success". This is important, because over a lifetime of work, all people go through ups and downs – where the fruits are not in their control. People who are focused on the fruits of success fall prey to disappointment, loss in motivation, quitting too early, trying to find shortcuts – when fruits don't come. Whereas people focused on building their engine of success continue to contribute steadily, irrespective of whether fruits come or not. This helps them make better choices in life, that leads to steady success & long-term career fulfillment in an uncertain world.	Same as above
5		**Career Development Pathways open to us** In this topic, students explore a range of diverse "career development models" and the possibilities for contribution that each opens up for them. This helps them open up hidden opportunities that such an environment offers. And free themselves from a herd mentality when making career	Same as above

		choices.	
6		**Unleashing our Power to Contribute** In this topic, students learn how to expand the contribution possible in any role they play. This helps them take charge of their own career growth & discover their power to contribute in any role or job.	Same as above
Project work		Project Assignments are given corresponding to each of the six topics. These projects require research and field work beyond the classroom that students are expected to do.	Beyond classroom, with student presentations in the class

Reference resources:

A. Basic reference for both students and teachers –

1. Student Resources for study comprising of key ideas learnt in the classroom in each topic and additional references to videos, articles etc. from the internet for continued exploration. These resources are made available via the Student App.
2. In-class Assessment Quizzes for each of the 6 modules that students do via the Student App.
3. Structured classroom presentations that teachers use to conduct classes systematically. This is provided via a digital delivery platform (only for teachers).
4. Guides and preparation material to help teachers prepare for the classroom sessions. This is also provided via the digital delivery platform.
5. Project Guides and support materials provided via the digital delivery platform and the Student App.

These will be made available by Illumine (www.illumine.in), Knowledge Partner for the Contributor Program.

B. Advanced reference for teachers –

1. On Contributors, Srinivas V.; Illumine Ideas, 2011
2. Awaken the Contributor Within (Contributor Ethic), Srinivas V.; Illumine Ideas, 2019
3. Becoming a Contributor Teacher (Contributor Ethic), Srinivas V.; Illumine Ideas, 2018
4. Reclaiming our intentionality: from “victims” to “creators of our destiny” (Design of Life), Srinivas V.; Illumine Ideas, 2016.
5. Examining our motives of work: can we ask more out of ourselves? (Design of Life), Srinivas V.; Illumine Ideas, 2016.
6. Building a Contributor Ethic in Organizations, Srinivas V.; Illumine Ideas, 2019.
7. Enlightened Citizenship and Democracy; Swami Ranganathananda, Bharatiya Vidya Bhavan, 1989
8. Eternal Values for a Changing Society – Vol I-IV, Swami Ranganathananda; Bharatiya Vidya Bhavan

9. Karma Yoga, Swami Vivekananda; Advaita Ashrama
10. Six Pillars of Self Esteem, Nathaniel Branden; Bantam, 1995
11. Mindset: The New Psychology of Success, Carol S. Dweck; Random House Publishing Group, 2007
12. Lasting Contribution: How to Think, Plan, and Act to Accomplish Meaningful Work, Tad Waddington; Agate Publishing, 2007
13. Why not? how to use everyday ingenuity to solve problems big and small, Barry Nalebuff, Ian Ayres; Harvard Business School Press, 2003
14. The value mindset: returning to the first principles of capitalist enterprise (Ch 8 & 9); Erik Stern, Mike Hutchinson; John Wiley and Sons, 2004
15. The Power of Full Engagement: Managing Energy, Not Time, is the Key to High Performance and Personal Renewal, Jim Loehr, Tony Schwartz; Simon and Schuster, 2003
16. Responsibility at work: how leading professionals act (or don't act) responsibly, Howard Gardner; John Wiley & Sons, 2007

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
Outcome of class sessions		
CO-1	Students are able to recognize the work ideal of a Contributor in terms of their motives for working and approach to work. They appreciate the value and importance of becoming Contributors in today's context.	10-12%
CO-2	Students are able to recognize & appreciate a "caged" approach as distinct from a "creator" approach in the way people deal with challenges and situations; and learn ways to develop a creator approach.	10-12%
CO-3	Students are able to recognize an "I Can" approach or way of thinking in situations. They learn how to apply this thinking to systematically develop themselves and their self-confidence in any area they choose.	10-12%
CO-4	Students are able to widen their understanding of success, that will help them make more sustainable career choices.	10-12%
CO-5	Students are able to recognize & appreciate different career development pathways and their value; to open up different career possibilities for themselves.	10-12%
CO-6	Students are able to recognize that any role has the potential for contribution. And they learn how to systematically expand the contributions and impact they can make in any role.	10-12%
Outcome of practical /project sessions		
	Students learn to apply the new thinking in the real world context	30%

EXAMINATION PATTERN:

End Semester Examination Pattern:

1.0 The final examination will cover all six modules included in the course content.

2.0 The examination is largely understanding and application oriented. Thus, a thorough appreciation of the key concepts of the course to recognize contributor thinking and application of the concepts in everyday life & work context, will help students to do well in the examination.

3.0 The examination paper will have ~30 questions and is to be completed in 1 ½ hours.

4.0 All questions are compulsory.

5.0 Pattern of questions –

- There are four sections in the question paper.
- All questions are in multiple-choice format (MCQ).
- The questions are in the form of scenarios / situations giving options. The student is expected to choose one option out of the given options.

6.0 The total number of marks is **70 marks**. The No. of questions and maximum marks per section is given below:

Section	Type of questions & No. of questions	Marking scheme
Section A	Case with 4 MCQs (with 2 or 3 options each). Student has to choose only one option.	2 questions x 3 marks each 2 questions x 2 marks each Max. marks = 10 marks Min. marks = zero
Section B	10 MCQs (with two valid options each). Student has to choose only one option.	10 questions x 2 marks each Max. marks = 20 marks Min. marks = zero
Section C	5 MCQs (with 3 or 4 options each). Student has to prioritize/ rank the statements & choose only one option that is closest to their ranking or priority-combination.	5 questions x 2 marks each Max. marks = 10 marks Min. marks = zero
Section D	10 MCQs (with 3 options each). Student has to choose only one option.	10 questions x 3 marks each Max. marks = 30 marks Min. marks = 10 marks

Sample Question Paper Pattern:

Section A

Instructions: This section has a scenario. Read carefully before answering the subsequent questions. There are 4 questions in this section. All questions are compulsory. Each question has 3 or 2 options. Choose ONLY ONE option which you consider the most appropriate option. Read carefully before answering.

Maximum Marks: 10

E-retailer Flipkart has announced that it will use the services of Dabbawalas of Mumbai for delivering goods to customers.

The Dabbawalas have been in the profession of transporting lunch boxes with absolute accuracy for more than 120 years. Their unique delivery system has been smooth, and reliable under all conditions. Their business involves no paper or administrative team. This helps in keeping the costs down.

However the Dabbawalas are not technology savvy which can be a problem for Flipkart.

1. The biggest advantage of this partnership is that… *[3 marks]*

a] …it will reduce Flipkart's cost of delivery significantly.
b] …it is an unusual and beneficial partnership for all concerned.
c] …it will give Dabbawalas additional income.

2. Suppose a partnership fails, your learning from it would be… *[2 marks]*
   a] These things happen, don't think about it but go forward.
   b] I need to think through more carefully whom to partner with and how we work together.

Section B

Instructions: There are 10 questions in this section. All questions are compulsory. Each question has 2 statements. Select ONLY ONE statement you feel is closest to your thinking and mark it on the answer sheet given to you.

[10 Qs x 2 marks = max. marks 20]

3. An astronomer made a discovery of a new planet at a unique location in the galaxy after several years of work. This helped prove and support an already well-established theory in Physics. Will the astronomer be called a Contributor?
   a] No, not a contributor, as finally his work led to nothing substantial (the theory was already well established).
   b] Yes, he is a Contributor because he continued for long and didn't give up so that he could make a discovery.

4. a] "I won the 'Best Athlete Award' last year. I should practice well enough to win it again this year."
   b] "I won the 'Best Athlete Award' last year. For this year's sports day, I should practice to improve my stamina and speed."

Section C

Instructions: This section will have 5 questions. All questions are compulsory. Each question has some statements with a unique number (e.g. 1, 2, 3, 4) and 3 or 4 options (e.g. a, b, c, d). Each option is either a combination of statements or a specific order of the statements. Choose ONLY ONE option closest to your thinking and mark it on the answer sheet given to you.

[5 Qs x 2 marks = max. marks 10]

5. What makes a project successful? *(Rank in the order of most likely to least likely option)*
   1. An inspiring team leader who can delegate jobs to his team.
   2. Hardworking team members who complete the tasks which are assigned to them.
   3. A team who believes the project should be successful.
   4. People who think like a 'team'.

   a] 4-3-2-1 b] 2-1-4-3 c] 2-1-3-4 d] 4-3-1-2

6. What are the different I CANs required to crack a job interview?
    1. I CAN learn to articulate my thoughts in a better manner
    2. I CAN overcome the fear of others judging me
    3. I CAN train myself to build my stamina
    4. I CAN think calmly to answer difficult questions

    a] 1, 2, 3 b] 1, 2, 4 c] 1, 3, 4 d] 2, 3, 4

Section D

Instructions: There are 10 questions in this section. All questions are compulsory. Each question has 3 options. Select ONLY ONE option you feel is the most appropriate and mark it on the answer sheet given to you.

[10 Qs x 3 marks = max. marks 30]

7. Which is a Contribution to Self, that a football player can make in his role?
    a] Asking for personalized attention from the coach and better opportunities to prove himself in the team.
    b] Improving his dribbling and passing techniques and his ability to work in smooth co-ordination with other players
    c] Winning more matches and increasing the number of goals scored by him in different matches.

8. Vaibhav, a mechanical engineering student, guides his classmates in completing their lab and group project work, gives regular updates on the progress to the teacher and works with everyone so that the journals of the entire class are submitted in time for external evaluation. What roles is Vaibhav playing in his college/class?
    a] Student leader, friend, role model
    b] Student, classmate, class representative
    c] Student, mentor, coordinator, representative of the class, assisting the teacher

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
Semester-IV

Course Title: Polyphase Transformers and Rotating AC Machines
(Course Code: 4340901)

Diploma programmer in which this course is offered	Semester in which offered
Electrical Engineering	4th Semester

1. RATIONALE

The electrical engineering applications in industries use small and large electric motors in some crucial application systems. This course will enable the students to develop skills to select, operate, and maintain various types of A.C. Motors and transformers. Practical features of the course will make the students capable of performing various tests on these machines. This course will also make the students familiar with the working and applications of Three-phase transformer and A.C. Motors.

2. COMPETENCY

The purpose of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Maintain various types of A.C. Motors and Three-phase transformers safely.**

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with the identified competency are to be developed in the student for the achievement of the following COs:

- ***a)*** Maintain the working of a three phase transformer.
- ***b)*** Maintain the working of three phase induction motor.
- ***c)*** Use the relevant single phase induction motor for various applications.
- ***d)*** Maintain the working of Synchronous machines.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
3	0	2	4	30*	70	25	25	150

(*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken

during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

***Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **CA** - Continuous Assessment; **ESE** - End Semester Examination.*

5. SUGGESTED PRACTICAL EXERCISES

The following practical outcomes (PrOs) are the subcomponents of the Course Outcomes (Cos). Some of the **PrOs** marked **'*'** are compulsory, as they are crucial for that particular CO at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'.

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Identify various parts of the three phase transformer.	I	2
2	Perform parallel operation of two three phase transformers.	I	4
3	Make connections of different vector groups in two three phase transformers.	I	4
4	Identify various parts of the three phase induction motor.	II	2
5	Perform direct loading test of three phase induction motor to find out efficiency.	II	2*
6	Perform no load and blocked rotor test on a three phase induction motor to obtain various parameters using a circle diagram.	II	4*
7	Make connections of DOL and Star delta starter with appropriate three phase induction motors.	II	2
8	Perform speed control of three phase squirrel cage induction motor.	II	2
9	Perform speed control of three phase slip ring induction motor.	II	2
10	Test the circuit of capacitor start capacitor run single phase induction motor used in a ceiling fan	III	2
11	Perform No load test on single phase induction motor to determine the friction and windage loss.	III	2
12	Perform direct loading test on alternator to find out voltage regulation.	IV	2*
13	Find out voltage regulation of alternator by synchronous impedance method.	IV	4*
14	Find out voltage regulation of alternator by ampere turns method.	IV	4
15	Perform parallel operation of two alternators.	IV	4
16	Synchronize given Alternator with infinite bus bar.	IV	4

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
17	Construct V-curve of synchronous motor at different load conditions to see the effect of variation of excitation.	V	4*
18	Use a synchronous motor to improve the power factor.	V	2
			28 Hrs.

Note

*i. More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list.*

*ii. The following are some **sample** 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency.*

Sr. No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Experimental setup, Procedure and conduction by following safety practices.	40
2	Conceptual clarity	30
3	Interpretation of Results and Ethical values.	30
Total		**100**

5. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

This major equipment with broad specifications for the PrOs is a guide to procure them by the administrators to use in uniformity of practical's in all institutions across the state.

Sr.No.	Equipment Name with Broad Specifications	PrO. No.
1	D.C. supply, 250 Volt, 25 Amp.	12 to 18
2	Three phase transformer, 1100/415 volt, 3 to 5 KVA	1,2,3
3	Three phase induction motor-DC shunt generator set. 5 HP, 415 volt.	5,6
4	Three Phase Squirrel cage Induction motor. 3 HP, 415 volt.	6
5	Three-phase auto transformer- 0 to 500 V, 25 Amp.	5,6,8,9
6	DC motor- Alternator Set (5 KVA, 415 volt, 3 phase 4 wire	12 to 16

Sr.No.	Equipment Name with Broad Specifications	PrO. No.
	Alternator)	
7	Synchronous Induction motor 415 volt 3 to 5 HP	17,18
8	Cut section of three phase induction motor.	4
9	Lamp load (10-20 A)	5,12

6. AFFECTIVE DOMAIN OUTCOMES

The following ***sample*** Affective Domain Outcomes (ADOs) are embedded in many of the above-mentioned COs and PrOs. More could be added to fulfill the development of this course competency.

a. Work as a leader/a team member (while doing a micro-project).
b. Follow safety practices while using D.C. and AC supply and electrical equipment.
c. Work as a group member (while performing experiments and taking readings)
d. Practice environmentally friendly methods and processes. (Environment related)

The ADOs are best developed through the laboratory/field-based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

i. 'Valuing Level' in 1st year
ii. 'Organization Level' in 2nd year.
iii. 'Characterization Level' in 3rd year.

8. UNDERPINNING THEORY

The major underpinning theory is given below based on the higher level UOs of *Revised Bloom's taxonomy* that are formulated for development of the COs and competency. If required, more such UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
Unit 1 Three Phase Transformer	**1a**. Justify the advantage of using 3- phase transformer over a bank of 3 single phase transformers **1b**. Sketch the different types of connections of 3-phase transformers including vector groups. **1c**. Explain the major parts of	**1.1** Comparison of three phase transformer with bank of three single phase transformer. **1.2** Construction of three phase transformer (Core and winding arrangement, Types of Winding.) **1.3** Winding Connections / Vector group of three phase transformers. (Star-Star, Delta-Delta, Delta-Star, Star-

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
	the 3-phase transformer. **1d.** Discuss the need and working of a tap changer. **1e**. Explain different cooling methods used in transformer,	Delta, Open Delta or V -V connection, Scott connection.) **1.4** Parallel Operation of three phase Transformers. **1.5** OFF load and ON load tap changer. **1.6** Accessories of three phase transformers, Buchholz relay, Name plate of three phase transformers. **1.7** Cooling of transformers, Natural and forced cooling.
Unit-II Three phase Induction Motors	**2a**. Explain how a rotating field is produced in a three phase induction motor **2b**. Differentiate between squirrel cage and wound rotor induction motor with their salient features. **2c**. Explain Torque slip characteristic of three phase induction motor. **2d**. Explain various methods of speed control of 3 phase induction motors. **2e**. Discuss Need of starters in three phase induction motors. **2f**. Solve numerical based on slip, Torque and power of three phase induction motors.	**2.1** Construction of a three phase induction motor and its types and applications. **2.2** Rotating magnetic field due to two phase supply and three phase supply. **2.3** Working Principle of three phase induction motor, Synchronous speed and Slip. **2.4** Effect of slip in rotor circuit parameters. **2.5** Derivation of Starting and Running torque, condition for maximum torque, Relation between torque and maximum torque. **2.6** Torque slip and torque speed curve of three phase induction motor. (Generating, breaking and motoring mode) **2.7** Power stages in an induction motor. **2.8** Equivalent circuit of 3 phase I.M. **2.9** Induction generator and its application **2.10** Starting of three phase I.M. Necessity and types of starters- DOL, Star delta. **2.11** Speed control of squirrel cage and slip-ring induction motor. **2.12** No Load, Block rotor test and Circle diagram.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
Unit-III Single Phase Induction motor	**3a**.Discuss two field revolving theory in single phase induction motor. **3b**.Describe the working principle of different types of single phase motors. **3c**. Select various single phase induction motors for relevant applications.	**3.1** Double field Revolving Theory. **3.2** Making Single phase induction motor self-starting. **3.3** Types of Single phase induction motor. Split phase induction motor, Shaded pole motor, Resistance start motor, Capacitor start motor, Capacitor start capacitor run motor. **3.4** Equivalent circuit of Single Phase induction motor.
Unit-IV Synchronous machines	**4a**. Explain the working principle of an alternator. **4b**. Differentiate between turbo generator and hydro generators **4c**. Derive e.m.f equation of alternator. **4d**. Determine the voltage regulation of an alternator by various methods. **4e**. Synchronize an alternator with an infinite bus bar. **4f.** Explain different cooling methods used in alternators. **4g**. Connect and operate synchronous motor using proper starting method **4h**. Improve the power factor of the system using synchronous condenser. **4i.** Explain the effect of excitation in a synchronous motor.	**4.1** Construction of Alternator and its types. **4.2** Alternator Operation, Frequency **4.3** A.C. Armature windings, Winding Factors, Numerical **4.4** EMF Equation of Alternator. **4.5** Equivalent Circuit and Phasor Diagram of Alternator. **4.6** Armature Reaction and its effect. **4.7** Voltage Regulation of Alternator Determination of voltage regulation by direct loading method and Synchronous impedance method. **4.8** Parallel Operation of alternator **4.9** Synchronization of alternator with infinite bus bar/ alternator. **4.10** Cooling of an alternator, Applications of alternators. **4.11** Construction and working of synchronous motor and its starting. **4.12** Effect of change in Excitation, V curve of Synchronous motor. **4.13** Hunting and its prevention. **4.14** Synchronous condenser and power factor improvement. **4.15** Applications of Synchronous motors and its comparison with induction motor.

9. SUGGESTED SPECIFICATION TABLE FOR QUESTIONPAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Three Phase Transformer	08	4	6	4	14
II	Three phase Induction Motor	14	8	8	7	23
III	Single phase Induction motor	06	4	4	2	10
IV	Synchronous machines	14	8	8	7	23
Total		**42**	**24**	**26**	**20**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*
Note*: This specification table provides general guidelines to assist students for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions to assess the attainment of the UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may slightly vary from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course. Students should perform following activities in group (or individual) and prepare reports of about 5 pages for each activity. They should also collect/record physical evidence for their (student's) portfolio which may be useful for their placement interviews:

a) Present seminar on various topics from course content
b) Prepare nameplate of three-phase transformer, three phase induction motor and alternator.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses (***MOOCs***) may be used to teach various topics/subtopics.
b) Guide student(s) in undertaking micro-projects.
c) ***'L' in section No. 4 means*** different types of teaching methods that are to be employed by teachers to develop the outcomes.
d) Show animation/ video related to course content.
e) Co-relating the importance of content of this course with other courses/ practical applications. (e.g. importance of a content course or whole course related to A.C. Machines, Transmission and Distribution of Electrical Power, Energy Conservation Switchgear and Protection etc. and in practical industrial &/ domestic applications.
f) Introduce E-waste recycling technology among the students.
g) Guide students on how to address issues on environment and sustainability

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-projects are group-based (group of 3 to 5). However, **in the fifth and sixth semesters**, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain a dated work diary consisting of individual contributions in the project work and give a seminar presentation of it before submission. The duration of the micro project should be about **12-14** ***(fourteen to sixteen) student engagement hours*** during the course. The students ought to submit micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. This has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher:

a) Make a working model of control wiring of Direct on Line starter. .
b) Make a working model of control wiring of star delta starter with contactors.
c) Make a working model of control wiring of sequence operation of two motors.
d) Make a working model of control wiring of forward reverse of three phase I.M.
e) Make a working model of control wiring of the autotransformer starter.
f) Prepare a chart of different vector groups of three phase transformers.
g) Prepare a chart showing different materials used for various parts of the Polyphase transformer and Polyphase Induction motor.
h) Collect specifications from different manufacturers of Polyphase transformers and prepare a market survey report.
i) Collect specifications from different manufacturers of single-phase Induction motors and prepare a market survey report.

13. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1	A textbook of Electrical Technology Volume-II	B. L. Theraja & A.K. Theraja	S. Chand and Co., New Delhi, 23 edition or Latest edition (ISBN : 9788121924405)
2	Principle of Electrical Machines	V.K.Mehta, Rohit Mehta	S.Chand and Co. Ltd, New Delhi ISBN: 9788121930888
3	A textbook of electrical machines	K R Siddhapura D B Raval	Vikas Publishing house PVT LTD ISBN: 9789325975620
4	Electrical Machinery	Dr. P.S.Bimbhra	Khanna Publication. New Delhi ISBN: 9788174091734
5	Electrical Machine	P.K. Mukherjee and S. Chakravorti	Dhanpat Rai Publications (P) Ltd. [2nd revised edition] ISBN: 9788189928667

14. SOFTWARE/LEARNING WEBSITES

WEBSITE

- https://archive.nptel.ac.in/courses/108/105/108105155/
- https://archive.nptel.ac.in/courses/108/105/108105131/
- https://www.electrical4u.com/electrical-engineering-articles/transformer/
- https://electrical4u.in/A.C.-machines/
- https://lectures.gtu.ac.in/
- https://circuitglobe.com/
- https://www.electricaltechnology.org/
- www.vlab.co.in
- https://www.powertransformernews.com
- https://nptel.ac.in/courses/108105017

15. PO-COMPETENCY-CO MAPPING:

Semester I	D.C. Machines and Transformer (Course Code:4330901)						
	POs						
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design / development of solution	PO4 Engineering Tools, Experimen-tation & Testing	PO 5 Engineering practices for society, sustainability & environment	PO 6 Project Manage-ment	PO 7 Life-long learning
Competency	**Maintain various types of A.C. machines and three -phase transformers safely.**						
Course Outcomes CO1 Maintain the working of three phase transformer.	3	2	2	1	2	-	2
CO2 Maintain the working of three phase induction motor.	3	2	2	2	2	-	2
CO3 Use the relevant single phase induction motor for various applications.	3	-	1	1	2	-	-
CO4 Maintain the working of Synchronous machines.	3	2	-	2	-	-	2

*Legend: '**3**' for high, '**2**' for medium, '**1**' for low and '**-**' for no correlation of each CO with PO.*

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

S. No.	Name and Designation	Institute	Contact No.	Email
1.	Mr. Ravi J. Dattani Lecturer Electrical Engg.	G.P. Jamnagar	9016593517	rjdele@gmail.com
2.	Mr. Nirav J Patel Lecturer Electrical Engg.	G.P. Navsari	9979563907	ernirav911@gmail.com

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
Semester-IV

Course Title: Distribution and Utilization of Electrical Power
(Course Code: 4340902)

Diploma programmer in which this course is offered	Semester in which offered
Electrical Engineering	4th Semester

1. RATIONALE

The study of distribution and utilization of electrical energy is critical for diploma electrical students as it provides a comprehensive understanding of the various electrical energy systems and the various methods of distribution and utilization of electrical energy. This course deals in detail about distribution system components, substation, cables, power factor improvement, illumination, electric drive and domestic appliances. The skilled technocrats are required to operate and maintain efficient as well as reliable power distribution and utilization. Essential efforts are made in this course to develop basic skills required to maintain economic power distribution and utilization.

2. COMPETENCY

The purpose of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Operate and maintain various distribution system and different types of electrical utilities and systems.**

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with the identified competency are to be developed in the student for the achievement of the following COs:

1. Identify basic components of power system distribution.
2. Interpret cable specifications, site selection process and layout of substations.
3. Acquire knowledge about tariff structures and power factor improvement.
4. Select appropriate lighting source on the basis of different parameters related to illumination.
5. Compare electrical drives and demonstrate working of various domestic electrical appliances.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
3	0	2	4	30	70	25	25	150

(*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

***Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** -Practical; **C** – Credit, **CA** - Continuous Assessment; **ESE** -End Semester Examination.*

5. SUGGESTED PRACTICAL EXERCISES

Following practical outcomes (PrOs) are the sub-components of the Course Outcomes (Cos). Some of the **PrOs** marked **'*'** are compulsory, as they are crucial for that particular CO at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'.

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	To study performance characteristics of typical AC distribution system in radial & ring main configuration.	1	2*
2	To Solve problem related to voltage drop and sending/ receiving end voltage of distribution line.	1	2
3	Prepare a report after studying distribution system of a residential colony.	1	2
4	Interpret the Blue Print of a Sub-Station.	2	2
5	Prepare a report on substation with its layout after visiting a nearby substation.	2	2
6	Prepare a report on pole mounted substation.	2	2*
7	Prepare a report about types of cables used in distribution system by visiting nearby cable suppliers/industries or otherwise with the help of internet.	2	2
8	To carry out pipe/plate/chemical earthing.	2	2
9	Measure a power factor of various electrical equipments with and without power factor improvement scheme.	3	2
10	Improve the power factor of available inductive load using static capacitor.	3	2*
11	Perform power factor correction using synchronous condenser.	3	2
12	Prepare a technical report on various power factor improvement devices adopted in an industry after visit of that industry. (otherwise from internet)	3	2
13	Prepare a report based on comparative study of various tariff structures of Gujarat state.	3	2*
14	Prepare Energy Bill based on energy consumption of residence/ Institute.	3	2
15	Identify the different lighting accessories required for various types of lamps and lamp fittings.	4	2
16	Measure Illumination at different places in college using luxmeter.	4	2*
17	Visit a small manufacturing unit to observe various electrical drives and prepare a technical report.	5	2
18	Analytical comparison between Electrical & Mechanical Drive.	5	2*

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
19	Write the procedure of servicing of any two domestic appliances after visiting nearby servicing centers of electrical domestic appliances.	5	2
20	Prepare a comparative report on two different manufacturing companies in India for any two electrical domestic appliances.	5	2*
21	Study about IE safety rules.	5	2
22	Study about recycle cables and electrical/electronic waste.	2	2
	Minimum 14 Practical Exercises		**28**

Note

i. *More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list.*
ii. *Care must be taken in assigning and assessing study report as it is a first year study report. Study report, data collection and analysis report must be assigned in a group. Teacher has to discuss about type of data (which and why) before group start their market survey.*

The following are some **sample** 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency.

Sr.No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Diagrams/Sketches/Tables	20
2	Experimental procedure and conduction by following safety practices.(for performance base experiment) **Or** Lucidity of report.(for study type experiment)	30
3	Conceptual clarity	30
4	Time bound completion, team work & ethical values	20
Total		**100**

6. EQUIPMENT/ INSTRUMENTS REQUIRED :

These equipments with broad specifications for the PrOs is a guide to procure them by the administrators to user in uniformity of practical's in all institutions across the state.

Sr. No.	Equipment Name
1	Prototype of Radial, parallel and ring main feeder.
2	Various safety devices used for first aid and electrical hazards.
3	Electrical safety devices for Protection such as Fuse, MCB, ELCB, earthing rods.
4	Different charts of Substation layout.
5	Raw material of Earthing.
6	Cut-section of different types of cable.
7	Electrical Component like Resistor, Inductor, Capacitor bank etc.
8	Various electrical measuring instruments such as Digital and analog Multimeter, Ammeter, Voltmeter, Wattmeter, Clamp on Meter, Megger, Digital Tachometer, power factor meter etc.
9	Synchronous condenser for Power factor improvement
10	AC & DC Drive Module.
11	Various Types of Lamps i.e Halogen lamp, SL, LED Lamp etc.
12	Software for design a lighting scheme i.e. Calculux etc.
13	Various Domestic appliances like fan, tube light, electrical iron, Microwave oven, Mixer, Vacuum cleaner etc.

8. UNDERPINNING THEORY

The major underpinning theory is given below based on the higher level UOs of *Revised Bloom's taxonomy* that are formulated for development of the COs and competency. If required, more such UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
Unit -I Distribution System Components	**1a**. State the need of distribution system & Various related terminology. **1b**. Describe with sketches various connection schemes of the distribution system. **1c**. Describe the Impact of wind and solar power on the distribution system. **1d**. Describe the measures to be adapted to take care of the distributed generation in the distribution system.	**1.1** AC distribution and its Requirements. **1.2** Classification of Distribution system. **1.3** Various Connection schemes of AC primary & secondary distribution system. **1.4** Issues of Distributed Generation Integrated to distribution Grid. **1.5** Impact a renewable energy on Distribution system. **1.6** Solution to challenges due to distribution generation integrated to distribution

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
	1e. Solve simple numerical problems.	grid. **1.7** Consequences of disconnecting neutral in a 3-Phase 4-wire System. **1.8** Methods of solving A.C. Single phase and three phase connected (balanced) distribution system.
Unit-II Sub-Station And Cable	**2a**. State the need for electrical Substations. **2b**. Sketch the single line diagram typical 220/66/11 kV electrical substation with various switchgear. **2c**. Describe pole mounted substation with sketch **2d**. State the selection of the bus bar and their arrangement. **2e**. Describe with sketches the various types of earthing adapted for substations. **2f**. State the features of unarmored and armored cables used in substation. **2g**. State the features of different types of cables used in a substation.	**2.1** Importance and Classification of substation. **2.2** Selection of site for substation. **2.3** Single line diagram of substation of 220/66/11 kV Substation. **2.4** Pole mounted substation **2.5** Different types of Busbar arrangement: Single Bus, Main and Transfer Bus, Breaker and Half Bus and Double bus & transfer bus. **2.6** Types of earthing used in substation. **2.7** General Construction of cable. **2.8** Insulating materials for cable. **2.9** Classification of cables. **2.10** Recycling of Cables.
Unit-III Tariff and Power Factor improvement	**3a**. Select the relevant tariff for the given applications with justification. **3b**. Explain with the sketches relevant method of power factor improvement for the given load. **3c**. Describe the procedure to maintain specified power factor of the system.	**3.1** Objectives and desirable characteristics of tariffs. **3.2** Types of consumers and Types of tariffs: Flat Rate, Block Rate, Three part, KVA maximum demand. **3.3** Problems based on tariff **3.4** Power factor: Disadvantages of low power factor and their causes, Advantages of improved power factor. **3.5** Power factor improvement by: Static capacitor, Synchronous Condenser, Location of power factor correction equipment.

