GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

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, Bio-Medical Engineering	First & Second

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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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	50	0	50

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/mndOIVCwFss
- 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
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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	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
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NITTTR Resource Persons

S. No	Name and Designation	Dept.	Contact No.	Email
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2	Prof. M.C.Paliwal, Associate Professor, DCEEE	DCEEE	9407271980	mcpaliwal@nitttrbpl.ac.in

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Course Title: Civil Engineering Drawing
(Course Code: 4320601)

Diploma programme in which this course is offered	Semester in which offered
Civil	Second

1. RATIONALE

Engineering drawing is considered as a language of engineering communication. Basic and primary features of engineering drawing are being taught in course "Basic Engineering Drawing and Graphics (code 4300013)". For a Diploma holder of civil engineering, it became essential to interpret the civil engineering drawing and also to prepare the working drawing and/ or submission drawing as and when required. Therefore, this course has been designed in such a way that a diploma holder can easily produce detailed civil engineering drawing related to construction of single storeyed, double storeyed residential/ public/ any other simple civil engineering structures giving due respect to building regulation and bye-laws as per local authorities. So, that plan gets approval by local civic authorities.

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 competencies:

- **Read and interpret the building construction drawings.**
- **Produce working and /or submission drawings for simple civil engineering structures with building services as per regulations and bye-laws considering green building aspects.**

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 given civil engineering drawing- symbols, conventions, abbreviations and scale.
b) Plan buildings as per principles of planning, building byelaws and regulation considering green building aspects.
c) Develop working drawings for simple civil engineering (single and double storied) structures and conceptual plan for multi-storeyed building.
d) Draw perspective view of given element/ building plan.
e) Propose appropriate building component and services as per its scope.

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. *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	Interpretation of building drawings approved by local authority.	I		02*
2	Draw various types of graphical symbols for materials, Doors and Windows, symbols for sanitary, water supply and electrical installations and write Abbreviations in sketch book.	I		02*
3	Study of building bye-laws act and national building code (NBC)	II		02*
4	Study of GRIHA and IGBC manual for green building.	II		02*
5	Draw the detailed plan, elevation, section, site plan and schedule of openings for an existing residential building by taking actual measurement.(Drawing Sheet-01)	III		08*
6	Draw details of foundation plan of at least two rooms building in sketch book.	III		04*
7	Draw working drawings for single storeyed residential building (bunglow) on 250sq.m plot with scale and show following detail: GF & FF plan with elevation, section and opening schedule. (Drawing Sheet-02)	III		16*
8	Prepare concept plan of any one other type of building considering local bye laws: high school building, Shopping centre, Hospital and Industrial building in sketch book.	III		08*
9	Develop perspective view of a complicated object/element using one point method. (Drawing Sheet-03)	IV	9-10 or 11	2
10	Develop perspective view of small objects such as-steps, pedestals using two point method. (Drawing Sheet-03)	IV		2
11	Develop perspective view of single room residential building with verandah & steps by any methods. (Drawing Sheet-03)	IV		04
12	Visit a residential building and observe the existing building service and Draw line plan for above services in sketch book.	V		04*
13	Design and draw the Plan, Elevation & section of a stair case from given data in sketch book.	V	Any One	04

S. No.	Practical Outcomes (PrOs)	Unit No.		Approx. Hrs. required
14	Draw parts of buildings such as stair cases, Weather sheds, Projections, columns, pier, slabs, footings etc. in sketch book.	V		04
			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. 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 2, 5-12, 14 & 15	
1	Neatness, Cleanness on drawing sheet	10
2	Uniformity in Drawing and line work	10
3	Creating given drawing	40
4	Dimensioning the given drawing and writing text	20
5	Answer the question	10
6	Submission of drawing in time	10
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	• Tape (10m, 20m, 30m Vinyl) • Drawing board • Mini drafter/T- square/Parallel	12 5-12,14 &15 5-12,14 &15

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 team member/ individual.
b) Follow ethical practices.
c) Follow safe practice on site.
d) 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

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)	Topics and Sub-topics
Unit – I **Introduction to Civil Engineering Drawing**	1a. Appreciate types of Drawings and its importance. 1b.Draw various types of Projections 1c. Use building drawing Symbols, Conventions and Abbreviations 1d.Apply various types of scales as per needs.	1.1 Types of drawing with appropriate scale &uses (index map, key plan, village map, site plan, layout plan.) 1.2 . Types of Projection adopted in Building Drawing. 1.3 Scales for various types of Drawings. 1.4 Working drawing, large scale drawing, enlarge scale drawing. 1.5 Symbols, Conventions and Abbreviations for Electrical fittings, water supply, sanitary fittings, material for construction etc.
Unit – II **Principles of Planning, Building byelaws and Regulation**	2a. Apply the Principles of Planning & Bye-laws for residential and other public buildings. 2b. Apply green building aspects.	2.1 Principles of planning for residential building in detail such as- Room dimension, area, height, privacy, roominess factor, orientation, grouping, drainage, aspect, prospect, economy. 2.2 Building bye laws of local body for residential building (show local authority publication) plot area, built up area, carpet area, FSI, size of rooms, margins, height, passages, ventilation, circulation and others 2.3 Color code for alteration and addition in existing building. 2.4 Approval procedure with respect to bye-laws. 2.5 Concept and components of green building. 2.6 Evaluation system of various authorities (GRIHA,IGBC)
Unit– III **Planning of**	3a. Develop concept plan of buildings.	3.1 Concept plan and drawing of residential single and two storeyed

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
Buildings.	3b. Prepare detail drawings for single and two storeyed residential building and public building.	buildings. 3.2 Concept plan of public buildings such as hospital, school, shopping center, office building and industrial unit. 3.3 Given situation & Plot area: preparation of detailed drawing of a single storeyed and double storeyed residential building with detail of Line plan, Detailed Plan, Ground floor Plan, First floor plan, Elevation and Sections.
Unit– IV **Perspective Drawings and modelling.**	4a. Generate perspective view of simple building by different methods. 4b. Develop building models.	4.1 Introduction of perspective view and other related terms. 4.2 Perspective view of single room residential building and simple public buildings. 4.3 Elements of perspective drawing. 4.4 Model preparation of simple buildings.
Unit– V Constructional details drawing of buildings	5a. Draw details of components of buildings. 5b. Provide scope and provisions for building components and services.	5.1 Drawings of Parts of buildings such as staircases, chajjas, projections, columns, pier, slabs, footings etc. 5.2 provisions in drawings for building services such as air conditioning, plumbing, water supply and firefighting, elevators, lifts and escalators etc. 5.3 Show building service like water supply, sanitary, electrification on line plan.

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	Introduction to Civil Engineering Drawing	3	04	02	00	06
II	Principles of Planning, Building byelaws and Regulation	7	02	05	05	12
III	Planning of Buildings	10	04	08	14	26
IV	Perspective Drawings and modelling	6	04	04	08	16
V	Constructional details drawing of Buildings	2	02	04	04	10
Total		**28**	**16**	**23**	**31**	**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) Visit a construction site and collect working drawings to study the project.
b) Draw proportionate line sketch (front elevation of any two storeyed residential building without using any drawing instruments.
c) Visit an urban development authority office and obtain a Development control regulations (bye-laws) of local Body.
d) Visit a public building like school, hospital, shopping centre etc, to have knowhow about essential requirements.
e) Undertake micro-project.
f) Give seminar on any relevant topic.

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-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) **Housing Colony**: Prepare a scaled layout plan of a housing colony within a plot of 3000 sq. mt to 8000 sq mt having the varaity of bunglows and/or tenements and/or raw houses considering bye-laws.
b) **Primary health center:** Prepare a scaled detailed plan for Primary health center (minimum 01 doctor room,01 dressing room,01vaccination room, office room, waiting area, wash rooms)
c) **Hostel Building:** Prepare the detailed plan for a hostel building (minimum 200 person)
d) **Secondary School:** Prepare the detailed plan for a secondary school building.
e) **Shopping mall:** Prepare the detailed plan for a shopping mall
f) **Library building:** Prepare the detailed plan for a library building
g) **Apartments:** Prepare the detailed plan for apartments.
h) **Model:** Prepare a scaled model of a simple building using card board.
i) Prepare a suggestive report on upgrading existing building into green building as per IGBC/GRIHA standards.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Civil engineering Drawing	V. B. Sikka	B. D. Kataria Sons, Ludhiana
2	Civil Engineering Drawing	Gurcharan singh, Subash chander	Standard Publishers Distributors, Delhi
3	Civil Engineering Drawing	R. S. Malek G. S. Meo	New Asian Delhi
4	Civil Engineering Drawing	B. H. Shukla	Atul Prakashan Ahmedabad
5	Building Bye laws	Urban Development Authority	Local Authority e.g. AUDA,GUDA,RUDA etc.
6	Understanding Construction Drawings	Mark W. Huth Delmar,	Cengage Publishers
7	National Building Code of India	Bureau of Indian Standards	Bureau of Indian Standards, Govt. Of India
8	I.S 962: 1989-CODE OF PRACTICE FOR ARCHITECTURAL AND BUILDING DRAWINGS	Bureau of Indian Standards	Bureau of Indian Standards, Govt. Of India

S. No.	Title of Book	Author	Publication with place, year and ISBN
9	Green Rating for Integrated Habitat Assessment (GRIHA) Manual	Ministry of New and Renewable Energy, GOI & The Energy and Resources Institute New Delhi	Ministry of New and Renewable Energy, Government of India and The Energy and Resources Institute New Delhi
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) Auto CAD, Zwcad, civil Architect, draw plus X5
c) www.Autodesk.com,
d) www.drawingnow.com
e) www.learn-to–draw.com
f) www.igbc.in
g) www.grihaindia.org

15. PO-COMPETENCY-CO MAPPING

Semester II	Civil Engineering Drawing (Course Code:4320601)									
	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	PSO 2	PSO 3 (If needed)
Competency	i. Read and interpret the building construction drawings. ii. Produce working and /or submission drawings for simple civil engineering structures with building services as per regulations and bye-laws considering green building aspects.									
Course Outcomes CO a) Interpret given civil engineering drawing-symbols, convections, abbreviations and types of scale.	3	2	-	-	-	-	2	-	-	-
CO b) Plan buildings as per principles of planning, building byelaws and regulation considering green building aspects.	3	3	3	-	2	-	2	-	-	-
CO c) Develop working drawings for simple civil engineering (single and double storied) structures and conceptual	3	2	2	-	1	-	2	-	-	-

	plan for multi-storeyed building.										
CO d)	Draw perspective view of given element/ building plan.	3	1	1	-	-	-	-	-	-	-
CO e)	Propose appropriate building component and services as per its scope.	3	2	1	-	-	-	1	-	-	-

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.Mohammed Shakil Malek	F. D. (Mubin) Institute of Engineering and Technology, Bahiyal	079-25391112	shakil250715@yahoo.co.in
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3	Shri Munaf Jagdu	Govt.Poly., Ahmedabad	079-26301285	mjagadu@gmail.com
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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	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.
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 ay 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 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

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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: Surveying
(Course Code: 4330601)

Diploma programme in which this course is offered	Semester in which offered
Civil Engineering, Environmental Engineering, Mining Engineering	Third

1. RATIONALE

Before development and planning process for any civil engineering or mining project, at first field survey of that area is carried out and various type of survey maps are prepared. These maps and drawing are used for taking various decisions regarding the planning, designing, estimation, execution and construction process etc.

The diploma pass outs/technicians should therefore know the various methods and instruments required for surveying. They should also have the skill and information to handle and operate the needed survey instruments. It is also important for them to be well aware about the use of advance surveying instrument such as total station, GPS and related software to enhance the knowledge and abilities required for surveying in field.

Therefore, this course is designed in such a way that diploma holder can easily carryout survey of given area using traditional and modern survey instrument like chain/tape, dumpy level, theodolite, total station, and use data obtained from survey to measure dimensions, compute area/volume and plot important stations on drawing sheet to obtain plan/map of desired area.

2. COMPETENCY

The course content should be taught and with the aim to develop different types of skills so that students are able to acquire following competencies.

1. Carry out civil engineering survey to prepare drawings & maps
2. Interpret the drawings and maps for calculating different physical quantities like length, area, volume, elevations etc.

3. COURSE OUTCOMES (COs)

1. Use basics of Surveying and choose appropriate scale.
2. Carry out civil engineering survey using chain and tape, compass & Plane table and prepare drawing
3. Carry out leveling using dumpy level/ Digital level/ Auto level and draw contours.
4. Carry out theodolite traverse survey, compute necessary data and draw traverse
5. Compute R.L. of given points using trigonometric survey.

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	
03	-	04	05	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	Perform ranging and chaining operations in different field conditions.	02	**02**
2	Perform chaining and ranging where different types of obstructionsare present.	02	**02**
3	Take offsets (Perpendicular and Oblique) in different field conditions.	02	**02**
4	Compute area of given plan by Mechanical/ Digital Planimeter	02	**02**
5	Perform temporary adjustments of Prismatic Compass	03	**02**
6	Determine bearings of different survey lines by using Prismatic Compass	03	**04**
7	Determine included angles from measured bearings.	03	**02**
8	Set plane table by different orientation methods on given surveystation	03	**04**
9	Project in Plane Table Survey: - Prepare map of open vacant land (min 600 sq.m) using anyplane table method	03	**04**
10	Perform temporary adjustments of Level Take and record the level reading in the level book Determine Reduced level using both methods by applying checks	04	**04**
11	Carry out fly levelling in different field conditions.	04	**02**
12	Carry out profile levelling in different field conditions	04	**02**
13	Project in Profile Levelling: Carry out the levelling survey on an undulated ground and prepare the drawing sheet (minimum area under survey (50 m X 60 m)	04	**06**
14	Identify various parts of the theodolite and Temporary Adjustment of Theodolite	05	**02**

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
15	Measurement of horizontal angle by Repetition & Reiteration	05	**04**
16	Measurement of vertical angle & deflection angle	05	**02**
17	To Carry out the project for a closed traverse 4 to 5 stations and prepare the drawing sheet using Gale's Table	05	**06**
18	Calculation of Height of Object using trigonometry survey	06	**04**
	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. 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	Operation and handling of survey instruments	20
2	Taking observations and recording	20
3	Computation of survey data and plotting/ Drawing	40
4	Answer the questions	10
5	Follow safe practices measures while performing practicals	10
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 practical in all institutions across the state.

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	Metric Measuring Chain (20m and 30m) as per IS 1492 - 1970. M.S. Arrows of 4 mm diameter and 40 cm height	1 to 3
2	Measuring Tape such as Metallic tape, fiber glass tape, invar tape, steel tape, linen tape etc (5m, 10m, 20m, 30m & 50m)	1 to 3, 8, 9, 12, 13, 17,18
3	Ranging Rods of length 2 to 3 meters with conical metallic shoe fitted at bottom & fully painted with 20 cm. long colour bands of either a) Black & White b) Red & White as per IS 2288 - 1963	1,2, 6, 7, 8, 9, 15, 17
4	Mechanical Planimeter: Accuracy: +/- 0.2 %	4
5	Digital Planimeter: Easy conversion function of unit and scale, Accuracy: Within +/-0.2%(Within +/-2/1000pluses)	4
6	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'.	5 to 7

S. No.	Equipment Name with Broad Specifications	PrO. No.
7	Plane table board of 750mm x 900 mm size with a fitted tripod, with standard accessories namely Trough compass, Telescopic alidade, Spirit level, Canvas cover, Plumbing Fork etc.	8, 9
8	Dumpy Level: Internal Focusing, Magnification 24x to 32x, Length of telescope 300 mm, objective aperture 40 mm, field of view 1° 30', resolution 0.01 cm at 100 mt, plate bubble size 12mm x 87.5 mm, circle diameter 75 mm(magnetic)	10 to 13
9	Digital Level: Accuracy of Height: 1 mm, Resolution of Display: 0.001 / 0.001 m Observing range: 1.6m to 100m, Zoom in: 32x	10 to 13
10	Auto Level: Magnification 24x to 32x, objective aperture 32 mm to 42mm, Field of view: 1° 20' to 1° 25' at 100m	10 to 13
11	Leveling Staff: Made of Aluminium body, Telescopic in 3 PCS, 4m in length, graduated in meters, dm and cm with white background and 5 mm thick black strips with suitable locking arrangement	10 to 13
12	Vernier Theodolite: Length of telescope 178 mm, Magnification 25X Effective Aperture 38mm, Field of View 2.6 M at 100M, Short Focus 1.5M, Stadia Ratio 1:100, Stadia Constant 0, Circle Diameter Hz113mm, V100 mm Graduation 20' / 10', Vernier Reading 20" / 10".	14 to 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 competency.

a) Work as a team member/ individual.
b) Follow ethical practices.
c) Follow safe practice on site.
d) 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

Only the major Underpinning Theory is formulated ashigher 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)	Topics and Sub-topics
Unit 1 **Introduction to Surveying**	1a. Explain the basics ofsurveying. 1b. Apply various types of scale as per needs.	1.1 Definitions, Objective and uses of surveying, Classification of Survey, Principles of Survey 1.2 Types of Scale and selection of scale, Construction of diagonal scale
Unit 2 **Linear Measurement**	2a. Explain procedure for linear measurements. 2b. Prepare drawing as per recorded measurementsin the field book. 2c. Compute area of plan by planimeter	2.1 Methods & Accessories of Linear Measurement, Principle of Chain Surveying, Method of Chaining on Level Ground 2.2 Errors and Mistakes in Chaining and precautions against it, Chain and Tape Corrections, Ranging, 2.3 Well-Conditioned and Ill-Conditioned Triangles, Selection of Survey Stations , Equipments for Chain Survey 2.4 Procedure of Field Work, Conventional Symbols , Procedure & Equipments for Plotting 2.5 Computation of Area from Plotted Plan using Planimeter 2.6 Computation of Area by The Mid-Ordinate Rule, The Average-Ordinate Rue, The Trapezoidal Rule and Simpson's Rule, Computation of Volume using Prismoidal Rule and Trapezoidal Rule
Unit 3 **Traverse by Compass and Plane Table**	3a. Explain procedure for angular measurements & Record bearing accurately 3b. Compute Interior angles from measured bearings. 3c. Prepare drawing as perfield conditions and requirements using plane table	**Compass:** 3.1 Introduction, Purpose, Definitions & Principle of Compass Surveying, Traversing , Methods of Traversing , Types of Compass , Temporary Adjustment of Prismatic Compass 3.2 Field Procedure of Observing Bearing, Problems on Whole Circle Bearing and Quadrantal Bearing 3.3 Problems on Fore and Back Bearings, Problems on Magnetic Declination 3.4 Problems on Included Angle, Problems on Local Attraction, 3.5 Field Procedure of Compass Traversing, Plotting of Compass Traverse , Adjustment of Closing Error , Sources of Error in Compass , Precautions to be Taken in Compass Surveying **Plane Table:** 3.6 Principle & Accessories of Plane Table , Orientation , 3.7 Procedure of Setting up Plane Table over a Station, Methods of Plane Tabling

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
		Special Methods of Resection 3.8 Procedure of Plane Table Traversing, Advantages and Disadvantages of Plane Tabling
Unit 4 **Leveling & Contouring**	4.a Explain procedure for leveling using instruments and levelling staff and record reading in level book page. 4.b Carry out corrections for errors in levelling 4.c Prepare contour maps by calculating Reduce level as per level book.	4.1 Introduction Basic terminology related with Leveling 4.2 Types of Level: Dumpy Level, Tilting Level, Auto Level, Digital Level 4.3 Components of Dumpy Level with neat Sketch, Types of Levelling Staffs 4.4 Temporary adjustment of Level, Classification of Levelling 4.5 Finding out the R. L. in Level Book by H.I. Methods withnecessary check with examples 4.6 Finding out the R. L. in Level Book by Rise & Fall Method with necessary check with examples 4.7 Correction for Curvature and refraction and related examples, Errors in Levelling 4.8 Contour, its uses of & Characteristics 4.9 Methods of Contouring, Interpolation of contours 4.10 Preparing drawing & estimation of gradients Calculation of capacity of reservoirs & related examples
Unit 5 **Theodolite Traverse**	5a. Explain the basic function of different parts theodolite. 5b. Operate theodolite and read horizontal and vertical angle. 5c. Determine the latitude and departure of given points.	5.1 Introduction to theodolite, Uses of theodolite, Sketch and parts of Transit Vernier theodolite 5.2 Reading of main and vernier scale on horizontal and vertical plate 5.3 Temporary adjustment of a theodolite 5.4 Permanent adjustment of theodolite (Fundamental axis of theodolite and their relationship) 5.5 Definitions and various technical terms 5.6 Methods of measuring horizontal angles and vertical angles 5.7 Use theodolite for measuring a magnetic bearing, prolong a line, ranging a line 5.8 Measuring direct and deflection angles 5.9Errors in theodolite work 5.10 Theodolite Traversing 5.11Traverse computations Closing errors, Balancing the traverse 5.12 Gale's Traverse Table & Related examples
Unit 6 **Trigonometric Survey**	6a. Calculate the height of objects through a trigonometrical levelling.	6.1 Introduction & Methods of observations (Direct and Reciprocal) 6.2 Methods of determining the elevation of a particular point when base of the object is accessible 6.3 when base of the object is inaccessible 6.4 Related examples using all methods

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	**Introduction to Surveying**	02	02	02	00	04
II	**Linear Measurement**	06	04	06	04	10
III	**Traverse by Compass and Plane Table**	08	02	04	04	14
IV	**Leveling & Contours**	10	04	04	08	16
V	**Theodolite Traverse**	12	06	06	08	20
VI	**Trigonometric Survey**	04	00	02	04	06
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 student for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions 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 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. Visit a working site and calculate area of land using planimeter and compare it with actual area
b. Visit nearby open plot and plot its boundaries with respect to adjacent road/ wall / using chain/tape or theodolite surveying
c. Undertake micro-project.
d. Give seminar on any relevant topic.

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

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:

1. Find out the area of the given plan by planimeter/ digital planimeter
2. Find out the area of an open plot using linear measurement instruments
3. Calculate the Volume of Earthwork of road/canal section using standard equations and compare the results.
4. Compute Interior angles from Fore bearings and back bearings using Prismatic Compass
5. Calculate the volume of earthwork from a given contour map
6. Measure the vertical height and find out the R.L. of the top of the tower/object using a theodolite
7. Prepare Auto CAD drawing of contour map
8. Prepare Auto CAD drawing of Theodolite traverse and find area of it
9. Prepare Auto CAD drawing of Compass Traverse
10. Collect the relevant technical and commercial information of the survey instruments available in the market with specifications.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Surveying and levelling Vol-I	T. P. Kanetkar & S. V. Kulkarni	Puna Vidyarthi GrihaPrakashan
2	Surveying and Levelling Vol-I	Dr. B. C. Punmia	Laxmi Publications Pvt.Ltd.
3	Surveying and Levelling Vol-I	Hussain & Nagrani	S. Chand New Delhi
4	Surveying	Mimi Das Saikia	PHI Learning Pvt. Ltd
5	Fundamentals of Surveying	S. K. Roy	PHI Learning Pvt. Ltd
6	Surveying and Levelling, 2nd Edition	N N Basak	McGraw Hill Education Pvt. Ltd
7	A Textbook of Surveying and Levelling	R. Agor	Khanna Publishers

14. SOFTWARE/LEARNING WEBSITES

1. www.nptel.iitm.ac.in
2. Auto CAD, Civil Architect
3. www.Autodesk.com,

15. PO-COMPETENCY-CO MAPPING

Semester II	Civil Engineering Drawing(Course Code:4320601)									
	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	PSO 2	PSO 3 (If needed)
Competency	1. Carry out civil engineering survey to prepare drawings & maps 2. Interpret the drawings and maps for calculating different physical quantities like length, area, volume, elevations etc.									
CO a) Use basics of Surveying and choose appropriate scale.	3	2	-	-	-	-	2	-	-	-
CO b) Carry out civil engineering survey using chain and tape, compass & Plane table and prepare drawing	3	2	2	3	-	2	3	-	-	-
CO c) Carry out leveling using dumpy level/ Digital level/ Auto level and draw contours.	3	3	3	3	-	3	3	-	-	-
CO d) Carry out theodolite traverse survey, compute	3	3	3	3	-	3	3	-	-	-

necessary data and draw traverse										
CO e) Compute R.L. of given points using trigonometric survey.	3	3	3	3	-	-	2	-	-	-

Legend: '**3'** for high,'**2**' for medium, **'1'** for low or **'-'**for the relevant correlationof eachcompetency, CO, with PO/ PSO

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

S. No.	Name and Designation	Institute	Contact No.	Email
1	Shri Ketan C Varmora	Government Polytechnic, Kheda	9725335599	kcvarmora@gmail.com
2	Shri Pranav P Mehta	Government Polytechnic, Ahmedabad	9904779952	pranavhy@gmail.com

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Course Title: Mechanics of Structures
(Course Code: 4330602)

Diploma programme in which this course is offered	Semester in which offered
Civil Engineering, Environment Engineering	Third Semester

1. RATIONALE

After learning Mechanics of rigid bodies in the second semester as a course Engineering Mechanics, Mechanics of Structures mainly deals with analysis of deformable structures. The primary purpose of the study of this course is to understand the behavior of various structural elements like beams, columns and truss members (struts/ties) under direct and transverse loads. Study of slope and deflection of beams will give insight to students about 'Stiffness', a very important property of the structure. This course enables the student to analyse the determinate structure and this will be helpful for safe and economical design of Steel & Concrete Structures used in Civil Engineering construction. Hence, this course is also a prerequisite of design of structure.