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
Unit-IV Illumination	**4a**.Define various illumination terminology and its units. **4b**.Explain the laws of illumination and its significance. **4c**. Explain with sketches the various lighting schemes. **4d**. Describe with the sketches working and applications of the various lamps and fittings in use.	**4.1**illumination terminology: Solid and plane angle, Luminous Flux, Luminous Intensity, Lumen, Candle Power, Lux, Lamp Efficiency, Specific Consumption, Glare, Space Height Ratio, Utilization Factor, Maintenance Factor, Absorption Factor, Reflection Factor. **4.2** Law of Inverse Squares and Lambert's Cosine Law **4.3** Various lighting schemes: features and applications **4.4** Construction and working of Incandescent Lamp, Halogen Lamps, Sodium Vapour Lamps, Compact Fluorescent Lamps (C.F.L.), L.E.D lamps and its comparative advantages.
Unit-V Electric Drives & Domestic Appliances	**5a**. Describe functions of major parts of an electric drive with block diagrams. **5b**. Differentiate between: I) A.C. and D.C. Drive. II) Individual & group drive.	**5.1** Electric drives and its advantages. **5.2** Block diagram of electric drive system and advantages of electric drive. **5.3** Comparison of D.C.& A.C. Drive and Individual & Group Drive.
	5c. Explain the working of various domestic electrical appliances in use.	**5.4** Working Domestic electrical appliances: i. Ceiling fan ii. Electric iron iii. Microwave oven iv. Mixer grinder v. Vacuum Cleaner vi. Washing machine

9. SUGGESTED SPECIFICATION TABLE FOR QUESTIONPAPER DESIGN

Unit	Unit Title	Teaching	Distribution of Theory Marks

No.		Hours	R Level	U Level	A Level	Total Marks
I	Distribution System Components	10	6	5	5	16
II	Substation and cable	10	6	6	4	16
III	Tariff and Power Factor improvement	6	2	4	4	10
IV	Illumination	8	8	3	3	14
V	Electrical Drives and Domestic Appliances	8	6	4	4	14

Legends: *R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should perform following activities in group (max.3-4 students) and prepare reports for each activity. They should also collect/record physical evidences for their (student's) portfolio which may be useful for their placement interviews.

a) Present seminar on various topics from course content.
b) Visit and prepare a report of substation
c) Undertake a market survey of different types of lighting sources.
d) Undertake a market survey of different types of light fitting accessory.
e) Solve numerical problems regarding course contents
f) Arrange group discussion on various topics on course content.
g) To become a familiar with basic lighting design software. i.e. Calculux, etc.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b) Guide student(s) in undertaking micro-projects.
c) ***'L' in section No. 4***means different types of teaching methods that areto be employed by teachers to develop the outcomes.
d) Show animation/video related to course content.
e) Show charts/photos related to various types distribution schemes, single line diagram of substations and substation layouts.
f) Guide students for interpretation of single line diagrams.
g) Visit nearby substation.
h) With respect to ***section No.10***, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
i) Co-relating the importance of content of this course with other courses and practical applications
j) Introduce E-waste recycling technology among the students.

12. SUGGESTED MICRO-PROJECTS :

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the **first four semesters**, the micro-projects are group-based (group of 3 to 4). However, **in the fifth and sixth semesters**, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The students ought to submit micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. This has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher:

1) Collect Different Samples Of Overhead Conductors, Underground Cables, Line Supports, And Line Insulators.
2) Prepare report on Survey of rural electrification and draw Single Line Diagram including following observation and calculation i) Visit to a village ii) Supply is taken from pole mounted transformer and distributed in various part of village iii) Load calculation iv) loading capacity of different equipment v) Verification of 3-phase balanced loading vi) Finding transformer rating based on loading.
3) Making drawing sheet representing Single line diagram of three phase distribution.
4) Prepare chart of various course topics like types of line Conductors, Various types of line supports, Types of Busbar arrangements, Single line diagram of various substation, Pole mounted substation, various tariff schemes, various earthing, working of various light sources, electric drives, working of domestic appliances etc.
5) Prepare a board of different types of wires or cables.
6) Prepare Model of Substation.

13. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1	A Course In Power Systems	Gupta J. B.	S.K.Kataria& Sons, New Delhi, 2013, ISBN: 978-9350143735
2	Electric Power Transmission and Distribution	Sivanagaraju S. Satyanarayana S.	Pearson Learning, New Delhi, 2008, ISBN: 978-8131707913,
3	Electrical Power Systems	Uppal S.L	Khanna publication, New Delhi, 2011, ISBN:978-8174092380
4	Electrical Power System	Wadhwa C. L.	New Age International Publishers, New Delhi, 2018 ISBN: 978-9393159175,
5	Principles of power system	Mehta V. K.	S. Chand and Co., New Delhi, 2020, ISBN: 978-8121924962,
6	Handbook of Electrical Power Distribution	Ramamurthy G.	Universities press, Hyderabad 2009, ISBN: 9788173716843

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
7	Sub-Station Engineering Design, Concepts & Computer Applications	Dahiya R. S.	S. K. Kataria& Sons, New Delhi, 2013, ISBN:978-9380027579,
8	Utilization of Electric Power & Electric Traction	Gupta J. B.	S. K. Kataria& Sons, New Delhi, 2012, ISBN:978-9350142585,
9	Utilization of Electric Power & Electric Traction	Garg G. C.	Khanna publication, New Delhi, 2019, ISBN:978-9386173355
10	Fundamentals of Electrical Drive	Dubey G. K.	Narosa Publishing, New Delhi, 2001, ISBN: 978-8173194283
11	Art & Science of Utilization of Electrical Energy	Partab H.	DhanpatRai& Sons , New Delhi, 2017, ISBN: 978-8177001440

14. SOFTWARE/LEARNING WEBSITES

- "Calculux" Software for lighting design.
- https://nptel.ac.in (for online courses and video of all engineering branches)
- https://sa-nitk.vlabs.ac.in/List%20of%20experiments.html(S/S Automation lab)
- https://lectures.gtu.ac.in/listview.aspx?br=09&course=DI (Course Content)
- https://em-coep.vlabs.ac.in/List%20of%20experiments.html(Synchronous condenser)
- https://electricalgang.com/chemical-earthing (For Chemical earthing)
- https://cpcb.nic.in/uploads/Projects/E-Waste/e waste_amendment_notification_06.04.2018.pdf(For E-waste Recycle guidelines)

Semester 4	Distribution and Utilization of Electrical Power (Course Code: 4340902)						
	POs						
Competency & Course Outcomes	PO 1 Basic &Discipline specific knowledge	PO 2 Problem Analysis	PO3 Design/ development of solutions	PO 4 Engineering Tools, Experimentation &Testing	PO 5 Engineering practices for society, sustainability & environment	PO 6 Project Management	PO 7 Life-long learning
Competency							
CO1: Identify basic components of power system distribution.	3	--	--	--	--	--	2
CO2: Interpret cable specifications, site selection process	3	2	2	--	--	--	2

and layout of substations							
CO3: Acquire knowledge about tariff structures and power factor improvement	2	2	2	2	2	--	2
CO4: Select appropriate lighting source on the basis of different parameters related to illumination.	3	3	2	1	2	--	2
CO5: Compare electrical drives and demonstrate working of various domestic electrical appliances	3	--	--	2	--	--	2

*Legend: '**3'** for high, '**2**' for medium, **'1'** for low and **'-'** for no correlation of each CO with PO.*

15. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons:

Sr. No	Name	Institute	Contact No.	Email
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GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2022 (COGC-2022)
Semester-IV

Course Title: Electrical Wiring Estimating, Costing and Contracting
(Course Code: 4340903)

Diploma programmer in which this course is offered	Semester in which offered
Electrical Engineering	4th Semester

1. RATIONALE

Electrical wiring plays a major role in distributing the electrical energy from electric utilities to consumer. Electrical diploma holders may work as Technicians and Supervisors for planning, installing, and testing various electrical wiring Installations such as residential, commercial and Industrial electrification schemes. They should be able to prepare costing and estimates for these schemes with a thorough understanding of the methods/procedure of estimating, tendering/ contracting is desired. Knowledge of IE rules for different types of electrical Installation, their planning considerations equips the students with the capability to plan and prepare different Installation projects. Essential efforts are made in this course to develop above skills in the students.

2. COMPETENCY

The purpose of this course is to help the student to attain the following competency through various teaching learning experiences

- **Carry out Electrical wiring estimating, costing and contract for various electrical installations.**

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with the identified competency are to be developed in the student for the achievement of the following COs:

- ***a)*** Select relevant wiring methods, tools, and accessories for electrical installations.
- ***b)*** Undertake tendering and purchase procedure.
- ***c)*** Estimate cost of various domestic and industrial installation as per IE Act-2003
- ***d)*** Estimate the materials and cost of electrification for different buildings
- ***e)*** Estimate cost of distribution line project as per IE Act-2003

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
3	0	2	4	30*	70	25	25	150

(*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be

taken during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.
***Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **CA** - Continuous Assessment; **ESE** - End Semester Examination.*

5. SUGGESTED PRACTICAL EXERCISES

The following practical outcomes (PrOs) are the sub-components of the Course Outcomes (Cos). Some of the **PrOs** marked **'*'** are compulsory, as they are crucial for that particular CO at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'.

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Undertake following wirings. a) Staircase Wiring b) Go down wiring	I	2
2	Select appropriate wiring and list materials and accessories for given project	I	2
3	Perform domestic Electrical Installation test.	I	4
4	Prepare Inquiry form, quotation, comparative statement, and order for any electrical work/materials required /small projects.	II	4
5	Prepare a tender notice for given project.	II	4*
6	Prepare cost estimate of a domestic installation cost (Residential building/ Laboratory building/Drawing Hall etc.	III	4*
7	Prepare cost estimate of an Industry Installation. (Workshop/ Agriculture, Flour mill, etc.)	III	4
8	Interpret and prepare electrical test report of a large building or complex.	IV	4*
9	Calculate Load for lift, and air conditioning in high rise building. (A group of 5 students, having one different complex per group.)	IV	4
10	Prepare cost estimate of an Overhead service connection. (Single phase/Three phase)	V	4*
11	Prepare cost estimate of an Underground service connection (Single phase/three phase)	V	4
12	Estimate of material and specification required for 440V, 3-phase, 4 wire or 3 wire Overhead Distribution line.	V	4*
	Total Hours (Perform any practical worth **28 hours** from above depending upon the availability of resources so that most units are covered		**44 Hrs**

Note

i. A suggestive list of PrOs is given in the above table. More such PrOs can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the Cos.

*ii. The following are some sample 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency.*

Sr. No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Prepare experimental setup/layout/line diagram	20
2	Use of the relevant wiring tools/materials	20
3	Follow safe practices.	20
4	Timely submission of work.	20
5	Answer to sample questions.	20
Total		**100**

5. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

This major equipment with broad specifications for the PrOs is a guide to procure them by the administrators to user in uniformity of practical in all institutions across the state.

Sr.No.	Equipment Name with Broad Specifications	PrO. No.
1	Electrician tool kit-01 Nos.	1 to 3
2	Wiring Materials	1 to 3
3	Megger 500 V-01 Nos.	03

6. AFFECTIVE DOMAIN OUTCOMES

The following ***sample*** Affective Domain Outcomes (ADOs) are embedded in many of the above-mentioned COs and PrOs. More could be added to fulfill the development of this course competency.

a) Work as a leader/a team member (while doing a micro-project)
b) Follow safety practices.
c) Work as a group member (while performing experiments and taking readings)
d) Follow ethical practices.
e) Practice environmentally friendly methods and processes. (Environment related)

The ADOs are best developed through the laboratory/field-based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

i. 'Valuing Level' in 1st year
ii. 'Organization Level' in 2nd year.
iii. 'Characterization Level' in 3rd year.

8. UNDERPINNING THEORY

The major underpinning theory is given below based on the higher level UOs of *Revised Bloom's taxonomy* that are formulated for development of the COs and competency. If required, more such UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
Unit – I Electrical Wiring and IE Rules	1a. Differentiate between different types of wiring system 1b. List the applications of different types of wiring tools 1d Explain the IE rules of wiring.	1.1 Types of wires, wiring system. 1.2 Specifications of Different types of wiring materials, Accessories 1.3 Wiring tools. 1.4 Wiring circuits. 1.5 I.E. rules for wiring, IE Act-2003.
Unit-II Elements of Estimating and concepts of contracting	2a Classify types of estimation and estimation tools 2b Describe Purchase procedure 2c Explain the types of contracts and contractors. 2d Explain the concept of contracts and Tenders 2e Explain the procedure for submission and opening of tenders. 2f Explain the principles of Execution of works 2g Explain the procedure for Billing of executed work 2h Explain the specified actions for e-tendering.	2.1 Estimation and estimation tools. 2.2 Electrical Schedule of rates, catalogues, Survey and source selection, Recording estimates 2.3 Quantity and cost of material required. 2.4 Purchase system, Purchase inquiry and selection of appropriate purchase mode, Comparative statement, Purchase orders, Payment of bills 2.5 Types of contract system. 2.6 Tendering procedure and preparation of simple tender, method of opening tender and e-tender 2.7 Earnest Money Deposit, Security Deposit
Unit– III Estimating and Costing of Domestic and Industrial Wiring	3a. Prepare Layout and wiring diagram for domestic wiring. 3b. Calculate the Load, quantity and cost of material required for domestic wiring. 3c. Prepare Layout and wiring diagram for industrial wiring. 3d. Calculate the Load, quantity and cost of material required for	3.1 General rules for wiring 3.2 Layout of wiring. 3.3 Number of points (light, fan, socket outlets, etc.) 3.4 Total load and number of sub-circuits. 3.5 Size of conductor. 3.6 Ratings of main switch and distribution board. 3.7 Case studies-Domestic wiring. 3.8 Important consideration regarding Motor Installation Wiring. 3.9 Input current to motors

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
	industrial wiring.	3.10 Rating of cables, safety accessories 3.11 Size of conduit, distribution board, main switch, and starter. 3.12 Case studies-Industrial Wiring
Unit– IV Electrification of multistoried building	4a.Calculate total load on electrical distribution work. 4b.Estimate floor wise electrical material requirements 4c.Calculate the size of bus bar, cables, panels. 4d.Maintain smoke detection system in multistoried buildings. 4e.Maintain Diesel Generator set as a stand by unit.	4.1 Calculation total electrical load on distribution work 4.2 Floor wise estimation of material requirements i) Specification of wiring material and accessories. ii) Estimation of total cost of electrification using schedule of rates (SOR) 4.3 Case studies 4.4 Requirements of approval from electrical inspection for high rise multistoried building 4.5 Load calculation for lifts, escalators, air conditioners 4.6 Distribution panels and bus bar system 4.7 Fire alarm system 4.8 Smoke detection system 4.9 Use of D.G. set as a standby power supply in case of emergency.
Unit–V Estimation of Overhead and Underground Distribution System	5a. Draw layout of overhead distribution line. 5b. Prepare plan of overhead distribution project work. 5c. Determine main components and specification of overhead distribution system. 5d. Estimate quantity of material and cost required for an overhead distribution project work. 5e. Explain types of service connection. 5f. Explain I.E. rules related to overhead lines and service connection.	5.1 Overhead distribution system. 5.2 Line supports, Factors governing height of pole 5.3 cross arms, pole brackets and clamps, guys and stays, conductor's configuration spacing and clearances, span lengths, overhead line insulators, insulator materials lightning arrestors, erection of supports, setting of stays, 5.4 Earthing of lines, Guarding of overhead lines, Clearances of conductor from ground, Spacing between supports conductors 5.5 Materials and accessories required for the overhead distribution system. 5.6 Estimate for 440 V, 3-phase, 4 wires or 3 wires overhead distribution system. 5.7 Describe Method of installation

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
		of service connection (1-phase and 3-phase), observing I.E. rules 5.8 Types of service connections 5.9 I.E. rules pertaining to overhead lines and service connection. 5.10 Case studies.
	5g. Draw layout of underground distribution system. 5h. Prepare plan of underground distribution project work. 5i. Determine main components and specification of underground distribution system. 5j. Estimate quantity of material and cost required for a overhead distribution project work.	5.11 Underground distribution system. 5.12 Materials and accessories required for underground distribution system. 5.13 Estimate for 440 V, 3-phase, 4 wires or 3 wires underground distribution system. 5.14 I.E. rules pertaining to underground system and service connection. 5.15 Case studies.

9. SUGGESTED SPECIFICATION TABLE FOR QUESTIONPAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Electrical Wiring and IE Rules	6	04	04	02	10
II	Elements of Estimating and concepts of contracting	6	04	04	02	10
III	Estimating and Costing of Domestic and Industrial Wiring	8	04	05	06	15
IV	Electrification of multistoried building	10	02	05	05	12
V	Estimation of Overhead and Underground Distribution System	12	05	09	09	23
Total		**42**	**19**	**27**	**24**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*

Note*: This specification table provides general guidelines to assist students for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions to assess the attainment of the UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may slightly vary from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the

various outcomes in this course. Students should perform following activities in group (or individual) and prepare reports of about 5 pages for each activity. They should also collect/record physical evidence for their (student's) portfolio which may be useful for their placement interviews:

a) Prepare abstract of Indian standards related to industrial and non-industrial installations.
b) Summarize given section of National Electrical Code (NEC), 2011 required for electrical installation.
c) Prepare report on market survey of various electrical accessories, wires, and cables (specification, manufacture, quality, cost, etc.)
d) Collect any one electrical drawing of existing electrical installation and prepare for the same.
e) Collect information of tender published in newspaper of e-tender related to industrial or non-industrial electrical installation and fill necessary documents.
f) Prepare power point presentation for acquiring electrical installation work.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses (***MOOCs***) may be used to teach various topics/subtopics.
b) Guide student(s) in undertaking micro-projects.
c) ***'L' in section No. 4*** means different types of teaching methods that are to be employed by teachers to develop the outcomes.
d) About **15 to 20% of the topics/subtopics** which is relatively simpler or descriptive in nature is to be given to the students for **self-directed learning** and assess the development of the COs through classroom presentation.
e) With respect to item No. 10, teachers need to ensure to create opportunities and provisions for **co-curricular activities.**
f) Field visit/Industrial visit.
g) Show animation/video related to course content
h) Guide students on how to address issues on environment and sustainability
i) Introduce E-waste recycling technology among the students.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-projects are group-based (group of 3 to 5). However, **in the fifth and sixth semesters**, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based, or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The duration of the micro project should be about **12-14** ***(fourteen to sixteen) student engagement hours*** during the course. The students ought to submit micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. This must match the competency and the COs. Similar micro-projects could be added by the concerned course teacher:

a) **Electrical Diagrams:** Prepare report on existing electrical drawings.
b) **Domestic and commercial Installations:** Collect civil drawing plan and prepare estimation for the same.
c) **Industrial Installations:** Collect industrial installation plan and prepare estimation for the same.
d) **Distribution lines:** Collect existing installation plan of distribution lines and prepare estimation for the same.
e) **Contracting:** Collect any tender document related to electrical installation and fill all related documents.

13. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1	Electrical Design, Estimating and Costing	Raina, K.B. and Bhattacharya, S.K.	New Age International publisher, First, reprint 2010, ISBN: 978-81-224-0363-3
2	Electrical Estimating and Costing	Uppal, S.L.	Khanna Publisher New Delhi, ISBN 9788174092403
3	Electrical Installation Estimating and costing	Gupta, J.B.	S.K. Kataria and sons; New Delhi Reprint Edition. 2013, ISBN:13:9789350142790
4	I.E. rules for wiring, Electricity supply act-1948	Bureau of Indian Standards	Electricity supply act-1948
5	Relevant IS Code for-service line connection, laying of cable, wiring installation	NBC	National Building Code-Vol. IV
6	IS: 732-1989, code of practice for Electrical Wiring Installation	Bureau of Indian Standards	IS: 732-1989,

14. SOFTWARE/LEARNING WEBSITES

WEBSITES

- https://ask-the-electrician.com/wiringdiagrams.html
- https://www.electricaltechnology.org/2013/09/electrical-wiring.html
- https://www.electrical4u.com/electrical-engineering-articles/utilities/
- https://home.howstuffworks.com/home-improvement/repair/how-to-do-home-electrical-repairs.htm
- http://www.neca-neis.org/the-standards

15. PO-COMPETENCY-CO MAPPING:

Semester IV	Electrical Wiring Estimating, Costing and Contracting						
	POs						
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design/ development of solution	PO4 Engineerig Tools, Experimen-tation&Testing	PO 5 Engineering practices for society, sustainability & environment	PO 6 Project Manage-ment	PO 7 Life-long learning
Competency	***Carry out Electrical wiring estimating, costing and contract for various electrical installations.***						
Course Outcomes CO1 Select relevant wiring methods, tools, and accessories for electrical installations.	3	2	-	2	2		2
CO2 Undertake tendering and purchase procedure.	3	-	-	-	3	2	2
CO3 Estimate cost of various domestic and industrial installation as per IE Act-2003	2	-	2	-	2	2	2
CO4 Estimate the materials and cost of electrification for different buildings	2	2	2	2	2	-	2
CO5 Estimate cost of distribution line project as per IE Act-2003	2	-	2	-	2	2	2

*Legend: '**3**' for high, '**2**' for medium, '**1**' for low and '**-**' for no correlation of each CO with PO.*

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

S. No.	Name and Designation	Institute	Contact No.	Email
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GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2022 (COGC-202)
Semester-IV

Course Title: Digital Electronics & Digital Instruments
(Course Code: 4340904)

Diploma programmer in which this course is offered	Semester in which offered
Electrical Engineering	4th semester

1. RATIONALE

Digital electronics has invaded all branches of engineering and electrical engineering in particular. Hence it is essential that the diploma electrical engineer have a sound understanding of the basic fundamentals of digital electronics. The tremendous power and usefulness of digital electronics can be seen from the wide variety of industrial and consumer products, such as automated industrial machinery, computers microprocessors, pocket calculators, toys, microwave ovens, cellular phones, digital watches, microcontrollers, digital life support machines, real time systems and clocks, TV games etc. which are based on the principles of digital electronics. The digital systems with some kind of human interface will perform highly complex tasks with very high reliability and speed, unattainable by any other means Similarly digital instruments are replacing the analog instruments. Therefore, this course has been designed so that basic skills to operate and maintain the basic digital circuits and digital instruments are developed in the students.

2. COMPETENCY

The course content should be taught and implemented with the aim to develop different types of skills so that students are able to acquire following competency:

Maintain digital electronic circuits and instruments.

3. COURSE OUTCOMES (COs)

The theory should be taught and practical should be carried out in such a manner that students are able to acquire different learning outcomes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

i. Perform computational activities using digital techniques.
ii. Use digital integrated circuit and logic family chips
iii. Build sequential and combinational logic circuits.
iv. Analyse working of A/D and D/A converters.
v. Select different digital meters for measurements.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
3	0	2	4	30*	70	25	25	150

(*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

***Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **CA** - Continuous Assessment; **ESE** - End Semester Examination.*

5. SUGGESTED PRACTICAL EXERCISES

The following practical outcomes (PrOs) are the sub-components of the Course Outcomes (Cos). Some of the PrOs marked '*' are compulsory, as they are crucial for that particular CO at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'.

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Build a circuit to Convert 4-bit Gray to Binary Code using logic gates.	I	2
2	Build a circuit to Convert 4-bit Binary to Gray Code using logic gates.	I	2
3	Verify the truth table of the different Logic Gates**.**	II	4*
4	Build and test 2 input basic logic Gates using NAND Gate.	II	2*
5	Build and test 2 input basic logic Gates using NOR Gate.	II	2*
6	Verify Demorgan's theorems.	III	4*
7	Build and test the logic circuit for a given Boolean Expression.	III	2
8	Build and test Half Adder Circuit.	III	2*
9	Build and test Full Adder Circuit.	III	4
10	Build and test Half Subtractor Circuit.	III	2*
11	Build and test Full Subtractor Circuit.	III	4
12	Test Eight channel Multiplexer and Eight channel Demultiplexer.	III	4
13	Build/Test the 4 bit Decoder circuit for seven segment display	III	2
14	Build/Test the 4 bit encoder circuit for seven segment display	III	2
15	Build and test 3 to 8 line decoder circuit.	III	2
16	Build and test 8 to 3 line encoder circuit	III	2
17	Display various alphanumeric characters on BCD and Seven segment LED Display	III	4
18	Build and test the working of the R-S Flip-Flop	IV	2*
19	Build and verify the truth table of D Flip-Flop.	IV	2

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
20	Build and verify the truth table of J-K Flip-Flop.	IV	2
21	Build and verify the truth table of master – slave J-K Flip-Flop.	IV	4
22	Build and test the working of the Shift Register.	IV	4
23	Build and Test the working of the Decade counter	IV	2
24	Build 4-bit ripple counter in count-up mode using J-K flip-flop.	IV	4
25	Convert given analog signal to 4 bit Digital output using ADC	V	4
26	Convert the given digital signal to analog output using DAC.	V	4
27	Build and Test various digital circuits with the help of simulation software and digital instruments	VI	2
	Minimum 10 Practical Exercises		28

Note

*i. More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list.*

*ii. The following are some **sample** 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency.*

Sr. No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Prepare experimental setup	20
2	Operate the equipment setup or circuit	20
3	Follow safe practices.	10
4	Record observations correctly	20
5	Interpret the result and conclude	30
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

This major equipment with broad specifications for the PrOs is a guide to procure them by the administrators to user in uniformity of practical's in all institutions across the state.

Sr.No.	Equipment Name with Broad Specifications	PrO. No.
1	Digital logic trainer kit	1 to 7
2	Combinational circuit trainer kit	8 to 11

Sr.No.	Equipment Name with Broad Specifications	PrO. No.
3	Multiplexer and Demultiplexer trainer kit	12
4	Encoder and decoder trainer kit	13 to 16
5	BCD to 7-segment LED display trainer kit	17
6	Flip-flop trainer kit	18 to 21
7	Register Trainer Kit	22
8	Universal Counter Trainer kit	23 & 24
9	ADC and DAC converter kit	25 & 26
10	Simulation software	27

7. AFFECTIVE DOMAIN OUTCOMES

The following ***sample*** psychomotor &Affective Domain Outcomes (Pos& ADOs) are embedded in many of the above-mentioned COs and PrOs. More could be added to fulfill the development of this course competency.

a) Work as a leader/a team member(while doing a micro-project)
b) Follow safety practices while using trainer kit.
c) Work as a group member (while performing experiments and taking readings)
d) Follow ethical practices.
e) Practice environmental friendly methods and processes. (Environmentrelated)

The ADOs are best developed through the laboratory/field based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

i. 'Valuing Level' in 1st year
ii. 'Organization Level' in 2nd year.
iii. 'Characterization Level' in 3rd year.

8. UNDERPINNING THEORY

The major underpinning theory is given below based on the higher level UOs of *Revised Bloom's taxonomy* that are formulated for development of the COs and competency. If required, more such UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Major Learning Outcomes	Topics and Sub-topics
Unit-I Number Systems	1a. Convert numbers from one to another system 1b. Perform binary	1.1 Introduction 1.2 Number Systems: 1.2.1 Decimal Number System

Unit	Major Learning Outcomes	Topics and Sub-topics
	arithmetical operations. 1c. State 1's complement and 2's complement numbers for a given binary number and perform addition and subtraction. 1d. Explain various types of binary codes and its applications.	1.2.2 Binary Number System 1.2.3 Octal Number System 1.2.3 Hexadecimal Number System. 1.3 Conversion of Number from one Number system to Another Including decimal points. 1.4 Arithmetic operations with binary numbers: 1.4.1 Binary Addition 1.4.2 Binary Subtraction 1.4.3 Binary Multiplication 1.4.4 Binary Division with Examples. 1.5 1's and 2's Complement of Binary numbers. 1.6 Binary subtraction using 1's and 2's Complement method. 1.7 Concepts of Digital codes, BCD, Gray Code,Excess-3 Code and Alphanumeric Codes.
Unit– II Logic Gates And Logic Families	2a. Differentiate different logic levels 2b. List the logic gates. 2c. Explain the operations of different types of gates in digital circuits. 2d. Prepare the truth table of Different types of gates OR,AND,NOT,NAND,NOR, EX-OR AND EX-NOR. 2e. Develop basic gates using Universal gates. 2f . Explain the features of various logic families and Characteristics of Digital ICs.	2.1 Concept of Positive Logic and negative Logic Levels. 2.2 Definition, symbols and truth tables of NOT, AND, OR, NAND,NOR,EX-OR and EX-NOR Gates. 2.3 NAND and NOR as Universal gates. 2.4 Various scales of Integration: SSI, MSI, LSI, VLSI and ULSI. 2.5 Classification of logic families. 2.6 Characteristics of Digital ICs : Logic Voltage level, Fan in, Fan out, Noise margin, Propagation Delay, Power Dissipation, Figure of Merit with reference to logic families. 2.7 Introduction to Resistor Transistor Logic and Diode Transistor Logic. 2.8 Basic logic gates using NMOS, PMOS and CMOS.

Unit	Major Learning Outcomes	Topics and Sub-topics
Unit– III Boolean Algebra and Combinational circuits.	3a. Create truth tables and Boolean expressions for basic logic gates. 3b. Apply laws of Boolean Algebra to logic diagrams and truth table to minimize the circuit size necessary to solve a design problem. 3c. State the need for De-Morgan's theorems & Apply De-Morgan's theorems and other postulates to simplify Boolean expressions to reduce resources used in the design and production of circuits. 3d. Build logic circuit for a given Boolean expression. 3e. Construct truth tables from logic expressions and vice versa. 3f. Build various combinational circuits. 3g. Design, construct and test adder circuits using logic gates to perform basic addition and subtraction using a binary numbering system. 3h. Explain the operation of multiplexer, De-multiplexer and Encoder. 3j.Describe the working of 3 to 8 decoder and BCD to Seven segment decoder	3.1 Laws of Boolean algebra. 3.2 Demorgan's theorems. 3.3 Simplification of given Boolean equation. 3.4 Converting Boolean expressions to logic circuits and vice versa. 3.5 Converting Boolean expression to truth tables and vice versa. 3.6 Block diagram of combinational circuits. 3.7 Adders: Definition and Types. 3.8 Half Adder: Block diagram, Logic diagram, truth table and working. 3.9 Full Adder: Block diagram, Logic Diagram ,truth table and it's working. 3.10 Types of subtractors. 3.11 Half Subtractor: Block diagram, Logic diagram, truth table and working 3.12 Full Subtractor: Block diagram, truth table and working. 3.13 Multiplexers: Definition, block diagram. 3.13.1 Classification of Multiplexer. 3.13.2 Basic 2:1 Multiplexer. 3.13.3 4:1 Multiplexer. 3.13.4 8:1 Multiplexer 3.13.5 Applications of MUX. 3.14 Demultiplexers: Block diagram. 3.14.1 Classification of Demultiplexer. 3.14.2 Basic 1:2 Demultiplexer. 3.14.3 1:4 Demultiplexer. 3.14.4 1:8 Demultiplexer 3.15 Encoders: 3.15.1 Octal to Binary Encoder, 3.15.2 Decimal to BCD Encoder 3.16 Decoders: 3.16.1 3-Line-to-8-Line Decoder, 3.16.2 BCD-to-Seven Segment Decoders.

Unit	Major Learning Outcomes	Topics and Sub-topics
Unit- IV Sequential	4a. Understand the working of	4.1 Block diagram of sequential

Unit	Major Learning Outcomes	Topics and Sub-topics
Circuits	Sequential Logic circuits. 4b. Explain the working of various Flip Flops with the help of truth table. 4c. Use of flip-flops or latches to store data, act as a memory device or transfer data through a shift register. 4d. Describe the working of various types of shift registers. 4e. Draw the waveform of Asynchronous and Synchronous counter 4f. Demonstrate the differences associated with asynchronous and synchronous circuits. 4g. Illustrate the decade counter and its waveforms. 4h. Compare and evaluate how sequential logic determines the operation of a circuit waveform and how a truth table can be used to predict an outcome.	circuits. 4.2 Comparison of Sequential Circuits with Combinational circuits 4.3 Concept of level and edge triggering. 4.4 Types of Flip-flop. 4.5 R-S flip-flop and clocked R-S flip-flop: Block diagram, truth table, logic diagram using NAND gates and working. 4.6 D flip-flop: Block diagram, truth table, logic diagram and working. 4.7 JK flip-flop: Block diagram, truth table, logic diagram using NAND gates and working 4.8 Master slave JK flip flop with preset and clear input: block diagram only, truth table and working. 4.9 Applications of Flip-flops. 4.10 Shift Register: 4-bit Shift Register: Serial-In, Serial-Out Shift Register, Serial-In,Parallel-Out ShiftRegister, Parallel-In,Serial-Out ShiftRegister, Parallel-In, Parallel-Out Shift Register using D flip flops. 4.11 Applications of Shift Registers. 4.12 Counters: Classification of Counters, Comparison between Asynchronous and Synchronous counters. 4.13 Four-bit Decade counter : Block diagram using JK flip-flops, truth table, timing diagram and working.
Unit-V **A to D And D to A Converters**	5a. Understand Analog to Digital and Digital to Analog Converters. 5b. List the different types of A to D and D to A converters. 5c. Describe the working of various types of A to D Converters & necessity of A to D converters 5d. Describe the working of	5.1 Necessity of A to D and D to A converters.. 5.2 D to A converter specifications: Resolution, accuracy, settling time. 5.3 Digital to Analog conversion: 5.3.1 Weighted Resistor Network type 5.3.2 Binary Ladder Network type 5.4 Analog to Digital conversion:

Unit	Major Learning Outcomes	Topics and Sub-topics
	various types of D to A converters & necessity of D to A converters.	5.4.1 Successive approximation type 5.4.2 Counter OR Staircase type 5.5 Applications of A to D and D to A Converters.
Unit-VI Digital Instruments	6a. State the features of digital instruments over Analog instruments. 6b. Draw the block diagram of digital instruments and explain each block. 6c. Explain the working of various Digital instruments with block Diagram.	6.1 Comparison of digital instrument with analog instrument. 6.2 Basic building blocks of digital instruments. 6.3 Types of Digital Voltmeter. 6.4 Ramp Type Digital Voltmeter. 6.5 Digital Multimeter. 6.6 Digital frequency Meter. 6.7 Digital watt meter 6.8 Digital energy meter .

9. SUGGESTED SPECIFICATION TABLE FOR QUESTIONPAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Number Systems	6	2	4	4	10
II	Logic Gates and Logic families	8	3	4	6	13
III	Boolean Algebra and Combinational Circuits	10	5	4	8	17
IV	Sequential Circuits	9	5	6	4	15
V	A to D and D to A Converters	4	2	2	3	07
VI	Digital Instruments	5	3	3	2	08
	Total	**42**	**20**	**23**	**27**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*
Note*: This specification table provides general guidelines to assist students for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions to assess the attainment of the UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may slightly vary from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Following is the list of proposed student activities such as:

i. Prepare solutions of different assignments given by subject faculty.

ii. Report writing on various topics from syllabus and beyond syllabus.
iii. Solve the numerical related to course contents.
iv. Prepare a report of different IC packages and mention different scale of integration.
v. List the ICs used for different logic gates with their pin diagram details.
vi. List the ICs used for Flip-flops, Shift registers, Counters with their pin diagrams.
vii. Build various combinational and sequential circuits using virtual lab/simulator softwares.
viii. Solve real life problems using binary logic theory and implement it using digital logic circuits.
Explore working of Digital Clock/Digital Panel.
ix. Student may validate the experimental results with that of results obtained using various simulation soft ware's.
x. Student may present seminar on a given topic from course content.
xi. Students may develop counters for practical use.
xii. Identification and checking ICs using IC Tester.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b) Visit to nearby electronic component manufacturing factories
c) Display of animation/video films on functioning of digital instruments.
d) Virtual Lab may be used to perform various practicals.
e) Introduce E-waste recycling technology among the students.
f) Guide students on how to address issues on environment and sustainability

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-projects are group-based (group of 3 to 5). However, **in the fifth and sixth semesters**, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The duration of the micro project should be about **14-16** ***(fourteen to sixteen) student engagement hours*** during the course. The students ought to submit micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. This has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher:

a) Build model to demonstrate logic gates
b) Build model of universal gates.
c) Build model of De-morgan's theorem.

d) Build model of various types adders and subtractors
e) Build model of encoder and decoder.
f) Build model of multiplexer and demultiplexer.
g) Build model of 3 to 8 line decoder using IC74LS138.
h) Build model of flip flops, shift registers and different counters.
i) Build model of A to D and D to A converter.
j) Build model of Decade Counter.
k) Prepare chart for various digital instruments.
l) Prepare chart for various combinational and sequential circuits.
m) Prepare chart of number systems.
n) Prepare chart for code conversion.
o) Rig up common anode 7 segment display circuit using Breadboard and display 0-9.

13. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication
1.	Digital Electronics	Sanjay Sharma	S.K.Kataria & sons.
2.	Digital Electronics	Dr.B.R.Gupta & V.Singhal	S.K.Kataria & sons.
3.	Digital Electronics (for Polytechnics)	Pratima Manhas Shaveta Thakral	S.K.Kataria & sons.
4.	Trouble shooting & Maintenance of Electronic equipments	K. Sudeep singh	S.K.Kataria & sons.
5.	Digital design : with an introduction to the verilog hdl	M. Morris Mano, Michael D. Ciletti	Pearson, 5th edition.
6.	Morden Digital Electronics	R P Jain	TMH
7.	Fundamentals of Digital circuits	A. Anand Kumar	PHI
8.	Digital Electronics	K. Meena	PHI
9.	Digital principles & Applications	Malvino. A. P., Leach D. P., Saha Goutam	Tata Mcgraw Hill Education Private Limited (2010), 7th Edition
10.	Pulse digital & switching wave forms	Millman & Taub	Mc. Graw Hill
11.	Electronic devices & circuits	Allen Mottershed.	Prentice Hall of India
12.	Principles of digital Electronics	Malvino & Leach	Tata Mc. Graw Hill
13.	Digital circuits & systems	Douglass V. Hall	Mc. Graw Hill
14.	Digital Electronics	B.R.Gupta	Dhanpat Rai & Co., New Delhi.

15.	Digital Systems,Principles and Applications	Ronald J. Tocci	Prentice Hall of India, New Delhi.
16.	Digital Electronics	Dr. R.S.Sedha	S. Chand
17.	Digital Circuits Design	S. Salivahanan, S. Arivazhagan	VIKAS Pub. House.
18.	Digital Electronics	P. RAJA	SCITECH Publication.
19.	Digital Electroncis Principles, Devices and Applications	Anil K. Maini	Wiley Publications
20.	Digital Integrated Electronics	Taub & Schilling	TMH

14. SOFTWARE/LEARNING WEBSITES

WEBSITES

1) www.nptel.iitm.ac.in
2) www.ocw.mit.edu
3) www.slideshare.net/
4) www.alldatasheet.com
5) www.nptl.iitm.ac.in
6) www.slideshare.net
7) www.authorstream.com
8) www.daenotes.com
9) www.youtube.com/nptelhrd
10) https://de-iitr.vlabs.ac.in/
11) https://dld-iitb.vlabs.ac.in/
12) http://vlabs.iitkgp.ac.in/dec/#

15. PO-COMPETENCY-CO MAPPING:

Semester I	**D.E. & D. I. (Course Code:4340904)**						
	POs						
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design/ development of solution	PO4 Engineerig Tools, Experimen-tation&Testing	PO 5 Engineering practices for society, sustainability & environment	PO 6 Project Manage-ment	PO 7 Life-long learning
Competency	**Maintain digital electronic circuits and instruments.**						

Course Outcomes							
CO1 Perform computational activities using digital techniques.	3	-	-	-	-	-	-
CO2 Use digital integrated circuits and logic family chips.	3	-	-	2	-	-	-
CO3 Build sequential and combinational logic circuits.	3	2	2	2	-	2	-
CO4 Analyse working of A/D and D/A converters.	3	2	-	2	-	-	-
CO5 Select different digital meters for measurements.	3	-	-	2	-	-	-

*Legend: '**3**' for high, '**2**' for medium, '**1**' for low and '**-**' for no correlation of each CO with PO.*

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

S. No.	Name and Designation	Institute	Contact No.	Email
1.	Shri Jasmin M. Patel Lecturer Electrical Engg.	SSGP Surat	9825719595	jasminp@ymail.com
2.	Ms. Dipa J. Kapupara Lecturer Electrical Engg	AVPTI, Rajkot	9409111405	dipakapupara.ee@gmail.com
3.	Mrs. Upasna M. Patel Lecturer Electrical Engg.	SSGP Surat	9428464009	Ups180191@gmail.com

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
Semester-V

Course Title: Entrepreneurship & Start-ups
(Course Code: 4300021)

Diploma programmer in which this course is offered	Semester in which offered
All Branches of Diploma Engineering	5th Semester

1. RATIONALE

Entrepreneurs have significant impact on our country's current developing economy. The social expectations towards engineering professionals are certainly emerging as job creators especially with the thrust given to "Make in India" and "Vocal for Local" campaigns. Startup India is a well-known flagship initiative of the Government of India, intended to catalyze startup culture and build a strong and inclusive ecosystem for innovation and entrepreneurship. The last 6 years have witnessed tremendous growth of start-ups i.e. from 733 in 2016-17 to 14000 in 2021-22. This course focuses on the basic roles, skills and functions of entrepreneurship with special attention to startup. The course is directed to help students to enhance capabilities in the field of managing the given task as well as to understand peripheral influencing aspects for starting a new business. It will certainly help students to think in a direction to establish a small industry /start-up and develop /validate it using fundamental know how.

2. COMPETENCY

The purpose of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Establish a small enterprise /start-up validate it and make it scalable.**

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with the identified competency are to be developed in the student for the achievement of the following COs:

Upon completion of the course, the student will be able to demonstrate knowledge of the following topics:

1) Understanding the dynamic role of entrepreneurship and Startups by Acquiring Entrepreneurial spirit and resourcefulness, quality, competency, and motivation
2) Identify a Business Idea and implement it
3) Select suitable Management practices like leadership and Ownership, resource institutes
4) Overview of Support Agencies and Incubators
5) Building Project Proposal & knowing CSR , Ethics, Ex-Im, & Exit strategies

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)	Total Credits (L+T+P/2)	Examination Scheme		
		Theory Marks	Practical	Total Marks

						Marks		
L	**T**	**P**	**C**	**CA**	**ESE**	**CA**	**ESE**	
3	0	0	3	30*	70	0	0	100

(*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

***Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **CA** - Continuous Assessment; **ESE** - End Semester Examination.*

5. SUGGESTED Soft PRACTICAL EXERCISES (During Theory)

The entrepreneurial or start-up journey begins by readying for your future dream from college projects and pursuing the same beyond college hours also. It is encouraged to go through COs and identify traits and search for various state and national agencies for your entrepreneurship / start-up journey and convert the same into successful product in market.

The following practical outcomes (SPrOs) are the sub-components of the Course Outcomes (COs). Some of the **SPrOs** marked **'*'** are compulsory, as they are crucial for that particular CO at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'.

Note

i. *Though the course does not contain any Practical work, a few **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The below table is only a suggestive list.*

ii. *The following are some **sample** 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency.*

Sr. No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Entrepreneur Traits and Behavior Modelling	30
2	Various State and Central Entrepreneurship Promotional Schemes and Start-up Policies	30
3	Business Model for a Startup and study of Unicorns*	40
Total		**100**

6. AFFECTIVE DOMAIN OUTCOMES

The following ***sample*** Affective Domain Outcomes (ADOs) are embedded in many of the above-mentioned COs and PrOs. More could be added to fulfill the development of this course competency.

a. Work as a leader/a team member (while doing a micro-project).
b. Model behavioral practices of an entrepreneur while planning for an enterprise
c. Practice ethics and consider methods/ processes that reduce waste and/or possibly conserve environment in designing a new business till it's commercialization.

The ADOs are best developed through the laboratory/field-based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

i. 'Valuing Level' in 1st year-Planning
ii. 'Organization Level' in 2nd year-Model Development
iii. 'Characterization Level' in 3rd year-Make it Scalable

7. UNDERPINNING THEORY

The major underpinning theory is given below based on the higher level UOs of *Revised Bloom's taxonomy* that are formulated for development of the COs and competency. If required, more such UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Major LearningOutcomes (in cognitive domain)	Topics and Sub-topics
1) Introduction to Entrepreneurship and Start – Ups	1a) Define Entrepreneurship 1b) Discuss characteristics and functions of entrepreneurship. 1c) Identify different types of Entrepreneurships 1d) Compare the concepts entrepreneurand intrapreneur and find out the motivation behind it 1e) Distinguish between entrepreneur and managers 1f) Identify 7-M Resources 1g) Know MSME & Startup India, standup India, SSIP and its registration process for both.	1. Definition, Traits of an entrepreneur, 2. Functions of Entrepreneurship - Job Creation, Innovation, Inspiration, Economic Development 3. Types of Entrepreneurship 4. Motivation for Intrapreneurship 5. Types of Business Structures, 6. Similarities and differences between entrepreneurs and managers. 7. 7-M Resources 8. Micro, Small, Medium Enterprise/ MSME - Industry Registration Process 9. Startup India, Standup India and SSIP Gujarat & Startup registration process

2) Business Ideas and their implement ation (Idea to Start-up)	2a) Finding Ideas and making an activity map 2b) Develop the plans forcreating and starting the business 2c) To identify business using the ideation canvas and the business model canvas 2d) To know market research related terms 2e) To know market mix related terms 2f) Learn Product related terminologies 2g) Emphasize on Innovation 2h) Explain concept of Risk and SWOT	1. Discovering ideas and visualizing the business with Activity map 1.1 Idea Generation 1.2 Product Identification 2. Business Plan- The Marketing Plan and Financial Plan/ Sources of Capital 3. Business opportunity identification and evaluation 4. Market research 4.1.1. Questionnaire design 4.1.2. Sampling 4.1.3. Market survey 4.1.4. Data analysis & interpretation 5. Marketing Mix (4Ps- product,price, promotion place) 5.1.1. Identifying the target market 5.1.2. Competition evaluation and Strategy adoption 5.1.3. Market Segmentation 5.1.4. Marketing, Advertising and Branding 5.1.5. Digital Marketing 5.1.6. B2B, E-commerce and GeM 6. Product Terms- PLC, Mortality Curve and New product Development Steps, Inventory, Supply Chain Management 7. Importance and concept of Innovation, Sources and Process 8. Risk analysis and mitigation by SWOT Analysis
3) Management Practices	3a) Explain the concept and differences between industry, commerce and business. 3b) Describe various types of ownerships in the organization. 3c) Explain different types of leadership models. 3d) Analyze the nature and importance of various functions of management 3e) Discuss Financial organization Management 3f) Distinguish management and administration	1. Industry, Commerce and Business 2. Types of ownership in the organization -Definition, Characteristics, Merits &Demerits 3. Different Leadership Models 4. Functions of Management- Merits & Demerits 4.1 Planning 4.2 Company's Organization Structure 4.3 Directing 4.4 Controlling 4.5 Staffing- Recruitment and management of talent. 5. Financial organization and management 6. Differences between Management and Administration

4) Support Agencies and Incubators	4a) Identify support agencies and current promotional schemes for enterprise and startups 4b) Advocacy to investor 4c) To Explain various Legal Issues	1. State & National Level Support agencies and Current Promotional Schemes for new Enterprise 2. Start-up Incubation and modalities 3. Communication of Ideas to potential investors – Investor Pitch 4. Legal Issues 4.1. Contracts 4.2. Copyrights 4.3. Insurance 4.4. IPR 4.5. Licensing 4.6. Patents 4.7. Trade Secrets 4.8. Trademarks
5) Project Proposal & Exit strategies	5a) To work on the development of a project proposal 5b) Describe social responsibility and relate with economic Performance. 5c) Explain managerialethics 5d) To know Ex-Im Policies 5e) Identify suitable strategies of succession and harvesting	1. Project Planning i. Project planning and report ii. Feasibility study iii. Project cost estimation iv. Breakeven point, v. Return on investment and Return on sales 2. Corporate Social Responsibilities and Economic performance 3. Business Ethics 4. Ex-Im policies 5. Succession and harvesting strategy 6. Bankruptcy and avoidance

8. SUGGESTED SPECIFICATION TABLE FOR QUESTIONPAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction to Entrepreneurship and Start – Ups	08	4	6	2	12
II	Business Ideas and their implementation (Idea to Startup)	08	6	4	4	14
III	Management Practices	12	6	8	8	22
IV	Support Agencies and	08	4	4	4	12

	Incubators					
V	Project Proposal & Exit strategies	06	2	4	4	10
Total		**42**	**22**	**26**	**22**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*
Note*: This specification table provides general guidelines to assist students for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions to assess the attainment of the UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may slightly vary from above table.*

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course. Students should make a portfolio i.e. perform at least FIVE from following list of activities individually or in group (not more than 2). They should prepare reports of about 2-5 pages for each activity and collect/ record physical evidence for their portfolio which may be useful for their placement interviews:

i. Develop two products from household waste (attach photographs).
ii. Download product development and innovative films from internet.
iii. Prepare a collage for "Traits of successful entrepreneurs."/ "Motivation & Charms of Entrepreneurship"
iv. Invite entrepreneurs, industry officials, bankers for interaction. Interview at least four entrepreneurs or businessman and identify
v. Identify your hobbies and interests and convert them into business idea.
vi. Mock Business Model- Choose a product and design a unique selling preposition, brand name, logo, advertisement (print, radio, and television), jingle, packaging, and labeling for it.
vii. Develop your own website. Share your strengths and weakness on it. Declare your time bound goals and monitor them on the website.
viii. Choose any product/ advertisement and analyze its good and bad points/ cost sheet/ supply chain etc. (individuals should select different ads)
ix. Compare schemes for entrepreneurship promotion of any bank.
x. Visit industrial exhibitions, trade fairs and observe nitty-gritty of business. Get news of Vibrant Gujarat Events. (Upcoming in Jan 2024)
xi. Open a savings account and build your own capital.
xii. Arrange a visit to a Mall, observe products, supply chain management and prepare report.
xiii. Organize industrial visit and suggest modifications for process improvement. Conduct a market survey for a product /project before visit. In the visit collect data on machinery specifications, price, output/hour, power consumption, manpower requirement, wages, raw material requirement, specification, price, competitor's product price, features, dealer commissions, marketing mix etc. Make a detailed report at the end of the visit.
xiv. Select a social cause, set objectives, plan and work for its accomplishment. Find details about some famous NGOs
xv. Present Own Dream Start-up story as Seminar OR Analyze 2 products from Shark Tank program.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses (***MOOCs***) may be used to teach various topics/subtopics.
b) Guide student(s) in undertaking micro-projects.
c) ***'L' in section No. 4 means*** different types of teaching methods that is to be employed by teachers to develop the outcomes.
d) Show animation/ video related to course content.
e) Various Apps related to subject topics/ sub-topics
f) Other Common instructions as under
    1) Instructors should emphasize more on exemplary and deductive learning.
    2) Students should learn to recognize, create, shape opportunities, and lead teams forproviding economic-social value to society.
    3) Business simulations should be used to enhance behavioral traits of successfulintrapreneurs and entrepreneurs amongst students.
    4) Emphasis should be on creating entrepreneurial society rather than only setting upof enterprise.
    5) They must be encouraged to surf on net and collect as much information aspossible.
    6) Each student should complete minimum ten activities from the suggested list.Minimum possible guidance should be given for the suggested activities.
    7) Students should be promoted to use creative ideas, pool their own resources, finishtheir presentation, communication and team skills.
    8) Alumni should be frequently invited for experience sharing, guiding andrewarding students.
    9) Display must be arranged for models, collages, business plans and othercontributions so that they motivate others.
    10) You may show video/animation film / presentation slides to demonstrate variousmanagement functions, traits of entrepreneur etc.
    11) Arrange a visit to nearby venture capital firm.
    12) Give 1 Mini project and 1project report for future business to all the students.
    13) The following pedagogical tools will be used to teach this course:
        a) Lectures and Discussions
        b) Role Playing
        c) Assignments and Presentations
        d) Case Analysis
        e) Quiz on Management and Entrepreneurship
        g) Mimic/ narrate examples from world's leading businessmen among the students.
        h) Guide students on how to address issues on environment and sustainability

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-projects are group-based (group of 3 to 5). However, **in the fifth and sixth semesters**, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain a dated work diary consisting of individual contributions in the project work and give a seminar presentation of it before submission. The duration of the guidance for micro project should be about **6-8 *(six to eight) student engagement hours*** during the theory/ course. The students ought to submit micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects/ practical exercise is given here. This has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher:
(It can be a Seminar with bound /hand written notes/ ppts of individual students OR a product/ service portfolio)

1) Entrepreneur Traits and Behavior Modelling
2) Various State and Central Entrepreneurship Promotional Schemes and Start-up Policies
3) Business Model for a Startup and study of Unicorns
4) Make your own Product / Service portfolio/ Proposal with USP, logo, advertisement (print, radio, and television), jingle,packaging, labeling and branding for it.

13. SUGGESTED LEARNING RESOURCES

Sr. No	Title of Book	Author	Publication with place, year and ISBN
1	Entrepreneurship in Action	Coulter	PHI 2nd Edition
2	Entrepreneurship Development	E. Gordon & K. Natarajan	Himalaya
3	Entrepreneurship	Robert D. Hisrich & Mathew J. Manimala	McGraw Hill Education; ISBN 978-1259001635
4	Entrepreneurial Development	S S Khanka	S Chand & Company; ISBN: 978-8121918015
5	Entrepreneurship Development and Management	A. K. Singh	Jain Book Agency (JBA) publishes, New Delhi
6	Entrepreneurship Development& Management	R.K. Singal	S K Kataria and Sons; ISBN: 978-8189757007
7	Small Scale Industries and Entrepreneurship	Vasant Desai	Himalaya 2008
8	Entrepreneurship	Roy Rajeev	Oxford University Press; ISBN: 978-0198072638
9	Industrial Engineering and Management	O.P.Khanna	Dhanpat Rai and Sons, Delhi
10	Industrial Organization and Management	Tara Chand	NemChand and Brothers; Roorkee
11	Industrial Management and Entrepreneurship	V. K. Sharma.	Scientific Publishers, New Delhi
12	Entrepreneurship Developmentand Small Business Enterprise	Poornima M Charantimath	Pearson Education; ISBN: 978-8131759196
13	Entrepreneurship Development	S Anil kumar	NEW AGE Intern. Pvt Ltd; ISBN: 978-8122414349

14	The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company	Steve Blank and Bob Dorf	K & S Ranch ISBN – 978-0984999392
15	The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses	Eric Ries	Penguin UK ISBN – 978-0670921607
16	Demand: Creating What People Love Before They Know They Want It	Adrian J. Slywotzky with Karl Weber	Headline Book Publishing ISBN – 978-0755388974
17	The Innovator's Dilemma: The Revolutionary Book That Will Change the Way You Do Business	Clayton M. Christensen	Harvardbusiness ISBN: 978-142219602
18	How to write a business plan,	Brian Finch	2nd edition, 2007, Kogan Page India Pvt. Ltd.
	Advance Reading		
19	HBR - Creating business plan	-	20-minute manager series, 2014.
20	HBR – Creating business plan	-	Expert solution to everyday challenges, 2007.

14. SOFTWARE/LEARNING WEBSITES

[A] List of Software/Learning Websites:

Sr. No.	Topic Key Word	Link
1	MoCI	https://www.india.gov.in/website-ministry-commerce-and-industry
2	MSME	1)https://msme.gov.in/ 2) https://www.msmex.in/learn/government-schemes-for-startups-and-msmes-in-india/
3	Start-up, Stand-up India & SSIP Gujarat	1) https://www.startupindia.gov.in/ 2) https://www.standupmitra.in 3) https://udyamimitra.in/page/standup-india-loans 4) https://www.ssipgujarat.in/
4	Make in India	https://www.makeinindia.com/
5	Atmanirbhar Bharat Abhiyan Vocal for Local	https://indiancc.mygov.in › uploads › 2021/08
6	Skill India	https://skillindia.gov.in
7	MSDE	https://www.msde.gov.in/
8	Vibrant Gujarat	https://www.vibrantgujarat.com/
9	NABARD	www.nabard.com
10	PAN	https://www.onlineservices.nsdl.com/paam/endUserRegisterContact.html
11	I-hub	https://ihubgujarat.in
12	GSTIN	https://reg.gst.gov.in/registration

13	IEC Code	https://www.dgft.gov.in/CP
14	Mudra	https://www.mudra.org.in/
15	Export-Import	http://niryatbandhu.iift.ac.in/exim/
16	NSIC	https://www.nsic.co.in/
17	DIC	https://ic.gujarat.gov.in/dic -contact.aspx -District Industries Centre
18	EDI	https://www.ediindia.org/
19	CED	https://ced.gujarat.gov.in/home
20	NIESBUD	https://www.niesbud.nic.in/
21	Start-up Talky	https://startuptalky.com/list-of-government-initiatives-for-startups/
22	Invest India	https://www.investindia.gov.in/startup-india-hub
23	SAAC	https://www.saccindia.org/india/startups.html?utm_source=google&utm_medium=cpc&gclid=EAIaIQobChMIutLQ4dfW_wIVeppmAh1cOAAIEAMYASAAEgIJO_D_BwE
24	Action for India	https://actionforindia.org/afi-activity-accelerator-programs.html?gclid=EAIaIQobChMIutLQ4dfW_wIVeppmAh1cOAAIEAMYAiAAEgLVGvD_BwE
25	Indian Chamber of Commerce	https://www.indianchamber.org/
26	FICCI	https://www.ficci.in/api/home
27	GCCI	https://www.gujaratchamber.org/

[B] Some Films (To be seen on Sundays/holidays by students on their own, not to be shown in polytechnics in any case**)**

i. Any Body Can Dance (2013)
ii. Corporate (2006)
iii. Do Duni Char (2010)
iv. Guru (2007)
v. Oh My God (2013)
vi. Pirates of Silicon Valley (1999)
vii. The Pursuit of Happiness (2006)
viii. Rocket Singh (2010)
ix. Start-up.com (2001)
x. The Social Network (2010)
xi. Wall Street (1987)
xii. Band Baja Barat (2010)
xiii. You've Got Mail (1998)
xiv. Steve Jobs (2015)
xv. Chef (2014)
xvi. "Office Space (1999)
xvii. Erin Brockovich (2000)
xviii. The Founder (2016)

15. PO-COMPETENCY-CO MAPPING:

Semester V	Entrepreneurship & Startups

	(Course Code: **4300021**)						
	POs						
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design / development of solution	PO4 Engineering Tools, Experimentation & Testing	PO 5 Engineering practices for society, sustainability & environment	PO 6 Project Management	PO 7 Life-long learning
Competency	Use concepts of management optimally to establish a small enterprise or start-up, validate it and make it scalable.						
CO1-Understanding the dynamic role of entrepreneurship and Startups by Acquiring Entrepreneurial spirit and resourcefulness, quality, competency, and motivation	3	1	2	-	-	2	2
CO2- Identify a Business Idea and implement it	3	2	2	1	1	3	3
CO3-Select suitable Management practices like leadership and Ownership, resource institutes	3	-	1	1	2	2	3
CO4- Overview of Support Agencies and Incubators	2	3	2	2	1	2	2
CO5- Building Project Proposal & knowing CSR , Ethics, Ex-Im, & Exit strategies	3	2	2W	1	1	3	3

*Legend: '**3**' for high, '**2**' for medium, '**1**' for low and '**-**' for no correlation of each CO with PO.*

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

S. No.	Name and Designation	Institute	Contact No.	Email
1.	Mr. Ujjval V Buch (MBA)	G.P.Ahmedabad	9825346922	uvbuch@gmail.com
2.	Dr. Satya Acharya	EDI, Bhat.	7600050606	satya@ediindia.org

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2022 (COGC-2022)
Semester –V

Course Title: Switchgear & Protection
(Course Code: 4350901)

Diploma programmer in which this course is offered	Semester in which offered
Electrical Engineering	5th Semester

1. RATIONALE

In power system abnormalities and fault are occurs. This phenomenon causes heavy fault current, damage costlier equipment and it leads power supply interruption. Hence, it is essential to study about switchgear and protection for diploma electrical engineer. It is expected that understanding of selection, principal, operation, testing and maintenance of various protective scheme will help them to maintain reliability of power system while performing the various duties like operator, supervisor, service engineer etc.