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 the principle of Mechanics of Structures to solve broad-based engineering related problems.**

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) Analyse structural behaviour of various materials under axial loading.
b) Determine moment of inertia of a symmetrical and asymmetrical section about a given axis.
c) Draw and Interpret shear force and bending moment diagrams and determine the bending and shear stresses in beams for various types and loading conditions.
d) Determine slope and deflection in cantilever and simply supported beams.
e) Determine axial forces in the members of simple truss.
f) Analyse the column for axial load with various end conditions.

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 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	Conduct tension test on a given sample of mild steel and draw stress-strain curve.	I	04*
2	Determine Young's Modulus of wire of given material.	I	02*
3	Find out Compressive Strength of Cast Iron, Mild Steel, Wooden specimen with parallel & perpendicular to grains & Concrete cube.	I	04*
4	Determine Izod impact value and Charpy impact value of given materials.	I	04*
5	Compute Polar Moment of Inertia of Fly Wheel.	II	02*
6	Conduct flexural test on wooden beam and find out ultimate bending stress.	III,IV	02*
7	Conduct shear test (Single and Double shear) on mild steel and cast iron specimen.	III,IV	02*
8	Find out deflection of cantilever beam for end point load and simply supported beam for central point load	V	02*
9	Analyse at least two simple trusses using analytical method (method of joints) and verify with graphical method.	VI	04*
10	Demonstrate End Conditions of Column.	VII	02*
	Total hours		**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	Identify components	10
2	Prepare experimental setup.	20
3	Operate the equipment setup.	20

Sr. No.	Sample Performance Indicators for the PrOs	Weightage in %
4	Follow safe practices .	10
5	Record observations correctly.	20
6	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.

Sr. No.	Equipment Name with Broad Specifications	PrO. No.
1	Universal Testing Machine with beam and shear attachment.	1,6 &7
2	Searl's apparatus to find Young's modulus of wire	2
3	Compression Testing Machine.	3
5	Izod & Charpy Impact Test Apparatus	4
4	Fly Wheel for polar moment of inertia	5
7	Deflection of beam apparatus	8
8	Working Model of End conditions of column	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 competency.

a) Work as a leader/a team member.
b) Follow safety practices while using equipment.
c) Realize importance of green energy. (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 Direct Stress & Strain	1a. Evaluate Material properties Under Longitudinal and Lateral Loads. 1b. Calculate stress and strain under thermal variation. 1c. Interpret stress strain curve for various material. 1d. Analyse composite & compound section for stress and strain. 1e. Compute Strain Energy under different types of loading on elements.	1.1 Direct stress, Linear strain, Elasticity, Elastic limit, Hook's law, Modulus of Elasticity or Young's modulus, Stress Strain curve for mild steel bar under tension with numerical problems. 1.2 Lateral stress and strain, Poisson's ratio, Volumetric strain, Bulk modulus, relation between three moduli and numericals. 1.3 Basics Concepts of Shear Stress , Shear Strain & Modulus of rigidity. 1.4 Concept of composite and compound section, modular ratio and numericals. 1.5 Concept of Thermal stress and strain, Thermal stresses for non-yielding and yielding condition with numericals. 1.6 Stresses due to gradual, sudden and impact load, corresponding deformation, Strain energy, Resilience, Proof resilience and Modulus of resilience with numericals.
Unit – II Moment of Inertia	2a. Locate the axis of symmetry & Centroidal axis in symmetrical & asymmetrical solid and hollow sections 2b. Apply Parallel axis theorem to determine moment of inertia, for symmetrical & asymmetrical sections about centroidal axis and any other reference axis. 2c. Apply Perpendicular axis theorem to determine Polar Moment of Inertia of a section.	2.1. Importance of Moment of Inertia. 2.2. Axis of symmetry, Centroidal axis and axis of reference. 2.3. Parallel Axis Theorem & Perpendicular Axis Theorem 2.4. Formulas to calculate Moment of Inertia of solid and hollow rectangle, square, circle, triangle shapes (without derivations). 2.5. Moment of Inertia of symmetrical and asymmetrical I-section, Channel section, T-section, Angle section, Hollow sections and Built up sections about Centroidal axis and any other reference axis using Parallel axis theorem. 2.6. Polar Moment of Inertia of solid & hollow circular sections.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
Unit– III **S.F. & B. M. in Beam**	3a. Identify statically determinate and statically indeterminate beams. 3b. Analyse statically determinate beam for Bending Moment and Shear Force. 3c. Draw Shear Force and Bending Moment diagram for statically determinate beams. 3d. Interpret Shear Force and Bending Moment diagram of statically determinate beams.	3.1 Statically Determinate and statically indeterminate beam examples. 3.2 Concept of Bending Moment and Shear Force in beam. 3.3 Sagging and Hogging Bending Moment. Positive and Negative Shear Force. 3.4 Calculation of Bending Moment and Shear Force at various sections of beam for cantilever simply supported and overhang beam subjected to point load and/ or u.d.l. 3.5 S.F. & B.M. Diagram for above beams 3.6 Point of Contra-flexure & its importance.
Unit– IV Bending & Shear Stress in Beam	4a. Determine Bending stress at a particular section of beam using the bending equation. 4b. Draw a Bending stress distribution diagram for a particular beam section. 4c. Determine Shear stress at a particular section of beam using the shear equation. 4d. Draw a Shear stress distribution diagram for a particular beam section. 4e. Identify factors affecting Bending and Shear stress.	4.1 Concept and theory of pure bending, assumptions, Bending equation (without derivation), Section Modulus, Bending stresses and their nature, Bending stress distribution diagram. 4.2 Concept of moment of resistance and simple numerical problems using bending equation. 4.3 Shear stress equation (without derivation), relation between maximum and average Shear stress for rectangular and circular section. 4.4 Shear stress distribution for square, rectangular, circle, hollow square, rectangular, circular, angle sections, channel section, I-section, T section. Simple numerical problems based on Shear equation.
Unit– V Slope and Deflection	5a. Differentiate between strength and stiffness of structural member. 5b. Calculate maximum slope and deflection in cantilever and simply supported beams under symmetrical loads. 5c. Identify factors affecting slope and deflection.	5.1 Concept of Slope & Deflection of beams. 5.2 Flexural rigidity and its significance. 5.3 Formulas (without derivation) of maximum slope & deflection for cantilever beams subjected to point load at free end and u.d.l. Over the entire span. 5.4 Formulas (without derivation) of maximum slope & deflection for simply supported beams subjected to point load at center and u.d.l. over the entire span.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
Unit– VI Analysis of Truss	6a. Suggest the type of truss for given situation with proper justification. 6b. Differentiate perfect, deficient and redundant truss 6c. Analyse the simple truss using the method of joints. 6d. Analyse the simple truss using a graphical method.	6.1 Type of truss - Simple, fink, compound fink, Howe truss, Pratt truss, North light truss, king post truss, queen post truss, French truss. Compare the simple truss with the beam. 6.2 Perfect, deficient and redundant truss. 6.3 Analysis of different trusses to find out axial forces in members using analytical method (method of joint) and graphical method.
Unit– VII Column & Strut	7a Interpret various column end conditions 7b Analyse column for load carrying capacity with Euler's theory 7c Analyse column for load carrying capcity with Rankine's theory	7.1 Column and Strut, radius of gyration, slenderness ratio, Short Column and Long Column. 7.2 End conditions & effective length of column. Mode of failure in column. 7.3 The limitations of Euler's theory for short column, Euler's formula for crippling load of long columns and numericals. 7.4 Rankin's formula for buckling load of short & long columns and numericals.

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	**Direct Stress & Strain**	**10**	**2**	**4**	**8**	**14**
II	**Moment of Inertia**	**04**	**2**	**2**	**4**	**08**
III	**S.F. & B. M. in Beam**	**08**	**2**	**4**	**8**	**14**
IV	**Bending & Shear Stress in Beam**	**06**	**2**	**2**	**6**	**10**
V	**Slope and Deflection**	**04**	**2**	**2**	**4**	**08**
VI	**Analysis of Truss**	**06**	**2**	**2**	**6**	**10**
VII	**Column & Strut**	**04**	**2**	**2**	**2**	**06**
Total		**42**	**14**	**18**	**38**	**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 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) Collect different situations with photographs of a structural members where axial force is predominant.
b) Collect the photographs of steel structural elements made of I-section, angle section, channel section and built-up section.
c) Collect different situations with photographs of a structural members where bending moment and shear force are predominant
d) Collect the photographs of five different types of truss in the field.
e) Collect the information with photographs of structural failure due to excessive axial load.
f) Collect the information with photographs of structural failure due to excessive bending moment
g) Collect the information with photographs of structural members having excessive deflection (beyond permissible limit)
h) Collect the information with photographs of failure of columns due to earthquake.

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 (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 spreadsheet or computer program to calculate the stresses in the composite section.
b) Compare tensile strength and cost of three locally available structural steel bars.
c) Compare modulus of elasticity of wires of three different materials using Searle's apparatus.
d) Prepare spreadsheet or computer program to calculate the support reactions of statically determinate beams.
e) Prepare spreadsheet or computer program to calculate the bending stress and shear stress in a beam having a rectangular or circular section.
f) Analyse statically determinate beam using freeware software.
g) Prepare spreadsheet or computer program to calculate slope and deflection of simply supported beam and cantilever beam for various load cases.
h) Calculate modulus of elasticity of a material by measuring deflection of beam.
i) Using drafting software, analyse the truss graphically.
j) Analyse the truss using freeware software.
k) Prepare spreadsheet or computer program to calculate safe load on column using Euler's and Rankine's formula.

13. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1	Mechanics of Structures (Vol.-I)	Dr. H.J. Shah & S.B. Junnarkar	Charotar Publication, Anand. (2016) ISBN: 97-893-850-392-70
2	Strength of Materials (Mechanics of Solids)	R.S.Khurmi N. Khurmi	S Chand Publishing, Delhi (2019) ISBN: 97-893-528-339-79
3	Strength of Materials	Dr. R.K.Bansal	Laxmi Publications(P) Ltd. New Delhi(2005) ISBN: 97-881-700-814-70
4	Strength of Materials	S. Ramamrutham & R.Narayanan	Dhanpat Rai Publishing Company (2011) ISBN:97-881-874-335-45
5	Theory of Structures	R.S.Khurmi	S Chand Publishing, Delhi (2000) ISBN: 97-881-219-052-06

14. SOFTWARE/LEARNING WEBSITES

a) https://nptel.ac.in/courses/105104160 (NPTEL Course :- Mechanics of Solids by IIT, Kanpur)

b) https://www.youtube.com/watch?v=GkFgysZC4Vc&list=PL27C4A6AEA552F9E6 (NPTEL Video Lectures by IIT, Kharagpur)

c) www.vlab.co.in (Virtual Lab by Ministry of Education, Government of India)

15. PO-COMPETENCY-CO MAPPING

Semester III	**Mechanics of Structures (Course Code: 4330602)**						
	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 the principle of Mechanics of Structures to solve broad-based engineering related problems.						
Course Outcomes COa) Analyse structural behaviour of various materials under axial loading.	2	3	-	3	2	2	2
COb) Determine moment of inertia of a symmetrical and asymmetrical section about a given axis.	2	3	-	2	2	2	2
COc) Draw and Interpret shear force and bending moment diagrams and determine the bending and shear stresses in beams for various types and loading conditions.	2	3	-	-	2	2	2

COd) Determine slope and deflection in cantilever and simply supported beams.	2	3	-	3	2	2	2
COe) Determine axial forces in the members of simple truss.	2	3	-	-	2	2	2
COf) Analyse the column for axial load with various end conditions.	2	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

Sr. No.	Name and Designation	Institute	Contact No.	Email
1.	Shri P.V. Rayjada, HOD Applied Mechanics	G.P.Rajkot	9824281646	satwikpr@gmail.com
2.	Dr. J.B.Oza, Sr. Lecturer Applied Mechanics	G.P.Rajkot	9429048253	jiteshboza@gmail.com
3.	Ms. Bhruguli H. Gandhi, Sr. Lecturer Applied Mechanics	G.P. Himatnagar	9099076555	bhruguli@gmail.com
4.	Shri S.M.Kondhiya, Sr. Lecturer Applied Mechanics	G.P. Rajkot	9825764005	sharadkondhiya@gmail.com
5.	Shri R.R. Makwana, Lecturer Applied Mechanics	L.E. College, Morbi (Polytechnic)	9824128087	rakesh_mak@rediffmail.com

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Course Title: Construction Material and Technology
(Course Code: 4330603)

Diploma programme in which this course is offered	Semester in which offered
Civil Engineering	Third

1. RATIONALE

In any Civil Engineering Project, material cost plays prime role in the total project cost. Therefore, selection of appropriate material is very much important. To suggest/ select appropriate material, first and for most necessary is to know materials' properties and characteristics. Moreover concepts, Principles and procedures are equally important to have a desired project life. Construction processes of sub structure, super structure and building finishes are core to the execution of any building. This course will enrich knowledge about materials and civil engineering techniques with the use of various construction equipments in to the students to make them competent performing their jobs with ease and confidence.

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 competencies:

- **To select appropriate building material supported by conceptual knowledge about building material.**
- **To develop awareness about latest/ green building materials.**
- **Implement civil engineering projects using state of the art technology in construction works following safety norms.**
- **Deploy appropriate construction machineries.**

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) Appreciate important properties of different building materials & function of various building components.
b) Select appropriate locally available brick/stone as per the requirement.
c) Select appropriate binding materials and /or concrete in building construction.
d) Deploy the ancillary material(s) such as Timber, Glass, PVC, paints, Varnish etc. as per the requirement.
e) Select the appropriate type(s) of foundation required for structure as per site/ soil condition.
f) Implement various construction activities like masonry, concreting, formwork, temporary structure, plastering, D.P.C, Anti termite treatment and Plumbing/ Electrical fittings etc using construction machinery, as per need.
g) Describe the importance of maintenance work and inculcate safety measures to be adopted in civil engineering activities.

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	-	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 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	Conduct local market survey for common civil engineering materials to tabulate cost and quality.	I	Home* assignment
2	Perform tests on given sample of brick such as • Soundness • Water absorption • Compressive strength	II	06*
3	Conduct field test on given sample of brick and cement.	II, III	2
4	Perform lab tests on given sample of cement • Initial and final setting time • Compressive strength	III	4*
5	Perform test on given sample of fine aggregate. • Sieve analysis • Silt and clay content.	III	2*
6	Assess the quality of different types of timber and timber products (please arrange to visit nearby saw mill or timber mart).	IV	2
7	Identify components of building and /structures in the given model.	I	2
8	Draw foundation plan and mark layout on the ground for a building of Two room load bearing structure from the given line out plan.	V	2*
9	Draw foundation plan and mark layout on the ground for a building of Four room load bearing structure from the given line out plan.	V	4
10	Arrange the bricks to make $1\frac{1}{2}$ brick thick wall in English	VI	2*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
	and Flemish bond. (Minimum 3 Course)		
11	Prepare a visit report to the construction site where activities such as Excavation, Foundation, Masonry, Scaffolding, Formwork, Centering and Concreting are being executed considering standard safety procedure.	V, VI and VII	4*
12	Prepare a visit report to the construction site where activities such as Flooring, Plastering/ Pointing and Painting are being executed considering standard safety procedure.	VI	2*
13	Identify various components of staircase and doors and windows from the model.	VI	2*
14	Draw sketches for Foundations-Various types, Doors & Windows and timbering in Trenches in sketch book.	V, VI	4*
		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 2, 3, 4, 5	
1	Preparation of experimental set up	20
2	Setting and operation	20
3	Safety measures	10
4	Observations and Recording	10
5	Interpretation of result and Conclusion	20
6	Answer to sample questions	10
7	Submission of report in time	10
	Total	**100**

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
	For PrOs 14	
1	Neatness, Cleanness on drawing sheet	10
2	Uniformity in Drawing and line work	10
3	Creating given drawing	40
4	Dimensioning the given drawing and writing text	20
5	Answer the question	10
6	Submission of drawing in time	10
	Total	**100**

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
	For PrOs 1, 8, 9, 11, 12	
1	Discipline	10
2	Involvement of construction at site	20
3	Data collection at site	20
4	Organization of report	20
5	Answer the question	10
6	Timely submission of report	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	Bricks, Compressive strength testing machine, Oven, Digital Balance, tray.	02
2	Vicat apparatus conforming to IS : 5513-1976, Balance, Gauging Trowel, Digital Stop Watch.	04
3	Cube moulds- 7.06 cm size (9 no.s), Vibrating machine, Enamel trough, Measuring cylinder- 100 ml/ 200 ml capacity, Trowels, Nonporous plates, Weighing balance of accuracy 0.02 gm, Grease/ lubricating oil, compression testing machine.	04
4	I.S Sieve set (Sizes- 80 mm, 40 mm, 20 mm, 10 mm, 4.75 mm, 2.36 mm, 1.18 mm, 600 µ, 300 µ, 150 µ) sieve shaker with adaptors.	05
5	Experimental set up for silt and clay content for fine aggregates as per IS 2386-2 (1963)	05
6	Measuring Tape, Pegs, Arrows, Line dori, Lime powder, Hammer of standard size and specification as per civil engineering application.	8, 9
7	Brick, Line dori, Hammer of standard size, Level tube, Plumbs, Mason square.	10
8	Models: • Model of a civil engineering structure depicting various components. • Cut section of building showing different components • Types of Bonds in Brick masonry • Types of Door and Windows • Types of Stairs	07, 13, 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 competency.

a) Work as a team member/ individual.
b) Follow ethical practices.
c) Follow safe practice on site.
d) 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

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)	Topics and Sub-topics
Unit – I **Introduction**	1a.Describe important properties of building materials used in civil engineering construction. 1b.Classify the building on the basis of the occupancy and type of construction. 1c.Develop concept of components of building.	1.1 Physical, chemical and engineering properties of building materials. 1.2 Application of different building materials. 1.3 Alternative materials for the common items in building construction. 1.4 Introduction of various Civil Engineering structures. 1.5 Functions of various components of building and other structures.
Unit – II **Bricks, Rocks and Stone**	2a.Select appropriate brick products for different uses in building construction. 2b.Select appropriate rock/ stone products for different uses in building construction.	2.1 Classification of clay products 2.2 Types of bricks 2.3 Manufacturing process of bricks 2.4 Test on bricks. 2.5 Standard requirements and grades of bricks as per BIS. 2.6 Classification of rocks. 2.7 Rock products. 2.8 Characteristics of stones. - Structure, texture, strength, gravity, porosity, absorption, hardness, durability, weight etc. 2.9 Standard requirement of building stone. 2.10 Important stones used in construction with its suitability.

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
Unit– III **Binding Materials and Concrete**	3a. Appreciate the uses of lime and Pozzolana products in building construction. 3b. Select appropriate ingredients of proper quality for cement concrete as per required BIS codes. 3c. Get prepared different types of concrete and its type.	3.1 Sources and classification of Lime 3.2 Uses of lime with specific field situation 3.3 Types of pozzolanic materials 3.4 Advantages of addition of pozzolonic Material. 3.5 Types of cement with their specific use 3.6 Grade of cement as per BIS 3.7 Engineering properties of cement 3.8 Field and laboratory tests of cement as per BIS. 3.9 Methods of storing the cement. 3.10 Types of aggregate as per BIS 3.11 Requirements of aggregate as per BIS. 3.12 Engineering properties of aggregate 3.13 Test on aggregate 3.14 Ingredients of concrete. 3.15 Production of concrete, transportation, placing, compaction, curing. 3.16 Concrete in different situations viz. hot weather, cold weather, under water etc.
Unit– IV **Timber And Miscellaneous material**	4a. Describe timber and wood products and its uses in building construction. 4b. Explain different types of advanced building materials and their uses in construction.	4.1 Types of timber 4.2 Uses and application of timber 4.3 Defects in timber and wood 4.4 Seasoning, 4.5 Wood products with specific uses. 4.6 Plastics and PVC 4.7 Paints and Varnish 4.8 Materials for anti termite treatment 4.9 Glass and fiber. 4.10 Steel and iron materials 4.11 Ceramic products 4.12 Concrete blocks 4.13 Refractory
Unit– V **Sub structure**	5a. Know type of foundation and its suitability to different type of soil. 5b.Explain the failure of foundation and remedial measures.	5.1 Classification and types of foundations 5.2 Selection of the suitable type of foundation for required structure and as per situation 5.3 Foundations in black cotton soil,

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
		loose soils etc. 5.4 Timbering in trenches 5.5 Failures in foundation, Precautions & remedial measures.
Unit– VI **Building items, Building construction & machinery**	6a. Appreciate the different types of building items. 6b. Explain various construction activities like damp proof course (D.P.C) and anti termite treatment. 6c. Able to know the different types of plumbing and electric fittings and laying procedure. 6d. Develop concept of different types of brick and stone masonry. 6e. Explain construction procedure. 6f.Develop concept about various type of form work for Beam, Slab, Column.	6.1 Plastering & pointing- its purpose, 6.2 Various types, construction procedures, advantages and disadvantages, suitability of each. 6.3 Damp proof course (DPC), water proofing 6.4 Anti-termite measures and treatments 6.5 Construction joints- need and materials used. 6.6 Plumbing and electrification- various types of fittings and laying procedure. 6.7 Brick and stone masonry. 6.8 Selection of suitable type of masonry 6.9 Construction procedures. 6.10 Purpose & types of scaffolding and centering. 6.11 Suitability of scaffolding as per situations and type of structures. 6.12 Erection of centering for different component.
Unit-VII **Building maintenance & Safety measures**	6a. Describe concept about the maintenance work, know causes, types and its remedial measures 6b. Understand about the important laws/norms and act of safety. 6c. Explain precautions and precautionary measures of safety.	7.1 Purpose, need, importance, methods. 7.2 Causes and types of defects in buildings. 7.3 Preparation of report on maintenance work. 7.4 Remedial measures and execution 7.5 Procedure of any one type of building maintenance work. 7.6 Importance of various Laws/ Norms/ Regulations/ Acts for safety. 7.7 Safety equipment used in building construction and maintenance. 7.8 Precautions and precautionary Measures. 7.9 Post- accident procedures

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	Introduction	04	02	04	00	06
II	Bricks, Rocks and stone	07	03	05	04	12
III	Binding Materials and Concrete	07	03	06	06	15
IV	Timber And Miscellaneous material	05	02	03	04	09
V	Sub structure	04	02	02	04	08
VI	Building items, Building construction & machinery	09	03	05	06	14
VII	Building maintenance & Safety measures	06	02	02	02	06
Total		**42**	**17**	**27**	**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 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) Visit a nearby construction site and collect samples of material being used with justification.
b) Collect samples of alternative Green building material and prepare a report.
c) Visit a nearby building and identify its type, and its components.
d) Visit a nearby building and prepare a report on arrangements of horizontal, vertical movement & ventilation.
e) Visit a construction site where green building technologies are being implemented and prepare report.
f) Undertake micro-project.
g) Give seminar on any relevant topic.

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-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) **Green Building material:** Prepare a report suggesting replacement of atleast 10 nos. of conventional building materials with Green building materials and justify it in terms of cost and environmental impact.
b) **Acoustic Material:** Prepare a report on application of acoustic materials and present with portfolio of sample materials.
c) **Refractory Material:** Prepare a report on application of refractory materials and present with portfolio of sample materials.
d) **Foundation:** Prepare a report on types of foundation (atleast 02) adopted in any near by building(s).
e) **Construction Technology:** Collect the information of latest technologies in building construction and prepare report on it.
f) **Maintenance:** Prepare a report on remedial measures that can be taken to repair the cracks in the nearby building.
g) **Miscellaneous material:** Carry out market survey for identifying various waterproofing materials and prepare a report including application procedure.
h) **Safety:** Prepare posters/ charts for the awareness of safety in various activates of civil engineering construction.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Construction Materials	D.N Goshe	Tata McGraw Hill, New Delhi.