2. COMPETENCY

The purpose of this course is to help the student to attain the following competency through various teaching learning experiences

- **To operate and maintain power system protection scheme.**

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with the identified competency are to be developed in the student for the achievement of the following COs:

- ***a)*** Interpret the principles of protection and the different components involved in protection
- ***b)*** Compare the over-current protection, distance protection and carrier-current protection of transmission line
- ***c)*** Use and maintain the various protective schemes of transformer
- ***d)*** Use and maintain the various protective schemes of Alternator and Induction Motor
- ***e)*** Interpret working, construction and application of circuit breaker
- ***f)*** Interpret insulation coordination and protect system against over voltage

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
3	0	2	4	30*	70	25	25	150

(*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

***Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **CA** - Continuous Assessment; **ESE** - End Semester Examination.*

5. SUGGESTED PRACTICAL EXERCISES

The following practical outcomes (PrOs) are the sub-components of the Course Outcomes (Cos). Some of the **PrOs** marked **'*'** are compulsory, as they are crucial for that particular CO at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'.

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Identify and understand working of various input and output ports of numerical relay	1	2
2	Find the polarity and various cores of an instrument transformer (Metering, Protection and PS class cores)	1	2
3	Test and verify the characteristics of a PS class core of an instrument transformer - Knee point Characteristics.	1	2
4	Test the overcurrent and earthfault relay for DMT and IDMT characteristics for different PSM & TMS.	1	2
5	Extract & Analyse the Disturbance Recorder data, Events data & Fault Data from the numerical protection relay after the occurrence of the fault.	2	2
6	Test the protective scheme of redial feeder	2	2
7	Test the protective scheme of parallel feeder	2	2
8	Test the distance protection scheme for transmission line	2	2
9	Test the working of Buchholz Relay and Oil Surge Relay (OSR) for detection of an internal fault of a power transformer.	3	2
10	Test the working of Pressure Release Valve (PRV), OTI & WTI (Thermal Protection Relays).	3	2
11	Test Percentage Biased Differential Protection Relay and Restricted Earth Fault Protection Relay. Plot the characteristics obtained from the tests for different current settings.	3	2
12	Understand the basics & operating principles of NIFPS system for the protection of a power transformer.	3	2
13	Test the various protective scheme of induction motor using numerical relay	4	2
14	Identify various components of a circuit breaker. SF6 CB, Vacuum CB, Tripping Circuit Supervision Relay and Gas Pressure Healthiness Assessment circuit.	5	2
15	Analyse, understand and interpret various electrical protective schemes & wiring diagrams used for the	5	2

	implementation of various types of protections of power system elements.		
16	Test the protective scheme of alternator	5	2
17	Set up a horngap type lightening arrestor	6	2
	Total Hours (Perform any practical worth 28 hours from above depending upon the availability of resources so that most units are covered)		**34**

Note

i. *A suggestive list of PrOs is given in the above table. More such PrOs can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the Cos.*

ii. *The following are some sample 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency.*

Sr. No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Prepare experimental setup/layout/line diagram	10
2	Use of the appropriate tools/materials	20
3	Follow safe practices.	10
4	Observation and recording	20
5	Interpretation of result and conclusion	20
6	Answer to sample questions.	20
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

This major equipment with broad specifications for the PrOs is a guide to procure them by the administrators to user in uniformity of practical in all institutions across the state.

Sr.No.	Equipment Name with Broad Specifications	PrO. No.
1	CT – PT 10-5/1-1 A, 440/110V	03
2	Combine overcurrent earth fault numerical relay	01
3	Numerical transformer relay	01
4	Numerical distance relay kit	01
5	SF6 and Vacuum circuit breaker	01
* For better understanding of concept, it is advised to perform various protection scheme using conventional relay as well as numerical relay		

7. AFFECTIVE DOMAIN OUTCOMES

The following ***sample*** Affective Domain Outcomes (ADOs) are embedded in many of the above-mentioned COs and PrOs. More could be added to fulfill the development of this course competency.

a) Work as a leader/a team member (while doing a micro-project)
b) Follow safety practices.
c) Work as a group member (while performing experiments and taking readings)
d) Follow ethical practices.
e) Practice environmentally friendly methods and processes. (Environment related)

The ADOs are best developed through the laboratory/field-based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

i. 'Valuing Level' in 1st year
ii. 'Organization Level' in 2nd year.
iii. 'Characterization Level' in 3rd year.

8. UNDERPINNING THEORY

The major underpinning theory is given below based on the higher level UOs of *Revised Bloom's taxonomy* that are formulated for development of the COs and competency. If required, more such UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	**Unit Outcomes (UOs)** (4 to 6 UOs at different levels)	**Topics and Sub-topics**
Unit – I Protective relay system	1a. Function of protective relaying scheme 1b. Evaluation of protective relaying technology 1.c Basic tripping circuit with transducer 1d. Main and backup protection 1e. Classification of relays : Conventional relay, numerical relay, tripping relay.	1.1 Types, cause and effect of fault 1.2 Elements of protection system 1.3 Role of CT and PT in protection system 1.3.1 Errors in CT – PT 1.3.2 Characteristic of CT and PT 1.4 Advancement in protection system technology 1.4.1 Numerical relays 1.4.2 Disturbance recorder 1.4.3 Optical Current transformer 1.4.4 Optical potential transformer. 1.5 Basic tripping circuit 1.5.1 Trip circuit supervision. 1.5.2 Basic logic circuit
Unit-II Feeder and Transmission line and busbar protection	2a Basic radial feeder and ring feeder 2b Overcurrent and earth fault protection 2c Directional and Non-directional overcurrent protection 2d Classification of relays for transmission line	2.1 Method of discrimination 2.1.1 Time discrimination 2.1.2 Current discrimination 2.1.3 Current – Time discrimination 2.2 Inverse Definite minimum time protection 2.3 Limitation of overcurrent protection

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
	protection 2e Protection zone, reverse zone protection 2f Busbar protection 2g Carrier aided protection	2.4 Impedance relay, Mho relay, reactance relay protection scheme 2.5 Power line carrier communication for protection 2.6 Auto reclosing 2.7 Requirement of bus zone protection 2.8 Differential protection for busbar 2.9 Breaker protection scheme : Local breaker backup and remote breaker backup 2.10 Travelling wave fault locator relay 2.11 Negative sequence relay for detection of broken conductor in transmission line 2.12 Basics of Centralised Control System - SCADA & IEC 61850 Protocol.
Unit– III Transformer Protection	3a. Fault in transformer 3b. Transformer protection schemes 3c. Numerical relay for transformer protection	3.1 Overcurrent – earth fault protection 3.2 Differential protection of transformer 3.3 Restricted earth fault protection of transformer 3.4 OTI – WTI : overheating protection 3.5 Buchholz protection, Pressure relief valve, Oil surge relay 3.6 Nitrogen injection fire protection system for power transformer. 3.7 Features of numerical differential relay and its advantages 3.8 Inrush Current Protection - Harmonic Restraint.
Unit– IV Rotating machine protection	4a. Faults on Alternator and Induction motor 4b. Protective relaying schemes for Alternator and Induction motor protection 4c. Conditions causing alarms for alternator	4.1 Inter-turn fault, stator earth-fault , rotor earth-fault 4.2 Negative phase sequence, field failure protection, overload protection, over-voltage protection

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
		4.3 Reverse power protection, back-up impedance, under-frequency protection 4.4 Class A, Class B and Class C protections conditions causing alarm and tripping 4.5 4.5 IM protection : Overloading, Single phasing, under voltage, stalling, differential protection.
Unit–V Circuit breaker	5a. Functions of circuit breakers 5b. Fundamentals of circuit breaking 5c. Quenching of AC & DC arc 5d. Arc interruption theories	5.1 Type of circuit breaker based on : Actuating mechanism, interrupting medium, based on installation, based on external design 5.2 Isolators 5.3 Making and Breaking capacity 5.4 Restriking voltage and recovery voltage 5.5 Air circuit breaker 5.6 SF6 Circuit breaker 5.7 Vacuum circuit breaker 5.8 Multi break circuit breaker 5.9 HCDC circuit breaker 5.10 Comparisons of different type of circuit breaker 5.11 Operation sequence interlocking
Unit – VI Lightening protection	6a. Cause of overvoltage 6b. Characteristics of LA 6c. Insulation coordination	6.1 Lightening and switching surges 6.2 Classification of LA based-on principle, construction and application 6.3 Basic impulse insulation level

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Protective relay system	08	02	05	03	10
II	Feeder, Transmission line and busbar protection	10	04	07	07	18
III	Transformer Protection	06	02	04	04	10
IV	Rotating machine protection	07	02	05	04	11
V	Circuit breaker	08	06	05	04	16
VI	Lightening protection	03	02	02	02	06

Total	42	18	28	24	70

Legends: *R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*
Note*: This specification table provides general guidelines to assist students for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions to assess the attainment of the UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may slightly vary from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course. Students should perform following activities in group (or individual) and prepare reports of about 5 pages for each activity. They should also collect/record physical evidence for their (student's) portfolio which may be useful for their placement interviews:

a) Visit EHV substation / Power station
b) Prepare report on market survey of various relays and circuit breaker.
c) Prepare technical report on construction of conventional relays.
d) Collect data of lightening arrestor.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses (***MOOCs***) may be used to teach various topics/subtopics.
b) Guide student(s) in undertaking micro-projects.
c) ***'L' in section No. 4*** means different types of teaching methods that are to be employed by teachers to develop the outcomes.
d) About **15 to 20% of the topics/subtopics** which is relatively simpler or descriptive in nature is to be given to the students for **self-directed learning** and assess the development of the COs through classroom presentation.
e) With respect to item No. 10, teachers need to ensure to create opportunities and provisions for **co-curricular activities.**
f) Field visit/Industrial visit.
g) Show animation/video related to course content
h) Guide students on how to address issues on environment and sustainability regarding SF6 circuit breaker.
i) Introduce E-waste recycling technology among the students.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-projects are group-based (group of 3 to 5). However, **in the fifth and sixth semesters**, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based, or field-based. Each micro-project should encompass two or more COs

which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The duration of the micro project should be about **12-14** ***(fourteen to sixteen) student engagement hours*** during the course. The students ought to submit micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. This must match the competency and the COs. Similar micro-projects could be added by the concerned course teacher:

a) **Case study:** Major electrical black out and role of protection system.
b) **Alternator / Induction motor protection schemes:** Prepare the detailed protection schemes
c) **Presentation:** Protection system of malfunctions .
d) **Transmission and distribution line :** Prepare the detailed protection schemes
e) Explore unique features of numerical relay.

13. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1	Fundamentals of Power System Protection	Y. G. Paithankar, S.R. Bhide	Prentice Hall, India, 2003 ISBN: 978-8120341234
2	Power System Protection and Switchgear	B. A. Oza, N.C. Nair, R.P. Mehta, V.H. Makwana	McGraw Hill Education Ltd, 2010 ISBN: 978-0070671188
3	Power System Protection and Switchgear	B. Ram, D N Vishvakarma, S R Mohanty	S.K. Kataria and sons; New Delhi Reprint Edition. 2013, ISBN:13:9789350142790
4	Network Protection and Automation Guide	Alstom Grid	Alstom, 2011

14. SOFTWARE / LEARNING WEBSITES

WEBSITES

- Web course on "Power System Protection" by Prof. S. A. Soman, IIT, Bombay available on NPTEL at http://nptel.ac.in/courses/108101039
- Power System Protection and Switchgear by Prof. Bhavesh Bhadja https://www.youtube.com/watch?v=QsGn7H_14VY&list=PLLy_2iUCG87BIJ6ZliVIRCx2Crf9_fJMB
- https://www.youtube.com/watch?v=3xsDFeTOC6w&list=RDQMlXdOHuLWmGw&start_radio=1

15. PO-COMPETENCY-CO MAPPING:

Semester V	SWITCHGEAR & PROTECTION						
	POs						
Competency & Course Outcomes	O 1 asic & iscipline ecific nowledge	PO 2 roblem nalysis	PO 3 Design/ developme nt of solution	O4 ngineering ools, xperimentati n & Testing	PO 5 Engineering ractices for ociety, ustainability & nvironment	PO 6 roject Manage- nent	PO 7 Life-long learning
Competency	***Carry out Electrical wiring estimating, costing and contract for various electrical installations.***						
CO1 Interpret the principles of protection and the different components involved in protection	3	2	-	2	2	-	2
CO2 Compare the over-current protection,	3	2	-	-	2	-	2

distance protection and carrier-current protection of transmission line							
CO3 Use and maintain the various protective schemes of transformer	3	2	2	-	2	-	2
CO4 Use and maintain the various protective schemes of Alternator and Induction Motor	3	2	2	-	2	-	2
CO5 Interpret working, construction and application of circuit breaker	3	2	2	-	2	2	2
CO6 Interpret insulation coordination and protect system against over voltage	3	2	2	-	2	-	2

*Legend: '**3'** for high, '**2**' for medium, **'1'** for low and **'-'** for no correlation of each CO with PO.*

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

S. No.	Name and Designation	Institute	Contact No.	Email
1.	B B Chauhan Lecturer Electrical Engg.	Government Polytechnic, Jamangar	+91 99252 10010	bbc.gpjam@gmail.com
2.	J A Sutariya Lecturer Electrical Engg.	RCTI, Ahmedabad	+91 95122 84422	

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
Semester-V

Course Title: Power Electronics and Drives
(Course Code: 4350902)

Diploma programmer in which this course is offered	Semester in which offered
Electrical Engineering	5th Semester

1. RATIONALE

Applications of power electronics are used in every field, for example, industrial applications, consumer applications, transportation and aerospace applications. This course address to reduce climate change, pollution and unreliability of energy grids. Power has become one of the most important components of modern life. This has led to the development of smaller, lightweight energy-dense batteries based on converters/inverters to lead the revolution in ESS.

2. COMPETENCY

The purpose of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Identify power electronic devices and implement different types of Power converters as per functioning of system required with safety.**

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with the identified competency are to be developed in the student for the achievement of the following COs:

a) Compare performance of various power semiconductor devices, along with its protection as per data sheet
b) Recognize different rectifiers and regulators according to device, phases and area of use.
c) Classify inverters and choppers with reference to different parameters and configuration
d) Distinguish the speed control of different motors using various AC and DC drives.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
3	0	2	5	30*	70	25	25	150

(*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs. ***Legends: L****-Lecture;* ***T*** *– Tutorial/Teacher Guided Theory Practice;* ***P*** *- Practical;* ***C*** *– Credit,* ***CA*** *- Continuous Assessment;* ***ESE*** *- End Semester Examination.*

5. SUGGESTED PRACTICAL EXERCISES

The following practical outcomes (PrOs) are the subcomponents of the Course Outcomes (Cos). Some of the **PrOs** marked **'*'** are compulsory, as they are crucial for that particular CO at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'.

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Test the performance of IGBT	1	2
2	Test the performance of GTO	1	2
3	Test the performance of MCT	1	2
4	Test and plot characteristics of SCR	1	2
5	Build and test Snubber circuits		
6	Test SCR commutating circuits.	1	2
7	Build and test SCR triggering circuit with firing angle control in R and RL series circuit	1	2
8	Compare the ratings and packages of IGBT, GTO, MCT using data sheet.	1	2
9	Simulate of single-phase controlled rectifier and analyze function of flywheel diode for RL load	2	2
10	Wire the three-phase half wave rectifier & test the performance.	2	2
11	Wire the three-phase full wave rectifier & test the performance	2	2
12	Check the performance of six phase half wave rectifier.	2	2
13	Analyze poly phase rectifier circuit performance through simulation	2	2
14	Test the performance of TRIAC for AC load control	2	2
15	Use R-C phase shift network for firing angle Control of single phase controlled rectifier	3	2
16	Test chopper circuits with load.	3	2
17	Simulate chopper circuit, observe and print the various wave forms.	3	2
18	Build/test parallel inverter using two SCRs	4	2
19	Test the Speed control of universal motor using SCR-UJT circuit	4	2
20	Simulate speed control of DC motor using chopper circuits	4	2
22	Simulate Speed control of three-phase induction motor using V/f control	4	2
23	Simulate speed control of single-phase Induction Motor using single phase voltage controller		
			28 Hrs.

Note

i. *More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list.*

ii. *The following are some **sample** 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency.*

Sr. No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Experimental setup, Procedure and conduction by following safety practices.	40
2	Conceptual clarity	30
3	Interpretation of Results and Ethical values.	30

Sr. No.	Sample Performance Indicators for the PrOs	Weightage in %
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

This major equipment with broad specifications for the PrOs is a guide to procure them by the administrators to use in uniformity of practical's in all institutions across the state.

Sr.No.	Equipment Name with Broad Specifications	PrO. No.
1.	DIAC, TRAIC, SCR, IGBT, GTO and MCT - 5 Nos. each of current rating at least 20 amps or above	5,6,7,8,9
2	Trainer Kits for testing the V-I characteristics of the following - 2 Nos. each: a) DIAC b) TRAIC c) SCR d) Power transistor e) Power MOSFET f) IGBT g) GTO h) MCT	5,6,7,9
3	Trainer kit to check the performance for different types of loads of the following - 2 Nos. each: a) 3-phase uncontrolled half wave rectifier b) 3-phase uncontrolled full wave rectifier	1,2
4	Trainer kit to check the performance using R, RL and RLC Load of the following - 2 Nos. each: **a)** Fully controlled three phase half wave converter **b)** Fully controlled three phase Full wave converter	1,2
5	Trainer kit to check the performance of Three-phase semi-converter using R, RL and RLC Load of the following - 2 Nos.	1,2
6	Chopper Trainer kit to check the performance of the following for different types of loads - 2 Nos. each: a) IGBT Based Chopper Circuit b) Jones Chopper Trainer Circuit c) Morgan Chopper Trainer Circuit	13,14,19
7.	Trainer kit to check the performance for different types of loads of the following - 2 Nos. each: a) Offline inverter b) Online inverter	15, 21
8	Trainer kit to check the performance for different types of loads of the following - 2 Nos. each: a) Class A Load Commutation b) Class B Resonant Pulse Commutation c) Class C Complementary Commutation d) Class D Impulse or Auxiliary SCR commutation e) Class F Line or natural Commutation	12
9	Electric DC Drive Trainer consisting of the following controlling schemes - set: a) Speed control of dc DC shunt motor using single phase fully controlled converter b) Speed control of DC shunt motor using three phase fully controlled converter c) Armature and field control of DC shunt motor	19

Sr.No.	Equipment Name with Broad Specifications	PrO. No.
	d) Speed control of DC shunt motor using SCR dual converter e) Thyristor chopper for DC motor drive f) DC series motor controller using jones chopper	
10	Experimental set up to perform Speed control of a 3 phase WRIM using Kramer drive - 1 set	20
11	Experimental set up to perform Speed control of a 3 phase induction motor using v/f method - 1 set	21
12	Experimental set up to perform speed control of a DC shunt motor using open loop and PID control system through computer interfacing - 1 set	19
13	3 Phase Power Analyzer 3 Nos. with the following specifications: □ 3 phase/1 phase measurement- □ True RMS Voltage 600/1200 V □ True RMS Current 80 A, □ Power measurement (Active, reactive and apparent power),□ Power factor measurement, □ Frequency Measurement, □ RS-232 serial communication, □ LCD display	

7. **AFFECTIVE DOMAIN OUTCOMES**The following ***sample*** Affective Domain Outcomes (ADOs) are embedded in many of the above-mentioned COs and PrOs. More could be added to fulfill the development of this course competency.

a. Work as a leader/a team member (while doing a micro-project).
b. Follow safety practices while using D.C. and AC supply and electrical electronic equipment.
c. Work as a group member (while performing experiments and taking readings)
d. Practice environmentally friendly methods and processes. (Environment related)

The ADOs are best developed through the laboratory/field-based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

i. 'Valuing Level' in 1st year
ii. 'Organization Level' in 2nd year.
iii. 'Characterization Level' in 3rd year.

8. **UNDERPINNING THEORY**

The major underpinning theory is given below based on the higher level UOs of *Revised Bloom's taxonomy* that are formulated for development of the COs and competency. If required, more such UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
Unit 1 **Power Electronic Devices- Characteristics protection and working parameters as per data sheet**	1a. Need of Power Electronic devices, types and application. 1b. Classify Power electronic devices 1c. Explain Construction, working, operation, characteristics, ratings and application of different Power electronic devices. i.e. Power Diode, Transistor, IGBT, SCR, MCT, GTO, Triac Diac, UJT. 1d. Justify need of Protection of power electronic devices 1e. Differentiate various commutation circuits 1f. Understanding data sheet and parameters	1.1 Thyristor family 1.2 Working and characteristics of SCR, IGBT, GTO, MCT, Diac, Triac 1.3 Need of SCR protection- Over voltage, over current, di/dt, dv/dt Heating, 1.4 Need of snubber circuit, heatsink, freewheeling diode. 1.5 Turnoff Methods of SCR- 1.6 Natural and forced commutation. 1.7 Voltage, current and power ratings of SCR
Unit-II **Three phase uncontrolled and Single-phase controlled rectifiers and regulators**	2a. Need of polyphase rectifier 2b. Compare various polyphase uncontrolled rectifier 2c. Differentiate working of single phase halfwave, full wave-controlled rectifiers. 2d. Effect of transformer reactance, PIV. 2e. Compare different single-phase regulators using 1, 2, and 4 diodes and SCR's combination	2.1 compare single phase and 3 phase rectifiers. 2.2 Three phase half wave, full wave uncontrolled rectifier 2.3 Six phase half wave, double star six phase rectifier 2.4 Derive rms current and voltage I_{dc} and E_{dc} for 3 phase half and full wave rectifier. 2.5 Transformer reactance, SUF, controlled rectifier. 2.6 Principle of AC Load control using SCR 2.7 Role of regulators and rectifiers in energy conservation
Unit-III **Choppers Inverters**	3a. Explain working principle D.C. Chopper 3b. Classify Chopper with configuration 3c. Class A, B, C, D E Chopper 3d. Chopper control methods 3e. Jone's Chopper 3f Morgan Choppers 3g. Classification of inverters 3h. Series and Parallel inverters 3i. Voltage control methods of inverter 3j. PWM control in inverter. 3k. Introduction to harmonics	3.1 Working Principle of Chopper 3.2 Configuration of Chopper 3.3 Chopper control 3.4 Principle of Inverter. 3.5 Single phase inverters- series parallel and half and full bridge, square wave, quasi wave inverter. 3.6 Methods of Voltage control in inverter- single pulse, multiple pulse and sine pulse modulation 3.7 Introduction to multilevel inverter- 3 level inverter diode clamped and capacitor clamped 3.8 Basics of Harmonics and power quality in power electronic 3.9 Application of inverter in solar energy using buck boost conversion.
Unit-IV **Electric drives and Control**	4a. Concepts of Electric drives 4b. Power Modulators and motors 4c. 4 Quadrant operation of DC Drives 4d. D C drive using chopper control 4e. Single phase DC drives 4f. Introduction to Cycloconverter 4g. A C drives- Voltage, frequency,	4.1 Block diagram of electric drives 4.2 Different parts of electric drives 4.3 Power Modulators 4.4 AC Drives – Inverter based 4.5 DC Drives- Rectifier and Chopper based 4.6 Cycloconverters -types, application and

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
	current control. 4h. Application of Electric Drives in EVs	disadvantages. 4.7 4 Quadrant operation of DC drive 4.8 Speed control of 3phase induction motor using chopper. 4.9 Regenerative braking control in E- Vehicles 4.10 Single phase half semi and full converter drives 4.11 Speed control of Induction motor using various controls- Voltage, frequency V/F control

9. SUGGESTED SPECIFICATION TABLE FOR QUESTIONPAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	**Power Electronic Devices- Characteristics protection and working parameters as per data sheet.**	12	8	7	5	20
II	**Single phase and three phase uncontrolled and controlled rectifiers and regulators.**	9	6	5	5	16
III	**Inverters, Choppers.**	10	4	8	6	18
IV	**Electronic drives and Control.**	11	4	6	6	16
Total		**42**	**22**	**26**	**22**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*
Note*: This specification table provides general guidelines to assist students for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions to assess the attainment of the UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may slightly vary from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course. Students should perform following activities in group (or individual) and prepare reports of about 5 pages for each activity. They should also collect/record physical evidence for their (student's) portfolio which may be useful for their placement interviews:

a) Present seminar on various topics from course content
b) Prepare nameplate of Control rectifier, inverter, electrical drives for DC motor, Induction motor.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses (***MOOCs***) may be used to teach various topics/subtopics.

b) Guide student(s) in undertaking micro-projects.

c) ***'L' in section No. 4 means*** different types of teaching methods that are to be employed by teachers to develop the outcomes.

d) Show animation/ video related to course content.

e) Co-relating the importance of content of this course with other courses/ practical applications. (e.g. importance of a content course or whole course related to Rectifiers, *inverters, Electrical Drives, FACT devices, Harmonic Filters* in practical industrial &/ domestic applications.

f) Introduce E-waste recycling technology among the students.

g) Guide students on how to address issues on environment and sustainability

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-projects are group-based (group of 3 to 5). However, **in the fifth and sixth semesters**, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain a dated work diary consisting of individual contributions in the project work and give a seminar presentation of it before submission. The duration of the micro project should be about **12-14** ***(fourteen to sixteen) student engagement hours*** during the course. The students ought to submit micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. This has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher:

1) Prepare a report on various types of drives used in nearby industries.
2) Prepare chart displaying various Power semiconductor devices and their symbols
3) Simulate following circuits in syllabus and take print out of various wave forms.
   (a) 3 phase half wave rectifier
   (b) 3 phase full wave rectifier
   (c) 6 phase half wave rectifier
   (d) Step up & Step-down chopper circuit
   (e) 1-phase half & full bridge inverter
4) Make a market survey for various types of thyristors available in market.
5) Present a dynamic animations prepared or collected from the internet to illustrate the following:
   (a) Working principle of inverter
   (b) Working principle of PWM inverter
   (c) Working principle of chopper
6) Build 3 phase half wave rectifier circuit & prepare report on it.
7) Build 3 phase full wave rectifier circuit & prepare report on it.
8) Build step up & step-down chopper & prepare report on it.
9) Single phase AC load control using Diac and Triac.
10) Demonstration of commutation circuit for SCR.
11) Single phase inverter using 2 MOSFET and transformer.
12) Square wave inverter using 4 MOSFET, IGBT, Transistor.
13) Overcurrent protection using crowbar circuit.
14) Design of snubber circuit.
15 Speed control of DC Motor using Chopper
16) Speed control of DC motor using 4 diode and 1 SCR
17) Design of Static switch up to 5 Amperes.

13. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1.	Power Electronics	Rashid, Muhammad H.	PHI Learning, New Delhi latest edition
2.	Power Electronics	Gupta, B. R., Singhal V.,	S.K. Kataria and sons, New Delhi
3.	Power Electronics	Singh,M. D. K. Khanchandani, B.	Tata Mc. Graw Hill, New Delhi
4.	Power Electronics	Bimbhra, P.S.	Khanna Publisher, New Delhi latest edition
5.	Power Electronics and its Application	Alok Jain	PENRAM International Publishing
6.	Industries and power Electronics	Rai, H.C.	Umesh Publications. New Delhi latest edition
7.	Fundamentals of electric drives	Dubey, G. K.	Narosa Publishing house New Delhi latest edition
8.	Electric drives- concepts and applications	Subramanyan, V.	Tata McGraw-Hill, New Delhi latest edition

14. SOFTWARE/LEARNING WEBSITES

WEBSITE

(1) www.nptel.iitm.ac.in

(2) www.youtube (lectures on Power electronics)

(3) www.howstuffworks.com

(4) www.alldatasheet.com

(5) MATLAB/SIMULINK

(6) Psim : https://powersimtech.com

(7) Electronics Work bench

(8) www.vlab.co.in

(9) Lectures on GTU portal: https://lectures.gtu.ac.in/listview.aspx?br=09&course=DI

15. PO-COMPETENCY-CO MAPPING:

Semester V	**POWER ELECTRONICS AND DRIVES (Course Code:4350902)**						
	POs						
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design/ development of solution	PO4 Engineering Tools, Experimen-tation & Testing	PO 5 Engineering practices for society, sustainability & environment	PO 6 Project Manage-ment	PO 7 Life-long learning
Competency	**Identify power electronic devices and implement different types of Power converters as per functioning of system required with safety.**						
Course Outcomes CO1: Compare performance of various power semiconductor devices, along with its protection as per data sheet	3	2	2	2	2	-	1
CO2: Recognize different rectifiers and regulators according to device, phases and area of use.	3	2	1	2	2	-	2
CO3: Classify inverters and choppers with reference to different parameters and configuration	3	-	1	2	2	-	2

CO4 : Distinguish the speed control of different motors using various AC and DC drives.	3	2	-	1	2	-	2

*Legend: '**3'** for high, '**2**' for medium, **'1'** for low and **'-'** for no correlation of each CO with PO.*

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

S. No.	Name and Designation	Institute	Contact No.	Email
1.	Ms.Chandni Chirag Shah Lecturer Electrical Engg.	A V Parekh Technical Institute Rajkot	7016146890	chandnicshah@gmail.com
2.	Mr Alpesh Mahyavanshi Lecturer Electrical Engg.	G.P. Dahod	9824573878	alpeshmahyavanshi@gmail.com

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
Semester-V

Course Title: Electrical Engineering Project-I
(Course Code: 4350904)

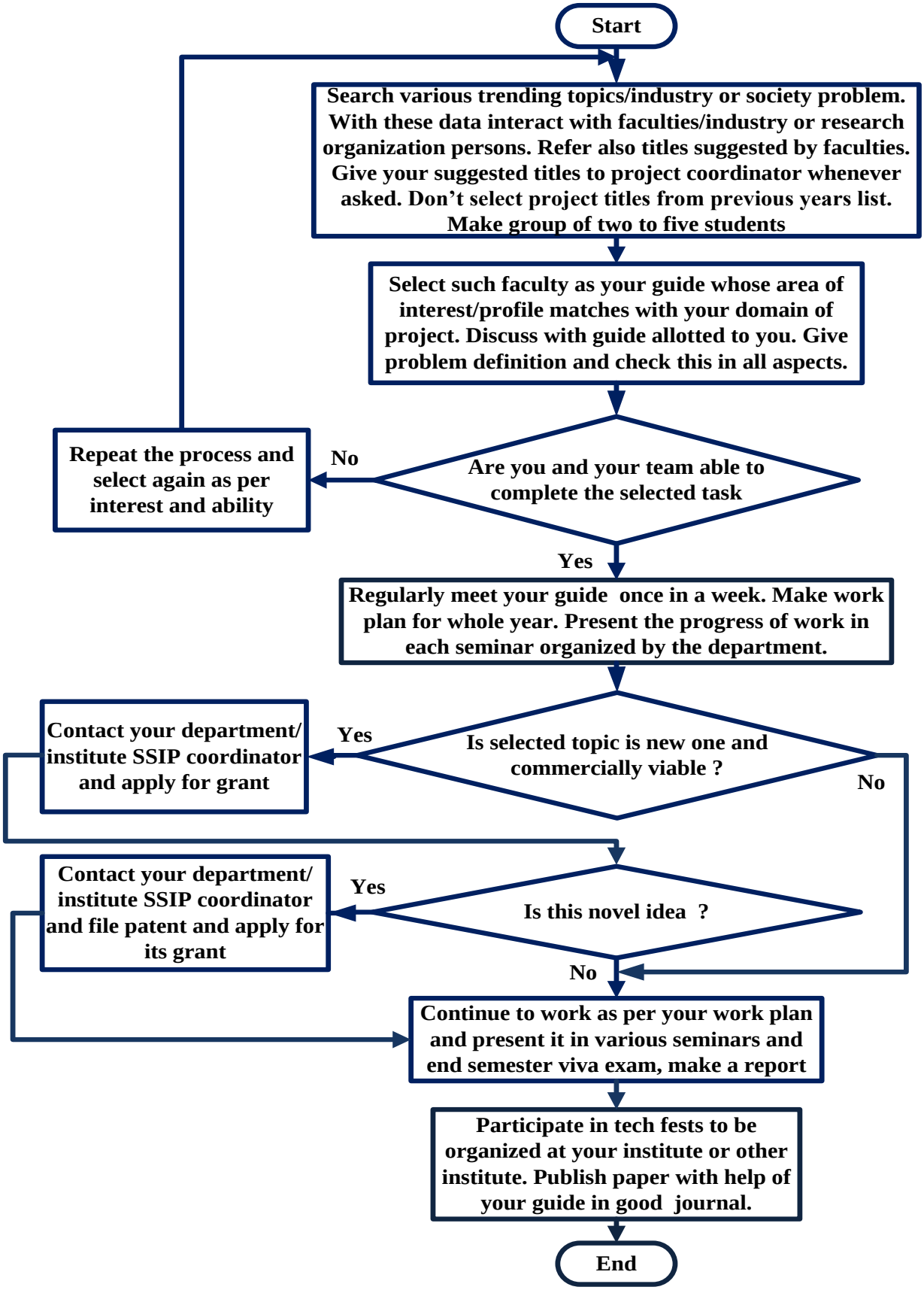
Diploma programme in which this course is offered	Semester in which offered
Electrical Engineering	5th Semester

1. RATIONALE

The course "**Electrical Engineering Project-I**" is designed with the aim that students will be able to keep pace with future changes in technology and the acquisition of knowledge and skills as and when needed. This course is designed to provide students with a virtual industrial experience. This course includes identifying the problem, different methods of solution, selection of an appropriate method, selection of appropriate equipment and components, selection of appropriate guide and making the work plan to complete the whole work within time limit. Four seminars are included in this course to develop communication skills in students as well as to assess the progress of the work done.

Project identification and guide allocation:

- First of all students have to form a group and select some proposed project titles based on their interest. To select proposed titles students have to visit various websites, visit industries, refer journals and books and meet and discuss with faculties.
- Faculty from a department whose work area/ area of interest seems to fit with the student's selected topic may be considered as the best guide for that particular group.
- Before the start of the fifth semester, project orientation should be held every year by the project coordinator. In this orientation, discussion regarding the selection of a topic, the formation of a team, and the selection of a guide should take place.
- A guide list with their expertise domain and area of interest should also be given to students.
- This list should also be uploaded to the departmental/institutional website.
- Students should also be given the choice to choose a guide whose area of interest matches with their project domain.The project title selection process and other related tasks are summarized in the following flow chart.


Start
Search various trending topics/industry or society problem. With these data interact with faculties/industry or research organization persons. Refer also titles suggested by faculties. Give your suggested titles to project coordinator whenever asked. Don't select project titles from previous years list. Make group of two to five students
Select such faculty as your guide whose area of interest/profile matches with your domain of project. Discuss with guide allotted to you. Give problem definition and check this in all aspects.
Are you and your team able to complete the selected task
No
Repeat the process and select again as per interest and ability
Yes
Regularly meet your guide once in a week. Make work plan for whole year. Present the progress of work in each seminar organized by the department.
Is selected topic is new one and commercially viable ?
Yes
Contact your department/ institute SSIP coordinator and apply for grant
No
Is this novel idea ?
Yes
Contact your department/ institute SSIP coordinator and file patent and apply for its grant
No
Continue to work as per your work plan and present it in various seminars and end semester viva exam, make a report
Participate in tech fests to be organized at your institute or other institute. Publish paper with help of your guide in good journal.
End

During 5th semester, students should have to follow these steps for project related work:

1) Interact with the institute guide/ industry/research organization personnel
2) Select focused project title.
3) Gather information and organize it in well manner-literature Survey.
4) Define, explain and submit problem definition.
5) Seek guidance from the guide and update him/her about your progress regularly.
6) Conceive and draw General block diagram of selected project.
7) Develop circuit diagram in detail.
8) Write algorithm and draw flowchart (particularly if project work is based on Microprocessor/Microcontroller).
9) Simulate circuit (if required).
10) Prepare project report (as per format given by department/available on departmental website)
11) Prepare PPT for presentation (**for various seminarsand final presentation at the end of the semester conducted for progressive assessment**)

2. COMPETENCY

The course content should be taught and implemented with the aim to develop different types of skills so that students are able to acquire following competency

1 To develop inquisitiveness, innovative skills, and confidence to work independently.
2. To participate effectively in group work.
3. To collect relevant data.
4. To plan and organize the work.
5. To analyze and synthesize the data.
6. To relate knowledge of various courses in a selected problem.
7. To make an appropriate decision whenever it is required.
8. To conduct a survey and investigation.
9. To solve industry problems.
10. To optimize the cost of the project.
11. To design the layout as per requirement.
12. To prepare block diagram, circuit diagram, simulation model and microcontroller program as per requirements.
13. To assess the financial implication and feasibility of the project.
14. To prepare the technical reports and ppt.

3. COURSE OUTCOMES (COs)

Students will be able to

CO.1 Review the existing literature/system to find possible problem in existing system.

CO.2 Select the best suitable solution to solve the defined problem along with budget.

CO.3 Design methodology to reach final solution.

CO.4 Initiate to assemble project after purchasing the component.

CO.5 Defend progress review for 5th semester with report writing, presentation and work done till date as individual and team.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
0	0	2	1	0	0	50	50	100

***Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **CA** - Continuous Assessment; **ESE** - End Semester Examination.*

5. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

This major equipment with broad specifications is a guide to procure them by the administrators to use in the laboratory dedicatedly made for the project work.

Sr.No.	Equipment Name with Broad Specifications
1	Dual channel D.C. supply, 0-30 Volt, 2 Amp with display
2	**Tool kits** that include spanners, screw drivers of various size, soldering iron, measuring tape, drilling machine, tester, multi meter, clip on meter, hammer, hack saw, flux, pliers, nose pliers, insulation tape etc.
3	Dual channel Digital Storage Oscilloscope
4	10 MHz function generator
5	Miscellaneous components like Diode, Transistor, Step down Transformers, LED, Relay, various analog digital and microcontroller ICs as per requirement.

Sr.No.	Equipment Name with Broad Specifications
6	Lamp load 3-phase 415 V, 0-10 A.
7	Single-phase, Three-phase supply panels with suitable measuring instruments.
8	Microcontroller Programming Software/ Integrated Digital Environment as per requirement
9	Simulation software like MATLAB, PSIM, Proteus etc. as per requirement
10	At least 2 PCs having latest specifications
11	LCD/LED projector to be used for presentation in seminars

6. AFFECTIVE DOMAIN OUTCOMES

The following ***sample*** Affective Domain Outcomes (ADOs) are embedded in many of the above-mentioned COs. More could be added to fulfill the development of this course competency.

a. Work as a leader/a team member (while doing a project work).
b. Follow safety practices while using D.C. and AC supply and electrical equipment.
c. Work as a group member (while testing the project)
d. Practice environmentally friendly methods and processes. (Environment related)

The ADOs are best developed through the laboratory/field-based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

i. 'Valuing Level' in 1st year
ii. 'Organization Level' in 2nd year.
iii. 'Characterization Level' in 3rd year.

7. UNDERPINNING THEORY

The major underpinning theory is given below based on the higher level UOs of *Revised Bloom's taxonomy* that are formulated for development of the COs and competency. If required, more such UOs could be included by the course teacher to focus on attainment of COs and competency. (**Overall work of Project-I should be done in following steps**)

Unit	Unit Outcomes (UOs)	Topics and sub topics
Unit-I Review the existing	1a. Carry out literature survey and industrial visits. 1b. Identify the problems in the area related	1.1 To select the appropriate project title, survey different types of research papers, books and websites. Do

literature/system	to the Electrical Engineering. 1c. Identify the information/data required related to selected problem. 1d. Make problem statement and abstract for selected problem/work.	industry visits if necessary. 1.2 Identify the problem related to the Electrical Engineering. 1.3 Identify and gather the information related to the selected problem. 1.4 From the gathered information (and with the help of guide) make appropriate problem statement and abstract.
Unit-II Select the best suitable solution	2a. Collect relevant data from different sources (books/internet/market/suppliers/experts etc.) 2b. Analyze the collected data and generate useful information from it. 2c. Present generated information visually in form of appropriate chart/graphs. 2d. Derive different possible solutions creatively. 2e. Attempt alternative solutions/revise aims and execute alternative plan in case of failures.	2.1 For the solution of selected problem collect relevant data from the various sources. 2.2 Analyze the collected data for the solution of selected problem. 2.3 If require make chart/graph/simulation to select relevant method. 2.4 Compare various methods for the solution of selected problem. 2.5 If selected solution does not work (after suggestion given by guide/industry mentor) select alternate method. 2.6 Assess the financial implication and feasibility of different solutions based on preliminary studies.
Unit-III Design methodology to reach final solution.	3a. Prepare project proposals before starting the project work. 3b. Prepare required drawings and detailed plan for execution of the work.	3.1 Analyze and compare different possible methods for solution of the selected problem considering financial implication. 3.2 Select relevant machine/equipment/instrument/software for the solution of selected problem. 3.3 Consider safety first while selecting the way to work. 3.4 For all above steps take help continuously from institute guide/industry mentor or other relevant person. 3.5 Prepare work plan of the project.

Unit-IV Initiate to assemble project after purchasing the component.	4a. Optimize the cost of components/material 4b. Incorporate safety measures in work.	4.1 Select components and equipments with required specification 4.2 Prepare cost schedule of the project. 4.3 All the students of the group should distribute the work according to the skill of each student. 4.4 Work persistently to achieve the targets.
Unit-V Defend progress review for 5th semester	5a.Participate effectively in group. 5b. Work independently for the individual responsibility undertaken. 5c. Prepare the technical report. 5d. Prepare presentations. 5e. Acknowledge the help rendered by others in the project. 5f. Present findings/features of the projects in seminars.	5.1 After assigning the work, each student should do the work independently to complete the particular task in minimum time. 5.2 Prepare project report as per the format provided by the project coordinator. 5.3 Prepare PPT and present it as per schedule. 5.4 Reflect your viewson experiences gained during project work in report and ppt. 5.5 Students can take help of any person relevant to the topic selected. That person must be acknowledged in the report/presentation. 5.6 Arrange mock presentations in the group before actual presentation. 5.7 Consider suggestions given by guide/evaluation team in previous seminar/meeting while preparing the report/presentation. 5.8 Confidently answer the questions asked during seminars.

Note:-*Departmental SSIP team may check each project and may decide whether any project is appropriate for SSIP scheme or not. If project is found viable for that, students of that group (with help of departmental SSIP coordinator) have to apply for grant from SSIP or other funding agency.*

8. (a) Scope of Projects

Scope of the project work should be decided based on following criteria:

(i) Relation to diploma programme curriculum: When student intend to select topics for the project work they need to choose a project which relates well to their curriculum (it may be beyond curriculum but it should relate to it) and requires implementation of theories already learnt and skills already possessed by them from the previous semesters.

(ii) Abilities possessed by the group of students: Projects should be chosen so that it can be completed mainly using students problem solving capabilities and depth of learning. It is natural that highly motivated

students or high achievers may come out with projects which are more complex and challenging. Teachers should guide students to choose challenging projects according to the student's ability.

(iii) Resources available: Students and Guides should keep in mind the availability of resources while deciding the topic and the scope of the project. Some of the important resources which need consideration are:

- Time available
- Raw material/components required
- Manufacturing/fabrication equipment and tools required
- Testing/Measuring equipment and instruments required
- Access to journals (library/digital)
- Expertise for theoretical guidance available in college (or nearby Institutions or nearby industries)
- Expertise and Technology required for fabrication (if required)
- Software required

8 (b) Types of Projects: In general the projects are of the following types:

(i) Design projects
(ii) Prototype (design, make, test and evaluate)
(iii) Advanced experimental work requiring the development of existing equipment to be need and developed
(iv) Field works: This could include surveys, using equipment, charting data and information from virtual observation.
(v) Comparative studies : Theoretical study of two systems/ mechanisms/ processes in detail and comparing them on the basis of cost/ energy conservation/ impact on environment/ technology used etc.
(vi) Application of emerging technology: Theoretical study of some emerging technology and feasibility of its application in some real life situation in detail.
(vii) Fabrication of some equipment/ machine etc.
(viii) Development of software/ application to solve some complex problem related to Electrical Engineering field.

9. ACCESSMENT OF PROJECT WORK

Project Guide and/or Program coordinator and/or Project evaluation committee will assess the project work in four different project seminars as per the assessment rubrics suggested here. Total four seminars are to be held during the fifth semester and continuous assessment (CA for 50 marks) is to be done as per the following suggested sheet. (Remaining 50 marks are for the end semester exam - ESE which shall be conducted by the GTU). If two independent projects for 5th and 6th semester are offered, project guide/program coordinator/ project evaluation committee will slightly change the assessment criteria.

Evaluation of **Electrical Engineering Project-I (4350905)**

Serial No.	Students Name	Enrollment Number		Project Title	Marks (Continuous Assessment)

			Name of Guide		Seminar-I (out of 10)	Seminar-II (out of 10)	Seminar-III (out of 10)	Final Evaluation (out of 20)	Total (out of 50)
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									

Project evaluation committee **Project Coordinator** **Head of the Department**

Sample assessment rubrics to be used to verify the progressive work done by the student for different seminars/final evaluation of progressively work done by students.

Assessment Rubrics of Electrical Engineering Project-I (4350905)

Sr. No.	Activity	Criteria for performan	High Proficiency	Proficiency	Some Proficiency	No/Limited Proficiency	Score

		ce	8 to 10 Marks	6 to 7 Marks	3 to 5 Marks	0 to 2 Marks	
1	Seminar-1	Literature Survey	Student surveyed all the possible literatures/resources	Student surveyed the possible literatures/resources	Student surveyed less literatures/resources	Student surveyed very less literatures/resources	Marks converted to out of 10
		Problem Identification	Student states the problem clearly and identifies underlying issues	Student adequately defines the problem	Student fails to define the problemadequately	Student does not identify the problem	
2	Seminar-2	Approach to the solution	Innovative approach	Fairly good approach	Simple approach	No approach at all for solution of selected problem	Out of 10
3	Seminar-3	Developing a plan to solve the problem	Student developed a clear and capsized plan to solve the problem, with alternative strategies	Students develops an adequate plan	Student develops a marginal plan	Student does not develop a coherent plan to solve the problem	Out of 10
4	Seminar-4 (Final evaluation at the end of 5th semester)	Interpreting findings and solving the problem and started assembling of project (Required till that time)	Student provides a logical interpretation of the simulation and findings and clearly solves the problem. Made required hardware.	Student provides a logical but incomplete interpretation of the simulations and findings but solves the problem. Made some portion of required hardware.	Student does not provide an interpretation of the simulations and findings but solves the problem.Make very small portion of required hardware.	Student does not interpret the findings/reach the conclusion. Did not start making of hardware.	Marks converted to out of 20
		Presenting the work effectively and confidently	Student explain the work very effectively and confidently	Student explain the work effectively and confidently	Student explain the work less effectively and with lack of confidence	Student not able to explain the work effectively and confidently	
						Total	Out of 50

10. SOFTWARE/LEARNING WEBSITES

- https://www.electronicsforu.com/
- https://www.electrical4u.com/
- https://www.mathworks.com/
- https://www.arduino.cc/
- https://www.alldatasheet.com/
- https://www.allaboutcircuits.com/
- https://circuitglobe.com/
- https://www.electricaltechnology.org/
- www.vlab.co.in

11. PO-COMPETENCY-CO MAPPING:

Semester I	Electrical Engineering Project-I (Course Code: 4350904)						
	POs						
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design / development of solution	PO4 Engineering Tools, Experimentation& Testing	PO 5 Engineering practices for society, sustainability & environment	PO 6 Project Management	PO 7 Life-long learning
Competency	**Initiate to assemble project as per required design and present the work done till date**						
Course Outcomes CO1 Review the existing literature/system to find possible problem in existing system.	2	3	-	-	-	3	3
CO2 Select the best suitable solution to solve the defined problem along with budget.	3	3	2	-	2	-	2
CO3 Design methodology to reach final solution.	3	-	3	-	3	3	3
CO4 Initiate to assemble project after purchasing the component.	1	-	-	3	-	-	3
CO5 Defend progress review for 5thsemester with report writing, presentation and work done till date as individual and team.	-	-	-	-	2	3	3

*Legend: '**3**' for high, '**2**' for medium, **'1'** for low and **'-'** for no correlation of each CO with PO.*

12. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

S. No.	Name and Designation	Institute	Contact No.	Email
1.	Dr Hemant I. Joshi Lecturer Electrical Engg.	R C Technical Institute, Ahmedabad	9998579554	hemantjoshi0711@gmail.com

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-Focused Outcome-based Green Curriculum-2021 (COGC-2021)
Semester - V

Course Title: Summer Internship-II
(Course Code: 4350905)

Diploma programme in which this course is offered	Semester in which offered
Electrical Engineering	5th Semester

1. RATIONALE

Idea of Embedded Internships- AICTE has made 7-10 weeks summer internships mandatory in the new curriculum which will equip the students with practical understanding and training about industry practices in a suitable industry or organization. Internships are educational and career development opportunities, providing practical experience in a field or discipline. The Summer Internship-II is a student centric activity that would expose the technical students to the industrial environment, which cannot be simulated in the classroom and hence creating competent professionals for the industry.

Internships are off-campus experiential learning activities designed to provide students with opportunities to make connections between the theory and practice of academic study and the practical application of that study in a professional work environment. Internships offer the opportunity to "try out" a career while gaining relevant experience and professional connections.

During the summer vacation after 4th Semester, students are ready for industrial experience. Therefore, they may choose to undergo Internship /Innovation /Entrepreneurship related activities. Students may choose either to work on innovation or entrepreneurial activities resulting in start- up or undergo internship with industry/ NGO's/ Government organizations/ Micro/ Small/ Medium enterprises to make themselves ready for the industry. In case a student wants to pursue his/her family business and don't want to undergo internship, a declaration by a parent may be submitted directly to the TPO.

1. **Offline internship in industry** - Student is supposed to produce joining letter for starting and relieving letter once the internship is over in case of Offline internship in any industry.
2. **Online internship** - Student can select from any of approved /supported / recommended by the All India Council of Technical Education for Internship (like Internshala/ NEAT/ Gujarat Knowledge Society Initiative etc.) or Approved by the state government or University approved.
3. **A Mini Project** - On some suitable topic related to respective branch. It can be small fabrication/ Experimental results/ simulations/ Application development / Design and / or Analysis of System(s) etc. depending on the branch of the student. Preferably a single student should carry out a mini-project.

2. COMPETENCY

The purpose of this course is to help the student to attain flavor of the following industry identified competency through summer internship experiences:

- Develop multiple types of skills such as planning, communication, collaboration, decision making / Problem solving and management skills along with selected technical knowledge.

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with the identified competency are to be developed in the student for the achievement of the following COs:

a) Be aware of duty, professional responsibility and ethics of an engineer.
b) Able to communicate effectively, develop professional work reports and presentations in the working environment.
c) Develop awareness about general workplace behavior and build interpersonal and team skills.
d) Obtain exposure and practical experience in the related field.
e) Able to apply theoretical knowledge to solve industrial problems.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
0	0	6	3	0	0	50	50	100

1. **Offline internship in industry: CA** will be carried out based on submitted progress card by Industry resource person and **ESE** / Assessment will be carried out by institute resource persons.
2. **Online internships: CA** will be carried out based on submitted certificate and **ESE** / Assessment will be carried out by institute resource persons.
3. **A Mini Project: CA** and **ESE** will be carried out based on project work by institute resource persons.

***Legends: L** - Lecture; **T** - Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** - Credit, **CA** - Continuous Assessment; **ESE** - End Semester Examination.*

List of Documents to be prepared for Submission:

- Detailed report duly signed and approved by the internal/external mentor.
- Presentation softcopy approved by the internal/external mentor.
- Poster of summer internship activities approved by the internal/external mentor.

Sample forms for Registration and Evaluation of Summer Internship-II are given below:

1) Both forms are mandatory to be filled at the commencement and completion of SI respectively.
2) It is recommended to file and map SI-I Registration (semester 3) and Evaluation with respective forms of SI-II (Semester 5) so that students get enough exposure of industry / technology. (Mapping doesn't mean same industry/ company/ project - it can be independent/ different also.)
3) Mapping will ease CA and ESE Evaluations.
4) A Seminar / Webinar can be arranged so that students coming from different industry / institute / project background can share experiences and learnings to their peers / all students of the same department.
5) Attached formats for Registration, Completion and Evaluation are suggestive. But, adhering to these formats is anticipated.

Summer Internship-II Registration Form

Note: Students needs to submit this registration form after finalizing mode of internship.

Student Details												
Enrollment Number												
Student Name												
Student Details	Mobile Number:											
	Email Address:											
Branch												
Code of the Institute	Name of the Institute:											
Mentor Details (Institute)	Name:											
	Designation:											
	Mobile No:											
	Email Address:											
Industry Details	Name:											
	Address:											
	Email:											
	Phone:											
	Website:											
Mentor Details (Industry)	Name:											
	Designation:											
	Mobile No:											
	Email Address											
Mode of Internship Carried Out	Online / Offline/ Mini Project											
Title of the Project/ Internship carried out												
Nature of Work Carried Out / Type of Industry	Power System / Power Electronics / Electrical Drives / Power Generation / Power Transmission / Power Distribution / Processing Plant / etc. Other type please Specify_____											

Student Signature **Faculty Signature**

Summer Internship-II - Suggested Letter for Completion

[Company or Institute letter head]

No: Date

TO WHOM SO EVER IT MAY CONCERN

This is to certify that, Mr. /Mrs._____

Enrollment No._____ student of _____

has successfully completed a two-week Internship in the field of_____

From the date: _____ to date: _____

[90% Attendance is mandatory for completion of Internship]

During the period of his / her summer internship program with us, He / She was exposed to the following different processes and was found sincere and hardworking.

1. _____

2. _____

3. _____

4._____

Mentor Signature **Head of the Department**

Stamp Stamp

Summer Internship-II-Evaluation Rubrics for Industry

Evaluation Rubrics (Industry)

Enrollment No: **Branch:**

Name of the Student: **Date of Evaluation:**

Continuous Assessment – 50 Marks CA (I) (To be carried out by the Industrial mentor) Minimum Passing Marks: 25					
Parameter	**Excellent**	**Good**	**Average**	**Not up the level of Satisfaction**	**Obtained Marks**
Mark range	**8 to 10**	**6 to 7**	**4 to 5**	**Below 4**	
Demonstrates skills needed for assigned tasks and effective use of engineering tools and techniques. **(10 Marks)**					
Maintains professional manner / appearance and Manages time/resources effectively. **(10 marks)**					
Receiving and providing feedback during the internship period. **(10 marks)**					
Team work in the organization and adaptation capacity**. (10 marks)**					
Dedication towards assigned task. **(10 marks)**					
Total Marks Obtained Out of 50 CA (I)					

Signature: **Industrial Mentor Name:**

Summer Internship-II-Evaluation Rubrics for Institute

Evaluation Rubrics (Institute)

Enrollment No: **Branch:**

Name of the Student: **Date of Evaluation:**

End Semester Examination/Institute/Internal Evaluation: 50 Marks ESE(V) (To be carried out by the Institute Mentor) Minimum Passing Marks:25					
Parameter	**Excellent**	**Good**	**Average**	**Not up the level of Satisfaction**	**Obtained Marks**
Mark range	**8 to 10**	**6 to 7**	**4 to 5**	**Below 4**	
Technical knowledge and awareness related to the specific discipline. **(10 Marks)**					
Intern attendance and punctuality during the internship period. **(10 Marks)**					
Skills learnt during internship. **(10 Marks)**					
Protocol and Processes learnt during the internship. **(10 Marks)**					
Report writing and Presentation Skill. **(10 Marks)**					
Total Marks Obtained Out of 50 ESE(V)					

Signature: **Institute Resource Examiner Name:**

Common Note:

1) For Summer Internship / Projects / Seminar etc. Evaluation is based on work done, quality of report, performance in viva-voce, presentation etc. The internal / external assessment is based on the student's performance in viva-voce / work record respectively.
2) In case Industry Supervisor is not available / Institute Mentor/ Faculty can fill up both.

5. AFFECTIVE DOMAIN OUTCOMES

The following affective Domain Outcomes (ADOs) are embedded in many of the above-mentioned COs. More could be added to fulfill the development of this course competency.

a) Work as a leader/a team member in the role of an Engineer.
b) Practice environmentally friendly methods and processes.
c) Follow safety precautions and ethical practices.

6. SUGGESTED STUDENT ACTIVITIES

Following are the suggested student-related curricular, **co-curricular** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should perform following activities and prepare reports and give presentation in front of students and faculty members. They should also collect/record physical evidences for their (student's) portfolio which may be useful for their placement interviews:

a) Perform various tasks given by industry resources person during offline internship.
b) Perform various tasks given during online internship.
c) Perform various task required to complete mini project work under guidance of faculty member.
d) Summer Internship program Interns are required to give a presentation before review committee consisting of a group of academic staff members.
e) The review committee gives feedback and suggests possible improvements in the work.
f) At the end of the program all the Summer Internship program Interns make a poster presentation of the work carried out. The poster presentation is open to the public. It is also evaluated by faculty members.
g) A completion certificate will be issued to all Summer Internship program Interns only after the completion of internship tenure.

7. SOFTWARE/LEARNING WEBSITES

An internship is a short-term work program usually offered to students by companies and institutes who require staff for assistance at junior levels. Thus, for the students undergoing internship, a professional learning experience is provided to benefit them in their skills as well as career. It will brush existing skills and provide exposure to new skills. Generally, it is provided at entry level in the industry.

Here is a suggestive list for reference only.

- http://www.gksgujarat.org/
- https://anubandham.gujarat.gov.in/home
- https://kaushalyaskilluniversity.ac.in/
- https://www.internshala.com
- https://swayam.gov.in
- https://nptel.ac.in/
- https://neat.aicte-india.org/
- https://www.edx.org/
- https://www.coursera.org/

- https://www.udemy.com/
- https://www.linkedIn.com
- https://www.stumags.com
- https://www.letsintern.com
- https://www.internship.com
- https://www.glassdoor.com

8. PO-COMPETENCY-CO MAPPING

Semester V	Summer Internship II (Course Code: 4350905)						
	Pos						
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design/ development of solutions	PO 4 Engineering Tools, Experimentation & Testing	PO 5 Engineering practices for society, sustainability & environment	PO 6 Project Management	PO 7 Life-long learning
CO1) Be aware of duty, professional responsibility and ethics of an engineer.	**2**	**1**	**1**	**1**	**1**	**1**	**1**
CO2) Able to communicate effectively, develop professional work reports and presentations in the working environment.	**2**	**1**	**1**	**1**	**1**	**1**	**1**
CO3) Develop awareness about general workplace behavior and build interpersonal and team skills.	**2**	**1**	**2**	**2**	**1**	**1**	**1**
CO4) Obtain exposure and practical experience in the related field.	**1**	**1**	**2**	**1**	**1**	**1**	**1**
CO5) Able to apply theoretical knowledge to solve industrial problems.	**2**	**1**	**1**	**1**	**1**	**1**	**1**

*Legend: '**3**' for high, '**2**' for medium, '**1**' for low and '**-**' for no correlation of each CO with PO.*

9. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

Sr. No.	Name and Designation	Institute	Contact No.	Email
1	Mr.Sanjay Jamnadas Patel, BOS & Sr. Lecturer in Electrical	A.V.P.T.I., Rajkot	9427257647	sjpatel3012@gmail.com
2	Mr.Chitrang Kamendu Vyas, Lecturer in Electrical	A.V.P.T.I., Rajkot	7405744810	ckv.avp@gmail.com

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
Semester-V

Course Title: Electric Traction & Control
(Course Code: 4350907)

Diploma Programme in which this course is offered	Semester in which offered
Electrical Engineering	5th Semester

1. RATIONALE

The country is leading towards the railway electrification and also moving towards metro, monorail system. The diploma student is required to know about the electric traction scheme and its latest trends. This subject is offered as one of the elective, highlighting the current and future trends in traction systems, auxiliary equipment, electric locomotives, control of traction motors and future-trends. The Diploma pass student with this elective will be able to maintain the traction systems, auxiliary equipment, electric locomotives and traction motors.

2. COURSE OUTCOMES

The theory should be taught and practical should be undertaken in such a manner that students are able to acquire different learning outcomes in cognitive, psychomotor and affective domains to demonstrate the following course outcomes:

I :-Distinguish different traction systems and Differentiate services of traction system based on speed time curve.
II:-.Control different types of traction motors.
III:-Explain the distribution system of a traction system and specific energy consumption.
IV:-Use various traction system auxiliaries
V : - Latest trends in traction systems.