S. No.	Title of Book	Author	Publication with place, year and ISBN
2	Civil Engineering Construction Materials	S.K Sharma	Khanna Publishing House, New Delhi.
3	Building Materials	P.C Varghese	PHI learning, New Delhi.
4	Engineering Materials	S.C Rangwala	Charotar Publisher, Ahmedabad.
5	Civil Engineering Materials	Somayaji, Shan	Pearson education, New Delhi.
6	Engineering Materials	R.K Rajput	S. Chand and Co. New Delhi.
7	Engineering Materials	C.P Sharma	PHI Learning, New Delhi.
8	Building Materials	S.K Duggal	New International, New Delhi.
9	Engineering Materials	Dr. Janardan Jha	Publisher. Khanna Publishers, Delhi
10	Building Construction	S. P. Arora and Bindra	Dhanpat Rai Publication, Delhi Edition 2013.1SBN: 9788189928803
11	Building construction illustrated	Francis D.K. Ching	Standard Publishers Distributors, Delhi
12	Building Construction	S. C. Rangawala	Charotar Publication, Dist-Anand (ISBN-13: 978-8185594859)
13	Building Construction	B. C. Punrnia and AK, Jain	Firewall Media, 2005 (ISBN 9788170080534)
14	Building Construction	S.K. Sharma	S. Chand and Co. Pvt. Ltd., New Delhi (ISBN:978-81-219-0479-7)
15	Building Construction	DrJanardan Zha	Khanna Publication, New Delhi 2007, ISBN —8174091106
16	Building Construction	S. S. Bhavikatti	Vikas Publication House Pvt. Ltd., New Delhi (ISBN: 978-93259-6079-41)
17	A to Z Building Construction	Sandip Marini	Satya Prakashan; New Delhi (2015) (ISBN-13: 978-8176849692)
18	PWD Handbooks for Materials, Masonry. Building, Plastering and Pointing-Foundation	All India Council for Technical Education	All India Council for Technical Education (AICTE)
19	Practical Civil Engineering Handbook	Khanna	Khanna Publication
20	National Building Code	BIS	Bureau of Indian Standard, New Delhi
21	BIS 962-1989 Code of Architectural and Building Drawing	BIS	Bureau of Indian Standard, New Delhi
22	BIS 1038- 1983 Steel Doors. Windows and Ventilators	BIS	Bureau of Indian Standard, New Delhi

14. SOFTWARE/LEARNING WEBSITES

a) www.nptel.iitm.ac.in

b) http://www.learningconstruction.comi
c) http://www.understandconstruction.corni
d) http://www.constructionknowledge.netiwww.learn-to–draw.com
e) https://www.khanacademy.org/
f) www.igbc.in
g) www.grihaindia.org

15. PO-COMPETENCY-CO MAPPING

Semester III	Construction Material and Technology (Course Code:4330603) 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**	**PSO 2**	**PSO 3** (If needed)
Competency	i. To select appropriate building material supported by conceptual knowledge about building material. ii. To develop awareness about latest/ green building materials. iii.Implement civil engineering projects using state of the art technology in construction works following safety norms. iv. Deploy appropriate construction machineries.									
Course Outcomes CO a) Appreciate important properties of different building materials & function of various building components .	3	-	-	-	-	-	2	-		
CO b) Select appropriate locally available brick/stone as per the requirement.	3	2	2	2	2	-	2			
CO c) Select appropriate binding materials and /or concrete in building construction..	3	2	2	3	2	-	2			
CO d) Deploy the ancillary material(s) such as Timber, Glass, PVC, paints, Varnish etc. as per the requirement.	2	-	-	-	2	-	1			
CO e) Select the appropriate type(s) of foundation required for structure as per site/ soil condition.	3	2	2	-	2	-	2			
CO f) Implement various construction activities like masonry, concreting, formwork, temporary structure, plastering, D.P.C, Anti termite treatment and Plumbing/ Electrical fittings etc using construction machinery, as per need.	3	-	-	-	2	2	2			
CO g) Describe the importance of maintenance work and inculcate safety measures to be adopted in civil engineering activities	3	-	-	-	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	Shri Munaf M. Jagadu	Govt.Poly., Ahmedabad	079-26301285	mjagadu@gmail.com
2	Shri Darshan V. Patel	Govt.Poly., Himatnagar	02772-229285	darshan.2228@gmail.com

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2022 (COGC-2022)
Semester-III

Course Title: Hydraulics
(Course Code: 4330604)

Diploma programme in which this course is offered	Semester in which offered
Civil Engineering, Environmental Engineering	Third

1. RATIONALE

It is necessary for civil, environmental and transportation engineers to understand the behavior of fluid flow in different conditions in pipes, channels, canals, notches, weirs etc. In the field these conditions are very common and diploma pass-outs have to solve problems related to water seepage and discharge.

The basic knowledge about hydraulics and fluid mechanics will be useful in subjects like Irrigation, Water Resources Management and Public Health Engineering. In this course, basics of hydraulics and its application oriented content has been kept with a focus that students should be able to solve practical problems. Competencies developed by this course would therefore be useful for students while performing his/her job in the field of Water resources / Irrigation/PHE and Environment Engineering.

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 competencies:

i. Measure the pressure and flow of water in different conditions using various measuring devices

ii. Compute discharge and loss of head through pipes, open channels, notches and other hydraulic structures.

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) To measure pressure and determine total hydrostatic pressure for different conditions.
b) To acquire knowledge of different types of flow, different types of energy, and different types of equation & theory.
c) To determine head loss of fluid flow through pipes.
d) To compute discharge by various formulas in open channels.

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	-	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 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	Measure the pressure of water in pipe using (a) Piezometer (b) Different types of manometers	I	04
2	Determine discharge through a given venturimeter.	II	04
3	Determine coefficient such as Cc, Cv, and Cd for different types of orifices	III	04
4	Compute coefficient of discharge for V notch and Preparation of calibration graph for interpolation and extrapolation	IV	04
5	Compute coefficient of discharge for Rectangular notch and Preparation of calibration graph for interpolation and extrapolation	IV	04
6	Determine loss of head in various diameter of pipes and effect of material of pipe on loss of head	III	04
7	Demonstrate functioning of Bernoulli's Apparatus	II	02
8	Demonstrate use of Reynold's number	II	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.*

Sr. No.	Sample Performance Indicators for the PrOs	Weightage in %
	For PrOs 2, 5-12, 14 & 15	
1	**Selection of appropriate Apparatus**	10
2	**Perform Standard Experimental Procedure**	30
3	**Observations and calculations**	30
4	**Follow Safety Precautions**	10
5	**Effective participation in practical group**	10
6	**Answer the question and Submission of work**	10
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 practicals in all institutions across the state.

Sr. No.	Equipment Name with Broad Specifications	PrO. No.
1	● Piezometer	1
2	● U-Tube Manometer	1
3	● Ventutrimeter	2
4	● V-notch	4
5	● Rectangular notch	5
6	● Pipes- PVC, G.I.,	6
7	● Measuring Tank	All
8	● Stop Watch	All
9	● Gauge	All
10	● Hydraulic Bench	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 competency.

a) Work as a team member/ individual.
b) Follow ethical practices.
c) Follow safe practice on site.
d) 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

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)	Topics and Sub-topics
Unit – I Pressure measurement and Hydrostatic pressure	1a. Explain the terms associated with Hydraulics 1b. Clarify different properties of fluid 1c. Describe different types of pressure and methods of measurement 1d. Explain the relationship between pressure and depth of liquid 1e.Compute total Pressure and Centre of pressure	1.1Technical terms used inHydraulics – Fluid Mechanics, Hydrostatics,Hydro-kinematics, Hydro-Dynamics-Ideal and RealFluid. 1.2Properties of liquid – Viscosity-Density-Specific Gravity-Surface Tension-Capillarity Vapour Pressure-Elasticity. 1.3Various types of pressure – Atmospheric Pressure- Gauge Pressure-Absolute Pressure Vacuum Pressure-Separation Pressure/s. 1.4Measurement of pressure/s by different methods 1.5Measurement of difference of pressure using “U”tube Manometer and inverted “U” tube Manometer 1.6Relationship between pressure and depth of liquid 1.6.1Pressure diagram for different conditions 1.7Total pressure and center of pressure 1.7.1 Computation of Total Pressure and depth of the center of pressure
Unit- II **Hydro kinematics & Hydrodynamics**	2a. Derive Continuity Equation 2b. Explain different types of flow 2c. Explain different kinds of energy 2d Apply Bernoulli’s theorem to measurethe pressure and Discharge.	2.1 Discharge & its units, Continuity Equation 2.2 Types of flow - Laminar --Turbulent --Uniform -- Non-uniform –Steady--Un-steady –Rotational and irrotational --One, Two and Three Dimensional flow 2.3 Reynold’s number 2.4 Types of Energy – Potential, Pressure, and kinematics 2.5 Bernoulli’s theorem: statement, assumptions, derivation & limitations. 2.6 Practical application of Bernoulli”s theorem

Unit- III **Flow through pipes**	3a. Explain Head losses 3b. Draw Hydraulic Gradient Line (HGL) and Total Energy Line (TEL) 3c. Computation of diameter of the equivalent pipe. 3d. Compute different Hydraulic Coefficients for different types of orifice	3.1Characteristics of flow through pipes 3.2 Major Head losses in pipe: Computation by Darcy's Weisbach equation, Use of Chezy's & Manning's formula, Nomograms 3.3Computation of minor head losses in a pipe. 3.4 Hydraulic Gradient Line (HGL) and Total Energy Line (TEL) 3.5 Flow through pipes in series (Compound Pipe), pipes in parallel. 3.6 Equivalent Pipe 3.7Discharge measurement using orifice 3.8 Various Hydraulic Coefficient and its relation
Unit- IV **Flow through Open Channel**	4a.Explain Geometrical properties of channel section 4b.Compute discharge through Notches and Weir with various formula. 4c. Explain conditions for most economical section	4.1Definition and classification of channel 4.2 Geometrical properties of channel section: Wetted area, wetted perimeter, hydraulic radius, hydraulic mean depth for rectangular and trapezoidal channel section, Froud's number, 4.3Determination of discharge by Chezy's equation and Manning's equation, Bazin's equation, and Kutter's equation. (Without derivation) 4.4Conditions for the most economical section: rectangular, Trapezoidal, and circular section of open channel. 4.5 Discharge measuring devices: Triangular and rectangular Notches. 4.6 Computation of discharge through different types of weir: Narrow, Broad, Sharp crested weir; Cippoletti weir and Ogee weir. 4.6 Specific energy diagram, Hydraulic jump 4.7 River gauging & measurement of mean velocity.

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	Pressure measurement and Hydrostatic pressure	10	4	8	4	16
II	Hydro kinematics & Hydrodynamics	08	2	6	6	14
III	Flow through pipes	12	4	8	8	20
IV	Flow through Open Channel	12	4	8	8	20
Total		**42**	**14**	**30**	**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 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:

Following is the list of proposed student activities like:

1.Student will visit nearby Canal Structure and Submit report consisting flow data, cross sections, hydraulic data etc. for the same.

2.Student will Survey an industry / Department for handling or using pressure measuring devices.

3.Student will carry out market survey for pipes of different materials.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES

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) Use demonstration, video/animation films field/industry visit for explaining complex/abstract concepts of Hydraulics.
d) This course requires lot of practice on numerical. Students may be asked to solve the numerical during lecture periods and tutorial periods, in addition home

assignments may be given. To avoid copying by students each problem must have different parameters for each student or at least there may be five to six sets of problems with different values., In other words each student will get same problem but with varied parameters. (Values of pressure, volume, flow, force, distance, speed etc may be different for each student)

e) ***'L' in section No. 4***means different types of teaching methods that are to be employed by teachers to develop the outcomes.

f) 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.

g) With respect to ***section No.10***, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.

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-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 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, 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) **Market Survey and comparison of different pipe material.**
b) **Case study and collection of different hydraulic parameters of open channel.**
c) **Develop practical to find out types of flow(Critical flow, Subcritical flow and Supercritical flow) based on Froude Number.**
d) **Determine loss of head of any single building in your campus.**
e) **Find out number of weirs and collect the different hydraulic parameters within state/district using Internet sources.**

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN

1	Hydraulics, Fluid Mechanics and Hydraulic machine	S.Ramamrutham	Dhanpat Rai
2	Hydraulics, Fluid Mechanics and Hydraulic machine	R. S. Khurmi	S.Chand
3	Hydraulics, Fluid Mechanics and Hydraulic machine	R K Bansal	S.Chand
4	Fluid Mechanics	A K Jain	Khanna Publishers
5	Journal of experiments in Hydraulics	Rao and Hasan	New Height
6	Hydraulic laboratory	Rao and Hasan	New Height
7	Fluid Mechanics	Dr.M.L.Mathur	Std.Publication
8	Fluid Mechanics & Hydraulics	S.C.Gupta	Pearson Education
9	Hydraulics and Hydraulic machine	Prof.V.P.Priyani	Charotar Publication
10	Hydraulics, Fluid Mechanics and Hydraulic machine	S.Ramamrutham	Dhanpat Rai

14. SOFTWARE/LEARNING WEBSITES (From Old Syllabus)

a) www.nptel.iitm.ac.in
b) www.waterbouw.tudelft.nl/
c) www.learnrstv.com
d) www.shiksha.com ,IIT, Roorkee
e) www.blackwellpublishing.com
f) www.hrpwa.org
g) www.creativeworld9.com

15. PO-COMPETENCY-CO MAPPING

Semester II	Civil Engineering Drawing (Course Code:4320601)									
	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**	**PSO 2**	**PSO 3** (If needed)
Competency	i. Read and interpret the building construction drawings. ii. Produce working and /or submission drawings for simple civil engineering structures with building services as per regulations and bye-laws considering green building aspects.									
Course Outcomes CO a) To Measure pressure and determine total hydrostatic pressure for different conditions.	3	2	2	3	-	-	2	-	-	-
CO b) To acquire knowledge of different types of flow, different types of energy, and different types of equation & theory.	3	2	-	2	-	-	2	-	-	-
CO c) To Determine head loss of fluid flow through pipes.	3	2	2	2	2	-	2	-	-	-

CO d) To Compute discharge by various formulas in open channels.	3	2	1	2	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

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GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Course Title: Computer Aided Drafting
(Course Code: 4330605)

Diploma programme in which this course is offered	Semester in which offered
Civil Engineering, Environmental Engineering	Third

1. RATIONALE

Computer Aided Drafting is invariably used for Civil Engineering Drawing and visual representation before actual construction. With advancement in Building Technology, new features have been introduced in structures. Further structural design has also been modernized. This has further increased the importance of drawing and drafting softwares which help in visualizing the structures thus increasing the understanding. Besides technological development in drafting softwares have made them more user friendly thus making them virtually indispensible. Hence knowledge of Computer Aided Drafting has become even more important skill than before. Civil Engineering Drawing, the language of a Civil Engineer helps him in efficiently representing engineering details like plan, elevation, section, foundation, building elements, etc. for easy understanding of the clients, authorities, etc. Computer Aided Drafting (CA Drafting) helps in easily performing the above task and drastically reducing the time of preparation of the drawings.

Computer Aided Drafting tools like AUTOCAD, REVIT, SKETCHUP have made civil engineering drawing simple, easy to represent details and time saving. Knowledge of above softwares is necessary for increasing employable skills of diploma engineers. Hence, the recent curriculum is framed keeping in mind the above requirements.

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 competencies:

- **Prepare detailed 2D drawing of building components (beam, slab, column and footing), plan, elevation and section drawings required for civil engineering activities using advance tools AutoCAD and basic tools of REVIT software.**
- **Prepare basic 3D drawing of a small building.**

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:

CO1 Prepare 2D drawings of building components like beam, slab, column and footing residential &commercial building using CAD.

CO2 Prepare 2D drawings like Plan, Elevation and Sectional of residential &commercial building using CAD.

CO3 Preparesimple3D drawing of residential &commercial building using CAD.

CO4 Prepare simple building drawing using REVIT

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	
-	-	4	2	-	-	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	Draw the sectional Elevation and Plan showing Reinforcement details of Beam	1, 2		4
2	Draw the sectional Elevation and Plan showing Reinforcement details of slab	1, 2		4
3	Draw the sectional Elevation and Plan showing Reinforcement details of Column footing.	1, 2		4
4	Drawing Furnished Plan, Elevation and Sectional View of Residential Building having Ground and preferably 1st floor construction showing title block, legends, schedule of opening; and margins with A3 page settings. Print/ Plot the above drawings using Plot Settings	1, 2		14
5	Develop a 3D drawing for a 1BHK Building. Print/ Plot the above drawings using Plot Settings.	3, 4		10
6	Prepare simple building drawings using REVIT	5		20
			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. 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 2, 5-12, 14 & 15		
1	Use of proper commands	30
2	Uniformity in Drawing and detailing	20
3	Accuracy in dimensioning, scaling, placing of drawings and text.	30
4	Timely completion and submission	5
5	Answer the questions	10
6	Attendance & Punctuality	5
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–minimum Intel Core i3 or equivalent processor, 4GB RAM, 500 GB Hard disk, graphics card.* • Printer and/or Plotter as per printing requirement • LCD Projector *As CAD Softwares are regularly updated, higher configuration of computer system may be required in future.	1 to 6

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 team member/ individual.
b) Work with care and safety.
c) Work with discipline and responsibility.
d) 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

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)	Topics and Sub-topics
Unit – I Introduction to CAD	1a.Demonstrate the basics of CAD software and its important commands 1b.Prepare a simple building drawing file using basic draw and modify commands	1.1 File menu of CAD with New, Open, Save, Save as and Close 1.2 Basic 2D commands like Line, Circle, Ellipse, Multi Line ,Construction Line, Polyline, Point, Donut, Ellipse, Polygon, Rectangle, Arc, Erase, Snap, Redraw, Regenerate, Zoom, Pan
Unit – II Demonstration of 2D commands in CAD	2a.Explain the applications of Edit commands 2b.Modify existing CAD Drawing 2c.Apply advance command for edit /modification of drawing 2d. Prepare typical Drawings using Different Layers 2e. Develop final Drawings with Dimension and Text and Hatching	2.1 Modify Properties of Drawing Entity 2.2 Copy, Move, Rotate, Mirror, Offset, 2.3 Array, Scale, Stretch, Lengthen, Trim 2.4 Extend, Break, Chamfer , Fillet 2.5 Block, Insert and Explode 2.6 Application of LAYER command in Civil Engineering 2.7 Layer command with its all sub commands, Line type, Color 2.8 Dimension command – linear , aligned, arc, length, radius, Diameter, Centre, Leader, Baseline and Continuous, Dimensioning, tolerance, override and Dimension updates Text and DTEXT commands with Text Style, Hatch command
Unit – III Demonstration of 3D commands in CAD	3a.Use 3D commands togenerate3dviewfrom2Ddrawing 3b. Prepare 3D Drawings using 3D Commands of CAD 3c.perform rendering/shading on 3D drawing	3.1 Units, Elevation, Thickness, UCS and UCS Icon 3.2 Viewports , Extrude , 3D Solids – Sphere, Box, Cylinder, Cone, Wedge, Interference 3.3 3D Surface – Revolved, Tabulated and Ruled Surfaces Hide, Render and Shade of3Ddrawings
Unit– IV Plot of 2D & 3DDrawings	4a.Setup printer, plotter for printing of drawings 4b.Plot 2D and 3D Civil Engineering Drawings as per requirement on different scale and sizes	4.1 PLAN, ELEVATION and 3D Views of Residential and Commercial Building. 4.2 PLOT and its Sub Command for Plotting Drawing on A1, A2 and A3 Size Paper using Printer and /or Plotter
Unit– V Introduction to REVIT/Similar software	5a. Explain basics of BIM 5b. Demonstrate components of REVIT UI 5c. Prepare simple building drawing using REVIT 5d. Demonstrate Rendering in REVIT 5e. Calculate data from REVIT	5.1 Introduction to BIM 5.2 Understanding of REVIT UI 5.3 Grid and Level 5.4 Model Line 5.5 Wall 5.6 Door & Window 5.7 Floor 5.8 Roof 5 9 Railing & Stair Case 5.10 Sheet Creation 5.11 Import & Export 5.12 Rendering in Revit 5.13 Calculate data from Revit Drawings

9. 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) 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.
d) Expert Lecture/Seminar regarding latest softwares lime Sketch Up, etc related to Computer Aided Drafting may be arranged.

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:

- Draw the Cross Section through Wall
- Draw different types of foundation (any five).
- Draw different types of brick masonry bonds (any five).
- Draw different types of stone masonry (any five).
- Draw different types of doors (elevation) (any five).
- Draw different types of windows (elevation) (any five).
- Draw different types of caissons.
- Draw profile leveling of longitudinal section of road. (Assume requireddata).
- Draw a contour map of 40 m by 40 m area showing minimum 5 contours. (Assume required data).
- Draw the detailed plan for a small school building.
- Draw the detailed plan for a small shopping complex.
- Draw a layout plan of a plot/scheme and its key plan.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	AutoCAD for dummies	Bill Fane	John Wiley & Sons, 2016
2	AutoCAD 2018 3D Drawing & Modeling-Student Guide	--	Ascent Centre for Technical Knowledge, 2017
3	Mastering AutoCAD 2019 and AutoCAD LT 2019	George Omura	Sybex, 2018
4	AutoCAD Workbook for Architects and Engineers	Shannon R.Kyles	Wiley-Blackwell, 2008
5	AutoCAD 2021 Beginning and Intermediate	Munir M.Hamad	Mercury Learning and Information, 2020
6	Mastering Autodesk Revit 2020	Robert Yori-Marcus Kim, Lance Kirby	Sybex, 2020

14. SOFTWARE/LEARNING WEBSITES

a) AutoCAD, REVIT,SKETCH UP
b) https://www.autodesk.com/education/edu-software/overview?sorting=featured&filters=individual
c) https://old.aicte-india.org/bfreedownloadsadesk.php
d) www.Autodesk.com
e) https://www.thesourcecad.com/autocad-tutorials/

15. PO-COMPETENCY-CO MAPPING

Semester III	Civil Engineering Drawing (Course Code:4320601)									
	POs and PSOs									
Competency & Course Outcomes	PO 1Basic& Discipline specific knowledge	PO 2 Problem Analysis	PO 3Design / development of solutions	PO 4Engineering Tools, Experimentation &Testing	PO 5Engineering practices for society, sustainability & environment	PO 6 Project Management	PO 7Life-long learning	PSO 1	PSO 2	PSO 3 (If needed)
Competency	• Prepare detailed 2D drawing of building components (beam, slab, column and footing), plan, elevation and section drawings required for civil engineering activities using advanced tools AutoCAD and basic tools of REVIT software. • Prepare basic 3D drawing of a small building.									
CO 1 Prepare 2D drawings of building components like beam, slab, column and footing residential & commercial building using CAD.	3	1	2	3	2	2	3	-	-	-
CO 2 Prepare 2D drawings like Plan, Elevation and Sectional of residential & commercial building using CAD.	3	2	2	3	3	2	3	-	-	-
CO 3 Prepare simple 3D drawing of residential & commercial building	2	1	2	2	2	1	2	-	-	-

using CAD.										
CO 4 Prepare simple building drawing using REVIT	1	1	2	3	2	1	1			

Legend: '**3'** for high,'**2**' for medium, **'1'** for low or **'-'**for the relevant correlationof eachcompetency, CO, with PO/ PSO

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

S. No.	Name and Designation	Institute	ContactNo.	Email
1	Shri K.P. Jasodani	Govt.Polytechnic, Himatnagar	02772-229285	jasodani_kamalkumar1@gtu.edu.in
2	Shri M.L. Patel	R.C. Technical Institute, Ahmedabad	079-27664785	mlpatel504@gmail.com
3	Shri C.B. Patel	Govt.Polytechnic,Ahmedabad	079-26301285	patel.chig@gmail.com
4	Dr. A.K.Patel	Govt.Polytechnic,Ahmedabad	9825009719	Ashutech.asp@gmail.com

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Semester – IV

Course Title: Essence of Indian knowledge and Tradition
(Course Code: 4340001)

Diploma programme in which this course is offered	Semester in which offered
All branches of Diploma Engineering	4th Semester

1. RATIONALE:

National education Policy 2020, has given ample emphasis on Indian Knowledge system. The significance of teaching of Indian knowledge and Tradition is very much required as for centuries this great tradition had been trampled under the feet of invaders. Even after Independence, Indian Knowledge System had been neglected and only Western parameters have been considered as standard.

The essence of Indian culture has been carried through centuries only because of its scientific and humanitarian approach. It is the need of the hour that young students learn the significance of the contribution made by Indian Knowledge Systems and contribute to the world with pride and confidence even in the field of Science and technology which had been mastered centuries ago but was perished by invaders. This course will provide an opportunity to the students the hidden secrets of the great heritage of knowledge that existed thousands of years ago in Indian Tradition.

2. COMPETENCY:

1) Study of IKS will enable students to respect and relish the greatness of our tradition. The awareness of IKS will make them feel proud about their own culture.
2) The knowledge of Indian knowledge will enable and empower them with the first hand knowledge of India's great heritage, culture and traditions.
3) This will create a scope and awareness amongst the foreigners regarding India and its contribution to the world.

3. COURSE OUTCOMES

1. Students will attain awareness regarding the significance of IKS
2. The syllabus will enhance their confidence in Indian traditional knowledge system and enable them to perceive at the problems with Indian perspective
3. This will also enable them to analyze the issues on their own and enable them for critical thinking.
4. The knowledge about the ancient Indian Scientific traditions will generate more confidence in themselves.
5. This will lead them to make research and innovative thinking which can result in global contribution at later stage.

4.TEACHING AND EXAMINATION SCHEMES

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

5.PRACTICAL / PROJECT :

The student can visit any historical / monumental sights like Adalaj step well or Rani Ki Vav – Patan and study about architectural skills of Indians in past.

Topics:-

1. **Ancient Indian Astronomy :**

- **Development of Astronomy**:
  A) Consideration of Purnima and Amavasya
  B) Beginning of The New Year- Vasant Ritu- (Vernal Equinox)
  C) Ancient Indian Calender
  D) Science Behind "Adhikmaas"
  E) Uttarayan and Dakshinayan

- **Knowledge about Constellations / planets / distance between planets etc.**

A) Saptarushi – seven Seers- Significant Knowledge of star and constellations
B) Knowledge of Speed of Light – Rigveda(1.50.04)
C) Distance between Earth and Sun (Hanuman Chalisa)

- **Advances in Mathematics and Geometry in Ancient India**

A) Sulbha- Sutra (Kalpa Sutra) composed by Baudhayana, Manava, Apastamba and Katyayana

B) Contribution of Ancient Rushis to Mathematics

A)Bodhayana's value of pie
B) Lilavati
C) Bhaskaracharya
D) Arya Bhatt.

2. **Town Planning in Ancient India**

A)Roads in Ancient India – Uttarpath by Chandra Gupta
B)Ancient Indian Trade Routs/ Waterways
C)Ship- Building In Ancient India
D)Temple Architecture
-Nagar Style/ Dravida style/ Vesara style

3. **Atomic Theory of by Kanada**

A) Concept of Seven Padartha and Nine Dravyas
B) Theory of Gurutva
C) Characteristics of Atom

4. **Metallurgical Discoveries in Ancient India**

- Lime a Mortar
- Bronze
- Gold & Silver /\
- Glass / Iron
- Nagarjuna's Contribution in making Alloys

5. **Vimanshastra - Airbourne Vehicles.**

A) References of Vimana- Flying Machines in Rigveda, Mahabharat and Ramayana
B) BhardwajSutra- Chapter-1 Rasyagnoadhikari

6.REFERENCE BOOKS:

1)History of Science, Arts & Technology By Dr. Shripad Dattatrya Kulkarni, Bhishma Prakashan, Mumbai -1998.

2)Introduction to Indian Knowledge System: Concepts and Applications by B. Mahadevan, Vinayak Rajat Bhat, Nagendra Pavana, PHI Learning Pvt. Ltd., Delhi
3)Town Planning in Ancient India by Binode Bihari Dutt, Thacker, Spink & Co.
4) ભારતનો વૈજ્ઞાનિક વારસો લેખક-જે . જે . રાવલ યુનિવર્સિટી ગ્રંથ નિર્માણ બોર્ડ, ગુજરાત રાજ્ય

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)

Semester – IV

Course Title: Integrated Personality Development Course
(Course Code: 4340003)

Diploma programme in which this course is offered	Semester in which offered
All branches of Diploma Engineering	4th Semester

1. TYPE OF COURSE

Value-based holistic personality development course for university students.

2. RATIONALE

IPDC aims to prepare students for the modern challenges they face in their daily lives. Promoting fortitude in the face of failures, unity amongst family discord, self-discipline amidst distractions, and many more priceless lessons. The course focuses on morality and character development at the core of student growth, to enable students to become self-aware, sincere, and successful in their many roles - as an ambitious student, reliable employee, caring family member, and considerate citizen.

3. COURSE OUTCOMES

- To provide students with a holistic value-based education that will enable them to be successful in their academic, professional, and social lives.
- To give the students the tools to develop effective habits, promote personal growth, and improve their wellbeing, stability, and productivity.
- To allow students to establish a stronger connection with their family through critical thinking and devolvement of qualities such as unity, forgiveness, empathy, and effective communication.
- To provide students with soft skills that complement their hard skills, making them more marketable when entering the workforce.
- To enhance awareness of India’s glory and global values, and to create considerate citizens who strive for the betterment of their family, college, workforce, and nation.
- To inspire students to strive for a higher sense of character by learning from role models who have lived principled, disciplined, and value-based lives.

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	0	2	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.

5. COURSE-CONTENT:

Each lecture can be taken in a continuous two-hour session, or in two separate one-hour sessions. In addition to the core lectures, an induction and concluding lectures are recommended as shown in the below table.

Lecture No.	Module & Subject	Subject Description	Hours
IPDC-1 (First Phase/Semester)			
Intro-duction	The Need for Values	Students will learn about the need for values as part of their holistic development to become successful in their many roles - as ambitious students, reliable employees, caring family members, and considerate citizens.	2
1	**Module:** Remaking Yourself **Subject :** Restructuring Yourself	Students learn how self-improvement enables them to secure a bright future for themselves. They will learn 6 powerful thought-processes that can develop their physical, intellectual, emotional, and spiritual quotients.	2
2	**Module:** Remaking Yourself **Subject :** Power of Habit	Students will undergo a study of how habits work, the habits of successful professionals, and the practical techniques that can be used to develop good habits in their life.	2
3	**Module:** Learning from Legends **Subject :** Tendulkar & Tata	Students will learn from the inspirational lives of India's two legends, Sachin Tendulkar and Ratan Tata. They will implement these lessons through relatable case studies.	2
4	**Module:** From House to Home **Subject :** Listening & Understanding	Active listening is an essential part of academic progress and communications. Students will learn to listen with their eyes, ears, mind, and heart.	2
5	**Module:** Facing Failures **Subject :** Welcoming	This lecture enables students to revisit the way in which they approach challenges. Through the study of successful figures	2

	Challenges	such as Disney, Lincoln and Bachchan, students will learn to face difficulties through a positive perspective.	
6	**Module:** Facing Failures **Subject :** Significance of Failures	Failure is a student's daily source of fear, negativity, and depression. Students will be given the constructive skills to understand failure as formative learning experiences.	2
7	**Module:** My India My Pride **Subject :** Glorious Past - Part 1	India's ancient Rishis, scholars, and intellectuals have made tremendous contributions to the world, they developed an advanced, sophisticated culture and civilization which began thousands of years ago. Students will learn the importance of studying India's glorious past so that they could develop a strong passion and pride for our nation.	2
8	**Module:** My India My Pride **Subject :** Glorious Past - Part 2	Our ancient concepts can be used to seek revolutionary ideas and to generate inspiration. Students will develop a deeper interest in India's Glorious Past – by appreciating the need to read about it, research it, write about it, and share it.	2
9	**Module:** Learning from Legends **Subject :** A.P.J. Abdul Kalam	Dr Kalam's inspirational life displayed legendary qualities which apply to students (1) Dare to Dream (2) Work Hard (3) Get Good Guidance (4) Humility (5) Use Your Talents for the Benefit of Others	2
10	**Module:** Soft Skills **Subject :** Networking & Leadership	Students are taught the means of building a professional network and developing a leadership attitude.	2
11	**Module:** Soft Skills **Subject :** Project Management	Students will learn the secrets of project management through the Akshardham case study. They will then practice these skills through an activity relevant to student life.	2
12	**Module:** Remaking Yourself **Subject :** Handling Social Media	Students will learn how social media can become addictive and they will imbibe simple methods to take back control.	2
13	**Module:** Facing Failures **Subject :** Power of Faith	Students will learn about the power and necessity of faith in our daily lives.	2
14	**Module:** From House to Home **Subject :** Bonding the Family	Students will understand the importance of strong family relationships. They will learn how to overcome the generation gap and connect with their family more.	2

15	**Module:** Selfless Service **Subject :** Seva	Students will learn that performing seva is beneficial to one's health, wellbeing, and happiness. It also benefits and inspires others.	2

6. COURSE MATERIAL / MAIN COURSE WORKBOOK:

Workbook will be designed and presented by IPDC Team. These official workbooks would be the course-material for study of IPDC. These workbooks will solve the purpose of study, submission, viva and exams for students.

IPDC Workbook-1 (*published by Swaminarayan Aksharpith)*

7. IPDC REFERENCES:

These are the reference material for the IPDC lectures. This is not compulsory reading for the students as the essential information is contained in the workbook.

Module No.	Module	References
1	Facing Failures	1. Thomas Edison's factory burns down, New York Times Archives, Page 1, 10/12/1914 2. Lincoln Financial Foundation, Abraham Lincoln's "Failures": Critiques, Forgotten Books, 2017 3. J.K. Rowling Harvard Commencement Speech | Harvard University Commencement, 2008 4. Born Again on the Mountain: A Story of Losing Everything and Finding It Back, Arunima Sinha, Penguin, 2014 5. Failing Forward: Turning Mistakes Into Stepping Stones for Success, John C. Maxwell, Thomas Nelson, 2007 6. Steve Jobs: The Exclusive Biography Paperback, Walter Isaacson, Abacus, 2015 7. Failing Forward: Turning Mistakes Into Stepping Stones for Success, John C. Maxwell, Thomas Nelson, 2007
2	Learning from Legends	1. Chase Your Dreams: My Autobiography, Sachin Tendulkar, Hachette India, 2017 2. Playing It My Way: My Autobiography, Sachin Tendulkar, Hodder & Stoughton, 2014 3. The Wit and Wisdom of Ratan Tata, Ratan Tata, Hay House, 2018 4. The Tata Group: From Torchbearers to Trailblazers, Shashank Shah, Penguin Portfolio, 2018 5. The Leader Who Had No Title, Robin Sharma, Jaico Publishing House, 2010 6. In the Joy of Others: A Life-Sketch of Pramukh Swami Maharaj, Mohanlal Patel and BAPS Sadhus, Swaminarayan Aksharpith, 2013

3	My India My Pride	1. Rishis, Mystics, and Heroes of India, Sadhu Mukundcharandas, Swaminarayan Aksharpith, 2011 2. Physics in Ancient India, Narayan Dongre, Shankar Nene, National Book Trust, 2016 3. The Rise of Civilization in India and Pakistan, Raymond Allchin, Bridget Allchin, Cambridge University Press, 1982 4. The Āryabhaṭīya of Āryabhaṭa: An Ancient Indian Work on Mathematics and Astronomy (1930), Walter Eugene Clark, University of Chicago Press, reprint, Kessinger Publishing, 2006
4	Remaking Yourself	1. Power of Habit, Charles Duhigg, Random House Trade Paperbacks, 2014 2. Change Your Habit, Change Your Life, Tom Corley, North Loop Books, 2016 3. The Seven Habits of Highly Effective People, Stephen Covey, Simon & Schuster, 2013 4. Seven Habits of Highly Effective Teens, Sean Covey, Simon & Schuster, 2012 5. Atomic Habits, James Clear, Random House, 2018 6. How a handful of tech companies control billions of minds every day, Tristan Harris, TED Talk, 2017
5	From House to Home	1. "What Makes a Good Life? Lessons from the Longest Study on Happiness", R. Waldinger, Ted Talks, 2015 2. Long Walk To Freedom, Nelson Mandela, Back Bay Books, 1995 3. Outliers, Malcolm Gladwell, Back Bay Books, 2011
6	Soft Skills	1. The 17 Indisputable Laws of Teamwork, John Maxwell, HarperCollins, 2013 2. Team of Teams: New Rules of Engagement for a Complex World, Stanley McChrystal, Portfolio, 2015 3. Predictably Irrational, Revised and Expanded Edition: The Hidden Forces That Shape Our Decisions, Dan Ariely, Harper Perennial, 2010
7	Selfless Service	1. Open: An Autobiography, Andre Agassi, Vintage, 10 August 2010 2. The Physiological Power of Altruism [online], James Hamblin, The Atlantic, December 30, 2015, https://www.theatlantic.com/health/archive/2015/12/altruism-for-a-better-body/422280/ [last accessed June 10, 2020] 3. TBI Blogs: From Entrepreneurs to Doorkeepers, Everybody Serves with Love & Warmth at This Ahmedabad Café [online], The People Place Project, The Better India, May 29, 2017, https://www.thebetterindia.com/102551/small-way-serve-ahmedabad-seva-cafe/, [last accessed June 10, 2020]

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Course Title: Advanced Surveying
(Course Code: 4340601)

Diploma programme in which this course is offered	Semester in which offered
Civil Engineering, Environmental Engineering, Mining Engineering	4th Semester

1. RATIONALE

Surveying is the basic andone of the most studied topics in civil engineering.Survey is used in the preparation of maps which help in the location of hills, valleys, rivers, boundaries, roads, canals and railways. It also helps in setting up plans for roads, railways and other important civil engineering structures. In addition to the instruments used for simple surveying, advanced surveying techniques such as Tachometric survey, Setting out of a curve, Total Station survey, use of G.P.S., D.G.P.S., U.A.V. etc. are essential as the speed and accuracy are in high demand in recent time. Also, these modern equipments use software which in turn encourages paperless work and use of green building materials.

At the diploma level, students are expected to study these aspects so as to develop their understanding, and performance-oriented abilities in order to apply their knowledge in the civil engineering field.

2. COMPETENCY

Thepurposeof this course is to help the student to attain the following industry identified competency through various teaching-learning experiences:

Carry out civil engineering surveys with the use of necessary software to prepare drawings &maps using a theodolite, total station, G.P.S., D.G.P.S., U.A.V., etc.

3. COURSE OUTCOMES (COs)

The practicalexercises, the underpinning knowledgeandthe relevant soft skills associated with this competency are to be developed in the studentsto display the following COs:

1. Carry out a contour survey for undulating/hilly regions using a Tacheometer and prepare contour map.
2. Setting out a horizontal curve using a theodolite.
3. Carry out traverse survey using total station, import the data in the computer, and preparedrawing using Auto CAD.
4. Record and retrieve the data using a Hand-Held GPS
5. Give a demonstration of the field procedure of modern surveyingequipments.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T/2+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marl
L	T	P	C	CA	ESE	CA	ESE	
3	-	4	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 thesub-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	Determine the constants of a tacheometer.	I	2
2	Determine the distance and R.L. of a point when a line of sight is horizontal.	I	2
3	Determine the distance and R.L. of a point when a line of sight is inclined for an angle of elevation.	I	2
4	Determine the distance and R.L. of a point when a line of sight is inclined for an angle of depression.	I	2
5	**Carry out the Tacheometry project for 4 to 5 stations for a closed traverse on undulating/hills regions and prepare the drawing sheet.**	**I**	**10**
6	Determine the elements of a simple circular curve.	II	2
7	Computation of the data for setting out the curve by an offset of long Chord method.	II	2
8	Computation of the data for setting out the curve By Rankine (one theodolite) method.	II	2
9	**Carry out the project for setting out a simple horizontal curve by Rankine's methods**	**II**	**4**
10	Identify the parts of the Total Station.	III	2
11	Set out the total station on a given station.	III	2
12	Set out the station by setting up a backsight.	III	2

13	Measure the horizontal, vertical and deflection Angle by total station.	III	2
14	Store and download the data from a total station in the computer and convert the same into Auto CAD file.	III	2
15	**Total Station survey:** **- Carry out the project for a small traverse with 4-5 stations on the ground and prepare the drawing with the required scale.**	**III**	**6**
16	An overview of Hand-held GPS device	IV	2
17	Record and retrieve the data using a Hand-Held GPS	IV	4
18	Know the uses of Modern Surveying techniques	V	2
19	Demonstration of Recording and Retrieving data collected from Modern Surveying techniques such as DGPS, UAV etc.	V	4
	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 theCOs.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 15& 17)		
1	Operation and handling of survey instruments	20
2	Taking observations and recording and storing	30
3	Computation/Retrieval of survey data and plotting/ Drawing	30
4	Answer the questions	10
5	Follow safe practices measures while performing practicals	10
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

These major equipments with broad specificationsfor the PrOsis a guide to procure them by the administrators to usher in uniformity of practical in all institutions across the state.

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	**Theodolite/Tacheometer:**	01 - 09

	Length of telescope 178 mm, Magnification 25X Effective Aperture 38mm, Field of View 2.6 M at 100M, Short Focus 1.5M, Stadia Ratio 1:100, Stadia Constant 0, Circle Diameter Hz113mm, V100 mm Graduation 20' / 10', Vernier Reading 20" / 10".	
2	**Total station:** Objective Lens Diameter-45mm (1.77 inches), Magnification-30x, Minimum Focus Distance-1.5 m, 1 prism 3,000m,3 prisms 4,000m, Measuring Accuracy-±(2mm + 2ppm x Distance) Mean Squared Error, Accuracy in angle measurement-5", with display panel and keyboard, Reflectorless operation from 30cm to 500m.	10 -15
3	**Hand-Held GPS:** Display size of screen-7 13 cm, Features-Moving map, Routes-50, Way points-1000.	16-17
4	Modern surveying equipments: (for demonstration only) DGPS&UAV	18-19

7. AFFECTIVE DOMAIN OUTCOMES

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

- Work as a leader/a team member.
- Follow ethical practices.
- Practiceenvironmental 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 isformulatedashigher 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)	Topics and Sub-topics
Unit – I **Tacheometric**	1a. Explain the principles and various methodologies involved in techeometry.	1.1 Introduction, Purpose andPrinciples of TacheometricSurveying. 1.2 Theory of Stadia Tacheometry, Analytic

Surveying	1b. Calculate R.L. and horizontal distance between object and instruments.	Lens andadvantages & disadvantages ofit. 1.3 Methods of determining constants of a Tacheometer 1.4 Methods of Tacheometry (Stadia &Tangential) Method of Fixed Hair : - When the line of sight is horizontal and Staffheld vertically - Whenthe line of sight is inclinedand staffheldvertically (Angle of Elevation & Depression) 1.5 Advantages and disadvantages of Tangential method 1.6 Related examples of Tacheometer constant &Tacheometricmethods
Unit – II **Curves**	2a. Describe differentelements of curves. 2b. Calculate necessarydata required to setting outcurve on field.	2.1 Types of circular curves 2.2 Definitions and notations 2.3 Designation of thecurve 2.4 Relation between Radius and degree of curve 2.5 Elements of a simple circular curve 2.6 Setting out a simple circular curve. 2.7 Methods of setting out simple circular curves 2.8 Transition curves - Requirements and purpose of it. 2.9 Vertical curves 2.10 Related examples of curves.
Unit – III **Total Station Survey**	3a. Explain the principlesof total station. 3b. Record data on total stationas well as on computer. 3c. Retrieving the data andgenerate the drawings usingapplication software.	3.1 Introductionand basics of Digital Theodolite 3.2 Principles of E.D.M. 3.3 Introduction and Basics of Total station - Parts of Total station - Advantages, disadvantages and uses of TotalStation - Types of Total Station - Advancement in Total Station Technology - Automatic Target Recognition ATR 3.4 Surveying using Total Station - Flow chart of data collection - Fundamental Parameters of Total Station 3.5 Precautions to be taken while using Total Station 3.6 Field equipments 3.7 Set up of Total Station

		- Centering, Levelling , back-sight,Azimuth Marks 3.8 Measurement with Total Station 3.9 Total Station Initial Setting 3.10 Field Book recording 3.11 Radial Shooting 3.12 Total Station Traversing 3.13 Survey Station description,Occupied Point Entries 3.14 Data Retrieval 3.15 Field-Generated Graphics 3.16 Construction layout using Total Station 3.17 Overview of Computerized Survey Data System 3.18 Equipment Maintenance 3.19 MaintainingBattery Power, TotalStation Job Planningand Estimating 3.20 Total Survey system errors Sources andhow to avoidthem. 3.21 Controlling errors
Unit IV **Global Positioning System**	4a. Applications ofGPS in civilEngineering. 4b. Retrieving the data and Generatemaps.	4.1 Introduction to GPS 4.2 Maps & types of digitalmap 4.3 Fundamentalsand uses of GPS 4.4 GPS Receivers (Hand-Held GPS Receivers) 4.5 Field procedures of GPS 4.6 Observations and applicationsin Civil Engineering
Unit V **Modern Surveying Techniques**	5a.Explainthe use of ModernSurveying Instruments. 5b.Demonstration of Recording AndRetrievingcollecteddata.	5.1 Introduction and use of modern surveying equipments such asDifferential Global Positioning System (DGPS),Unmanned Arial Vehicle(UAV). 5.2 Field procedures of modern surveying equipments 5.3 Data Retrieval 5.4 Understanding GIS and its components 5.5 Applications of GIS

***Note**:TheUOs 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 ofTheory Marks			
			RLevel	ULevel	ALevel	Total Marks
1	Tacheometry Surveying	12	04	04	12	20

2	Curves	8	02	04	08	14
3	Total Station Survey	10	02	06	08	16
4	Global Positioning System	6	04	02	04	10
5	Modern Surveying Techniques	6	04	06	00	10
Total		**42**	**16**	**22**	**32**	**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, the following are the suggested student-related ***co-curricular*** activities that can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct the 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) Preparea seminar on the relevant topic
b) 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 assessedusing different assessment methods.
e) With respect to ***section No.11***, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
f) Guide students on how to address issues on environmental and sustainability
g) Expert lecture by a practicing surveyoron modern surveying equipments.
h) Expert lecture on the latest software used for modern surveying.

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. 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 orientedCOs.

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) Measure Horizontal and vertical distance of given objects(minimum 02 objects)
b) Compute Tacheometric constants in the field
c) Calculation of Elements of a simple circular curve from given data
d) Use different methods of setting out simple circular curves.
e) Prepare technical specifications of the Total station.
f) Find out the height of the tower or tall object by total station.
g) Carry out small levelling projects with the help of a total station.
h) Prepare a report on field procedures of GPS.
i) Stack out waypoints with the help of GPS
j) Prepare areport on GIS, its components and its application

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Surveying and Levelling Vol-II	T.P.Kanetkar&S. V.Kulkarni	PunaVidyarthiGrihaPrakashan
2	SurveyingandLevellingVol-II	Dr.B.C.Punmia	Laxmi Publications Pvt.Ltd.
3	SurveyingandLevellingVol-II	S.S. bhavikatti	WILEY-India
4	FundamentalsofSurveying	S.K.Roy	PHILearningPvt.Ltd
5	Surveying and Levelling	N NBasak	McGraw Hill Education Pvt. Ltd
6	A Textbook of Surveying and Levelling	R. Agor	Khanna Publishers

14. SOFTWARE/LEARNING WEBSITES

a) https://www.digimat.in/nptel/courses/video/105107121/L01.html
b) https://www.digimat.in/nptel/courses/video/105107121/L02.html
c) https://www.digimat.in/nptel/courses/video/105107121/L03.html
d) https://www.digimat.in/nptel/courses/video/105107121/L04.html
e) https://www.digimat.in/nptel/courses/video/105107121/L05.html
f) https://www.digimat.in/nptel/courses/video/105107121/L27.html
g) https://www.digimat.in/nptel/courses/video/105107121/L28.html
h) https://www.digimat.in/nptel/courses/video/105107158/L17.html
i) https://www.digimat.in/nptel/courses/video/105107158/L18.html
j) https://www.digimat.in/nptel/courses/video/105107158/L20.html
k) https://www.digimat.in/nptel/courses/video/105107158/L21.html
l) https://www.digimat.in/nptel/courses/video/105107158/L23.html
m) https://www.digimat.in/nptel/courses/video/105107158/L24.html

Note: For more videos students are suggested to visit the website of NPTEL

15. PO-COMPETENCY-CO MAPPING

Semester IV	**Advanced Surveying (Course Code: ……)**									
	POs and PSOs									
Competency & Course Outcomes	**PO 1 Basic & Discipline - 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**	**PSO 2**	**PSO 3 (If needed)**
Competency → / **Course Outcomes ↓**	**Carry out civil engineering surveys with the use of necessary software to prepare drawings & maps using a theodolite, total station, G.P.S., D.G.P.S., U.A.V., etc.**									
CO a) Carry out a contour survey for undulating/ hilly regions using a Tacheometer and prepare contour map.	3	3	2	3	-	3	2	-	-	-
CO b) Setting out a horizontal curve using a theodolite.	3	2	2	2	-	2	2	-	-	-

CO c) Carry out traverse survey using total station, import the data in the computer, and prepare drawing using Auto CAD.	3	2	2	2	2	2	3	-	-	-
CO d) Record and retrieve the data using a Hand-Held GPS	2	1	1	2	-	-	1	-	-	-
CO e) Give a demonstration of the field procedure of modern surveying equipments	2	1	1	1	1	-	1	-	-	-

Legend: '**3'** for high,'**2**' for medium, **'1'** for low or **'-'**for the relevant correlationof eachcompetency, CO, with PO/ PS

17. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

S. No.	Name and Designation	Institute	ContactNo.	Email ID
1	Ketan C.Varmora I/C HOD	Government Polytechnic Kheda	9725335599	kcvarmora@gmail.com
2	Pranav P.Mehta Lecturer	Government Polytechnic Ahmedabad	9904779952	pranavhy@gmail.com
3	H.K.Rana I/C HOD	Government Polytechnic Waghai	9638883777	hkrgp2011@gmail.com

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Course Title: Soil Engineering
(Course Code: 4340602)

Diploma programme in which this course is offered	Semester in which offered
Civil Engineering	4th Semester

1. RATIONALE

After learning Mechanics of deformable bodies and Hydraulics in 3rd semester, this subject "Soil Engineering" is introduced in 4th semester, as it deals with the natural material "Soil" whose behavior is somewhat intermediate between solids and fluids. Soil Engineering involves study of Soil, its behavior and application as an engineering material. Design of foundation of building, dams, towers, embankments, roads, railways, retaining wall, bridges is mainly governed by characteristics and behavior of Soil, hence this subject is very important for civil engineering students.