3.TEACHING AND EXAMINATION SCHEME

Teaching scheme (in hours)			Total contact hrs/week	Total credits L+T+(P/2)	Examination Scheme				
					Theory marks		Practical marks		Total marks
L	T	P			CA	ESE	CA	ESE	
3	0	2	5	4	70	30	25	25	150

(*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to betaken during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.
Legends:L-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **CA** - Continuous Assessment; **ESE** - End Semester Examination.

4.SUGGESTED LIST OF EXERCISES/PRACTICALS

The tutorial/practical/exercises should be properly designed and implemented with an attempt to develop different types of cognitive and practical skills **(Outcomes in cognitive, psychomotor and affective domain)** so that students are able to acquire the competencies.

Note: Here only outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of **Programme Outcomes/Course Outcomes in affective domain** as given in a common list at the beginning of curriculum document for this programme. Faculty should refer to that common list and should ensure that students also acquire those Programme Outcomes/Course Outcomes related to affective domain.

Sr. No.	Unit No	Practical Exercises (Major outcomes in Psychomotor Domain)	Approx Hours. required
1	I	Investigate the various traction systems in Indian railways.	02
2	I	Solve Numerical on speed time curves	02
3	II	Justify the use of D. C. Series motor as traction motor	02
4	II	Calculate energy saving by series parallel control of D. C. Motor (for two and four motors).	02
5	II	Investigate the energy recovered using regenerative braking	02
6	III	Study of major equipments in AC traction substations.	02
7	III	Solve numerical on specific energy consumption.	02
8	IV	Study of layout of D. C. locomotive and diesel locomotive.	02
9	IV	Study of power diagram of A.C. locomotive and its equipment.	02
10	IV	Draw sketch of the Overhead current collecting equipment.	02
11	IV	Describe the train lighting system	02
12	V	Investigate various latest trends in electric traction systems	02
13	V	Understand the working of high speed train	02
14	V	Prepare A report on Traction visit / Metro visit	02
		TOTAL HOURS	26

Note

i. More Practical Exercises can be designed and offered by the respective course teacher to develop the present industry/traction system relevant skills/outcomes to match the COs. The above table is only a suggestive list.

ii. The following are some sample 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed Practical Exercises of this course required which are embedded in the COs and ultimately the competency.

Sr.no.	Sample Performance Indicators for the PrOs	Weightage in %
1.	Diagram / sketches / tables	**30**
2.	Conceptual clarity	**20**
3.	Team work & ethical values	**20**
4.	Experimental setup, Procedure and conduction by following safety practices.	**30**

5.UNDERPINNING THEORY

The major underpinning theory is given below based on the higher level UOs of Revised Bloom's taxonomy that are formulated for development of the COs and competency. If required, more such UOs could be included by the course teacher to focus on attainment of COs and competency

Unit	UNIT OUTCOMES (UOs)	Topics and Sub-topics
UNIT-I TRACTION SYSTEM AND SPEED TIME CURVE	1a. History of Railway. Explain types of traction systems and their significance. 1b. Explain the general arrangement of different types of Electric traction systems and their significance. 1c. Select a traction system for a given application. 1d.Draw the speed time curve related to different traction system. 1e. Solve numerical based on speed time curve.	1.1 Steam, diesel, diesel-electric, Battery and electric traction systems 1.2 General arrangement of D.C.,A.C single-phase, 3phase ,Composite systems 1.3 Choice of traction system - Diesel-Electric or Electric. 1.4 Analysis of speed time curves for main line, suburban and urban services 1.5 Simplified speed time curves. 1.6 Relationship between principal quantities in speed time curves. 1.7 Numerical on speed time curve
UNIT– II TRACTION MOTORS AND ITS CONTROL	2a.Statethedesirablefeaturesoftractionmotors. 2b. Explain Significance of D.C. seriesmotoroverD.C.Shuntmotor. 2c.ExplainworkingofvariousA.C.motorsas tractionmotors. 2d. Compare different traction motors.2e.Applyvarious control methods Appliedtotractionmotors. 2f.Explaindifferenttypesofelectricbrakingsystem	2.1Featuresoftractionmotors. 2.2 SignificanceofD.C.seriesmotoras tractionmotor 2.3 A.C.Tractionmotors-singlephase, Three phase, LinearInductionMotor 2.4 Comparison betweendifferenttractionmotors 2.5 Series-parallelcontrol 2.6 Open circuit, Shunt andbridgetransition 2.7Pulse Width Modulationcontrolofinductionmotors 2.8Typesofelectricbraking System.
UNIT-III FEEDING, DISTRIBUTION SYSTEM AND SPECIFIC ENERGY CONSUMPTION CALCULATION	3a.Explain the distribution & feeder system pertaining to traction 3b. Classify traction substations 3c. Describe different methods of feeding the traction sub- station 3d. Tractive effort 3e. Calculate specific energy consumption. 3f. State the factors affecting Specific energy consumption	3.1Distribution systemspertaining to traction(distributionsandfeeders) 3.2Traction sub-stationrequirementsandselection 3.3Methodoffeedingthetractionsub-station 3.4 Requirement of tractive effort 3.5 derivation of expression for tractive effort 3.5 Calculation of train resistance and derivation of general equation 3.6 Energy output from driving axle 3.7 Numerical on specific energy consumption
UNIT-IV	4a. Classify electric locomotive	4.1 Important features of electric locomotives

Electric Locomotives and Auxiliary Equipment	4b. Describe the function of auxiliaries in traction system 4c. Describe the different current collecting methods in locomotives 4d. Explain different control and auxiliary equipment used in the locomotive 4e. Describe the Power conversion and transmission systems 4f. Explain Coach wiring and lighting devices	4.2 Different types of locomotives 4.3 Current collecting equipment 4.4 Coach wiring and lighting devices 4.5 Power conversion and transmission systems 4.6 Control and auxiliary equipment
UNIT V MODERN TRENDS IN ELECTRIC TRACTION SYSTEM	5a.ExplainthepresentscenarioofINDIAN Railways- High speedtraction, bullet train, hyper loop , Metro 5b.Detailthelatesttrendsintraction.6c. magnetic levitation 5d.linear Electric motor (LEM)	5.1 future plans for traction and present day facilities in INDIAN RAILWAYS 5.2 metro rail electrical system 5.2.1 substation 5.2.2 traction system and operational control centre (OCC) 5.2.3 Earthing system and reliability measures 5.3 magnetic levitation 5.4 linear induction motor (LIM) 5.5 high speed train on magnetic levitation 5.6 variable frequency operation of 3 phase induction motor 5.7 electro magnet suspension c and electro dynamic suspension

6.SUGGESTED SPECIFICATION TABLE WITH HOURS and MARKS (THEORY)

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Traction System And Speed Time Curve	08	04	02	04	10
II	Traction Motors And Its Control	14	05	07	10	22
III	Feeding, Distribution System And Specific Energy Consumption Calculation	08	02	04	04	10
IV	Electric Locomotives And Auxiliary Equipment	08	06	08	06	20
V	Modern Trends In Electric Traction System	04	04	04	00	08
	TOTAL	42	21	25	24	70

Legends: R = Remembrance; U = Understanding; A = Application and above levels (Revised Bloom's taxonomy)
Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

7.SUGGESTED LIST OF STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student related co-curricular activities which can be undertaken to accelerate the attainment of the various outcomes in this course. Students should perform following activities in group (or individual) and prepare reports of about 10 pages for each activity. They should also collect/record physical evidence for their (student's) portfolio which may be useful for their placement interviews.

a) Present seminar on various topic form course content
b) Prepare a report after visiting electric traction substation / metro rail system

c) Prepare report on the following D.C. locomotive ,A.C/DC locomotive and diesel electric locomotive
d) Solve numerical problem regarding course contents
e) Prepare a report on current collector system with complete arrangement of pantograph its location and electric wiring system with locomotive
f) Seminar on latest electric traction in world.

8.SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

a) Massive open online courses (MOOCs) may be used to teach various topics/subtopics.
b) Guide student(s) in undertaking mini-projects
c) Arrange visit to nearby locomotive workshop / loco shed
d) Arrange nearby visit to metro rail system
e) Arrange nearby visit to electric locomotive loco shed
f) Co-relating the importance of content of this course with other courses and practical applications
g) Arrange nearby visit to traction substation
h) Show animation/video related to course content
i) Have group discussion on various topic on course content and get updated with latest trends in traction system

9.SUGGESTED MICRO-PROJECTS:

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-projects are group-based (group of 3). However, **in the fifth and sixth semesters**, the number of students in the group should not exceed three. The micro-project could be industry application based, internet-based, workshop based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The students ought to submit micro-project by the end of the semester to develop the industry-oriented COs. A suggestive list of micro-projects is given here. This has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher

A) Prepare the model of traction substation
B) Working model of hybrid locomotive
C) Prepare Model for catenary system
D) Making drawing sheet of control system and type of switch
E) Working model of single battery system
F) Collect the sample overhead cable, supports and line insulator
G) Model for conductor rail system and finding the transformer rating based on loading
H) Prepare chart of various upgrade locomotive and traction system
I) Making drawing sheet of representing tractive effort

10.SUGGESTED LEARNING RESOURCES

Sr.no.	Title of books	Author	Publication
1.	ELECTRIC TRACTION	J UPADHYAY,S.N.MAHENDRA	ALLIED PUBLISHERS LTD.
2.	ELECTRIC TRACTION	A.T.DOVER	MAC MILLAN, DHANPAT RAI AND SONS, NEW DELHI

3.	Power Electronics and Electric Drives for Traction Applications	Gonzalo Abad Top of Form Bottom of Form	John Wiley & Sons.
4.	Metro Rail in India for Urban Mobility	M. M. Agarwal , Sudhir Chandra, K. K. Miglani	Prabha& Co.
5.	Electric Traction - Motive Power and Energy Supply	Andreas Steimel Top of Form Bottom of Form	OldenbourgIndustrieverlag
6.	Modern Electric Traction	Tarlok Singh	S.k. Kataria
7.	Utilization of Electrical Energy and Traction	J.B.GUPTA, Rajeev Manglik, RohitManglik	S.K. Kataria& Sons
8.	ELECTRIC TRACTION HAND BOOK	R.B.BROOKS	SIR ISAAC PITMAN AND SON LTD. LONDON
9.	MODERN ELECTRIC TRACTION	H.PARTAB	DHANPAT RAI AND SONS, NEW DELHI

List of Major Equipment/ Instrument with Broad Specifications

i. Models of different traction systems and equipment
ii. Working Models of different traction motor

11.SOFTWARE/LEARNING WEBSITES WEBSITES

a. www.scrailway.gov.in
b. www.wr.railnet.gov.in/bctweb/ELECTRICAL.htm
c. www.irieen.com(IndianRailwaysInstituteofElectricalEngineering,NasikRoad)
d. www.vlab.co.in
e. www.electricaltechnology.org/
f. www.electrical4u.com
g. www.lectures.gtu.ac.in
h. https://circuitglobe.com/electrical-earthing.html

12.PO-COMPETENCY – CO MAPPING:

SEMESTER V	ELECTRICAL TRACTION AND CONTROL COURSE CODE (4350907)						
	POS						
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledg	PO 2 Problem Analysis	PO 3 Design/ development of solution	PO4 Engineering Tools, Experimentation &Testing	PO5 Engineering practices for society, sustainability & environment	PO 6 Project Management	PO 7 Life-long learning

Competency	Operate and maintain various types of Electrical Traction System						
Course Outcomes CO1 Distinguish different traction systems andDifferentiate services of traction system based on speed time curve	**3**	**2**	**2**	**-**	**3**	**-**	**2**
CO2 Control different types of traction motors	**3**	**3**	**3**	**-**	**-**	**-**	**2**
CO3 Explain the distribution system of a traction system and specific energy consumption	**3**	**2**	**2**	**-**	**2**	**-**	**2**
CO4 Use various traction system auxiliaries	**3**	**-**	**-**	**-**	**-**	**2**	**2**
CO5 Latest trends in traction systems.	**3**	**2**	**-**	**-**	**3**	**-**	**2**

Legend: '**3**' for high, '**2**' for medium, '**1**' for low and '-' for no correlation of each CO with PO.

13.COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU RESOURCE PERSON

SR.NO.	NAME	INSTITUTE	CONTACT NO.	EMAIL
1.	Smt. Devangi J Jain	B&B Institute of Technology v.v.nagar	9724308429	devangijjain@gmail.com
2.	M.K.CHAWDA	Tolani F G Polytechnic Adipur	8460583331	Manishchawda1992@gmail.com

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
Semester-VI

COURSE TITLE: ELECTRICAL INSTALLATION, COMMISSIONING AND MAINTENANCE (E.I.C. & M.)
(Course Code: 4360901)

Diploma Program in which this course is offered	Semester in which offered
Electrical Engineering	Sixth (6^{th})

1. RATIONALE:

Electrical Power system and Electrical system in industry & commercial places comprises of numerous electrical apparatus and equipment at distinct stages as well as in vicinity of other apparatus or equipment like transformers, rotating machines, circuit breakers and other equipment's which require installation, commissioning and regular maintenance to prevent permanent break down. Many times, an engineering diploma holder has to carryout/supervise installation, commissioning and maintenance of various electrical equipments in power stations, substations as well as industry. This course will enable the diploma pass out student to understand the significance of appropriate procedure of installation, commissioning and maintenance of electrical equipments, concepts, principles along with acquiring basic skills of installation, commissioning and maintenance of electrical equipments in power stations, substations and industry by means of experimentation.

2. COMPETENCY:

The basic objective of this course is to develop required skills among the students so that they are able to acquire following competency:

- **Undertake installation, commissioning and maintenance of various electrical Equipments and Machines**

3. COURSE OUTCOMES (COs):

The theory should be taught and practical should be undertaken in such a manner that students are able to acquire different learning outcomes in cognitive, psychomotor and affective domains to demonstrate the following course outcomes:

i. Install various electrical equipments/machines.
ii. Commission & Test various electrical equipments/machines
iii. Carryout maintenance of different electrical equipments and machines.
iv. Troubleshoot various electrical equipments/machines and domestic electrical appliances.
v. Apply electrical earthing, safety rules and safety practices.

4. TEACHING AND EXAMINATION SCHEME:

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
3	0	2	4	30	70	25	25	150

(*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be conducted during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

Legends: L-Lecture; T – Tutorial/Teacher Guided Theory Practice; P - Practical; C – Credit, CA - Continuous Assessment; ESE - End Semester Examination.

5. SUGGESTED PRACTICAL EXERCISES:

The following practical outcomes (PrOs) that are the sub-components of the COs. Some of the PrOs marked '*' are compulsory, as they are crucial for that particular CO at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'.

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1.	Prepare layouts of wiring and plan pre-erection activity for installation of different electrical machine with specification in your Electrical machine Laboratory	1	2*
2.	Perform BDV test on insulating oil used in power transformer	2	2
3.	Measure insulation resistance of a winding/cables/wiring installation	2	2*
4.	Prepare test report of three phase transformer after commissioning	2	2*
5.	Prepare test report of three phase induction motor after commissioning	2	2
6.	Prepare test report of vacuum circuit breaker after commissioning	2	2*
7.	Prepare maintenance schedule for power transformer	3	2*
8.	Prepare maintenance schedule for three phase induction motor	3	2*
9.	Prepare maintenance schedule for Circuit Breaker	3	2
10.	Trouble shoot for DC Motor- Generator set available in your Electrical machine laboratory.	4	2*
11.	Trouble shoot for three phase Induction Motor- Alternator set with DOL starter available in your Electrical machine lab.	4	2*
12.	Trouble shoot for vacuum circuit breaker for 11 KV bus bar system	4	2
13.	Measure earth resistance of installation of building/domestic wiring and appliances by different methods	5	2*
14.	Demonstrate plate/pipe earthing as per IS and measure the earth resistance	5	2
15.	Enlist the action and remedy to be taken when a person comes in contact with a live wire	5	2
16.	Undertake Mock drill of students by using fire extinguisher for safety against fire	5	2*

Note:

i. More Practical Exercises can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list**.**

ii. The following are some sample 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed Practical Exercises of this course required which are embedded in the COs and ultimately the competency.

Sr. No.	Sample Performance Indicators for the PrOs	Weightage in %
1.	Set up / Connection of experimental	20
2.	Follow safe practices measures	10
3.	Perform specific operation on the equipment or Machines	20
4.	Record observations correctly if applicable	20
5.	Interpret the result and conclude	30

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED:

This following major equipment with broad specifications for the PrOs is a guide to procure them by the administrators to usher in uniformity of practicals in all institutions across the state.

Sr. No.	Equipment Name with Broad Specifications
1.	**Digital Multimeter:**4 ½ digit hand held 9 V batteries operated, DC Voltage: 0 to 0.001 mV – 1000 V, AC Voltage: 0 to 0.01 mV – 1000 V, AC Current: 0 to 100 nA – 10 A, DC Current: 0 to 100 nA – 10 A.
2.	**Digital Tachometer:** Hand held, battery operated, 5digit display contact Type, 60 to 50000 R.P.M.,
3.	**Oil testing kit:** Mains Supply: 230V AC ±10%, 50Hz, Single Phase Variac: 230V/ 0-270V, High Voltage Source: 80kV, 20mA, Voltmeter: 0 to 100kV
4.	**Megger:** Insulation Testing: 250V:500V:1000V: 1000 MΩ range, Auto-ranging, Auto discharge
5.	**Oil Testing kit:** Power supply - 240V AC ±10%, 50 Hz (single phase), with both fully Automated and manual operation, output range – 0 to 80 KV, output current – 20mA or may vary, resolution 0.1KV.

7. AFFECTIVE DOMAIN OUTCOMES

The following sample Affective Domain Outcomes (ADOs) are embedded as per respective above-mentioned COs and PrOs. More could be supplemented to fulfil the development of this course competency.

- **a.** Develop skill for Installation of electrical equipments
- **b.** Develop skill for commissioning of electrical equipments
- **c.** Develop skill for maintenance of electrical equipments

d. Develop skill for trouble shooting of distinct kind of faults in electrical equipments
e. Follow safety practices while using electrical Machines and Equipments.
f. Practice environment friendly methods and processes. (Environment related)

The ADOs are developed through the laboratory/field-based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

a. 'Valuing Level' in 1st year
b. 'Organization Level' in 2nd year
c. 'Characterization Level' in 3rd year

8. UNDERPINNING THEORY:

The major underpinning theory is given below based on the higher level UOs of *Revised Bloom's taxonomy* that are formulated for development of the COs and competency. If required, more such COs could be included by the course teacher to focus on attainment of COs and competency.

Units	Major Learning outcomes	Topic and Sub-topics
Unit – I Installation of Electrical Equipment	**1a.** Describe the planning before unloading of heavy electrical equipments at site **1b.** Select appropriate tools for installation of electrical equipment **1c.** Explain the procedure for handling, inspection, storage and installation of static and rotating electrical equipment as well as for Solar plant and wind plant	1.1 Unloading of electrical equipment at site 1.2 Inspection of electrical equipment at site 1.3 Storage electrical equipment at site 1.4 Foundation electrical equipment at site 1.5 Alignment of electrical machines 1.6 Lists of Tools/Instruments required for installation 1.7 Technical report, Inspection, storage & handling of transformer, switchgear & motors and Standard Field quality plan for installation of Power transformer, HT Motor and SF6 circuit breaker. 1.8 Standard procedure for Installation of domestic and industrial Solar plant and wind plant
Unit – II Commissioning and Testing	**2a.** Describe various commissioning tests on electrical equipment/machines **2b.** Describe the specific test on electrical equipment/machines **2c.** Explain the standard tests performed on insulation oil **2d.** Determine the insulation resistance of electrical equipment/machines **2e.** Explain the procedure of	2.1 Tests before commissioning of electrical equipment-Electrical and Mechanical test, Preparations before commissioning of power transformer, Instruments required for testing 2.2 Specific tests on -Transformer, Induction motor, alternator, synchronous motor 2.3 Commissioning of power transformer, three phase induction motor and switchgear 2.4 Transformer insulation oil: Properties as per IS, sampling, testing and filtering/purifying, standard tests as per IS, classification of insulation resistance 2.5 Measurement of insulation resistance and

	drying the winding of electrical equipment/machines **2f.** Explain the various factor affecting the insulation resistance **2g.** Explain the need for gradual loading of electrical equipment **2h.** Commissioning and testing of GIS substation Installation. **2i.** Commissioning and testing of Solar plant and wind plant	Polarization Index, Factors affecting the insulation resistance of insulating materials 2.6 Drying the winding of electrical equipment and its record 2.7 Tests before and after commissioning of the Power transformer, Induction motor and HV circuit breaker 2.8 Test report on commissioning and test certificate. 2.9. Gradually loading of electrical equipment and Commissioning & testing of GIS substation Equipments 2.10 Standard procedure for Commissioning of domestic and industrial Solar plant and wind plant.
Unit – III Maintenance of Electrical Equipment	**3a.** Explain the need of different types of maintenance **3b.** Explain the reason of failure of electrical equipment due to poor maintenance **3c.** Prepare maintenance schedule of different equipment **3d.** State the probable faults due to poor maintenance in various electrical equipment **3e.** Conditioning & monitoring of electrical equipment used in power system **3f.** Prepare Maintenance schedule of domestic and industrial Solar plant and wind plant and their core components	3.1 Need and functions of the Maintenance Department; Reasons of failure of electrical equipment 3.2 Preventive maintenance: need, classification, activities, advantages and Frequency of maintenance 3.3 Breakdown maintenance: concept, advantages, activities 3.4 Factors for preparing maintenance schedule 3.5 Maintenance schedule of transformer below and above 1000kVA 3.6 Maintenance schedule - Induction motor, Alternator used in TPP and SF6 circuit Breaker 3.7 Probable faults due to poor maintenance in transformer, induction motor, Alternator, circuit breaker, overhead lines, battery and solar plant inverter. 3.8 Advantages of conditioning and monitoring of equipments 3.9 Conditioning and monitoring of three phase Transformer and three phase Induction Motor 3.10 Maintenance of domestic and industrial Solar plant and their core components and wind plant
Unit – IV Troubleshooting Electrical equipments	**4a.** State various internal and external faults that occur in electrical equipment **4b.** State common troubles in various electrical equipment and machines	4.1 Causes of faults in electrical equipment (Internal and external) 4.2 Instruments and tools for trouble shooting 4.3 Common troubles in electrical equipment – DC Machines, AC Machines, Transformers, Circuit-breaker, under-

	4c. Prepare trouble shooting chart for various electrical equipment, machines and domestic appliances. **4d.** State common causes of faults and their trouble shooting in domestic and industrial Solar Plant and wind plant	ground cable, electrical Installation 4.4 Need of trouble shooting chart. 4.5 Trouble shooting chart for DC Machine and both 1 Phase and 3 Phase Transformer. 4.6 Trouble shooting chart for Synchronous Motor, Induction Motor and Alternator for thermal power plant. 4.7 Trouble shooting chart for SF6 Circuit-breaker and Vacuum Circuit-breaker. 4.8 Trouble shooting chart for Domestic appliances-electrical iron, ceiling fan, washing machine, Air cooler 4.9 Common causes of faults and their trouble shooting in domestic and industrial Solar Plant and wind plant
Unit – V Electrical Accidents & Safety	**5a.** Explain the major causes of electrical accidents and their consequences **5b.** Explain the need of earthing and the different methods of earthing **5c.** Explain the various factors affecting on the earth resistance **5d.** Describe the various methods of measuring the earth resistance **5e.** Explain the earthing procedure in different types of electrical installations **5f.** Describe the procedure for shutting down of substation and power lines **5g.** Explain the operation of different types of fire extinguishers	5.1 Major causes of electrical accidents 5.2 Consequences of electrical accidents, factors affecting the severity of electrical shock and Preventive steps against electrical accidents 5.3 Necessity of earthing, various factors affecting on the earth resistance, advantages and types of earth electrodes 5.4 Methods of earthing: plate earthing, pipe earthing and coil earthing and Chemical Earthing 5.5 Measurement of earth resistance: voltmeter-ammeter method, earth tester method, ohm meter method and earth loop tester method 5.6 Earthing procedure - Building installation, Domestic appliances, Industrial premises, earthing of substation, generating station and overhead line 5.7 Describe the procedure for shutting down of substation and Certificate of (i) requisition for shut down (ii) Permit to work and (iii) Line clear certificate 5.8 Fire Extinguishers-Fixed installation and portable devices

9. SUGGESTED SPECIFICATION TABLE FOR QUESTIONPAPER DESIGN:

Sr. No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
1.	Installation of Electrical Equipment	08	7	3	4	14
2.	Commissioning and Testing	10	3	4	7	14
3.	Maintenance of Electrical Equipment	10	4	3	7	14
4.	Trouble Shooting of Electrical Equipment	08	3	4	7	14
5.	Electrical Accidents & Safety	06	4	7	3	14
Total		42	21	21	28	70

Legends: R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)

Note: This specification table provides general guidelines to assist students for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions to assess the attainment of the COs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may slightly vary from above table.

10. SUGGESTED STUDENT ACTIVITIES:

Other than the classroom and laboratory learning, following are the suggested student-related co-curricular activities which can be performed to meliorate the attainment of the various outcomes of the course: Students should perform following activities individually or in group to accomplish distinct task and prepare reports of about min 5 pages for each activity. They should also collect/record physical evidences for their (student's) portfolio which may be useful for their placement:

Followings are the list of proposed student activities such as:

I. Prepare journals based on practical performed in laboratory
II. Enlist latest equipment and tools used for the commissioning of the machines and equipments
III. Solving numerical from different books for practice
IV. List various instruments and tools used for troubleshooting
V. Explore latest trouble shooting techniques and steps to troubleshoot various electrical equipments and machines by expert lecture, webinar and Industrial visits
VI. Prepare trouble shooting chart for various electrical equipments
VII. Inspect all the earthing point within college campus and measure their values
VIII. Site visit for installation, commissioning and testing of Transformer/Rotating AC machine

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

This is as

I. Show video/animation film to demonstrate earthing, grounding

II. Arrange a visit to nearby industry/substation to observe installation/commissioning and troubleshooting of various electrical equipment and machines.
III. Use Flash/Animations to demonstrate installation of various electrical equipment and devices.
IV. Arrange expert lectures of the professional engineers involved in installation, commissioning and testing of heavy power equipments/machines.
V. Allocate Mini projects to students

12. SUGGESTED MICRO-PROJECT LIST:

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. However, in the fifth and sixth semesters, microproject should preferably be assigned **individually** undertaken to build up the skill and confidence in every student to become problem solver so that she/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should **not exceed three**.

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs & COs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The duration of the microproject should be about 14-16 (fourteen to sixteen) student engagement hours during the course. The students ought to submit micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. This has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher:

Sr. No.	Projects
1.	Prepare chart of planning for inspection of any of electrical machines / Equipments. (Existing in your laboratory)
2.	Enlist necessary tools and Instruments used for Installation of electrical machines / Equipments
3.	Enlist commissioning test to be carried out on any of electrical machines / Equipments
4.	Prepare report on tests conducted on Insulating oil in laboratory.
5.	Prepare chart for maintenance schedule of solar roof top installed at your institute premises.
6.	Prepare chart for maintenance schedule of UPS set installed within your institute premises.
7.	Enlist the common probable faults occurring in the any of electrical machines / Equipments.
8.	Prepare causes of faults along with their trouble shooting chart for any of electrical machines / Equipments
9.	Prepare chart with neat diagram for any of earthing methods along its significance
10.	Prepare report of earthing resistance of each earth points existing within college campus.
11.	Prepare maintenance schedule for both domestic and industrial solar plants.
12.	Prepare maintenance schedule for wind plant.
13.	Prepare charts or PPT for causes of electrical accidents.

Note: ‘Any’ stands for name of particular electrical machine or equipment

13. SUGGESTED LEARNING RESOURCES:

Sr. No.	Title of Book	Author	Publication
1.	Installation Maintenance and Repair of Electrical Machines and Equipments	Madhvi Gupta	S.K. Kataria & Sons, New Delhi
2.	Electrical Workshop Safety Commissioning Maintenance & Testing of Electrical Equipment	R. P. Singh	Dreamtech Press
3.	Installation, Commissioning and Maintenance of Electrical equipment	Tarlok Singh	S. K. Kataria & Sons, New Delhi
4.	Testing Commissioning Operation and Maintenance of Electrical Equipments	S. Rao	Khanna Publication, New Delhi
5.	Electrical Power System	C. L. Wadhwa	New Age International Publications, New Delhi
6.	Residential, Commercial and Industrial Electrical Systems: Protection, Testing and Commissioning	Hemant Joshi	Dreamtech Press

14. SOFTWARE/LEARNING WEBSITES

1. **http://cercind.gov.in/ElectSupplyAct1948.pdf**
2. **https://cea.nic.in/wp-content/uploads/pse___td/2021/09/Transformer_Manual__Amendment_01.pdf**
3. **https://www.youtube.com/live/-G9sv557tNk?si=aKuyqRZiaKwD8J5a**
4. **https://youtu.be/CvuDFgFFOa8?si=H-v3LZMygCdeotoM**
5. **https://youtu.be/KOH1TVf1EuY?si=qDJ5iHytJnSJkZyI**
6. **https://www.getcogujarat.com/getco_newsite/files/safetypolicy.pdf**

15. PO-COMPETENCY-CO MAPPING:

Semester VI	Electrical Installation, Commissioning and Maintenance (Course Code:4360901)						
	POs						
Competency & Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
Undertake Installation, Commissioning and Maintenance of various power system components and equipment.							
CO1: Install various electrical equipments/machines.	3			2	2	2	2
CO2: Commission & Test various electrical equipments/machines	3	2	2	3	2	1	
CO3: Carryout maintenance of different electrical equipments and machines.	2	2		3	2		2
CO4: Troubleshoot for various electrical equipments/machines and domestic electrical appliances.	3	2	2	3			2
CO5: Apply safety rules, safety practices and electrical earthing.	2			2	3	2	3

Abbreviation: '3' for high, '2' for medium, '1' for low and '-' for no correlation of each CO with PO.

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons:

Sr. No.	Name and Designation	Institute	Contact No.	Email
1.	Ashok N. Lakum (Lecturer)	C. U. Shah Polytechnic, Surendranagar	9825721872	ashok.lakum7@gmail.com
2.	Ankit K. Tiwari (Lecturer)	C. U. Shah Polytechnic, Surendranagar	7984747564	ankittiwaricusp@gmail.com

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
Semester-VI

Course Title: Microprocessor and Controller Applications
(Course Code:4360902)

Diploma programmer in which this course is offered	Semester in which offered
ELECTRICAL ENGINEERING	6th

1. RATIONALE

The microprocessor is challenging and very dynamic field. This course explores architecture of a microprocessor and its programming in assembly language. The student will be able to apply logics to various given problems and develop programs using assembly language construct that would help them to develop real time microprocessor based application programs.
The engineering technologists (i.e. diploma engineering holders) have to develop skills for system design of Automatic circuit operations in various fields. Microprocessors & Microcontroller are the sole of all embedded electronic equipment and are used in most of the areas of electronics. They include product ranges from tiny consumer electronic products to complex industrial process controllers. A diploma engineer needs to maintain such systems. Programming practices will further help the students to develop indigenous microprocessor and microcontroller-based applications. Hence this course is designed to achieve the system maintenance competency among students.