2. COMPETENCY

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

- **Evaluate and interpret test results for selection of proper Soil as a construction material and as a strata for foundation.**

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) Identify types of Soil according to mode of deposition and mode of transportation.
b) Determine the physical and index properties of soil to estimate behaviour and other important engineering properties for given construction activities.
c) Classify coarse grained and fine grained soil by IS method
d) Determine Coefficient of permeability and shear parameters of soil and apply results in foundation analysis and other construction activities.
e) Determine O.M.C. and M.D.D. values of soil and select suitable method of soil stabilization.
f) Compute bearing capacity of soil and earth pressure and interpret results.

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 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	Determine moisture content of soil by oven drying method	I	02*
2	Determine field density and dry density of soil by Core cutter method	I	02*
3	Determine field density and dry density of soil by Sand replacement method	I	02*
4	Determine specific gravity of soil by pycnometer/density bottle	I	02*
5	Classification of soil by sieve analysis method	II	04*
6	Determine Liquid limit, Plastic limit and Shrinkage limit of soil	III,IV	04*
7	Determine Permeability of soil by constant head method	III,IV	02*
8	Determine Permeability of soil by falling head method	V	02*
9	Determine Shear parameters of soil by Direct Shear test	VI	04*
10	Determine OMC & MDD of soil by standard proctor test [Light compaction Test]	VII	04*
	Total hours		**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	Identify components	10
2	Prepare experimental setup.	20
3	Operate the equipment setup.	20
4	Follow safe practices .	10
5	Record observations correctly.	20
6	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.

Sr. No.	Equipment Name with Broad Specifications	PrO. No.
1	Assembly of Core cutter for In-situ density determination.	02
2	Assembly of Sand replacement for In-situ density determination.	03
3	Sieve set & sieve shaker for mechanical analysis of soil.	05
4	Standard Proctor test apparatus for OMC & MDD determination of soil.	10
5	Density bottles/ Pycnometer for specific gravity determination.	04
6	Direct shear test apparatus.	09
7	Permeability test apparatus for constant water head.	07
8	Permeability test apparatus for falling water head.	08
9	Casagrande apparatus for Liquid limit determination.	06
10	Shrinkage Limit test apparatus.	06
11	Hot air oven with temperature control	01 to 10
12	Electronic weighing balance.	01 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 competency.

a) Work as a leader/a team member.
b) Follow safety practices while using equipment.
c) Realize importance of green energy. (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 Overview of Soil Engineering	1a. Identify the types of soil according to mode of deposition and mode of transportation 1b. Identify structures where soil is used as construction material 1c. Identify structures where soil is used as a strata/foundation to safely bear loads. 1d. Locate the major soil deposits in India.	1.1 Definition of Soil, Soil Mechanics, Soil Engineering, Importance of Soil engineering 1.2 History of Soil Engineering 1.3 Soil formation in Geological cycle 1.4 List of Structures where soil is used as construction material 1.5 Types of Soil according to mode of Transportation 1.6 Major Soil deposits of India
Unit – II Physical and Index properties of Soil	2a. Identify physical and index properties of soil and their relevance with important engineering properties. 2b. Interpret two and three phase of soil from given conditions. 2c. Derive interrelationships among different properties of soil from phase diagrams. 2d. Perform tests for determining properties of soil using relevant IS Code and interpret test results 2e. Calculate physical properties of soil from given data using interrelationships	2.1. Soil as a three phase system, assumptions for drawing two phase & three phase diagrams, 2.2. Fundamental definitions of physical properties- Water content, Bulk density, Dry density, Saturated density, Submerged density, Density of solids, Specific gravity-Absolute & Mass specific gravity, void ratio, porosity, Degree of saturation, Air content, Percentage air voids, Relative density 2.3. Derivation of following relations from phase diagrams and numericals on each : 2.3.1 e= n/n-1, n=e/1+e 2.3.2 w×G =e×sr 2.3.3 Ɣd=Ɣb/1+w 2.3.4 Ɣd=Ɣb/1+w 2.3.5 Ɣsat= (G+e)Ɣw/(1+e) 2.3.6 Ɣsub=(G-1)Ɣw/(1+e) 2.3.7 Ɣd= G Ɣw/1+e 2.4. Methods to determine moisture content of soil. 2.5. Determination of Bulk & Dry density

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
		of soil by Core Cutter method and Sand Replacement method. 2.6. Determination of Specific Gravity of soil by pycnometer.
Unit– III **Classification of Soil**	3a. Use different methods of Classification. 3b. Interpret the particle size distribution curve for given soil samples. 3c. Analyse fine grained Soil based on Consistency Limits. 3d. Classify given soil samples by IS method.	3.1 Classification of soil as per grain size by IS method. Basic criteria of classification of soils. 3.2 Difference between coarse grained and fine grained soil on the basis of their size and engineering properties. Mechanical Analysis of coarse grained soil. Sedimentation analysis of fine grained soil. 3.3 Particle size distribution curve. Nature of various grading Curves. Coefficients of uniformity and curvature. 3.4 Classification of soil on the basis of plasticity. Atterberg's limits of consistency: Liquid limit, plastic limit and shrinkage limit. Plasticity index, Liquidity Index and Consistency Index. 3.5 Determination of Liquid limit, Plastic limit and Shrinkage limit as per IS.
Unit– IV Permeability and Seepage	4a. Identify the factors affecting the permeability for a given type of soil sample. 4b. Compute coefficient of Permeability for given type of soil sample. 4c. Interpret the concept of seepage pressure.	4.1 Definition of permeability, permeable and impermeable soil, Darcy's law of permeability. 4.2 Factors affecting the permeability of soil. Coefficient of permeability, Difference between flow through pipe and flow through soil. 4.3 Laboratory Methods to determine Coefficient of Permeability- Constant Head Method and Falling Head method. 4.4 Field methods to determine Coefficient of Permeability: Pumping-out tests and Pumping-in tests. 4.5 Definition of Seepage and seepage pressure. Quick sand condition. Types of flow net. Characteristics and application of flow net.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
Unit– V Compaction and Stabilization of Soil	5a. Apply the principle of Compaction and choose the method of compaction for different soils. 5b. Differentiate phenomenon of compaction from consolidation of soil. 5c. Determine optimum moisture content and maximum dry density of soil in the laboratory. 5d. Suggest suitable method of Soil stabilization for ground improvement in a given situation.	5.1 Concept of compaction and its effect on various soil properties like density, permeability, shear strength & bearing capacity. 5.2 Factors affecting compaction like water content, types of soil, nature of soil, method of compaction, admixtures. 5.3 Optimum moisture content (O.M.C) and maximum dry density (M.D.D.) by IS standard compaction test- Light and Heavy compaction test(Proctor Test). Standard compaction curves. 5.4 Method of field compaction. Various compaction equipment, role of O.M.C. in field. 5.5 Concept and requirements of soil stabilization. Different methods of soil stabilization–Mechanical soil stabilization and Chemical soil stabilization (Use of cement, lime, fly ash, bitumen). Use of Geo-Synthetic as a stabilizing material. 5.6 Necessity of site investigation and sub soil exploration. Types and purpose of exploration. Basic field identification test of soil.
Unit– VI Shear Strength of Soil	6a. Interpret various shear parameters of soil. 6b. Compute shear strength of soil for given condition. 6c. Identify shear failure of soil in various situations.	6.1 Cohesion, Angle of internal friction, shear strength. 6.2 Coulomb's law for shear strength. 6.3 Different methods to find shear strength of soil in the laboratory. Procedure to find shear strength using Box shear test. 6.4 Types of soil- C-soil, ø-soil and C-ø soil. Mohr's circle method to find shear envelope and shear strength parameters.
Unit– VII Bearing capacity of Soil and Earth Pressure	7a Identify the factors affecting Bearing Capacity of soil. 7b Determine bearing capacity of different soils. 7c Suggest type of foundation for the given situation of soil. 7d Calculate earth pressure by Rankine's formula.	7.1 Concept of bearing capacity. Types of Bearing capacity- Ultimate bearing capacity, Safe bearing capacity, Net bearing capacity and Allowable bearing pressure. Influence of water table on bearing capacity. 7.2 I.S. method to determine bearing capacity of soils. Different theoretical

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
		methods to determine bearing capacity of soils. Introduction to Terzaghi's analysis. Assumptions and limitations of Terzaghi's theory. Different field methods for determination of bearing capacity – Plate load Test and Standard Penetration Test. 7.3 Different types of footings. Types of shear failure of footings. Methods to improve bearing capacity of soils. 7.4 Define Earth Pressure. Active and passive earth pressure for no surcharge condition. Rankine's formula to determine coefficient of earth pressure. 7.5 Liquefaction: Definition, Causes, Effect and Remedy of Liquefaction.

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	**Over view of soil engineering**	**02**	**02**	**02**	**00**	**04**
II	**Physical and Index properties of soil**	**08**	**02**	**04**	**06**	**12**
III	**Classification of Soil**	**06**	**02**	**02**	**06**	**10**
IV	**Permeability and Seepage**	**06**	**02**	**02**	**06**	**10**
V	**Compaction and Stabilization of Soil**	**08**	**02**	**04**	**08**	**14**
VI	**Shear Strength of Soil**	**06**	**02**	**02**	**06**	**10**
VII	**Bearing Capacity ofSoil and Earth Pressure**	**06**	**02**	**02**	**06**	**10**
Total		**42**	**14**	**20**	**36**	**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 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) Collect different photographs of a nearby soil deposit by natural formation.
b) Collect the photographs of different types of footings/foundations being constructed nearby with their primary details.
c) Collect different photographs of structural members where compaction of soil is being done before construction.
d) Collect the photographs of five different types of soil wrt classification of soil.
e) Collect the information with photographs of structural failure due to issue of soil stability.
f) Collect the information with photographs of soil improvement by different methods available in field.
g) Collect the information with photographs of structural members having excessive settlement of soil nearby.
h) Collect the information with photographs of failure of soil due to liquefaction.
i) Collect the information with photographs of different geo-synthetics.

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 semester, 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 field application based, internet-based, workshop-based, laboratory-based or theory 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) Determine void ratio of soil by performing necessary tests in the laboratory.
b) Compare specific gravity of fine grained soil, coarse grained soil and Aggregate.
c) Compare OMC and MDD values of two different types of soil available nearby.
d) Prepare spreadsheet or computer program to calculate the OMC and MDD of given soil sample by standard compaction method.
e) Prepare spreadsheet or computer program to determine type of soil using particle size distribution curve and mechanical sieve analysis.
f) Prepare spreadsheet or computer program to determine Liquid Limit and Plastic Limit of given soil sample.
g) Compare coefficient of permeability values of two different types of soil available nearby.
h) Classify the soil from one source by performing necessary tests in the laboratory.
i) Prepare spreadsheet or computer program to calculate shear parameters of soil by performing direct shear test in the laboratory.
j) Prepare a working model of liquefaction of soil.
k) Calculate Bearing Capacity of Soil performing necessary tests in the laboratory.
l) Prepare and Compare working models of embankment filling with and without geo-synthetics.

13. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1	Soil Mechanics and Foundations	Dr. B.C.Punamia	Laxmi Publications Pvt. Ltd. NewDelhi ISBN: 81-700-808-19
2	Soil mechanics and Foundation Engineering	Dr. P.N.Modi	Standard Book House, New Delhi ISBN: 978-81-89401-30-6
3	Soil Mechanics and Foundation Engineering	S.K.Garg	Khanna Publishers, Delhi ISBN: 81-7409-104-1
4	Soil Mechanics and Foundation engineering	Dr. K.R. Arora	Standard Publishers ISBN-13: 978-8180141126
5	A Textbook of Soil Mechanics and Foundation Engineering	Murthy V.N.S.	CBS Publishers & Distributors Pvt. Ltd., New Delhi ISBN : 9788123913629

14. SOFTWARE/LEARNING WEBSITES

a) NPTEL Course :-Soil Mechanics by IIT, Guwahati
https://nptel.ac.in/courses/105103097

b) NCTEL Video series for Soil Mechanics laboratory Tests :
https://www.youtube.com/results?search_query=nctel+soil

c) Virtual Lab by Ministry of Education, Government of India www.vlab.co.in

15. PO-COMPETENCY-CO MAPPING

Semester III	Soil Engineering (Course Code: 4340602)						
	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	Evaluate and interpret test results for selection of proper soil as a construction material and as a strata for foundation.						
Course Outcomes COa) Identify types of Soil according to mode of deposition and mode of transportation.	3	-	-	-	2	-	2
COb) Determine the physical and index properties of soil to estimate behaviour and other important engineering properties for given construction activities.	2	3	-	3	2	2	2
COc) Classify coarse grained and fine grained soil by IS method	2	3	-	3	2	2	2
COd) Determine Coefficient of permeability and shear parameters of soil and apply results in foundation analysis and other construction	2	3	-	3	2	2	2

activitieS.							
COe)Determine O.M.C. and M.D.D. values of soil and select suitable method of soil stabilization.	2	3	-	3	2	2	2
COf) Compute bearing capacity of soil and earth pressure and interpret results	2	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

Sr. No.	Name and Designation	Institute	Contact No.	Email
1.	Shri P.V. Rayjada, HOD Applied Mechanics	L.E. College (Diploma), Morbi	9824281646	satwikpr@gmail.com
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GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Course Title: Estimating, Costing & Valuation
(Course Code: 4340603)

Diploma programme in which this course is offered	Semester in which offered
Civil Engineering	4th Semester

1. RATIONALE

Construction industry projects are typically cost intensive. Specifications of the construction items greatly influence the project cost. Further, construction equipment hire charges wherever applicable and labour costs also play a significant role in cost estimation of construction projects. Hence, accurate calculation of quantities of works, proper framing of specifications becomes even more important.

Likewise resale of properties holds a significant market in Real estate industry. Real estate prices historically have always followed an upward trajectory. Predicting the market value of pre-existing property especially in a volatile market is very difficult. Knowledge of valuation and factors affecting valuation of property becomes handy in dealing in pre-existing construction projects. Further there is a large scope of personnel with expertise in valuation in today's times especially from banking credit finance point of view.

Lastly, in recent times, green building concept is need of the times and in trend too. For a diploma civil engineer, basic knowledge of costs of green building related construction items will be very useful.This course provides the necessary knowledge and skills in developing the competency in the areas mentioned above in professional manner.

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 the quantities, cost estimate and rate analysis of civil engineering works.**
- **Illustrate factors affecting valuation of property.**

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) Select the modes of measurements for different items of works.
b) Prepare detailed estimate of a civil engineering works.
c) Justify the rate for given items of work using rate analysis techniques.
d) Illustrate the factors affecting the value of property and rent fixation.
e) Prepare rate analysis of construction items involving green building materials.

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	-	4	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 thesub-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	Prepare the check list of items to be executed with units for detailed estimate of the given structure from the given drawing.	I	2
2	Prepare a comparative report on market rates and rates as per SOR (forbasic materials, labour wages, hire charges of tools & equipment. At least 10 items of each.)	IV	2*
3	List of various items to be provided to learn the modes of measurements according to prevailing IS	I	2*
4	Draft detailed Specification for any eight construction items.	II	4*
5	Estimate in detail for load bearing single floor residential building	III	8*
6	Estimate in detail for RCC beam	III	4*
7	Estimate in detail for RCC column	III	4*
8	Estimate in detail for RCC footing	III	4*
9	Estimate in detail for RCC lintel with weather shed	III	4*
10	Estimate in detail for RCC retaining wall	III	4*
11	Estimate in detail for RCC culverts	III	4
12	Estimate in detail for earthwork for road works using all four methods.	III	6*
13	Calculate the reinforcement quantities from the given set of drawings for a room size of 3 m X 4 m with bar bending schedule (footing, column, beam, lintel with weather shed , slab)	III	2*
14	Prepare the rate analysis for any five construction items.	IV	4*
15	Solve at least 10 examples related to various form of value, depreciation, loan amount, annual rent, capitalized value, year purchase, etc.	V	4*
16	Use the MS excel to prepare detailed estimate of a Septic Tank	III	2

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
	well.		
	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. 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 5 to 12	
1	Calculation of quantities	40
2	Preparing measurement sheet	30
3	Preparing Abstract sheet	10
4	Submission of report in time	10
5	Neatness in work and drawings	10
Total		**100**

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
	For PrOs1 to 4 and 13 to 15	
1	Initiative of work allotted	10
2	Neatness in work	10
3	Answer the question related to exercises	30
4	Followed formula and methods sequentially	30
5	Timely completion and submission of given work	10
6	Attendance & Punctuality	10
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	PrO.No.
1	Computer system (An computer system with basic configuration)	16

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 isformulatedashigher 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 Basics of Estimating & Costing	1a. Describe the terminologies related to estimating and costing; types of estimates. 1b. Illustrate the role of estimator. 1c.Select the mode ofmeasurements for givenitems of work as per IS code 1d. Apply the rules of deduction as per IS code for calculating the quantities of a structure.	1.1. Estimating and Costing — definition, purpose and related terminologies like: provisional sum, prime cost, spots item, day work, administrative approval and technical sanction of civil works, etc. 1.2. Types of estimates -Approximate estimate and detailed estimate. 1.3. Roles and responsibility of Estimator. 1.4. Modes of measurement, measurement units, Rules for deduction in Masonry work, Plastering and Pointing and Painting work of different items of work as per IS code.
Unit – II Specifications of civil engineering works	2a.Describe the Importance, types and principles of specifications 2b. Write detail specifications of basic constructions items	2.1. Importance of specifications 2.2. Types of specification 2.3. Principle of writing specification 2.4. Detailed specifications of different construction items: Excavation, cement concrete, Brick masonary, R.C.C. Work, Plastering Work, Painting, Flooring etc.
Unit– III Detailed Estimate of	3a. State the various methods of detailed estimation 3b. Prepare Bar bending schedule	3.1. Methods of detailed estimation: Individual wall method (Long wall-short wall), centre-line method

Unit	Unit Outcomes (UOs) (4 to 6 UOs at Application and above level)	Topics and Sub-topics
civil engineering works	3c. Prepare estimate of quantities for different civil construction works using different methods of estimation. 3d. Prepare abstract of estimated cost. 3e. Calculate the earthwork quantity for the given civil engineering works	3.2. Steel requirement for footing, column, beam, Lintel, weather shade and slab 3.3. Bar bending schedule 3.4. Detailed estimation of a. Two rooms b. RCC footings, Column, beams, slab, lintel with weather shade c. RCC retaining wall and culvert 3.5. Estimate of earthwork quantities for roads/canal by: a. Mid-sectional area method b. Mean sectional area method c. Prismoidal method d. Trapezoidal method
Unit– IV Rate Analysis	4a. Explain Basic terminologies related to rate analysis. 4b. State the factors affecting task work 4c. Describe importance and use of SOR. 4d. Prepare the rate analysis of various types of work 4e. Select suitable type of construction item based on their rate analysis comparison.	4.1. Rate Analysis: Definition, purpose, importance and factors affecting. 4.2. Lead (Standard and Extra), lift, overhead charges, water charges and contractor's profit 4.3. Task work- Definition, factors affecting, types. Task work of different skilled labours for different items. 4.4. Importance and use Schedule of Rates (SOR) 4.5. Categories of labours, their daily wages as per SOR, types and number of labours for different items of work 4.6. Preparing rate analysis of different items of work-Earth work in excavation, PCC,RCC work in (column, beam, lintel, slab), brick masonry, Vitrified tile flooring, plastering, pointing, white washing, painting with stiff paint
Unit– V Valuation	5a. Differentiate between cost, price and value 5b. Differentiate between depreciation and obsolescence 5c. Describe different forms of value 5d. Illustrate the factors affecting	5.1 Cost, Price and Value 5.2 Types of property and Objects of valuation 5.3 Depreciation and Obsolescence 5.4 Different forms of Value 5.5 Valuation tables and Valuation methods for property and land

Unit	Unit Outcomes (UOs) (4 to 6 UOs at Application and above level)	Topics and Sub-topics
	the value of property. 5e. Calculate rents forthe property using different methods.	5.6 Types of rents and fixing standard rents 5.7 Numerical of valuation and rent fixation
Unit– VI Rate analysis of Green-Building items	6a. Describe green building concept 6b. Select appropriate green building material for apt item. 6c. Prepare rate analysis of construction items involving green building materials	6.1. Green building concept 6.2. Green building material 6.3. Use of Green building material in Construction items 6.4. Rate analysis of following items using green building material: a. Plain cement concrete using fly ash b. Distempering with 1st quality Acrylic distemper having low VOC(Volatile Organic Compounds) c. Brick work with clay fly ash bricks d. Fly ash as filling material e. Thermal insulation of roofing with exposed polystyrene

***Note**:TheUOs 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 QUESTIONPAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A	Total Marks
I	Basics of Estimating & costing	4	4	3	-	7
II	Specifications of civil engineering works	6	2	2	3	7
III	Detailed Estimateof civil engineering works	16	4	3	21	28
IV	Rate Analysis of civil engineering works	6	-	3	4	7
V	Valuation	8	2	4	8	14
VI	**Rate analysis of Green-Building items**	2	4	3	-	7
Total		**42**	**16**	**18**	**36**	**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) Prepare seminar on relevant topic
b) Collect current DSR from PWD and prepare report on it.
c) Undertake micro project.

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.11***, 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
g) Expert lecture by practicing valuer on Valuation techniques, methods and criteria of any property.
h) Expert lecture on latest software for Estimating and costing

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) Prepare detailed estimate of any load bearing structure using available software.
b) Prepare cost estimate for dismantling of plaster, flooring, walls and doors and windows ofone room load bearing structure using latest SOR
c) Prepare estimate for Renovation of an existing building (any five items).
d) Prepare cost estimate for waterproofing of given size existing bathroom using any one prevalent material and methods of water proofing.
e) Prepare the report on the salient provisions made in IS:1200 with special reference to load bearing structure.
f) Prepare valuation report of own/any house as per prevalent jantri.
g) Prepare detailed estimate of W.B.M.Road of one kilometre length from the given drawing
h) Prepare detailed estimate of C.C. Road of one kilometre length from the given drawing

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Estimating and Costing in Civil Engg.	B.N.Dutta	UBS Publishers Distributor Pvt. Ltd. New Delhi ISBN:9788174767295
2	Estimating and Costing in Civil Engg.	S.C.Rangwala	Charotar Publishing House PVT. LTD., Anand (Gujrat) Pin 388001 ISBN: 9789385039058
3	Estimating and Costing	G.S.Birdie	DhanpatRai Publishing Company(P) Ltd.NewDelhi-110002 ISBN : 9789384378134
4	Estimating and costing, specification andvaluation in civilengineering	M. Chakraborti	MonojitChakraborti, Kolkata (2006) ISBN-10: 818530436X ISBN-13: 9788185304366
5	Civil Engineering Contracts and Estimates	B.S.Patil	Orient Longman, Mumbai, Ed.2010 ISBN: 9788173715594, 8173715599
6	Estimating and Costing	Prof. V.N. Vazirani and Prof. S.P. Chandola	Khanna Publishers ISBN-10 : 8174091270 ISBN-13 : 978-8174091277
7	CPWD SOR (2012)	CPWD	Published under the Authority of Director General, CPWD, New Delhi

14. SOFTWARE/LEARNING WEBSITES

a) www.ensoftindia.com
b) www.newtonindia.com
c) www.estimator.com

d) www.cpwd.gov.in › Publication

15. PO-COMPETENCY-CO MAPPING

Semester IV	ESTIMATING, COSTING & VALUATION(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**	**PSO 2**	**PSO 3** (If needed)
Competency	• *Prepare the quantities, cost estimate and rate analysis of civil engineering works.* • *Illustrate factors affecting valuation of property.*									
Course Outcomes CO a) Select the modes of measurements for different items of works.	3	-	-	-	-	-	-	-	-	-
CO b) Prepare detailed estimate of a civil engineering works.	2	3	3	1	2	3	2	3	2	-
CO c) Justify the rate for given items of work using rate analysis techniques.	1	1	2	2	2	1	1	1	2	-
CO d) Illustrate the factors affecting the value of property and rent fixation	2	3	2	-	1	-	2	3	2	-
CO e) Prepare rate analysis of construction items involving green building materials	1	1	2	2	3	1	1	1	2	-

Legend: '**3'** for high, '**2**' for medium, **'1'** for low or **'-'** for the relevant correlation of each competency, CO, with PO/ PSO

17. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

S. No.	Name and Designation	Institute	Contact No.	Email
1	Dr. A.K. Patel	G.P. Ahmedabad	079-26301285	ashutech.asp@gmail.com
2	Shri M.L. Patel	G.P. Himatnagar	02772-229285	mlpatel504@gmail.com
3	Smt. M.A. Milisia	G.P. Kheda	9558066245	margee.milisia@gmail.com
4	Shri K.P. Jasodani	G.P. Himatnagar	02772-229285	jasodani_kamalkumar1@gtu.edu.in
5				

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Course Title: Basic Transportation Engineering
(Course Code: 4340604)

Diploma programme in which this course is offered	Semester in which offered
Civil Engineering	4th Semester

1. RATIONALE

Economy of the nation is directly driven by movement of the people and goods effectively and efficiently. Moreover, In India population blast has made it mandatory to explore the quick and economical mode of transportation. Transportation is classified in general as Road transportation, Railway, Airway and Waterways. Out of all the available modes, water transportation is the cheapest one but it takes much more time; On the contrary, air ways provide quickest transport at costlier rates. Road transportation is easiest, flexible and most convenient mode of transportation for people and goods. Therefore, this course is designed to enrich students with knowledge about all the modes of transportation with the emphasis to road construction and maintenance to confidently execute construction, operation and maintenance as a part of their jobs in field.

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 competencies:

- **To supervise construction and maintenance of roads, railways, bridges, airways, docks and harbour.**
- **To carry out testing of materials used for road construction.**

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) Explain different modes of transportation and its effectiveness in terms of economy.
b) Implement various types of road construction work with different tests of road materials.
c) Maintain different types of drainage, bridges and its components.
d) Maintain railway track and its components.
e) Explain the function of harbours, docks and airways.

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	-	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 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	Draw the sketches showing standard cross section of NH/ SH, MDR/ ODR in embankment and cutting also draw road junction, Road curve and widening.	I		Home* assignment
2	Conduct Flakiness index test and Elongation index test on the aggregate.	II		04*
3	Conduct Los Angeles abrasion test on the aggregate.	II		02*
4	Conduct aggregate crushing test.	II		02*
5	Conduct aggregate Impact test.	II		02*
6	Conduct California Bearing Ratio Test	II		02
7	Conduct Softening Point test on Bitumen.	II		02*
8	Conduct Penetration test on Bitumen.	II		02*
9	Conduct Flash and Fire Point test on Bitumen.	II		02*
10	Conduct Ductility test on Bitumen.	II		02
11	Visit the site at which construction of flexible/ Rigid pavement is undergoing to have the knowhow of construction of sub-base and / or base and / or surfacing coat as well as provision of drainage and prepare a report of it.	II,III		04*
12	Visit the constructed road for visual inspection to identify defects and suggest remedial measures.	II,III		04
13	Draw neat sketches of Diamond crossing, Double slip crossing.	IV		02*
14	Prepare a visit report to a nearby Railway Station to visually observe fixtures, fasteners, track, slippers etc. and Junction/ Yard if any.	IV		04*
15	Draw sketches of layout of airport with brief description.	V		02*
16	Visit to nearby airport and prepare a report on types of runway and taxiway.	V		04
			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 2, 3, 4, 5,6,7,8,9,10		
1	Preparation of experimental set up	10
2	Setting and operation	20
3	Safety measures	20
4	Observations and Recording	10
5	Interpretation of result and Conclusion	20
6	Answer to sample questions	10
7	Submission of report in time	10
	Total	**100**

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
For PrOs 1,13,15		
1	Neatness, Cleanness on drawing sheet	10
2	Uniformity in Drawing and line work	10
3	Creating given drawing	40
4	Dimensioning the given drawing and writing text	20
5	Answer the question	10
6	Submission of drawing in time	10
	Total	**100**

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
For PrOs 11,12,14,16		
1	Discipline	10
2	Involvement at construction site	20
3	Data collection at site	20
4	Organization of report	20
5	Answer the question	10
6	Timely submission of report	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 practical's in all institutions across the state.

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	-Thickness gauge containing openings for aggregate sizes 63, 50, 40,31.5, 25,20,16,12.5,10 & 6.3mm as per IS:2386(Part I)-1963. -Length gauge containing openings for aggregate sizes 63, 50, 40,31.5, 25.20,16,12.5,10 & 6.3mm as per IS:2386(Part I)-1963.	02

2	Compression testing machine-2000 kN capacity.	04
3	IS sieve set (sizes- 80 mm, 40 mm, 20 mm, 12.5mm,10 mm, 4.75 mm, 2.36 mm,1.18 mm, 600 µ, 300 µ. 150 µ and pan), sieve shaker with adaptors.	04,05,06
4	Los Angeles abrasion testing machine.	03
5	Crushing mould, measuring cylinder with plunger.	04
6	Impact testing machine.	05
7	California Bearing Ratio Test Apparatus.	06
8	Ring and Ball test apparatus (Hot plate 160mm dia. with magnetic stirrer, brass ring, steel ball and glass vessel 600ml and glass thermometer +80°c. Standard Penetrometer with penetration needle 100gm weight, container 55mm dia. and 53mm ht. as per IS:1203.	07
9	Standard Penetrometer with penetration needle 100gm weight, Container 55mm dia and 53mm ht. as per IS 1203.Water bath maintain (25°±0.1 °C), Thermometer range 0-44 °C.	08
10	Pensky Marten's Flash and Fire Point test apparatus 100x200x240mm with measurement range 0-95 as per IS:1209-1953. Thermometer range 0-200 °C.	09
11	Ductility Testing Machine with ductility mould and base plate.	10
12	Weighing Balance.	For 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 competency.

a) Work as a team member/ individual.
b) Follow ethical practices.
c) Follow safe practice on site/ lab.
d) Practice good housekeeping.
e) Maintain tools and equipment.

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)	Topics and Sub-topics
Unit – I **Introduction**	1a. Discuss various modes of transportation. 1b. Interpret the various components of a road section. 1c. Describe the basic parts of railway track and its functions. 1d. Describe Harbour Classification and terms used in Harbour. 1e. Describe the airport classifications with various terminologies.	1.1 Modes of transportation. 1.2 Importance & Classification of roads, various terms used in road geometry. 1.3 Requirements of good roads and its advantages. 1.4 Importance of railways, role of civil engineer in construction and maintenance of railway. 1.5 Elements of harbor and their function. 1.6 Classification and types of Harbours based on their utility and location. 1.7 Airport classifications. 1.8 Air transport authorities, air transport activities.
Unit – II **Road Transportation**	2a. Describe road geometry. 2b. Describe the basic requirement of road alignment. 2c. Explain various types of tests on road materials. 2d. Describe various types of road construction methods. 2e. Explain various types of failures and maintenance of road.	2.1 Road geometry, Transition curve and Road Gradient, types of Pavement and Soil Stabilization. 2.2 Road alignment, Factors affecting the alignment, their types and its Importance. 2.3 Materials used in road Construction. 2.4 Various tests on Aggregate and bitumen. 2.5 Construction of Flexible and Rigid Pavement. 2.6 Types of Failures in roads. 2.7 Maintenance of roads and its components.
Unit – III **Drainage system and Bridges**	3a. Explain importance of drainage and its maintenance. 3b. Discuss the function of various parts of bridge. 3c. Explain requirement of an ideal bridge. 3d. Carry out the maintenance Report.	3.1 Importance of drainage. 3.2 Methods of Surface and Sub-surface drainage. 3.3 Maintenance of drainage system. 3.4 Component of Bridge and its function. 3.5 Requirement of an ideal bridge. 3.6 Classification and types of bridge. 3.7 Factor affecting the selection of Bridge site and Scour, Afflux, Runoff, Economic Span, Clearance, Freeboard etc. 3.8 Maintenance of Bridges and its components.
Unit– IV **Permanent**	4a. Describe the basic parts of railway track and its functions. 4b. Interpret the Joints and Gauge.	4.1 Typical cross section of various permanent ways as per IRS. 4.2 Function of Various Components.

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
ways	4c. Interpret basic knowledge of points and Crossing. 4d. Discuss the function of various yards. 4e. Explain requirement of track Maintenance.	4.3 Method of fixing the rails with slipper. 4.4 Railway gauge, its types and uniformity of gauge. 4.5 Function of Rail joints. 4.6 Function of point and crossing. 4.7 Factors affecting point and crossing. 4.8 Components of Turn outs and types of crossing. 4.9 Classification of Yards. 4.10 Function of Various Yards. 4.11 Requirement of Track Maintenance. 4.12 Daily and periodical Maintenance. 4.13 Maintenance of Alignment, Drainage, Track Material and its components, Point and crossing and level crossing.
Unit– V **Water Transportation and Airway**	5a. Describe Harbour Classification and terms used in Harbour. 5b. Describe the natural phenomenon and site investigation. 5c. Describe various types of berthing structures. 5d. Explain Docks Dry dock, Wet dock, Entrances, Entrance lock and size, Break water. 5e. Describe Fenders, Mooring and Dredging. 5f. Explain aircraft components and its function. 5g. Describe Regional planning. 5h. Describe the requirements of an ideal airport layout.	5.1 Classification and types of Harbours based on their utility and location. 5.2 Growth of ports in India, Requirements of good harbour, Element of harbour and their function. 5.3 Wind characteristics, Wind rose, Tide, Tide forces and theories, types of currents. 5.4 Hydrographic and Topographic Survey, Site selection for Harbour 5.5 General aspects of selection for berthing structures, Piers, Wharf, Quay wall, Jetty, Dolphins, trestle, Moles and mooring accessories. 5.6 Construction of Dock wall, classification of Break water and construction method of Break water wall. 5.7 Necessity for Fenders, types of fenders, mooring system and types of dredger. 5.8 Aircraft components and their functions. 5.9 Location and planning aspects of various airport elements. 5.10 Ideal airport layout.

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	**Introduction**	06	04	04	02	10
II	**Road Transportation**	12	02	06	12	20
III	**Drainage system and Bridges**	08	02	06	06	14
IV	**Permanent ways**	10	04	06	04	14
V	**Water Transportation and Airway**	06	04	04	04	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 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) Collect the details of all types of existing NE, NH and SH constructed and under construction across the country.
b) Collect samples of alternative Green material for road construction and prepare a report.
c) Visit the crowded area i.e. city/ town/ village and note down the traffic control devices to suggest the possible action for smooth traffic.
d) Collect the sample of drawings and documents required for road project from R & B office.
e) Visit the nearby road construction site and collect the sample information of various materials for road construction in different layers.
f) Visit the nearby bridge site and inspect all components of it.
g) Visit nearby railway station for collect information about cross section of rail components, arrangements of station yard, layout of railway station.
h) Visit to nearby airport and prepare a report.
i) Collect the information of different codes related to Airport design.
j) Prepare a report depicting summarized procedure of Land Acquisition for any Transportation project.
k) Prepare a Proposal exploring connectivity to unconnected Habitations as part of a poverty reduction strategy of Govt. of India under PMGSY.
l) Visit nearby port site and collect the information about layout and its port components.
m) Undertake micro-project.
n) Give seminar on any relevant topic.

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-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) Collect the details of all types of existing NE, NH and SH across the country and prepare a report on it.
b) Collect the details of different types of bridges with its components and prepare a report on it.
c) Prepare a model of different types of interchanges in roadway.
d) Collect the information of failure in flexible and rigid pavements.
e) Inspect the nearby road to enumerate the defects (if any) and prepare the report suggesting the remedial measures.
f) Develop the 2D and 3D photographic model of pavement construction nearby site.
g) Develop the model of urban road showing the surface and sub-surface drainage system.
h) Collect information on latest technology used for maintenance of urban roads.
i) Green Road Approach in Rural Road Construction for the Sustainable Development of India.

j) Prepare a report on green highway and practice of green highway.
k) Develop the 2D and 3D model of rail components and layout of a railway station and yard.
l) Prepare a model/ prototype of different types of crossing in Railways.
m) Develop the models of different gauge used in Railway.
n) Collect the information of defects in railway track and suggesting the remedial measures for ensuring its stability.
o) Prepare a model of airport with all landing and take-off markings.
p) Prepare a model of artificial port with all facilities.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Highway Engineering	Khanna S.K, Justo, C.E G and Veeraragavan,A.	New Chand and Brothers, Roorkee, 2010. ISBN 978-8185240800.
2	Road, Railway, Bridge and Tunnel Engineering.	Birdi, Ahuja,	Standard Book House, New Delhi, March 2010, ISBN: 978-8189401337.
3	Road, Railway, Bridge & Tunnel Engineering	B L Gupta	Standard Publishers. Delhi
4	Traffic Engineering and Transport Planning	Kadiyali,L.R	Khanna Publishers, New Delhi, 2008, ISBN:978-8174092205
5	Principles, Practice and Design of Highway Engineering	Sharma, S.K	S. Chand Publication, New Delhi, 2012, ISBN: 9788121901314
6	Laboratory Manual in Highway Engineering	Duggal, Ajay K. and Puri, V.P	New Age International (P) Limited, Publishers, New Delhi, 2010, ISBN: 9788122403107.
7	Transportation Engineering Vol. I & II	V N Vazirani& S P Chaondola	Khanna Publishers. Delhi
8	Element of Bridge Tunnel and Railway Engineering	S P Bindra K Bindra	DhanpatRai& Sons Delhi
9	Dock and Harbour Engineering	H P Oza G H Oza	Charotar Publishing House, Anand
10	Harbour, Dock and Tunnel Engineering	R. Shrinivasan	Charotar Publishing House, Anand
11	Airport Engineering: Planning and Design	Subhash C. Saxena	CBS Publisher
12	Airport Engineering	Rangwala	Charotar Publishing House, Anand

14. SOFTWARE/ LEARNING WEBSITES

a) www.nptel.iitm.ac.in
b) https:/ / www.youtube.com/ watch?v=9HZE6DNfF5U&t=3s
c) https:/ / www.youtube.com/ watch?v=-yBXl4z70mI
d) https:/ / www.youtube.com/ watch?v=TE8zYxUJHt0
e) https:/ / www.khanacademy.org/

f) https:/ / www.youtube.com/ watch?v=37WMS483T7Y
g) https:/ / onlinepubs.trb.org/ onlinepubs/ millennium/ 00014.pdf
h) www.airports.deerns.com

15. PO-COMPETENCY-CO MAPPING

Semester III	Basic Transportation Engineering (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	PSO 2	PSO 3 (If needed)
Competency	i. To supervise construction and maintenance of roads, railways, bridges, airways, docks and harbour. ii. To carry out testing of materials used for road construction.									
Course Outcomes CO a) Explain different modes of transportation and its effectiveness in terms of economy.	3	-	-	-	-	-	2			
CO b) Implement the various types of road construction work with different tests on road material.	3	2	2	2	2	2	2			
CO c) Maintain different types of drainage, bridges and its components.	3	2	2	-	2	-	2			
CO d) Maintain railway track and its components.	3	2	2	-	2	2	2			
CO e) Explain the function of harbours, docks and airways.	3	-	-	-	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	Shri Darshan V. Patel	Govt.Poly., Ahmedabad	079-26301285	darshan.2228@gmail.com
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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
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GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Course Title: Concrete Technology
(Course Code: 4350601)

Diploma programme in which this course is offered	Semester in which offered
Civil Engineering	Fifth Semester

1. RATIONALE

After learning Construction material and technology in 3rd semester, this subject "Concrete Technology" is introduced in 5th semester. Concrete is the most widely used man-made construction material in the world and is second only to water as the most utilized substance on the planet. It is the material of choice where strength, impermeability, durability, performance, fire resistance and abrasion resistance are required. It plays an important role in nation building through infrastructure and private building construction. The knowledge of concrete and its properties in the plastic condition and in hardened condition are highly important in order to make Civil Engineering structure safe and serviceable. This course focuses on students' acquisition of knowledge, skills & practices in concrete works and also focuses on the recent advances in the field of concrete technology with emphasis on quality control of concrete.

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 concrete of required strength and other specifications with quality control measures.**

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 suitable concrete materials for different site conditions and required concrete works.
b) Prepare concrete of required specifications under different conditions.
c) Check the quality of concrete.
d) Design concrete mix proportions for required specification.
e) Prepare special concrete using relevant admixture and concreting materials.
f) Apply appropriate repairs and retrofitting techniques for concrete structures.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme	Total Credits	Examination Scheme

(In Hours)			(L+T+P/2)	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 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	Determine Fineness (with sieve) and Soundness of cement.	I	02*
2	Determine compressive strength of cement.	I	02*
3	Determine Flakiness and Elongation index of coarse aggregate	I	02*
4	Determine Impact, Crushing and Abrasion value of coarse aggregate	I	04*
5	Determine specific gravity of fine and coarse aggregate	I	02*
6	Determine grading zone of fine aggregate	I	02*
7	Determine suitable proportion of all-in-aggregate as per grading limits	I	02*
8	Measure workability of concrete by slump test and compaction factor test.	II	02*
9	Determine compressive strength of concrete specimen.	III	02*
10	Determine tensile strength of Concrete specimen (cylinder and beam specimen)	III	02*
11	Non Destructive Test on concrete - Rebound Hammer		02
12	Design concrete mix proportions as per IS: 10262, guidelines	III	04*
	Total hours		**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	Identify components	10
2	Prepare experimental setup.	20
3	Operate the equipment setup.	20
4	Follow safe practices .	10
5	Record observations correctly	20
6	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.

Sr. No.	Equipment Name with Broad Specifications	PrO. No.
1	Le- Chatelier test apparatus and other relevant assembly	01
2	Assembly of compressive strength of cement determination along with a cement cube vibrating machine.	02
3	Thickness gauge with other relevant assembly	03
4	Elongation gauge with other relevant assembly	03
5	Aggregate impact testing machine	04
6	Aggregate crushing test apparatus	04
7	Los Angeles aggregate abrasion testing machine	04
8	Density bottles/ Pycnometer for specific gravity determination.	05
9	Slump cone test apparatus	08
10	Compaction factor test apparatus	08
11	Compression testing machine	2,4,9 and 10
12	Rebound hammer	11
13	Tools and Containers for mixing of concrete mixture	8 to 10 and 12
14	Concrete mixture and other required equipments for mixing	8 to 10 and 12
15	Vibrating table for concrete moulds	9,10 and 12
16	Electronic weighing balance, Different size concrete moulds, Gauging Trowel, Shovel, Sieve set, Small and big Containers etc	1 to 12

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 safety practices while using equipment.
c) Realize importance of green energy. (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 Cement, Aggregates and Water	1a. Determine Physical Properties of Cement. 1b. Select suitable type of cement as per site condition. 1c. Determine Physical properties of Aggregate. 1d. Determine Quality of water to be used for making concrete at site.	1.1 History of cement invention. 1.2 Overview of Cement Manufacturing. 1.3 Bogue's compounds and its functions 1.4 Physical and Chemical properties of cement. 1.5 Testing of cement as per BIS. 1.6 Various Grades and types of cements for different site conditions and its properties. 1.7 Role of Aggregate, types of aggregate and it's source, Classification of aggregate, Soundness of aggregate, Alkali Aggregate Reaction, Grading of aggregate. 1.8 Testing of aggregate as per BIS. 1.9 Quality of water, impurities in mixing water and permissible limits as per BIS.
Unit – II Fresh Concrete	2a. Measure workability of fresh concrete. 2b. Prepare concrete of required workability. 2c. Select suitable method of Batching, mixing, transporting, placing and finishing of fresh concrete as per site condition with	2.1 Concrete chain - Various stages of making fresh concrete at site 2.2 workability, factors affecting workability, Effect of water cement ratio, adjustments of materials to avoid segregation and bleeding , methods of Measurement of workability as per BIS - slump test, compaction factor test, flow table test,

	available resource materials. 2d. Select suitable method of Curing of concrete as per site condition.	vee bee test . 2.3 Methods of Batching, mixing of materials for making fresh concrete - hand mixing and machine mixing, mixing time. 2.4 Methods of Transportation of fresh concrete - conventional and through pumps and pipeline. 2.5 Placing of concrete - formwork stripping time, under water concreting 2.6 Compaction, importance of compaction, methods - hand 2.7 compaction, machine compaction - various vibrators and other equipments, time of vibration, vibrating techniques and precautions. 2.8 Methods of finishing of fresh concrete, Laitance & its removal. 2.9 Curing, importance of curing, period of curing accelerated curing, Conventional methods of curing - water curing methods, Special methods of curing- steam, membrane, Infrared, Electrical.
Unit– III Hardened Concrete	3a. Evaluate Properties of Hardened Concrete 3b. Conduct destructive tests and interpret its results. 3c. Conduct non destructive tests and interpret its results. 3d. Check the quality of concrete as per acceptance criteria.	3.1 Hardened Concrete and its Properties: Compressive Strength, Tensile Strength, Bond Strength, Flexural Strength, Durability and impermeability. 3.2 Factors affecting Compressive Strength. 3.3 IS Test Procedure to find Compressive & Tensile Strength of Concrete, Acceptance Criteria, Mean Strength & Standard Deviation. 3.4 Creep and Shrinkage of Concrete & its effect, factors affecting Creep and shrinkage. 3.5 Durability of Concrete & factors affecting it. 3.6 Importance of NDT. 3.7 Methods of NDT for Concrete- Rebound Hammer Test, Ultrasonic Pulse Velocity Test.
	4a. Differentiate Nominal Mix	4.1 Nominal Mix and Design Mix.

Unit– IV Concrete Mix Design	and Design Mix. 4b. Interpret test results of materials for concrete for concrete mix design 4c. Design concrete mix for required grade of concrete (for ordinary and standard grade)	4.2 Concrete Mix Design and its importance. 4.3 Different methods of Mix Design and its suitability. 4.4 Concrete Mix Design as per IS 10262. 4.5 Example of Mix design as per IS method for ordinary and standard grade of concrete without and with admixtures.
Unit– V Chemical Admixture, Special Concrete and Modern Trends	5a. Use relevant admixture according to purpose of concrete 5b. Prepare special concrete for given purpose 5c. Apply knowledge of modern trends and research in concrete technology in the field.	5.1 Admixtures in concrete: Purpose, properties and application for different types of admixture such as accelerators, retarders, water reducing admixtures, air entraining agents and super plasticizers. 5.2 Special Concrete: Properties, Advantages and limitations of the following types of Special Concretes Self-Compacting Concrete (SCC), Pervious Concrete, Fiber reinforced concrete, Ready mix concrete, Fly ash concrete, Recycled Aggregate Concrete, High performance Concrete, 3D printed Concrete 5.3 Modern trends and research in concrete technology, relevant journals and institutes.
Unit– VI Repair Rehabilitation and Retrofitting of Concrete Structures	6a. Differentiate repair, rehabilitation and retrofitting. 6b. Apply appropriate repair and rehabilitation techniques for damaged concrete structures. 6c. Apply appropriate retrofitting methods to concrete structures.	6.1 Definition of repair, rehabilitation and retrofitting 6.2 Deterioration of concrete, types, causes and prevention. 6.3 Corrosion of reinforcement, causes and prevention. 6.4 Repair and Rehabilitation stages- Removal of damaged concrete, Pretreatment of surfaces and reinforcement, Application of repair materials, Repair Procedure. 6.5 Repair and Rehabilitation material - Cement, Steel and special material like, Shotcrete, Epoxy resins, Epoxy mortar, Gypsum cement mortar, Quick setting cement mortar etc. 6.6 Repair and Rehabilitation techniques - Grouting, Guniting, Routing and

		sealing, Stitching, Drilling and Plugging etc. 6.7 Retrofitting Methods - Adding Steel Bracing, Jacketing Method, External Plate Bonding, Base Isolation Technique, Mass Reduction Technique, Wall Thickening Technique, Fiber Reinforced Polymer (FRP), Adding Shear Wall, Epoxy Injection Method, Section Enlarging Reinforcing Method etc.