Under this subjects Architecture and instruction sets of 8 bit processor have been discussed. Microcontroller (MC) may be called computer on the chip since it has basic features of a microprocessor with internal ROM, RAM, Parallel and serial ports within a single chip. Microcontroller is a programmable digital processor with necessary peripherals. Both microcontrollers and microprocessors are complex sequential digital circuits meant to carry out job according to the program / instructions. Sometimes analog input/output interface makes a part of microcontroller circuit of mixed mode (both analog and digital nature).

2. COMPETENCY

The course content should be taught and implemented with the aim to develop different types of skills so that students are able to acquire following competency:

- **Maintain microprocessor-based system.**
- **Maintain microcontroller-based system/equipment.**

3. COURSE OUTCOMES (COs)

The theory should be taught and practical should be carried out in such a manner that students are able to acquire different learning outcomes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

I :-Interpret the salient features of 8085 microprocessor.
II :- Interpret the salient features of 8051 microcontrollers.
III :- Apply knowledge of microprocessor and microcontroller in various applications.
IV :-Maintain PLC and SCADA based system.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
3	0	2	4	30	70	25	25	150

Out of 30 marks under the theory CA, 10 marks are for assessment of the micro project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.
***Legends:L**-Lecture;**T**–Tutorial/TeacherGuidedTheoryPractice;**P**-Practical;**C**–Credit,*
***CA**-Continuous Assessment; **ESE**–End Semester Examination.*

5. SUGGESTED PRACTICAL EXERCISES:

The following practical outcomes (PrOs) are the sub-components of the Course Outcomes (Cos)

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Explore various blocks of Microprocessor System.	I	2
2	Demonstrate the architecture of 8085 microprocessor.	I	2
3	Test and verify the features of 8085 Trainer Kit.	I	2
4	Test and verify the features of 8051 Trainer Kit.	II	2
5	Identify various pin of Microprocessor chip 8085.	I	2

6	Identify various pin of Microcontroller chip 8051.	II	2
7	Learn architecture of Microcontroller chip 8051.	II	2
8	Demonstrate of kit/simulator of 8085.	I	2
9	Use 8085 Simulation tool / Trainer kit for running ASM programs.	I	2
10	Develop assembly language program for arithmetic addition of two 8-bit numbers using µP 8085 kit/8085 Simulator.	I	2
11	Develop assembly language program for arithmetic subtraction of two numbers using µP 8085 kit/8085 Simulator.	I	2
12	Develop assembly language program for arithmetic multiplication of two numbers using µP 8085 kit/8085 Simulator.	I	2
13	Develop assembly language program to find One's Complement of an 8-bit Number.	I	2
14	Develop assembly language program to find Two's Complement of an 8-bit Number.	I	2
15	Use 8051 Simulation tool / Trainer kit for running ASM programs.	II	2
16	Implement a program to exchange the content of two memory locations.	I	2
17	Implement a program to perform Exclusive OR of two numbers.	I	2
18	Use 8085 microprocessor for SCR firing angle control.	III	2
19	Design 1-kilobyte Memory Interface with 8085 microprocessor.	III	2
20	Use arithmetic function of PLC for a typical application	IV	2
21	Use timer function of PLC for a typical application(introduce delay).	IV	2
22	Develop an application of PLC using Up-Down Counter.	IV	2
23	Study hardware and software associated with PLC.	IV	2
24	Understand Simple Ladder program of PLC using kit/Virtual lab.	IV	2
25	Study computational / arithmetic instructions used in PLC ladder programming using kit/Virtual lab.	IV	2
	Minimum10 Practical Exercises		28

Note:

a) *More Practical Exercises can be designed and offered by there respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list.*

b) *The following are some **sample** 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency.*

Sr.No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Prepare and operate experimental setup	30
2	Follow safe practices	10
3	Executing of exercise	30
4	Interpret the result and conclude	10
5	Quality of Answer related to experiment(Q&A)	20
Total		100

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

Sr.No.	Equipment Name with Broad Specifications
1	8085 microprocessor trainer kit with necessary accessories.
2	Microcontroller 8051 trainer kit with necessary accessories.
3	Free simulation tools
4	Computer System
5	Multimedia Projector
6	Kit for add on cards for performing different applications of PLC.
7	Power supply for above kits and applications

7. AFFECTIVE DOMAIN OUTCOMES

The following ***sample*** Affective Domain Outcomes (ADOs) are embedded in many of the above-mentioned Cos and PrOs, more could be added to fulfill the development of this course competency.

a) Work as a leader/a team member(while doing a micro-project).
b) Follow ethical practices.
c) Work as a group member (while performing experiments and taking readings).
d) Practice environmental friendly methods and processes. (Environment related).

The ADOs are best developed through the laboratory/field based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's' Affective Domain Taxonomy' should gradually increase as planned below:

I. 'ValuingLevel'in1st year
II. 'OrganizationLevel'in2nd year.
III. 'CharacterizationLevel'in3rd year.

8. UNDERPINNING THEORY:

The major underpinning theory is given below based on the higher level UOs of *Revised Bloom's taxonomy* that are formulated for development of the Cos and competency. If required, more such UOs could be included by the course teacher to focus on attainment of CO s and competency.

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
Unit I: Basics of Microprocessor	1a.Distinguish between a microprocessor and a microcomputer. 1b.List advantages and disadvantages of microprocessor control.	1.1 Introduction of Microprocessor, microcomputer. 1.2 Von-Neumann architecture 1.3 Advantages and disadvantages of microprocessor control.
	1c.Explain microprocessor based system with bus Architecture. 1d. Define various buses and their functions	1.4 Organization of a Microprocessor-Based System. 1.5 CPU, Control Unit, Arithmetic logic Unit (ALU), Memory Unit, Power Unit and Input-Output unit. 1.6 Concept of Bus, Microprocessor Bus organization : Data Bus, Address Bus and Control Bus.
	1e.Explain the difference between machine language and assembly language of the 8085 microprocessor. 1f. Explain low level language and high level language. 1g. Describe ASCII code.	1.7 Define machine language ,assembly language, low level language and high-level language. 1.8 Define ASCII code.

	1h.List the operations of microprocessor	1.9 Operations of microprocessor: internal data operations, microprocessor initiated operations and peripheral or external initiated operations.
	1i. Describe Pins diagram of 8085 microprocessor.	1.10 Pin details of 8085 and related signals.
	1j.Explain block diagram of 8085 microprocessor. 1k. Classify interrupts. 1l. Explain various flags in 8085 microprocessor. 1m.Explain Demultiplexing of Address/Data Bus. 1n. Describe Working of 8085 microprocessor.	1.11 Architecture of intel-8085- registers, timing and control, add buffer and add data, decoders, interrupts, serial input and output control. 1.12 Registers, Accumulator, Flags, Program Counter, Stack pointer, memory 1.13 Demultiplexing of address and data bus by ALE signal. 1.14 Instruction fetching operation 1.15 Decoding and Execution of Instruction
	1o. Interpret addressing modes and operations with various types of instruction. 1p. Classify Instruction Word Size 1q. Develop simple assembly language programs	1.16 List Various addressing modes 1.17 Instruction set of 8085. 1.18 Instruction Word Size 1.19 Simple programs with 8085 instruction (only simple arithmetic operations- addition, subtraction, One's Complement, Two's Complement)
UNIT: II. Basics of Microcontroller 8051	2a.Describe the function of each pins of 8051 chip	2.1 Introduction to microcontroller. 2.2 Pin diagram of 8051 microcontroller and Functions of each pin of 8051.
	2b.Explain 8051 architecture with block diagram. 2c.Explain brief internal memory and external memory in reference to 8051 microcontroller. 2d. Define Special Function Registers in 8051	2.3 Blocks of Microcontroller 8051: ALU, PC, DPTR, PSW, Internal RAM, Internal ROM, SFRs, General purpose registers, Timer/Counter, Interrupt, Ports. 2.4 Concept of Internal memory and 2.5 External memory (RAM and ROM) 2.6 Internal RAM structure. 2.7 Various registers and SFRs of 8051.

	2e. Differentiate Stack, Stack Pointer and stack operation	2.8Stack, Stack Pointer and Stack operation
	2f.Describe External Memory Interfacing with 8051. 2g. Compare microprocessors and microcontrollers.	2.9 External Memory Interfacing with 8051. 2.10 Comparison between microprocessor and microcontroller.
UNIT: III Microprocessor and Microcontroller Applications	3a. Compare various types of semiconductor memories. 3b. Explain interfacing of microprocessor with memory. 3c. Explain Data transfer scheme in microprocessor based system. 3d. Describe use of microprocessor/microcontroller for temperature control of furnace 3e. Describe use of microprocessor for SCR firing angle control 3f. Explain Data acquisition system.	3.1 Different types of memories:ROM, RAM, PROM, EPROM, EEPROM. 3.2 Memory Interfacing. 3.3 Data transfer Techniques in microprocessor based system. 3.4 Simple application of microprocessor and microcontroller: 3.4.1Temperature control of furnace using microprocessor 3.4.2 SCR firing angle control using micro processor, 3.5 Data acquisition system.
UNIT: IV Recent trends in controller.	4a. Explain working of each module of PLC. 4b. Compare relay panel and PLC. 4c. State the criteria for selection of PLC for the given application. 4d. Explain architecture of PLC. 4e. Give advantages and disadvantages of PLC. 4f. List the applications of PLC. 4g. Describe the functions of SCADA. 4h. State the applications of SCADA.	4.1 Introduction of Programmable logic controller 4.2 Basic difference between PLC and digital computer. 4.3 Role of automation in Industries. 4.4 Benefits of Automation 4.5 Necessity of PLC 4.6 History and evolution of PLC 4.7 Difference between relay panel and PLC. 4.8 Simple Block diagram of PLC 4.9 Architecture of PLC 4.10 Inputs/Outputs 4.11 Some terms regarding PLC: Souring and Sinking, Set-Reset, Latch-Unlatch. 4.12Programming of PLC: Entering programme in PLC. 4.13 Advantages and disadvantages of PLC 4.14 Types of PLC 4.15 Selecting a PLC

		4.16 Applications of PLC 4.17 Introduction to SCADA 4.18 SCADA functions 4.19 Components of SCADA and Block diagram 4.20 Configuration of communication system 4.21 Applications of SCADA.

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN:

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Basics of Microprocessor	14	8	10	6	24
II	Basics of Microcontroller 8051	10	7	7	2	16
III	Microprocessor and Microcontroller Applications	10	6	6	4	16
IV	Recent trends in Controller	08	5	7	2	14
	Total	42	26	30	14	70

Legends:*R=Remember,U=Understand,A=Applyandabove(RevisedBloom'staxonomy)*

Note*:Thisspecificationtableprovidesgeneralguidelinestoassiststudentsfortheirlearnin gandtoteacherstoteachandquestionpaperdesigners/setterstoformulatetestite ms/questionstoassessthe attainment of the UOs. The actual distribution of marks at different taxonomy levels (of R, UandA)in thequestion paper mayslightlyvaryfrom abovetable.*

10. SUGGESTED STUDENT ACTIVITIES

Following is the list of proposed student activities like:

i. Prepare journals based on practical performed in laboratory.
ii. Prepare chart to represent the block diagram of different interfacing chips. Develop a practical application using 8051 Microcontroller.
iii. Develop any module of to be useful in real life applications.
iv. Multimedia presentation of module developed by the students.
v. Library/E-book survey regarding assembly language programming used in computer industries.

vi. Prepare power point presentation for showing different types of Assembly language programming applications.
vii. Undertake a market survey of different devices based on microprocessor and microcontroller applications.
viii. Find and utilize web based/simulator, android application related to microprocessors and microcontrollers.
ix. Interface microprocessor and microcontroller with external devices for developing mini project.
x. Prepare chart and assembly language programming for basic arithmetic operations.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b) Guide student(s) in undertaking micro-projects.
c) Some ***of the topics/sub-topics*** is relatively simple and very easy to the students for ***self- learning***, but to be assessed using different assessment methods.
d) Guide students for using latest Technical Magazine.
e) Arrange visit to relevant industry
f) Show video lectures on Microprocessor and Microcontroller Applications with help of internet.
g) Assembly level programming practices on simulators (free downloadable).

12. SUGGESTED PROJECT LIST:

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. Students groups have to be formed for micro-projects, the number of students in the group should *not exceed four.*

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. The total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** during the course. The student have to submit micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned course teacher.

MICRO PROJECT 1: Prepare following Items.

1. Prepare Table/chart for Instruction classification.
2. Design a chart for pin diagram of 8085 microprocessor.
3. Design a chart of 8085/8051 Architecture.
4. Design a chart for pin diagram of 8051 microcontroller.

5. Test and verify the features of 8085 Trainer Kit.
6. Test and verify the features of 8051 Trainer Kit.

MICRO PROJECT 2: Prepare following Designs.

1. Design minimum hardware system for 8051 circuit.
2. Develop 8051 based application board/circuit on PCB.

MICRO PROJECT 3: Design Application oriented basic Project using 8051.

1. Design and Implement LED flasher circuit.
2. Design and Implement circuit for relay-based operation using switch.
3. Design and Implement LCD Interfacing circuit displaying your name on it.
4. Design and Implement Water Level Indicator/controller circuit.

13. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1	Microprocessor Architecture, Programming, and Applications with the 8085	Ramesh Gaonkar	Penram Publications
2	The 8051 Microcontroller and Embedded Systems: Using Assembly and C	Mazidi&Mazidi	Pearson Publication
3	The 8051 Microcontroller	Kenanth Ayala	Cengage Learning India
4	Microprocessor and interfacing (Programming and hardware)	Hall, Douglas V.	McGraw Hill Education.
5	Microprocessors and microcontrollers	Latha, c., Murugeshwari,B.	SCITECH PUBLICATIONS, CHENNAI.
6	Microprocessor and its application	Ram, B.	BPB, New Delhi, latest edition
7	Microprocessors and Microcontrollers	Kumar, Senthil, Saravanan, Jeevananthan	Oxford University , New Delhi, latest edition
8	Introduction to Microprocessor	Mathur, A.P.	TMH, New Delhi, latest edition

9	Programmable Logic Controllers And Applications	Webb, John W Ronald Reis. A.	Prentice Hall of India, New Delhi, (latest Edition)
10	Programmable Logic Controllers Programming Methods and Applications	John R. Hackworth, Frederick D., Hackworth Jr.,	PHI Publishers
11	SCADA supervisory control and data acquisition	Stuart A Boyer	ISA, 4th Revised edition
12	Introduction to Programmable Logic Controllers	Gary Dunning	Thomson, Latest Edition
13	Microprocessors and Microcontrollers: Architecture, Programming and System Design 8085, 8086,8051,8096	Krishna Kant	PHI Publishers, Latest Edition

14. SOFTWARE/LEARNING WEBSITES

i. Simulator such as : http://8085simulator.codeplex.com/ http://gnusim8085.org/ or its equivalent
ii. Latest processor configuration : http://www.intel.com/pressroom/kits/quickreffam.htm
iii. Intel 8085 microprocessor architecture: http://www.cpu-world.com/Arch/8085.html
iv. 8085 sample programs :http://www.8085projects.info/page/free-programs-for-8085-microprocessor.aspx
v. 8085 ppts: http://www.slideshare.net/shashank03/assembly-language-programming-of-8085.
vi. www.tutorialspoint.com
vii. www.javatpoint.com
viii. www.electronicshub.org
ix. www.circuitdigest.com
x. http://www.academia.edu/
xi. http://www.nptel.iitm.ac.in/
xii. http://www.8051.com/
xiii. www.keil.com/
xiv. www.allaboutcircuits.com
xv. www.nmbtc.com
xvi. http://nptel.ac.in/courses/Webcourse-contents/IIT - KANPUR/microcontrollers/micro/ui/Course_home1_1.htm
xvii. Go for free open source software wherever applicable

15. PO-COMPETENCY-CO MAPPING:

Semester VI	MICROPROCESSOR AND CONTROLLER APPLICATIONS (Course Code:4360902)						
	POs						
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design/ development of solution	PO4 Engineering Tools, Experimen-tation& Testing	PO 5 Engineering practices for society, sustainability & environment	PO 6 Project Manage-ment	PO 7 Life-long learning
Competency							
Course Outcomes CO1 Interpret the salient features of 8085 microprocessor.	3	2	2	2	-	-	-
CO2 Interpret the salient features of 8051 microcontrollers.	3	-	-	2	-	-	-
CO3 Apply knowledge of microprocessor and microcontroller in various applications.	3	2	2	2	-	-	-
CO4 Maintain PLC and SCADA based system.	3	-	-	2	-	-	-

*Legend: '**3**' for high, '**2**' for medium, '**1**' for low and '**-**' for no correlation of each CO with PO.*

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

Sr. No.	Name and Designation	Institute	Contact No.	Email
1.	DIPA J. KAPUPARA Lecturer-Electrical Engg.	A.V.P.T.I. -RAJKOT	6352400310	dipakapupara.ee@gmail.com
2.	DHARA V. SODHA Lecturer-Electrical Engg.	GP-JUNAGADH	9429215260	dharasodha18@yahoo.com

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
Semester-VI

Course Title: ENERGY CONSERVATION & AUDIT
(Course Code: 4360903)

Diploma programmer in which this course is offered	Semester in which offered
Electrical Engineering	6th Semester

1. RATIONALE

Electrical energy is the most common and widely used type of energy in the world. The subject of energy conservation is a concern for most energy users particularly industry. Energy conservation becomes even more important for the third world, developing countries, where the rising energy costs and the use of efficient energy apparatus are of significant concern to both the industry and the utility. The pressure of Technological development in all sectors on the energy sources has led to the growing the cost of energy around the world. Efficient and judicious use of the available energy sources would lead to the easing of such pressures. Thus it is necessary to save and conserve energy to the maximum possible extent. Also essential theoretical knowledge and practical skills about the concept of energy conservation is to be provided through different approaches of energy conservation in industries, project management and economic accepts. The process of energy audit will help to identify the various possible avenues in which savings of energy can be effectively adopted. This course makes the diploma holder well acquainted in the techniques of energy conservation in the fields of engineering. It also introduces him to the energy audit procedures.

2. COMPETENCY

The course content should be taught and implemented with the aim to develop different types of skills as per industrial and societal need so that students are able to acquire following competency:

- **Undertake energy conservation and energy audit.**

3. COURSE OUTCOMES (COs)

The theory should be taught and practical should be carried out in such a manner that students are able to acquire different learning out comes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

- **Interpret** the need of energy conservation.
- **Implement** energy conservation techniques in electrical machines.
- **Evaluate** the techno economic feasibility for the energy conservation projects.
- **Demonstrate** energy conservation measures to improve efficiency of electrical power system.
- **Carry** out energy audit for an industry/organization.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
3	0	2	4	30	70	25	25	150

Legends:

L – Lecture; T – Tutorial/Teacher Guided Theory Practice; P – Practical; C – Credit, CA – Continuous Assessment; ESE – End Semester Examination.

Note:

Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be conducted during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

5. SUGGESTED PRACTICAL EXERCISES:

Sr No	Practical Exercises (Major Outcomes in psychomotor domain)	Unit No.	Approx. Hrs. required
1	Identify star labelled electrical apparatus and compare the data for various starratings.	I	2*
2	Prepare a technical report on energy conservation act 2001.	I	2
3	Estimate energy saving by improving power factor of an Induction Motor.	II	2*
4	Compare Conventional Transformer and Energy Efficient Transformers.	II	2*
5	Compare power consumption of different types of TL with choke and electronic ballast.	II	2*
6	Compare power consumption of different types of conventional tubelight, CFL and LED lamps by direct measurements.	II	2
7	Determine depreciation cost of a given energy conservation project/equipment.	III	2*
8	Find out the payback period and return on investment for a given energy conservation project/equipment.	III	2*
9	List the various energy conservation methods useful in power generation, transmission and distribution	IV	2
10	Collect electricity bill of an industrial consumer and suggest suitable tariff for energy conservation and its impact on energy bill	IV	2*
11	Collect electricity bill of a commercial consumer and suggest suitable tariff for conservation and reduction of its energy bill	IV	2*
12	Identify various measuring instruments used for energy audit.	V	2*
13	Use various measuring instruments for carrying out energy audit. (Any two)	V	2
14	Prepare a sample energy audit questionnaire	V	2*
15	Prepare a sample energy audit report	V	2*
A suggestive list of Practical Exercises is given in the above table. A judicial mix of minimum 10 or more practicals need to be performed, out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of 'Psychomotor Domain Taxonomy' as generally required by the industry.			

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

Sr.No.	Equipment Name with Broad Specifications	Pra. No.
1	3 - φ induction motor	3
2	3 - φ or 1 - φ transformer	4
3	Ammeters MI Type: AC/DC 0-5-10Amp	3, 4
4	Voltmeter MI Type: AC/DC, 0-150/300V, 0-250/500V	3, 4
5	Wattmeter: Three phase double element 5/10Amp. 250/500V	3, 4
6	Wattmeter: Single phase, single element 2.5/5Amp, 200/400V	3, 4
7	Low power factor wattmeter : Single phase, 5/10Amp, 250/500V	3, 4
8	Three phase Power factor meters: AC, 415V, 50 Hz, 5-10 Amp	3, 4
9	Load bank: Resistive	3, 4
10	FTL, Electric choke. Electronic ballast	5
11	Clip on meter (amp, volts) digital	3, 4, 5
12	Multimeter	3, 4, 5
13	CFL & LED of different ratings	5, 6
14	Lux meter	12, 13

7. AFFECTIVE DOMAIN OUTCOMES

Students are able

- To create awareness regarding energy conservation in society.
- To select appropriate techniques to reduce energy wastage in household appliances.

8. UNDER PINNING THEORY:

Unit	Major Learning Outcomes	Topics and Sub-topics
Unit - I Elements of Energy Conservation	1a. Explain the concept of energy conservation and its benefits. 1b. Explain energy conservation act 2001 1c. Explain the concept of star labelling 1d. Explain Important Aspects of Energy Conservation	1.1 Indian energy scenario 1.2 Need of energy conservation 1.3 Energy conservation Principle 1.4 Benefits of energy conservation 1.5 Energy conservation act 2001 and its Purpose 1.5 Mandatory provision of the energy conservation act 2001. 1.6 Important features of energy conservation act 2001: • Standards and labelling (S&L) • Demand side management (DSM) • Energy conservation Building Code (ECBC) • Designated consumers • Bachat lamp Yojana (BLY) 1.7 Star labelling: need and benefits 1.8 Economic aspect and Environment aspect for energy conservation.
Unit - II Energy Efficient Technologies in Electrical Systems	2a. Identify energy conservation opportunities in various electrical systems in industries 2b. Explain the energy conservation strategies in induction motor 2c Explain the energy conservation strategies in transformer 2d Explain the energy conservation strategies in electric lighting	2.1 Energy efficient induction motor and its advantages 2.2 Benefits of power factor improvement 2.3 Power factor improvement techniques: static capacitor method, synchronous condensor method, phase advancer and related numericals 2.4 automatic power factor controllers 2.5 Maximum demand controllers 2.6 Energy conservation by variable speed drive 2.7 Need of Energy efficient transformer 2.8 Comparision between Conventional Transformer and Energy Efficient Transformers

		2.9 Advantages of amorphous transformers 2.10 Transformers loss reductions 2.11 Energy efficient luminaires: CFL & LED 2.12 Advantages of electronic ballast and electronic fan regulator 2.13 Good lighting practice
Unit - III Technoeconomic Evaluation of Energy Conservation Project	3a. Calculate the cost of energy conservation project 3b. Calculate the depreciation cost 3c. Calculate the payback period and return on investment	3.1 Different cost of an energy conservation project 3.2 Depreciation and methods to calculate it: • straight line method • sinking sund method • diminishing value method • Related numericals 3.3 Modes of economic analysis: • Payback period • Return on investment and • Related numericals
Unit - IV Energy Conservation in Power Generation, Transmission and Distribution	4.a Identify scope of energy conservation in electrical power generation 4.b Identify scope of energy conservation in electrical power transmission 4.c Identify scope of energy conservation in electrical power distribution	4.1 Co-generation and its need 4.2 Types of co-generation 4.3 Advantages of co-generation 4.4 Measures to reduce transmission line losses 4.5 Energy conservation by demand side management 4.6 Reconstruction of tariff (types of tariff are not included)
Unit - V Energy Audit	5.a Explain the concept of energy audit and its benefit 5.b Describe the methodology for preliminary anpd detailed energy audit 5.c Preperation of the Energy Audit Report 5.d Demonstrate the function of instruments used in energy audit 5.e List roles and resposibilities of energy auditor	5.1 Energy audit and its benefits 5.2 Types of energy audit 5.3 Methodology for conduction of energy audit 5.4 Structure of the Energy Audit Report 5.5 Energy Audit Instruments 5.6 Roles and resposibilities of energy auditor

9. SUGGESTED SPECIFICATION TABLE FOR QUESTIONPAPER DESIGN:

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Elements of Energy Conservation	6	3	4	3	10
II	Energy Efficient Technologies in Electrical Systems	12	3	8	7	18
III	Technoeconomic Evaluation of Energy Conservation Project	8	3	4	7	14
IV	Energy Conservation in Power Generation, Transmission and Distribution	8	6	4	4	14
V	Energy Audit	8	3	4	7	14
Total		**42**	**18**	**24**	**28**	**70**

Legends: R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)

Note: This specification table provides general guidelines to assist students for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions to assess the attainment of the COs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may slightly vary from above table

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related co-curricular activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct any two of the following activities in group and prepare reports of each activit:

- Carry out internet survey to collect information related Energy conservation projects.
- Collect the catalogues of star labeled equipments (min.2)
- Write report on performance of motor after rewinding.
- Collect videos to demonstrate working of Energy Conservation Equipments (any 2)
- Prepare PPT presentation on energy efficient motors.
- Prepare PPT presentation on energy efficient transformers.
- Collect information about energy efficient luminaries.
- Collect videos to demonstrate working of Energy Audit instruments.
- Visit a facility adopting cogeneration systemand prepare a presentation.
- Assignments on solving simple numericals
- Prepare a report based on a survey of at least two nearby industries on energy conservation measures adopted by them using questionnaire.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the faculty can use to accelerate the attainment of the various outcomes of this course:

- Massive open online courses (MOOCs) may be used to teach various topics/sub topics.
- About 15-20% of the topics/sub-topics which is relatively simpler or descriptive in nature is to be given to the students for self-directed learning and assess the development of the COs through classroom presentations.

12. SUGGESTED PROJECT LIST (MICRO PROJECT)

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. However, in the fifth and sixth semesters, microproject should preferably be assigned individually undertaken to build up the skill and confidence in every student to become problem solver so that she/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should not exceed three.

Suggestive list of micro-projects is as under. Similar micro-projects could be added by the concerned faculty:

a. **Energy efficient lamps:**
   Prepare comparative charts with ratings, cost and manufacturer details.
b. **Energy efficient home appliances:**
   Interpret star labelling, its needs and benefits.
c. **Energy conservation campaign:**
   Prepare charts/slogans to create energy conservation awareness among people.
d. **Energy efficient electrical machines:**
   Prepare technical presentation on details of energy efficient transformers/motors.
e. **Energy conservation policies:**
   Prepare report on energy conservation policies of Government of Gujarat.
f. **Energy Audit:**
   Prepare charts based on various measuring instruments for carrying out energy audit
g. **Energy Manager and Energy Auditor:**
   Identify roles and responsibilities of energy manager as well as energy auditor.

13. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication
1	Energy Technology	O.P. Gupta	Khanna Publishing House, New Delhi
2	Energy management	Dr. Sanjeev Singh	S K Kataria & Sons, New Delhi,
3	Financial Management	Prasanna Chandra	Tata Mcgraw Hill, New Delhi
4	Project Management T	Prasanna Chandra	Tata Mcgraw Hill, New Delhi
5	Energy Management and Conservation	Sharma, K. V., Venkataseshaiah	I K International Publishing House Pvt. Ltd
6	Electric Energy Generation, Utilisation and Conservation	S. Sivaganaraju	Pearson, New Delhi, 2012
7	Electrical Power	V. K. Mehta	Khanna and Khanna Publishers, New Dehli

14. SOFTWARE/LEARNING WEBSITES

1. https://beeindia.gov.in/
2. http://indianpowersector.com/
3. www.mnes.nic.in
4. https://powermin.nic.in/
5. https://www.anert.gov.in/
6. www.nptel.iitm.ac.in
7. www.energymanagertraining.com
8. www.greenbusiness.com
9. www.worldenergy.org

15. PO-COMPETENCY-CO MAPPING:

Semester VI	Electrical Engineering: Energy Conservation & Audit (Course Code: 4360903)						
	POs						
Competency & Course Outcomes	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7
Competency	**Undertake energy conservation and energy audit.**						
Interpret the need of energy conservation	1	2	-	2	3	-	2
Implement energy conservation techniques in electrical machines	3	3	1	3	2	3	3
Evaluate the techno economic feasibility for the energy conservation projects.	3	-	-	-	2	-	1
Demonstrate energy conservation measures to improve efficiency of electrical power system	3	2	-	-	3	2	3
Carry out energy audit for an industry/ organization**.**	3	2	2	3	3	3	2

*Legend: '**3**' for high, '**2**' for medium, **'1'** for low and **'-'** for no correlation of each CO with PO.*

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

Sr. No.	Name and Designation	Institute	Contact No.	Email
1.	**Mr. ASHVIN M MAHESHWARI**	Government Polytechnic, Dahod	9427533123	ampcity25@gmail.com
2.	**TEJAL H PATEL**	Dr. S & S Ghandhy college, Surat	8141971675	pateltejal.239@gmail.com

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
VI – Semester
Course Title: Green Technology
(Course Code: 4360904)

Diploma programmer in which this course is offered	Semester in which offered
Electrical Engineering	Sixth

1. RATIONALE

India has declared the goal to achieve net zero emissions by 2070. As India's growth story unfold, its demand for energy and resources is set to rise. Energy use has doubled in the last 20 years and is likely to grow by least another 25% by 2030. India currently imports over 40% of its primary energy requirement, worth over USD 90 billion every year. Major sectors of Indian economy depend on imported fossil fuels. This necessitates shift towards technologies that enable enhanced share of renewable source and progressively reduce the reliance on fossil fuels

2. COMPETENCY

The purpose of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Understanding renewable energy technologies, optimization, regulation and Policies**

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with the identified competency are to be developed in the student for the achievement of the following COs:

COs	Statement
CO1	Describe the different sources of renewable energy
CO2	Analyze PV system performance.
CO3	Understand the operation of wind turbine generators.
CO4	Understand government policies for renewable energy sources

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
3	0	2	4	30*	70	25	25	150

(*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

***Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **CA** - Continuous Assessment; **ESE** - End Semester Examination.*

5. SUGGESTED PRACTICAL EXERCISES

The following practical outcomes are the sub-components of the Course Outcomes (COs).