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	**Cement, Aggregates and Water**	**06**	**2**	**4**	**4**	**10**
II	**Fresh Concrete**	**08**	**4**	**4**	**6**	**14**
III	**Hardened Concrete**	**08**	**4**	**4**	**6**	**14**
IV	**Concrete Mix Design**	**06**	**2**	**2**	**6**	**10**
V	**Chemical Admixture, Special Concrete and Modern Trends**	**08**	**2**	**4**	**6**	**12**
VI	**Repairs, Rehabilitation and Retrofitting of Concrete Structure**	**06**	**2**	**4**	**4**	**10**
Total		**42**	**16**	**22**	**32**	**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 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) Conduct a market survey for cement for various companies, cement grade and price.
b) Conduct a market survey for fine aggregate for various types and prices.
c) Conduct a market survey for coarse aggregate for various types and prices.
d) Conduct a market survey for various types of admixtures and price
e) Visit and collect photographs of Batching, mixing, transporting, placing and finishing of fresh concrete from two different construction sites.
f) Visit and collect information and photographs of workability tests carried out on fresh concrete on construction sites.

g) Visit and collect information regarding quality control measures for concrete taken by site engineers on any construction site.
h) Visit the nearby RMC plant.
i) Prepare presentation on at least one research paper related to latest trends of concrete technology from any journal of civil engineering.

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 ***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-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 field application based, internet-based, workshop-based, laboratory-based or theory 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 **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) Compare at least two physical properties of cement of two different companies with different prices.
b) Compare at least two properties of fine aggregate from two different sources with different prices.
c) Compare at least two properties of coarse aggregate from two different sources with different prices.
d) Measure the effect of water cement ratio on workability of concrete by slump test.

e) Measure the effect of water cement ratio on workability of concrete by compaction factor test.
f) Measure the effect of water cement ratio on compressive strength of concrete.
g) Measure the effect of curing on the compressive strength of concrete.
h) Measure the effect of admixture on workability and strength of concrete.
i) Prepare special concrete with non conventional material.
j) Measure the quality of concrete at two different places with non-destructive tests.
k) Prepare a computer program or spread sheet for Concrete Mix Design as per IS:10262 .

13. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1	Concrete Technology Theory and Practice	M S Shetty	S Chand & Company Ltd, New Delhi ISBN-13:978-9352533800
2	Concrete Technology	Shanthakumar A R	Oxford University Press, New Delhi ISBN-13: 978-0199458523
3	Concrete Technology Theory and Practice	M L Gambhir	McGraw Hill Education (I) Pvt Ltd, New Delhi ISBN-13: 978-1259062551
4	Concrete: Microstructure, Properties, and Materials	P Kumar Mehta Paulo J M Monterio	McGraw Hill Education (I) Pvt Ltd, New Delhi ISBN-13: 978-9339204761
5	Properties of concrete	A M Nevill J J Brooks	Pearson Education ISBN-13: 978-9353436551
6	IS 10262		Bureau of Indian Standards

14. SOFTWARE/LEARNING WEBSITES

a) NPTEL Course :-Concrete Technology by IIT, Delhi https://nptel.ac.in/courses/105102012
b) Concrete Technology laboratory Tests : https://www.youtube.com/playlist?list=PLkyVnO47pDX9YJglk1o2iYzWgABo5I_xA Video series for Concrete Tec
c) Virtual Lab by Ministry of Education, Government of India www.vlab.co.in

15. PO-COMPETENCY-CO MAPPING

Semester V	Concrete Technology (Course Code: 4350601)						
	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 concrete of required strength and other specifications with quality control measures.						
Course Outcomes COa)Select suitable concrete materials for different site conditions and required concrete works.	2	-	-	3	2	2	2
COb) Prepare concrete of required specifications under different conditions.	2	-	-	3	2	2	2
COc) Check the quality of concrete.	2	-	-	3	2	2	2
COd) Design concrete mix proportions for required specification.	2	2	3	3	2	2	2
COe)Prepare special concrete using relevant admixture and concreting materials.	2	-	-	3	2	2	2
COf) Apply appropriate repairs and retrofitting techniques for concrete structures.	2	-	-	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

Sr. No.	Name and Designation	Institute	Contact No.	Email
1.	Shri P. V. Rayjada, HOD Applied Mechanics	L.E. College (Diploma), Morbi	9824281646	satwikpr@gmail.com
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3.	Shri V. J. Thekdi, Sr Lecturer Applied Mechanics	R.C.T.I., Ahmedabad	9228415246	vthekadi@gmail.com

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GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Course Title: Water Resource Engineering
(Course Code: 4350602)

Diploma program in which this course is offered	Semester in which offered
Civil Engineering	5th Semester

1. RATIONALE

The quantitative study of the hydrologic cycle, or how water is distributed and circulated among the earth's atmosphere, land, and oceans, is known as water resources engineering. Civil engineers play a vital role in water resource systems' optimal planning, design, and operation. Due to extensive industrial development, population increase, and changing lifestyles, our need for water is rising quickly. As a main supply of water, rain is what we rely on the most. Engineer having the challenge to restore water of unequal and uneven rainfall over rainy seasons so need to river connected structure to storage so resolving the water storage issue by diverting excess water from plains to deficient regions. The groundwater system is another significant source of water, and it likewise heavily depends on prior years' rainfall. We know that the groundwater table is fast dropping due to extensive consumption, overuse, and annual rainfall deficiency. This course is specifically created for Diploma in Civil Engineering students in order to emphasize the concept of water resource engineering while also raising knowledge about the proper use and conservation of water. It has been made an effort to acquire theoretical knowledge with a focus on particular elements of managing water resources. The curriculum especially addresses the themes of hydrology, runoff, interlinking of river, watershed management, groundwater recharge, water harvesting structures, etc.

2. COMPETENCY

The curriculum should be established and course material should be presented with the intention of helping students develop a variety of abilities that will enable them to achieve the following competency:

- **Impart the fundamental skills and knowledge necessary to execute the practice of water resources engineering.**

3. COURSE OUTCOMES (COs)

The theory should be taught and the exercises should be done in a way that allows students to illustrate the course objectives by demonstrating various learning outcomes in the cognitive, psychomotor, and affective domains to demonstrate following courses outcomes.

(1) Explain the importance and principles of Hydrology.
(2) Estimate hydrological parameters and apply concepts of it in the interlinking of rivers.
(3) Articulate the basics of Groundwater flow.
(4) Calculate reservoir capacity and select suitable storage work for given site condition.
(5) Design the appropriate rainwater harvesting scheme and required structures for given

Conditions.

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	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 is 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 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
	Draw labelled sketch of:		12*
1	• Hydrological cycle	I	
2	• Rain gauge	I	
3	• Components of gravity dam and earthen dam section.	IV	
4	• Components of Diversion Head works	IV	
5	• Roof-top rainwater harvesting system	V	
6	• Types of Aquifers	II	
7	• Concept of interlinking of river structure and assemble	III	
8	Calculate average rainfall for the given area using the arithmetic mean method & Isohyetal method	I	2*
9	Draw a Thiessen polygon for a given area with rain gauge station points.	I	2*
10	Calculate Runoff for given catchment area using empirical formula	I	2*
11	Compute optimum number of rain gauge for given catchment area	I	2*
12	Calculate reservoir capacity from the given data.	II	2*
13	Estimation of flood using unit hydrograph.	II	2*
14	Prepare presentation on the technical details of any one emerging technique in water resource engineering.	III	2
15	Field Visit	IV	2
	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	Weight age in %
For PrOs 1 to 12		
1	Initiative of student in collecting data and computation.	20
2	Ability to work with team/Group	10
3	Comprehension and presentation skill	30
4	Correctness of design calculations and drawing	30
5	Punctuality and Neatness	10
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	PrO. No
1	Technical Drawings, maps	1,2,4,6,7
2	Digital Plan meter	9
3	Drawing instruments	1,2,4,6,7,8,10, 11
4	Computing Devices	8,10,11,12

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) Demonstrate working as a leader/a team member.
b) Follow safety practices on site.
c) Follow ethical practices.
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** Only the major Underpinning Theory is formulated as higher level UOs of *Revised Bloom's taxonomy* in order for the 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 Introduction and Hydrology	1.a Justify the need of irrigation for the given area 1.b Describe the advantages and ill effects of irrigation in the given situation 1.c Estimate Average Rainfall in the given situation using the given method 1.d Explain the construction and functioning of the given type of rain gauge.	1.1 Introduction to W.R.E., Objectives of Water Resource development, water resources of India 1.2 Utilization of Water resources 1.2.1 Irrigation 1.2.2 Water supply 1.2.3 Hydroelectric power generation 1.3 Types & Methods of Irrigation 1.3.1 Subsurface irrigation 1.3.2 Surface irrigation i Uncontrolled flooding method, ii Border strip method, iii Check method, iv Basin method, v Furrow method, vi Sprinkler irrigation method vii Drip irrigation method 1.4 Advantages & ill Effects if irrigation. 1.5 Hydrology: 1.5.1 Definition & Concept of Hydrological Cycle, forms & Types of Precipitation 1.6 Measurement of Rainfall 1.6.1 Rain Gauge i Non Recording type Rain gauge ii Recording type Rain gauge 1.7 Methods of calculating average rainfall i Arithmetic mean method, ii Isohyetal method, iii Theissen polygon method. 1.8 Determine optimum no. of rain gauges for given catchment area.
Unit – II Runoff and Interlinking of Rivers	2.a Describe Runoff 2.b Compute Runoff using by various empirical formula 2.c Explain Evaporation transpiration, factor affecting on it 2.d Explain Hydrograph, unit	2.1 Runoff 2.1.1 Introduction of runoff 2.1.2 Factor affecting Runoff 2.1.3 Runoff calculating using empirical formula only 2.2 Evaporation, Transpiration & Evapotranspiration 2.2.1 Factor affecting Evaporation

Unit	Unit Outcomes (UOs) (4 to 6 UOs at Application and above level)	Topics and Sub-topics
	hydrograph and uses in Engineering. 2.e Discuss the interlinking of rivers and NRL projects in India. 2.f Identify various interlinking Projects in India, Needs, Plan. 2.g Describe Classification of rivers, Flood in river, fore casting methods, flood Control in India.	2.3 Hydrograph 2.3.1 Unit hydrograph 2.3.2 Uses 2.4 Introduction of interlinking of rivers 2.4.1 National River linking project [NRLP] 2.4.2 Benefits of National River linking project 2.4.3 Interlinking of rivers in India: Need, objective and plan 2.4.4 Technical features of Saurashtra Narmada Avtran Irrigation Yojana [SAUNI YOJNA] 2.5 Classification of rivers 2.5.1 Major rivers in India and Gujarat 2.5.2 Interlinking of rivers in India and its importance 2.6 Flood, flood forecasting 2.7 Flood control in India 2.7.1 River training works 2.7.2 Object of river training 2.7.3 Classification of river training 2.7.4 Methods of river training 2.7.5 Levees 2.7.6 Guide banks 2.7.7 Spurs 2.7.8 Types 2.7.9 Artificial cut offs 2.7.10 Launching apron 2.7.11 Pitching of bank 2.7.12 Pitched Island 2.7.13 Miscellaneous methods
Unit– III Groundwater and its Management	3.a Define ground water and identify ground water sources 3.b Explain the terms related to ground water 3.c List the types of wells and describe characteristics of each type of well 3.d Illustrate necessity of ground water recharging 3.e Compare various methods of Recharging ground water. 3.f Explain phenomenon of Sea water intrusion	3.1 Sources of ground water 3.2 Importance of ground water and Comparison of ground water source with other sources of water on dependability 3.3 Terms related to groundwater engineering: 3.3.1 Aquifer, Aquiclude, Aquifuge, Aquitard, porosity, Specific yield, Specific retention, storage coefficient, coefficient of permeability, coefficient of transmissibility, Yield, specific yield 3.4 Types of well Open, Tube and flowing

Unit	Unit Outcomes (UOs) (4 to 6 UOs at Application and above level)	Topics and Sub-topics
		well concept, location and importance 3.5 Necessity of recharging 3.6 Types of artificial recharge i Spreading method. ii Pit method / khet-talavadi iii Induced recharge method iv Recharge well method. v Sub-surface dam. vi Check dam series vii Ponds viii Unlined canals 3.7 Sea Water Intrusion phenomenon 3.8 Relationship between Salt water/Fresh water interface 3.9 Disadvantages and Remedial measures to counteract salt water intrusion
Unit– IV Storage and Distribution Works	4.a Explain Various Surveys/Investigation carried out In Storage works 4.b Discuss reservoir capacity And its Losses 4.c Explain the Storage zones of The reservoir 4.d Give Classification and types Of dams 4.e Describe the purposes & Components of Diversion Head works 4.f Explain about weir and Barrage 4.g Give a Classification of the Canal based on function &Canal lining	4.1 Surveys/Investigation for; 4.1.1 Hydrological data 4.1.2 Geological data 4.1.3 Topographical investigation 4.1.4 Legal data 4.1.5 Water Rights Policy 4.1.6 Economic data 4.1.7 Benefit-cost ratio 4.2 Site Selection for Reservoir & Storage zones 4.3 Methods of estimating reservoir Capacity 4.4 Losses in Reservoir 4.5 Classification of Dams & their Types 4.5.1 Gravity dam 4.5.2 Earthen dam 4.5.3 Arch dam 4.5.4 Buttress dam 4.5.5 Rock fill dam 4.6 Factors affecting the selection of the type of dams and selection criteria for the site of the dam 4.7 Components of Gravity Dam and Earthen dam 4.8 Purpose and Components of Diversion head works 4.9 Explain the difference between the

Unit	Unit Outcomes (UOs) (4 to 6 UOs at Application and above level)	Topics and Sub-topics
		Weir and Barrage and their types 4.10 Classification of canal based on Function 4.11 Canal Lining, Advantages , Materials and methods used
Unit – V Watershed Management & water Harvesting & Water Reuse	5.a Describe important characteristics of "water shed" 5.b Explain necessity of soil erosion 5.c Describe Rain water harvesting & methods. 5.d Evolve strategies of enhancing people's participation in Watershed management. 5.e Discuss water harvesting & water reuse	5.1 Concept of "water shed" 5.2 Classification of water sheds **5.3 Characteristics of water shed, size, shape** 5.4 Soil & Water conservation 5.5 Necessity of Soil erosion 5.5.1 Causes 5.5.2 Effects 5.5.3 Remedial measures against erosion 5.6 Necessity of rain water harvesting 5.6.1 Importance of Rain water harvesting 5.7 Roof-top rain water harvesting method and its design 5.8 Watershed management & people's participation. 5.9 Role of cooperative society in watershed management 5.10 Water harvesting 5.11 Runoff collection 5.12 Onsite detention basin 5.13 Seepage control 5.14 Method evaporation control 5.15 Water reuse 5.16 Types of reuse technology 5.17 Water reuse methods 5.18 Benefits of recycled water
Unit– VI GIS Application &software used in water Resources Engineering	6.a Understanding the Basic Concept of GIS 6.b Illustrate the Uses of GIS in Water resource engineering 6.c Describe the Software Used for GIS application in Water resource	6.1 Fundamentals of Geographical Information system and Geospatial data 6.2 List out uses of GIS in water resource Engineering and give its brief. 6.2.1 Use in the Management of Geospatial data 6.2.2 Flood and Drought Risk Assessment 6.2.3 Mapping of water resources 6.2.4 Groundwater management 6.2.5 Quality analysis of water 6.2.6 Water supply management 6.3 List out software used for GIS application in the water resource field and its Primary function

Unit	Unit Outcomes (UOs) (4 to 6 UOs at Application and above level)	Topics and Sub-topics
		6.3.1 Esri ArcGIS/QGIS 6.3.2 HEC RAS

***Note**:TheUOs 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 QUESTIONPAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A	Total Marks
I	Introduction and Hydrology	6	3	3	4	10
II	Runoff and interlinking of rivers	10	4	6	6	16
III	Groundwater and Its management	6	2	2	6	10
IV	Storage and Distribution works	10	2	4	10	16
V	Watershed management & water harvesting and water re-use	8	2	4	8	14
VI	GIS application & software used in water resource engineering	2	2	2	--	4
Total		**42**	**15**	**21**	**34**	**70**

***Legends:** R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*
***Note**: This specification table provides general guidelines to assist students in 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 vary slightly from the above table.*

10. SUGGESTED STUDENT ACTIVITIES

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

a) Collect data and drawings from various departments.
b) Assimilate data to be used in the required form
c) Undertake micro project
d) Interpret data
e) Prepare drawings and calculations
f) Prepare presentations
g) Case study of Technical features of Saurashtra Narmada Avtran Irrigation Yojana [SAUNI YOJNA]
h) Visit the nearby Dam, Canal network, SUNI YOJNA, water shed structure like ket-talavdi , Rain water harvesting structure.

i) Conducted awareness program on Water Harvesting , Ground Water Recharge , Sea water Intrusion

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 M 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.11***, teachers need to ensure the creation of opportunities and provisions for ***co-curricular activities***.
f) Guide students on how to address issues on environmental and sustainability
g) Expert lecture by water resource engineer about the emerging scenario of this field or industry experts

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 is group-based. However, in the fifth and sixth semesters, it should preferably be ***individually*** undertaken to build up the skill and confidence in every student to become a 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-bawd, or field-based. Each macro-project should encompass two or more Cos which are in fact, integrations of PrOs, UOs and ADOs. Each student will have to maintain a date work diary consisting of individual contributions to the project work and given seminar presentation of it before submission. The total Duration of the micro-project work should not be less than 16 [sixteen] student engagement hours during the course. The student ought to submit a micro-project by the end 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 list of existing Storage works and diversion works of the district with full details.
b) Prepare a report on existing water harvesting structures in your city.
c) Conduct survey related to any watershed development projects in your state.
d) Prepare presentations on emerging topics or from the theory related to water resources engineering.
e) Identify irrigation methods used in your city/village and prepare a report on it.

f) Prepare a technical summary of all rain gauge stations situated in your district from irrigation department/concerned offices in groups of two/three students.
g) Collect technical details of river interlinking project of your state/country Except SAUNI YOJNA.
h) Prepare list of Perennial/Non perennial river of India on which any dam is situated.
i) Collect information about ground water observation well/recharge well (location, size, diameter, shape, depth, purposes) of your district from ground water board/ concerned offices in group of two/three students and prepare summary of it.
j) Develop the 2D or 3D model of Rail water forecast equipment , dam, canal, watershed structure , River linking project

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year, and ISBN
1	Engineering Hydrology	K. Subramanya	McGraw Hill Education ISBN-10: 1259029972
2	A Textbook of Hydrology and Water Resources Engineering	R K Sharma	Dhanpatrai & Sons, Delhi ISBN: 8121921287
3	Groundwater	H M Raghunath	New Age International Ltd., New Delhi ISBN: 9788122419047
4	Hydrology & Water Resources Engg.	S.K. Garg	Khanna Publications, Delhi ISBN-13. 978-8174090614
5	GIS in water resource engineering	Dr. Gajraj Singh	SBS Publishers Pvt Ltd. ISBN: 9789380090511
6	Interlinking of Indian Rivers	Radhakant bharti	Lotus Press ISBN-13. 978-8183820417
7	Morden water Resources Engineering	Lawrence k. Wang , Chih Ted Yang	Springer Science, ISBN: 978-1-62703-595-8

14. SOFTWARE/LEARNING WEBSITES

(1) https://swhydrology.gujarat.gov.in/

(2) https://guj-nwrws.gujarat.gov.in/

(3) https://sardarsarovardam.org/

(4) https://archive.nptel.ac.in/courses/

(5) Virtual Lab by Ministry of Education, Government of India https://www.vlab.co.in/

(6) https://www.youtube.com/watch?v=fx1uUek3Iqg

(7) https://www.youtube.com/watch?v=vDr1PiNhYz8

(8) https://www.youtube.com/watch?v=2s2b5-EsmV0

15. PO-COMPETENCY-CO MAPPING

Semester IV	Water Resources Engineering (Course Code: 4350602)									
	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	PSO 2	PSO 3 (If needed)
Competency	• **Impart the fundamental skills and knowledge necessary to comprehend the practice of water resources engineering**									
CO a) Explain the importance and principles of Hydrology	3	--	--	--	2	--	3			
CO b)Estimate hydrological parameters and apply concepts of it in the interlinking of rivers	3	3	3	2	3	3	3			
CO c) Articulate the basics of Groundwater flow	3	3	2	2	2	3	3			
CO d)Calculate reservoir capacity and select suitable storage work for given site condition.	2	3	3	3	3	2	3			
CO e)Design the appropriate rainwater harvesting scheme and required structures for given Conditions.	3	3	3	2	3	3	3			

Legend: '**3**' for high, '**2**' for medium, **'1'** for low or **'-'** for the relevant correlation of each competency, CO, with PO/ PSO

17. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

S. No.	Name and Designation	Institute	Contact No.	Email
1	Mr. R.S. Oza	Govt. Polytechnic, Jamnagar	9426994979	rahuloza.engg@gmail.com
2	Smt. P.A. Vyas	Govt. Polytechnic, Rajkot	9426338119	Pritivyas16@gmail.com
3	Mr. A.R. Desai	Sir B.P.T.I, Bhavnagar	7878246020	Desaiakshay1989@gmail.com

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

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

Course Title: Civil Engineering Project-I
(Course Code: 4350603)

Diploma Programme in which this course is offered	Semester in which offered
Civil Engineering	5th Semester

1. RATIONALE

In order to help the students development, live project challenges should be offered to them as often as possible. For the students to be able to use and apply engineering-based knowledge and skills to address real world challenges, they must have first-hand experience and confidence. The selected pursuits should be relevant to student's academic interests and of professional relevance to organizations in the industrial sphere. So as to participate and manage a large civil engineering projects in future.

The Project and Seminar are both combined with the goal of developing a specific set of communication skills (report preparation, survey report writing, lab experiment results writing, participating in group discussions, verbally defending the project in the form of Seminar, etc.).

2. COMPETENCY

The goal of this project is to enhance capabilities among the students for comprehensive analysis and practices in a systemic way to develop differenttypes of skills so that students are able to acquire following competencies:

1. Apply the theoretical and practical knowledge and abilities which have learned in disciplines and courses to a project that will work in a real-world working context, ideally one that is industrial
2. Describe the functioning of the industrial setting and its working practices.
3. Explain what entrepreneurship is and how to become an entrepreneur
4. Determine and compare the gap between the technical knowledge gained through the curriculum and the real industrial requirement and to make up for it by acquiring additional knowledge as needed
5. Field computing and gaining practical experience in the planning, designing and execution of civil engineering projects.

3. COURSE OUTCOMES

Upon successful completion of this course, students will be able to;

CO.1 Apply principles of basic science and engineering fundamental in analysis, design and operation of civil engineering systems.

CO.2 Assess societal needs and plan suitable infrastructure

CO.3 Analyze and design components of civil engineering projects

CO.4 Develop team spirit and inter-personal dynamics for effective execution and management of projects

CO.5 Engage in lifelong learning and adapt to changing professional and societal needs

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	E	M	I	V	
0	0	4	2	0	0	50	50	100

Legends: L - Lecture; **T** – Tutorial, **P** – Practical, **E** – Theory External, **M** - Theory Internal, **I** – Practical External, **V** - Practical Internal,

5. COURSE DETAILS

The project is offered to the students of 5th and 6th semester in order to inculcate innovation and attitude to develop skills. A group of four to eight students (maximum of fifteen students) work as a team for major project work.
The project should be selected such that it could be completed within 5th and 6th semester.

Project work should be distributed in three phases

1. Shodh Yatra :- Project topics searching starts during 4th semester
2. Project proposal :- Submission of project proposal against department PRC at the commencement of 5th semester (Project Review Committee)
3. Submission of final project report :- Submission of final project report at the end of semester.

GUIDELINE FOR THE PROJECT– I, FOR DIPLOMA ENGINEERING

Each final year (Fifth and Sixth Semesters) Project will be a Major Project. It will be divided into two Semesters

Project – I: 5th Semester (Marks: 100), L:T:P – 0:0:4, Credits: 2

- Out of 100 marks, 50 marks are to be given as Practical Internal as per scheme suggested.
- The college, Through Internal Assessment, will assess the User Defined Problems (UDP)/Industry Defined Problems (IDP), submitted by students as per time limit prescribed by the university in the fifth semester.