Sr. No.	Practical Outcomes	Unit No.	Approx. Hrs. Required
1	To plot the I – V characteristics of solar cell and determine fill factor.	II	2
2	Perform P – V characteristics of solar cell.	II	2
3	To measure efficiency of solar cell	II	2
4	To study effect of irradiance on the I – V and P – V characteristics of solar cell	II	2
5	Analyze the performance of solar panel based on tilt angle of solar panel	II	2
6	Analyze the performance of solar cell based on azimuth angle of the solar panel.	II	2
7	Estimate size of solar panel for small residential load	II	2
8	Estimate AC energy output of small solar farm considering	II	2

	fixed array, one axis tracking and dual axis tracking.		
9	Estimate AC energy output of small solar farm, cost of power plant and payback period.	II	2
10	To measure sunshine hours by using sunshine recorder	II	2
11	Measure solar irradiance & record it during solar time of a place	II	2
12	Prepare technical report on small solar farm / solar plant visit	II/III	4
13	Estimate Bifacial gain by the albedo in the solar panel	II	2

Note

i. *More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list.*

ii. *The following are some **sample** 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency.*

Sr. No.	Sample Performance Indicators for the Practical	Weightage in %
1	Prepare experimental setup	20
2	Operate the equipment setup or circuit	20
3	Follow safety practices.	10
4	Record observations correctly	20
5	Interpret the result and conclude	30
		100

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

This major equipment with broad specifications for the Practical is a guide to procure them by the administrators to user in uniformity of practical in all institutions across the state.

Sr. No.	Equipment Name with Broad Specifications	Practical No.
1	Solar Tracker (Track solar energy, Applications in solar radiation network, meteorological)	--
2	ISO 9060 Pyranometer (Solar Radiation Measurement)	--

3	Pyrgeometer (Highest Quality Scientific Solar Radiation for all weather condition)	--
4	Pyrheliometer (Radiometer for the measurement of direct normal irradiance)	--
5	Albedometer Mounting Kit (To measure ratio of irradiance reflected to the irradiance received)	--
6	Sunshine Duration Sensor (Product Link)	--
7	Data Logger (Non-power radiometer to display and record measurement of solar irradiance)	--
8	Solar IV Tester (To check deterioration in the solar system)	--
9	Digital Anemometer (Wind speed meter)	--
10	Wind vane sensor (Measure wind direction)	--
11	Thermal Imager or Thermography Camera (Detect hotspot in PV Modules)	--

7. AFFECTIVE DOMAIN OUTCOMES

The following ***sample*** Affective Domain Outcomes (ADOs) are embedded in many of the above-mentioned COs and Practical. More could be added to fulfill the development of this course competency.

a) Work as a leader/a team member (while doing a micro-project)
b) Follow safety practices
c) Follow ethical practices
d) Maintain tools and equipment
e) Practice environment friendly methods and processes. (Environment related)

The ADOs are best developed through the laboratory/field-based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

i. 'Valuing Level' in 1st year
ii. 'Organization Level' in 2nd year.
iii. 'Characterization Level' in 3rd year.

8. UNDERPINNING THEORY

The major underpinning theory is given below based on the higher level UOs of *Revised Bloom's taxonomy* that are formulated for development of the COs and competency. If required, more such UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
Unit 1 Renewable Energy Resources	• Understand the energy scenario in India and advance non-conventional energy resources	• Energy resource in India, India's total installed capacity, India's generation capacity, energy demand – supply, impact on environment due to fossil fuel • Yearly generation growth, Renewable energy generation state-wise • Advance non – conventional energy sources • Hydrogen: Characteristics, advantages, and applications • Green hydrogen, Blue hydrogen & Grey hydrogen • Biofuels, Bioethanol, Biodiesel, Advance Biofuels, Drop in fuels, bio CNG, Di-Methyl Ether
Unit-II Solar Energy	• Knowledge of solar energy and its potential • Understand various terminology associated with solar energy • Estimate solar energy output for different tilt angle, azimuth angle and tracking system	• Solar energy potential in India, National institute of solar energy, Off grid solar PV Programme • Intensity of light, Electromagnetic radiation • DNI, DHI, GHI and relation between them, factors affecting global irradiance • Albedo, Factors affecting albedo • Working of solar cell, Monocrystalline, Polycrystalline, Thin film solar cell, Comparison • Series & Parallel Connection of Solar array • Solar cell, modules and array • I – V and P – V Characteristics of Solar Cell, Maximum power point, fill factor, effect of irradiance on characteristic of solar cell • Sun – Earth relation: Equinox, Summer solstice, Winter solstice

		• Tilt angle & its case study. Solar hour angle, Declination angle, Altitude angle, Zenith angle, Azimuth angle & its case study • Orientation of solar panel, case study • Solar inverter: Grid connected inverter, central inverter, string inverter, micro inverter, off grid inverter, hybrid inverter, Estimation of inverter size and battery size • Solar tracking: single axis tracking, dual axis tracking, Cosine effect in solar tracking • Shadow analysis: distance between two arrays • Solar Farm, Case Study
Unit-III Wind Energy	• Estimate the wind energy potential in India • Understand HAWT, VAWT and working of wind measuring instruments • Classify wind generators	• Wind energy potential in India, Wind energy potential at 120 m, 150 m and above 150 m level • Wind power equation • Wind power curve • HAWT, VAWT, Savonius & Darries wind turbine • Wind speed measure instrument: Cup type, pitot tube type, impeller type, ultrasonic type, LIDAR and SODAR anemometer • Construction and working of wind generator: squirrel cage, wound rotor, double fed, wound rotor permanent magnet and permanent magnet synchronous generator
Unit-IV Renewable Energy Policies	• Describe Government Incentive Schemes & Policies to promote renewable energy	• Grid connected solar roof top solar programme, objectives, CFA for different sectors • Grid connected solar power projects • PM KUSUM Scheme, component A, component B and component C, incentives, Feeder level solarization scheme • Solar park and Ultra mega solar power plant policy • Wind data sharing policy • National offshore wind energy

		policy, 2015, objective of policy, incentives • Wind solar hybrid policy 2018, objective of policy, incentives, waiver of charges • National green hydrogen mission: Objectives and Incentives for electrolyzer and green hydrogen production

9. SUGGESTED SPECIFICATION TABLE FOR QUESTIONPAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Renewable Energy Resources	6	4	6	0	10
II	Solar Energy	18	8	14	8	30
III	Wind Energy	12	8	10	2	20
IV	Renewable Energy Policies	6	4	6	0	10
Total		42	24	36	10	70

Legends: *R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*

Note*: This specification table provides general guidelines to assist students for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions to assess the attainment of the UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may slightly vary from above table.*

10. SUGGESTED STUDENT ACTIVITIES

The following student related co-curricular activities are suggested other than laboratory learning which are helpful to attain various outcomes of the course. Students should perform following activities in group (or individual) and prepare reports of about 5 pages for each activity.

a) Present seminar on course related topics
b) Group discussion on course related topics
c) Estimate solar energy potential in India
d) Prepare a display chart of solar energy map
e) Prepare chart of wind energy potential in India

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

There are some of the sample strategies that course teacher can implement to accelerate the attainment of various course outcomes.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-projects are group-based (group of 3 to 5). However, **in the fifth and sixth semesters**, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of Pracaticals, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The duration of the micro project should be about **14-16** ***(fourteen to sixteen) student engagement hours*** during the course. The students ought to submit micro-project by the end of the semester to develop the industry-oriented COs. A suggestive list of micro-projects is given here. This has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher:

a) Series and parallel connection of solar cell
b) Trainer kit for I – V characteristics of solar cell
c) Prepare display chart for HAWT and VAWT
d) Renewable energy map of India
e) Solar power bank
f) Mini solar power station
g) Solar street light
h) Solar study lamp
i) Solar display board
j) Small wind power station

13. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication with place, Year and ISBN
1	Renewable and Efficient	Gilbert M.	John Wiley & Sons Ltd

	Electric Power Systems	Masters	
2	Energy Harvesting	Alireza Khaligh & Omer C. Onar	CRC Press, Taylor and Francis Group
3	Wind Power in Power Systems	Thomas Ackerman	John Wiley & Sons Ltd
4	Wind Energy	J.F.Manwell, J.G.Mcgowan, A.L. Rogers	John Wiley & Sons Ltd
5	Fundamental of photovoltaic modules and their applications	G N Tiwari & Swapnil Dubey	RSC Publishing
6	Renewable energy resources & Emerging technology	Kothari D P	PHI publications

14. SOFTWARE/LEARNING WEBSITES

- www.mnre.gov.in
- https://solarrooftop.gov.in/rooftop_calculator
- Solar energy corporation of India limited
- National renewable energy laboratory
- US Department of Energy
- Bureau of Energy Efficiency
- NPTEL Online Course – Renewable Energy
- NPTEL Online Course – Wind Energy

15. PO-COMPETENCY-CO MAPPING:

Semester VI	**Green Energy (Course Code:4320901)**						
	POs						
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
Competency & Course Outcomes	Basic & Discipline specific knowledge	Problem Analysis	Design/ development of solution	Engineering Tools, Experiments and Testing	Engineering practices for society, sustainability & environment	Project Management	Life-long learning
Competency	**Understanding renewable energy technologies, distribution**						

	grid, regulation, and policies.						
Describe the different sources of renewable energy	1	1	-	1	-	-	-
Analyze PV system performance	1	2	1	2	-	1	2
Understand the operation of wind turbine generators.	1	-	-	1	-	-	-
Understand government policies for renewable energy sources	1	-	-	1	1	-	-

*Legend: '**3**' for high, '**2**' for medium, **'1'** for low and **'-'** for no correlation of each CO with PO.*

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

Sr No.	Name and Designation	Institute	Contact No.	Email
1.	R D Panchal Lecturer Electrical Engg.	A. V. Parekh Technical Institute, Rajkot	9825776648	rajup1178@gmail.com
2.	B B Chauhan Lecturer Electrical Engg.	Government Polytechnic, Jamnagar	9925210010	bbc.gpjam@gmail.com

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
Semester-VI

Course Title: Electrical Engineering Project-II
(Course Code: 4360906)

Diploma programme in which this course is offered	Semester in which offered
Electrical Engineering	6th Semester

1. RATIONALE

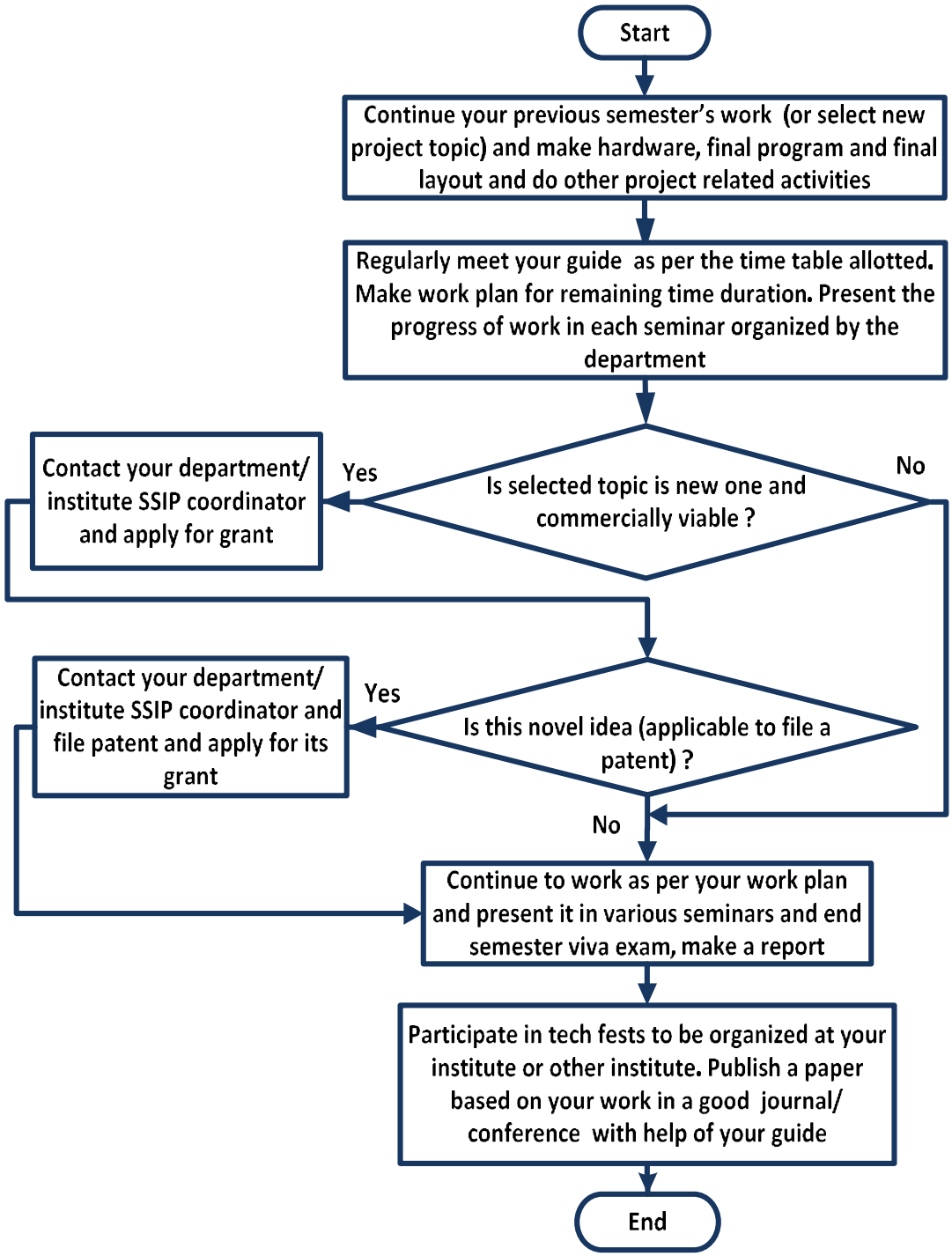
To provide an opportunity to the students for applying the knowledge and technical skills acquired by identifying real life problem of the industries /research organization / society as a whole and providing its innovative solution with implementation, which is economically and technically viable.

In this course - **Electrical Engineering Project-II,** the problem is already identified in 5th semester (or to be identified) for providing solution under the mentoring of the institute guide/industry mentor to develop various competencies. This course is designed to provide virtual industrial experience to the students. This course includes summarizing of the work done in the previous semester (or identify a new problem and start the work), trouble shooting of the project work, testing and assembling of the project, report writing and presenting the final model. Four seminars are included in this course to develop communication skills along with other competencies in students as well as to assess the progress of the work done. This course advocates a holistic student entrepreneurship approach, including startup initiation, grant funding, and patent protection, in alignment with India's self-reliance mission.

Project identification and guide allocation:

- Before the start of the sixth semester, project orientation should be held every year by the project coordinator. In this orientation, discussion regarding the selection of a topic (if the work of this semester is not in continuation with the 5th semester's work), the formation of a team, and the selection of a guide (**if it is required to change**) should take place.
- A list of guides with their expertise domain and area of interest should also be given to students.
- This list should also be uploaded to the departmental/institutional website.
- Students should also be given the choice to choose a guide whose area of interest matches with their project domain.
- Students can continue their work from fifth semester's work or select new topic and continue the work.

- The ongoing process and other related tasks are summarized in the following flow chart.



During 6th semester, students should have to follow these steps for project related work:

1) Create actual PCB in laboratory from layout. You may take help of your guide/expert.
2) Component mounting/soldering/wiring practice.
3) Visit the industry related to your work regularly.
4) Get help from guide/Innovation council/research organization to implement method/strategy selected.

5) Report to institute guide/industry mentor regarding stage wise progress regularly.
6) Continue testing and debugging of software with diverse tools to achieve an error-free and efficient compact solution.
7) Write algorithm and draw a flowchart (particularly if project work is based on Microprocessor/Microcontroller).
8) Simulate the circuit (if required).
9) Prepare project report (as per format given by department/available on departmental website).
10) Prepare PPT for presentation (**for various seminars as well as final presentation - at the end of the semester conducted for progressive assessment**).
11) If the project is innovative, explore grant opportunities to support the establishment of a new startup.
12) With help of SSIP coordinator examine intellectual property rights for the purpose of patenting the project.

2. COMPETENCY

The course content should be taught with the aim of developing various skills, enabling students to acquire the following competencies

1 To develop inquisitiveness, innovative skills, and confidence to work independently.
2. To participate effectively in group work.
3. To collect relevant data.
4. To plan and organize the work.
5. To analyze and synthesize the data.
6. To relate knowledge of various courses in a selected problem.
7. To make an appropriate decision whenever it is required.
8. To conduct a survey and investigation.
9. To solve industry problems.
10. To optimize the cost of the project.
11. To design the layout as per requirement.
12. To prepare block diagram, circuit diagram, simulation model and microcontroller program as per requirements.
13. To assess the financial implication and feasibility of the project.
14. To troubleshoot the faults during assembling and testing.
15. To modify the component/system whenever it is required.
16. To prepare the technical report and ppt.
17. To present the work as individual and team.

18. To publish a paper in a good journal/ conference based on the work.
19. To prepare a comprehensive plan for startup grants and consult a SSIP coordinator/patent attorney to identify eligibility of the project work for filing a patent.

3. COURSE OUTCOMES (COs)

CO.1 Summarize the work done in previous semester.

CO.2 Troubleshoot the faults during assembling procedure.

CO.3 Execute testing of project after assembling of final hardware to verify the result.

CO.4 Modify the components of the project, if required.

CO.5 Defend final review with hardware model, report writing, presentation as individual and team.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
0	0	4	2	0	0	50	50	100

Legends: ***L****-Lecture;* ***T*** *– Tutorial/Teacher Guided Theory Practice;* ***P*** *- Practical;* ***C*** *– Credit,* ***CA*** *- Continuous Assessment;* ***ESE*** *- End Semester Examination.*

5. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

This major equipment with broad specifications is a guide to procure them by the administrators to use in the laboratory dedicatedly made for the project work.

Sr.No.	Equipment Name with Broad Specifications
1	Dual channel D.C. supply, 0-30 Volt, 2 Amp with display
2	**Tool kits** that include spanners, screw drivers of various size, measuring tape, drilling machine, tester, multi meter, clip on meter, hammer, hack saw, flux, pliers, nose pliers, insulation tape etc.
3	Dual channel Digital Storage Oscilloscope
4	10 MHz function generator
5	Miscellaneous components like Diode, Transistor, Step down Transformers, LED, Relay, various analog digital and microcontroller ICs, soldering irons, soldering wire, connectors, wires, general purpose PCBs and other items required for offered projects as per requirement
6	Lamp load 3-phase 415 V, 0-10 A.
7	Single-phase, Three-phase supply panels with suitable measuring instruments

Sr.No.	Equipment Name with Broad Specifications
8	Microcontroller Programming Software/ Integrated Digital Environment as per requirement
9	Simulation software like MATLAB, PSIM, Proteus etc. as per requirement
10	PCs having latest specifications as per the requirements of the students
11	LCD/LED projectors to be used for presentation in seminars

6. AFFECTIVE DOMAIN OUTCOMES

The following ***sample*** Affective Domain Outcomes (ADOs) are embedded in many of the above-mentioned COs. More could be added to fulfill the development of this course competency.

a. Work as a leader/a team member (while doing a project work).
b. Follow safety practices while using D.C. and AC supply and electrical equipment.
c. Work as a group member (while assembling, testing and presenting the project)
d. Practice environmentally friendly methods and processes. (Environment related)

The ADOs are best developed through the laboratory/field-based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

i. 'Valuing Level' in 1st year
ii. 'Organization Level' in 2nd year.
iii. 'Characterization Level' in 3rd year.

7. UNDERPINNING THEORY

The major underpinning theory is given below based on the higher level UOs of *Revised Bloom's taxonomy* that are formulated for development of the COs and competency. If required, more such UOs could be included by the course teacher to focus on attainment of COs and competency. (**Overall work of Electrical Engineering Project-II should be done in following steps**)

Unit	Unit Outcomes (UOs)	Topics and sub topics
Unit-I Summarize the work done in previous semester.	1a. Monitor the entire work and check the progress of whole work considering the work plan made in previous semester. 1b. Do multiple task (e.g. provide safety/protection/control for electrical power system/ machines) use micro controller. 1c. To make the application smarter use IOT approaches (If it is necessary).	1.1 By adapting innovative/creative ideas try to make the model as per industry standard. 1.2 If applicable and/or feasible try to use microcontroller/microprocessor to control the process. 1.3 Adapt smarter techniques to control the power/process (e.g. control the power/process using WiFi/Bluetooth/SMS etc.).

		1.4 Create Printed Circuit Board/Panel.
Unit-II Troubleshoot the faults during assembling procedure.	2a. Identify components with required ratings. 2b. Select appropriate method/process to make the working model. 2c. Prepare program for microcontroller (if required) as per the algorithm made in previous part of the project. 2d. Divide the work of hardware as well as software among the team as per the ability of each student. 2e. Identify the faults and trouble shoot it while assembling.	2.1 Verify Component ratings and Specifications. 2.2 Develop program in Assembly/high level language (if it is required). 2.3 Do Mounting, Soldering and wiring. 2.4 Make final design for model/panel that requires less space. 2.5 Do continuity test for PCB tracks/wiring. 2.6 Start to make final program as per algorithm. 2.7 Assemble hardware and check. 2.8 Trouble shoot the faults if arises.
Unit-III Execute testing of project after assembling of final hardware to verify the result.	3a. Test the project 3b. Acquire results to check whether any changes are necessary or not.	3.1 Analyze and test the hardware after loading the software (if microcontroller is used). 3.2 Check and modify program of microcontroller (if necessary). 3.3 Complete remaining fabricating, soldering and wiring of hardware after testing.
Unit-IV Modify the components of the project, if required.	4a. Make the final model as per the requirement. 4b. Care for safety while using/demonstrating it. 4c. Make the model as per the industry standard (if possible). 4d. Modify the components (and microcontroller program also if required) while doing above three steps.	4.1 Design final layout. 4.2 Arrange different sections/parts logically and properly. 4.3 fabricate and construct final model as per industry standard (if possible). 4.4 Modify the components if is found necessary in previous stages. 4.5 Modify the microcontroller program also (if required) if is found necessary in previous stages.

Unit-V Defend final review with hardware model, report writing, presentation as individual and team.	5a. Complete the work of making the model and give final touch to it. 5b. Prepare the final report of whole work. 5c. Mention future scope of the work done in the report. 5d. Prepare the final presentation. 5e. Take part in the relevant competition, conference, symposium etc. 5f. Prepare and publish a paper.	5.1 Finish the work of hardware and programming (if required). 5.2 Prepare project report as per institute/GTU guideline. 5.3 At last portion of report/presentation, mention the future scope of the work done. This may give proper direction to other students/industries to work further/better on the selected and/or similar topic. 5.4 Prepare PPT and present as per schedule. 5.5 Demonstrate the work with model and ppt. 5.6 Take part in various competitions (like conference, symposium hackathon, ideathon, model making competition and SSIP events) arranged by GTU or any other institutes/ organizations. 5.7 Prepare a research paper (if it is appropriate and advisable) based on the work done with help of your guide and present it in a good journal/ conference. 5.8 Apply for grant to SSIP or other funding agencies and protect the work by applying for a patent if it is required and advisable.

Note:- *Departmental SSIP (Student Startup Innovation Policy) team may check each project and may decide whether any project is appropriate for SSIP scheme or not. If project is found viable for that, students of that group (with help of departmental SSIP coordinator) have to apply for grant (for Startup and/or patent filing) to SSIP or other funding agency.*

8. SCOPE OF PROJECTS

Scope of the project work should be decided based on the following criteria:

(i) Relation to diploma programme curriculum: When student intend to select topics for the project work, they need to choose a project which relates well to their curriculum (it may be beyond curriculum but it should relate to it) and requires implementation of theories already learnt and skills already possessed by them from the previous semesters.

(ii) Abilities possessed by the group of students: Projects should be chosen so that it can be completed mainly using student's problem-solving capabilities and depth of learning. It is natural that highly motivated students or high achievers may come out with projects which are

more complex and challenging. Teachers should guide students to choose challenging projects according to the student's ability.

(iii) Resources available: Students and Guides should keep in mind the availability of resources while deciding the topic and the scope of the project. Some of the important resources which need consideration are:

- Time available
- Raw material/components required
- Manufacturing/fabrication equipment and tools required
- Testing/Measuring equipment and instruments required
- Access to journals (library/digital)
- Expertise for theoretical guidance available in college (or nearby Institutions or nearby industries)
- Expertise and Technology required for fabrication (if required)
- Software required

9. TYPES OF PROJECTS: In general, the projects are of the following types:

(i) Design projects
(ii) Prototype (design, make, test and evaluate)
(iii) Advanced experimental work requiring the development of existing equipment to be need and developed
(iv) Field works: This could include surveys, using equipment, charting data and information from virtual observation.
(v) Comparative studies: Theoretical study of two systems/ mechanisms/ processes in detail and comparing them on the basis of cost/ energy conservation/ impact on environment/ technology used etc.
(vi) Application of emerging technology: Theoretical study of some emerging technology and feasibility of its application in some real-life situation in detail.
(vii) Fabrication of some equipment/ machine etc.
(viii) Development of software/ application to solve some complex problem related to Electrical Engineering field.

10. ACCESSMENT OF PROJECT WORK

Project Guide and/or Program coordinator and/or Project evaluation committee will assess the project work in four different project seminars as per the assessment rubrics suggested here. Total four seminars are to be held during the fifth semester and continuous assessment (CA for 50 marks) is to be done as per the following suggested sheet. (Remaining 50 marks are for the end semester exam - ESE which shall be conducted by the GTU). If two independent projects for 5^{th} and 6^{th} semester are offered, project guide/program coordinator/ project evaluation committee will slightly change the assessment criteria.

Evaluation of Electrical Engineering Project-II (4360906)

Serial No.	Students Name	Enrollment Number	Name of Guide	Project Title	Marks (Continuous Assessment)				
					Seminar-I (out of 10)	Seminar-II (out of 10)	Seminar-III (out of 10)	Final Evaluation (out of 20)	Total (out of 50)
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									

Project evaluation committee **Project Coordinator** **Head of the Department**

Sample assessment rubrics to be used to verify the progressive work done by the student for different seminars/final evaluation

Sr. No.	Activity	Criteria for performance evaluation	High Proficiency	Proficiency	Some Proficiency	No/Limited Proficiency	Score
			8 to 10 Marks	6 to 8 Marks	3 to 5 Marks	0 to 2 Marks	
1	**Seminar-1**	Make necessary hardware/software till time and start troubleshooting the faults during assembling procedure.	Made necessary hardware/software. Assembled required hardware and started troubleshooting the faults during assembling.	Made small portion of necessary hardware/software. Assembled hardware and troubleshooting the faults during assembling.	Made very small portion of necessary hardware/software. Assembled hardware and not started troubleshooting the faults during assembling.	Did not make necessary hardware/software. Did not assemble hardware and not started troubleshooting the faults.	Out of 10
2	**Seminar-2**	Execute the testing of project after assembling of final hardware to verify the result.	Started testing of project and verified the result	Started testing of project and verified some result	Started testing of project and not verified the result	No approach at all for testing of project as well as verification of results	Out of 10
3	**Seminar-3**	Modify the components (and program of microcontroller if required) of the project whenever it is required	Did all the possible tests and modified the components (and program of microcontroller if required)	Did all the possible tests and modified some components (and program of microcontroller if required)	Did all the possible tests and did not modify any components	Did not perform any tests and did not modify any components	Out of 10
4	**Seminar-4 (Final evaluation at the end of 6th semester)**	Defend final review with hardware model, report writing, present as individual and team.	Student explained the work very effectively and confidently and successfully demonstrated the hardware/model	Student explained the work very effectively and confidently and demonstrated the hardware/model with less confidence	Student explained the work with less confidence and not able to demonstrate the hardware/model confidently	Student didn't explain the work effectively and confidently and not able to demonstrate the hardware/model confidently	Out of 20
						Total (Internal assessment)	**Out of 50**

11. SOFTWARE/LEARNING WEBSITES

- https://www.electronicsforu.com/
- https://www.electrical4u.com/
- https://www.mathworks.com/
- https://www.arduino.cc/
- https://www.alldatasheet.com/
- https://www.allaboutcircuits.com/
- https://circuitglobe.com/
- https://www.electricaltechnology.org/
- www.vlab.co.in

12. PO-COMPETENCY-CO MAPPING:

Semester I	Electrical Engineering Project-II (Course Code: 4360906)						
	POs						
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design/ development of solution	PO4 Engineering Tools, Experimentation & Testing	PO 5 Engineering practices for society, sustainability & environment	PO 6 Project Management	PO 7 Life-long learning
Competency	**Troubleshoot the faults during assembling & testing, modify the work whenever it is required, make final working model and present as individual and team**						
Course Outcomes CO1 Summarize the work done in previous semester.	3	-	-	-	-	-	-
CO2 Troubleshoot the faults during assembling procedure.	3	-	3	3	-	3	-
CO3 Execute testing of project after assembling of final hardware to verify the result.	3	3	3	3	3	3	3
CO4 Modify the components of the project, if required.	2	3	3	3	3	3	3
CO5 Defend final review with hardware model, report writing, presentation as individual and team.	3	-	2	-	-	3	3

*Legend: '**3**' for high, '**2**' for medium, '**1**' for low and '**-**' for no correlation of each CO with PO.*

13. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Person

Sr. No.	Name and Designation	Institute	Contact No.	Email
1.	Dr Hemant I. Joshi, Lecturer in Electrical Engineering	R C Technical Institute, Ahmedabad	9998579554	hemantjoshi0711@gmail.com