- The remaining 50 marks are for the Practical External which shall be conducted by the GTU.
- Each defined project needs to be from Industry/Research organization/Govt. organization/ socio-technical issues and according to the need of time for solving real life problems.
- There should be one Project Review Committee(PRC) in consists of following members
    - Head of Department (HOD)
    - Faculty member from the department-Project In charge
    - Internal faculty/Industry resource person

6. PROJECT GUIDELINE FOR STUDENT:

- Project identification should be based on "Shodh-Yatra" carried out by the students, during 4th Semester. The "Shodh Yatra" should be completed by the end of the first week from the commencement of the fifth semester.
- Students may visit the syllabus on GTU website for getting guidelines for final year project provisional titles or areas.
- They may consult the faculties of their choice of Civil Engineering for getting more clarity.
- Problem definition for the project needs to be submitted by every student/group of students within prescribed time limit against PRC. There should be one presentation of project proposals against PRC.
- After approval student should assign to the project guide in the beginning of 5th semester and students may work on areas approved under the supervision of allotted supervisor.
- There are two project review presentation during the semester against PRC. One for finalizing project proposal and one at the mid of the semester. The suggestions given by PRC have to be incorporated before completing the project.
- They may have to show their progress periodically to their supervisor as per directions given by supervisor.
- The students may submit their final project report duly signed/approved by their supervisor to the department at the end of semester.
- Real time problems, Industry related problems, and environment friendly problems should be chosen as a final year project.
- **Identification of Topic:** The selection of topic is of crucial importance. It should be decided based on your understanding of the study, in the field and interest. The topic should be discussed with the project supervisor. It should be in harmony with your areas of interest and the specialization of the project supervisor.
  Environment friendly and having low or zero carbon emission projects will be given priority.
- Students are advised to select project supervisor who are active professionals in the relevant area of the selected topic.
- The internal assessment marks will be evaluated based on progressive evaluation and oral presentation by the internal supervisor

7. PROJECT ALLOCATION POLICY:

- Students may have to submit their project proposal/ research interest with proposed supervisor if they have consulted to PRC within a week from commencement of 5th semester.
- There should be one power point presentation against PRC.

- PRC will access the proposal received by the students group and then finalize their titles/research areas and allocate them supervisor.
- The groups of students have to work under guidance of their allocated supervisor.

8. TYPES OF PROJECT:

The types of project may include:

1. Field study (empirical study).
2. Statistical and case studies
3. Experimental investigation,
4. Computational work,
5. Data collection and its analysis,
6. Design oriented.
7. Comprehensive case study (problem formulation, analysis and recommendations),
8. Comparison of practices/ validation of theory/ method of testing, survey of quality Management practices

The project should be challenging but manageable within the resources and time available and it should be helpful to society.

Some of suggested projects topics are given below:

- Advance Construction Techniques
- Smart Materials
- Rehabilitation Techniques.
- Advanced Pavement Design
- Stability of High Rise Buildings.
- Water Resources Engineering
- Analysis for Seismic Retrofitting Of Buildings.
- Bridge Bearings & Stability
- Advanced Earthquake Resistant Techniques
- Advanced Pavement Design
- Use of Polymer Composites In Bridge Rehabilitation
- Formwork Types & Design
- Marine Pollution
- Rectification of Building Tilt
- Interlinking of Rivers
- Flexible Pavement
- Value Engineering In Construction.
- Intelligent Transport System
- Development of Remote Monitoring System For Civil Engineering
- Fly-Ash Concrete Pavement
- Eco- Friendly Housing
- Non-Destructive Testing Of Concrete
- Offshore Structures.
- E – Waste Disposal

- Advanced Construction Equipments
- Study of Un Burnt Bricks
- Interlinking of Rivers
- Effects of Truck Impacts on Bridge Piers.
- Analysis for Seismic Retrofitting of Buildings.
- Hydraulic & Hydrological impacts on Bridges.
- Performance Evaluation of Existing Bridges Under Vehicle Dynamic Effects
- Zero Energy Buildings.
- Bamboo as a Building Material.
- Rectification of Building Tilt.
- Silica Fume Concrete.
- Sewage Treatment Plant of Taluka Place.
- Ground Improvement Techniques.
- Improvement of Bearing Capacity of sandy Soil By Grouting.
- Rural Road Development.
- Cellular Light Weight Concrete.
- Improvement of Bearing Capacity of sandy Soil by Grouting.
- Flexural Performance of Fiber Reinforced Mortar with Low Fiber Content.
- E - Waste Disposal of District Head Quarter.
- Ground Improvement Techniques.
- Assessment of Cracks in R.C.C Building.
- High-Performance Smart Materials & Structures.

9. ROLE OF PROJECT REVIEW COMMITTEE:

- There should be one Project Review Committee(PRC),which consists of following members
    - Head of Department (HOD)
    - Faculty member from the department-Project In charge
    - Internal faculty/Industry resource person
- PRC will arrange two reviews for the project in semester
    - One review for finalizing project titles/proposals and allotment of supervisor for each group of students
    - One midterm review.

- The PRC will give suggestions for improving quality of each project.

10. ROLE OF SUPERVISOR/GUIDE:

- The supervisor will supervise/guide the group of students allotted to him throughout the semester.
- He/she will assess the students individually as per stipulated assessment guidelines and keep record of it.
- Suggest resources to the students.
- Guide students on how to address issues on environmental and sustainability. Environment friendly and having low or zero carbon emission projects will be given priority.

- Motivate continuously students allotted to him for doing best projects.

11. ASSESSMENT CRITERIA FOR EFFECTIVE EVALUATION OF THE PROJECT:

The Diploma 5th Semester students project-I will be evaluated as per the scheme suggested below.

50 Marks are for Progressive Assessment to be evaluated by Institute concern Faculty /Supervisor for the Part-I only based on following criteria.

Sr. No.	Description	Marks
1	Identification of problem and Framing of Problem Statement	10%
2	Problem Analysis	10%
3	Feasibility of proposed solution	10%
4	Adherence to Action plan	10%
5	Content appropriateness	10%
6	Technical knowledge and awareness related to the project	15%
7	Project Report	15%
8	Presentation	10%
9	Question-Answer Technique	10%
	TOTAL	**50**

12. PO-CO MAPPING:

Semester: V	**Project-I (Course Code: 4350603)**									
	POs and PSOs									
Competency &Course Outcomes	**PO:1** Basic & Discipline 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**	**PSO: 2**	**PSO: 3**
CO:1	3	3	3	3	3	3	3	-	-	-
CO:2	-	3	3	2	3	2	-	-	-	-
CO:3	3	3	3	3	2	2	3	-	-	-
CO:4	-	-	-	-	3	3	3	-	-	-
CO:5	-	-	3	3	3			-	-	-

Legend: '3' for high,'2' for medium, '1' for low or '-'for the relevant correlation of each competency, CO, with PO/ PSO

Note: These is suggested mapping, supervisor should change these mapping according to the type of project and assess accordingly.

13. SAMPLE EVALUATION RUBRICS:

Title and Feasibility (Problem Identification)

Parameters	Excellent	Adequate	Average	Satisfactory
Identification of problem & Framing of Problem Statement	Detailed and extensive explanation of the purpose and need of the project	Good explanation of the purpose and need of the project	Average explanation of the purpose and need of the project	Moderate explanation of the purpose and need of the project
Problem Analysis	Compete explanation of the key concepts , strong descriptions of the technical requirements of the projects	Compete explanation of the key concepts , Insufficient description of the technical requirements of the projects	Compete explanation of the key concepts but little relevance to literature , Insufficient description of the technical requirements of the projects	All key concepts are not explain and very little relevance to literature , Insufficient description of the technical requirements of the projects
Feasibility of proposed solution	Detailed and extensive explanation/ analysis of content	Collects a great deal of information and good study of the content	Collects a great deal of information and moderate study of the content	Collects information and satisfactory study of the content
Adherence to Action plan	Strictly adhered to the Action Plan prepared in advance and achieved all the mile stones within specified time limit.	Adhered to the Action Plan prepared in advance and achieved all the mile stones within time limit.	Followed the Action Plan prepared in advance but delayed in achieving one or two of them but ultimately completed the project within time limit.	Carried out the activities randomly without following the Action Plan but ultimately completed the project within time limit.

Abstract and Depth of Knowledge/Analysis & Result / Implementation & Execution

Parameters	Excellent	Adequate	Average	Satisfactory
Content appropriateness	Appropriate Content and also presented in a logical sequence	Content is moderately relevant, but presented in a logical sequence	Content is moderately relevant, but presented randomly without logical concern	Presented content was partially relevant and also not in logical concern.
Technical knowledge and awareness related to the project	Extensive knowledge related to the project	Adequate knowledge related to the project	Average knowledge related to the project	Lacks sufficient knowledge
Project Report	Project report is according to specified format, reference included	Project report is according to specified format, but reference not included	Project report is partially as per specified format	Project report is not as per specified format

Presentation and viva

Parameters	Excellent	Adequate	Average	Satisfactory
Presentation	Presentations are appropriate and well delivered, Proper eye contact with audience and clear voice with good spoken language	Presentations are appropriate and well delivered, clear voice with good spoken language but less eye contact with audience	Presentations are appropriate but not well delivered, eye contact with few audience and unclear voice	Content of Presentations are not appropriate, eye contact with few audience and unclear voice
Question-Answer Technique	Answered all the questions satisfactorily.	Answered some questions satisfactorily.	Answered 1 or 2 questions satisfactorily.	Unable to answer the questions satisfactorily.

14. ARRANGEMENT OF CONTENTS IN PROJECT REPORT:

The sequence in which the project report material should be arranged as follows:

1) Cover Page
2) Title Page
3) Certificate
4) Abstract
5) Table of Contents
6) List of Tables
7) List of Figures
8) List of Abbreviations and Nomenclature
9) Chapters
   i. Introduction
   ii. Exhaustive Literature Survey/Review of Literature
   iii. Define the problem.
   iv. Body of project (Developing the main theme of the present investigation project work)
   v. Analysis/Results and Discussions
   vi. Conclusions
   vii. Future Enhancements / Recommendations
10) References
11) Appendices

Each chapter should be given an appropriate title. Tables and figures in a chapter should be placed in the immediate vicinity of the reference where they are cited. Footnotes should be used sparingly. They should be typed single space and placed directly underneath in the very same page, which refers to the material they annotate.

15. ARRANGEMENT OF PARAGRAPH IN A CHAPTER:

- Each paragraph in a chapter should be properly numbered for example, 1.1, 1.2 etc., where first digit represents the Chapter Number and second digit the paragraph number. There is no need to indicate the number for the first paragraph in a chapter.
- Sub-paragraphs, if any indicated as 1.1.1, 1.1.2 etc. i.e. first digit representing the chapter, the second representing the paragraph and third representing the sub-paragraph.
- **Don't underline the headings or subheadings or side heading**. Instead use the bold letters.

16. APPENDICES:

- Appendix showing the detailed data, design calculations, derivation etc
- Appendices are provided to give supplementary information, which is included in the main text may serve as a distraction and cloud the central theme.
- Appendices should be numbered using Arabic numerals, e.g. Appendix 1, Appendix 2, etc. Appendices, Tables and References appearing in appendices should be numbered and referred to as appropriate places just as in the case of chapters.

- Appendices shall carry the title of the work reported and the same title shall be made in the contents page also.

17. LIST OF REFERENCES:

- References should be numbered from 1st chapter to the last chapter in ascending order and should be shown in square brackets.
- The bibliography list should be made strictly in alphabetical order of the name of the authors.
- The listing of references should be typed 4 spaces below the heading
- **References** in alphabetical order in single spacing left – justified.
- The reference material should be listed in the alphabetical order of the first author.
- The name of the author/authors should be immediately followed by the year and other details.
- A typical illustrative list given below relates to the citation example quoted above.

[Chapter]Author Name, „Title of the book or paper", Publisher name, (year), Page No

References:

1. [1] Ariponnammal, S. and Natarajan, S. 'Transport Phonomena of SmSel – X Asx', Pramana (1994) – Journal of Physics Vol.42, No.1, pp.421-425.

18. TABLE AND FIGURES:

- In the references by the word Table, is meant tabulated numerical data in the body of the project report as well as in the appendices.
- All other non-verbal materials used in the body of the project work and appendices such as charts, maps, photographs and diagrams may be considered as figures.

19. TYPING INSTRUCTIONS:

- The impression on the typed copies should be black in colour.
- The project report should be submitted in **A4** size (29 cm x 20 cm).
- Good quality or Bond paper should be used for the preparation of the project report.
- Typing should be done on one side of the paper with character font in **size 12** of **Times New Roman.**
- 1.5 line spacing should be used for typing the general text.
- Subheading should be typed in bold Font size 12 and heading bold Font size 14.
- The layout should provide a margin of 1.50 Inches on the left, 1.00 Inches on the top, bottom and right.
- The page numbers should be indicated at the top-middle or bottom-middle of the each page.
- Heading s should be in bold should not underline the heading/subheadings and should not put colons (:) in headings or subheadings.

APPENDIX 1 (Cover page)

(A typical Specimen of Cover Page)<Font Style Times New Roman Bold>

TITLE OF PROJECT REPORT

<Font Size 18><1.5 line spacing>

A PROJECT REPORT

<Font Size 14>

Submitted by
<Font Size 14><Italic>

NAME OF THE CANDIDATE(S)
<Font Size 16>

In partial fulfilment for the award of the diplomaof

<Font Size 14><1.5 line spacing><Italic>

DIPLOMA IN CIVIL ENGINEERING PROGRAMME
<Font Size 16>

IN
DEPARTMENT OF CIVIL ENGINEERING
Font size(14)
logo

NAME OF THE COLLEGE
<Font Size 14>

GUJRAT TECHNOLOGICAL UNIVERSITY
<Font Size 16>
<1.5 line spacing>

Year of submission: (MONTH & YEAR)
<Font Size 14>

APPENDIX 2 (Title page)

(A typical Specimen of Title Page) <Font Style Times New Roman – Bold>

A

Project

Report on

<TITLE OF THE PROJECT WORK>

Submitted for partial fulfilment of the requirements for the award of the

DIPLOMA IN CIVIL

ENGINEERINGIN

DIPLOMA IN CIVIL ENGINEERING PROGRAMME

BY BATCH

<Mr. / Ms. Name of the Student (Roll No.)>
<Mr. / Ms. Name of the Student (Roll No.)>
<Mr. / Ms. Name of the Student (Roll No.)>
<Mr. / Ms. Name of the Student (Roll No.)>
<Mr. / Ms. Name of the Student (Roll No.)>

Under the guidance of

<Name of the Staff with designation>

Civil Engineering Department

.

Department of Civil Engineering
<<**NAME OF INSTITUTE**>>
<<**ADDRESS OF INSTITUTE**>>

APPENDIX 3 (Certificate)

(A typical specimen of Bonafide Certificate)
<Font Style Times New Roman>

COLLEGE NAME

<Font Style Times New Roman – size -18>

CERTIFICATE

<Font Style Times New Roman – size -16>

<Font Style Times New Roman – size -14>

It is certified that this project report **"…….TITLE OF THE PROJECT… ....."**

is the bonafide work of "**……..NAME OF THE CANDIDATE.....**" who has carried out the project work under my supervision.

<<Signature of the Head of the Department>>

SIGNATURE

<<Name>>

HEAD OF THE DEPARTMENT

<<Department>>

<<Full address of the Dept & College >>

<<Signature of the Project Supervisor>>

SIGNATURE

<<Name>>

PROJECT SUPERVISOR

<<Academic Designation>>

Department of Civil Engineering

<<Full address of the Dept & College >>

External Examiner .....<<Signature, Name, Designation& Address>>.....

20. COURSE CURRICULUM DEVELOPMENT COMMITTEE:

GTU Resource Persons

No.	Name and Designation	Institute	Contact No.	Email ID
1	Hiteshkumar T. Patel, Lecturer in Civil Engineering	K D Polytechnic, Patan	8128699640	htpatel20@gmail.com
2	Devendrakumar N. Sheth, Lecturer in Civil Engineering	Government Polytechnic, Palanpur	9978441158	devendra_civil@yahoo.com
3	Arvindkumar R. Patel, Lecturer in Civil Engineering	Government Polytechnic, Palanpur	9998515817	arvindpatel19@gmail.com

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Course Title: Summer Internship-II
(Course Code: 4350604)

Diploma programme in which this course is offered	Semester in which offered
Diploma in Civil Engineering	5th semester

1. RATIONALE

The rise in global competition has prompted organizations to devise strategies to have a talented and innovative workforce to gain a competitive edge. AICTE has initiated various activities for promoting industrial internship at the diploma level in technical institutes. The internship experience will augment outcome-based learning process and inculcate various attributes in a student in line with the graduate attributes defined by the NBA. Internships are educational and career development opportunities, providing practical experience in a field or discipline.

New technologies are developing fast and its 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, adopting mechanism of ongoing work of industry and to obtain various types of skills.

The duration of internship will be 6 weeks. It will be started during summer vacation after 4th semester or during 5thSemester.

Offline internship in industry - During the summer vacation after 4thsemester, 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.
Students are suggested to select branch specific training in Civil Industry. Students are supposed to produce joining letter and relieving letter once the internship is over.

Student's needs to report at institute for 6 weeks progress to internal internship guide/supervisor in suggested reporting format which is given in syllabus and represent his/her work carried out for monitoring and evaluation purpose.

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 multiple types of skills such as planning, supervision, work ethics, 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 in the field of Civil Engineering are to be developed in the student for the achievement of the following COs:

CO:1 Learn and adopt the engineer's role and responsibilities with ethics.

CO:2 Develop Skills required for business environment, operations, and procedures.

CO:3 Understand the psychology of the workers and their habits, attitudes and approach to problem solving.

CO:4 Get possible opportunities to learn, understand and sharpen the technical skills required for technical advancement.

CO:5 Develop life-long learning skills for a successful professional career.

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	E	M	I	V	
0	0	6	3	0	0	50	50	100

Offline internship in industry: I & **V** Assessment will be carried out based on submitted progress report by Industry resource person & report and presentation of student work by institute resources person.

Legends:L- Lecture;**T–**Tutorial,**P–**Practical,**E–** Theory External, **M** - Theory Internal, **I–** Practical External, **V** - Practical Internal,

List of Documents to be prepared for Submission:

1. All 6 weeks Work Report Sheet signed by internal/external mentor from industry (suggested format given in syllabus).
2. Student Attendance Sheet Report for summer internship (suggested format given in syllabus).
3. Detail report duly signed and approved by the internal/external mentor from industry.
4. Presentation softcopy approved by the internal/external mentor from industry.
5. Poster of summer internship activities approved by the internal/external mentor from industry.

Note: Department Internship Program Coordinator/TPO should inform students in advance about Summer Internship-II as First six weeks will be as summer internship. So, a student needs to finalize offline training from industry before commencement of 5th semester and report at institute.

5. INTERNSHIP GUIDELINES:

The T&P cell of the department/college will arrange internship for students in industries/organization after fourth Semester or as per AICTE/ Gujarat Technological University (GTU) guidelines. The general procedure for arranging internship is given below:

Step 1: Request Letter/ Email from the office of Training & Placement cell of the department/college should go to industry to allot various slots of Summer Internship-II (6 weeks) during summer vacation after 4th semester as internship periods for the students. Students request letter/profile/ interest areas may be submitted to industries for their willingness for providing the training.

Step 2: Industry will confirm the summer internship-II slots and the number of seats allocated for internships via Confirmation Letter/ Email. In case the students arrange the summer internship-II themselves the confirmation letter will be submitted by the students in the office of Training & Placement cell of concerned department. Based on the number of slots agreed to by the Industry / University guideline, TPO in consultation with Head of the Department (HOD) will allocate the students to the industry. In addition, the Internship slots may be conveyed through Telephonic or Written Communication (by Fax, Email, etc.) by the TPO or other members of the T&P cell / Faculty members who are particularly looking after the Summer Internship-II of the students.

Step 3: Students on joining summer internship-II at the concerned Industry / Organization, submit the Joining Report/Letters / Email.

Step 4: Students undergo industrial training/ summer internship-II at the concerned Industry / Organization. In-between internship guide/supervisor evaluate(s) the performance of students once/twice by visiting the Industry/Organization or if field visit is not possible then he/she may contact students by video calling and evaluate accordingly.

Step 5: Students will submit training report after completion of internship to their internship guide/supervisor.

Step 6: Department will keep all the record of the students.

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) Summer Internship program Interns are required to give a presentation before the review committee consisting of a group of academic staff members.
c) The review committee gives feedback and suggests possible improvements in the work.
d) 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.
e) A completion certificate will be issued to all Summer Internship program Interns only after the completion of internship tenure.

7. PO-COMPETENCY-CO MAPPING

Semester V	**Summer Internship-II(Course Code: 4350604)**						
	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: Develop effective programming skills, problem-solving abilities, and technical knowledge to design and develop innovative solutions during gaining hands-on experience for professional development opportunities.							
Course Outcomes 1. Learn and adopt the engineer's role and responsibilities with ethics.	2	2	2	2	2	1	1
2. Develop managerial skills required for business environment, operations, and procedures	1	1	1	1	1	3	2

3. Understand the psychology of the workers and their habits, attitudes and approach to problem solving.	-	2	-	-	-	1	2
4. Get possible opportunities to learn, understand and sharpen the technical skills required for technical advancement.	2	2	3	2	2	-	1
5. Develop life-long learning skills for a successful professional career.	1	1	1	1	-	1	3

Legend: '**3'** for high, '**2**' for medium, **'1'** for low or **'-'** for the relevant correlation of each competency, CO, with PO/ PSO

8. INTERNSHIP EVALUATION:

Internship is an academic assignment and the grade will be determined based on the following criteria:

Course Requirements	**Percent**
External Mentors Evaluation	30%
Student Attendance Report	10%
6-week Worksheet Reports	20%
Internship Report preparation	20%
Presentation Evaluation/viva-voce	20%

Summer Internship-II Registration Form

Student Details												
Enrollment Number												
Student Name												
Student Details	Mobile Number:											
	Email Address:											
Branch												
Institute Code and Name												
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	Offline
Title of Internship carried out	
Nature of Work Carried Out	Construction/maintenance/repair/retrofitting/restoration/design/irrigation /survey/soil/testing Other please Specify_____

Student's Signature Internship Mentor's Signature

Summer Internship–II Suggested Letter for Completion

[Company/Institute/Department letterhead]

No: Date

TO WHOM SOEVERITMAYCONCERN

This is to certify that, Mr. /Mrs. _____

Enrollment Number of Student _____

Has successfully completed a six-weeks 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 activities/processes and were found sincere and hardworking.

1. _____

2. _____

3. _____

4._____

Internship Mentor Signature with stamp

SUMMER INTERNSHIP –II SUGGESTED 6 WEEK WORK SHEET REPORT				
Student Name:				
Enrollment No:				
Summer Internship Company/ Organization Name				
Address of Company/ Organization				
Student's Activity Details:				
Week Number	Start Date to End Date	Tasks to be assigned	Tasks to be completed	Remarks

Signature of Company Person/mentor

[TO BE FILLED BY INTERNAL INTERNSHIP GUIDE/FACULTY ONLY]

Any Suggestion/Remarks

Signature of Internal Internship Guide/Faculty

SUGGESTED STUDENT ATTENDANCE SHEET REPORT

RGANIZATION INFORMATION

Organization Name	
Organization Address	
Organization Email ID	

STUDENT INFORMATION

Name of Student:	

Enrollment No:		Name of Course:	
Date of Commencement of training:		Date of Completion of Training	
Internship Title			

Student's Attendance Sheet

Week No	Day of week	Day1	Day2	Day3	Day4	Day5	Day6	Total Present days
Week 1	Date							
	PR/AB							
Week 2	Date							
	PR/AB							
Week 3	Date							
	PR/AB							
Week 4	Date							
	PR/AB							
Week 5	Date							
	PR/AB							
Week 6	Date							
	PR/AB							
Total Count of student's presents during internship								
Total Working days of company during internship								
Student's percentage present during internship								

NOTE:1. Attendance sheet should be submitted after completion of training to internal internship mentor.

Comments if any:

Signature of Company internship person with company stamp/seal:

Name of Company internship person:

Contact No of Company internship person:

SUGGESTED INDUSTRY SUPERVISOR EVALUATION OF INTERN

Student Name:	
Enrollment No:	
Internship Title:	
Company/ Organization Name:	

Name of mentor:	
Date of Internship:	

Please evaluate your intern by indicating the frequency with which you observed the following behaviors:

Parameters	Needs improvement	Satisfactory	Good	Very Good	Excellent
Behaviors					
Performs in a dependable manner					
Cooperates with co-workers and supervisors					
Shows interest in work					
Learns quickly					
Shows initiative					
Produces high quality work					
Accepts responsibility					
Accepts criticism					
Demonstrates organizational skills					
Uses technical knowledge &expertise					
Shows good judgment					
Demonstrates creativity/originality					
Analyzes problems effectively					
Is self-reliant					
Communicates well					
Writes effectively					
Has a professional attitude					
Gives a professional appearance					
Is punctual					
Uses time effectively					

Overall performance of student (circle one): (Needs improvement/ Satisfactory/Good/Very good/Excellent)

Additional comments, if any:

Signature of Industry supervisor_____

SUGGESTED EVALUATION REPORT FOR INTERNAL MENTOR:

Student Name:	
Enrollment No:	
Internship Title:	

Company/ Organization Name:	
Name of mentor:	
Date of Internship:	

Presentation/Poster evaluation		1 to 5
A. Poster/Report		
Clarity	Clearly expressed, easily understood, comprehensible.	
Relevance	Relevant, related to the matter at hand, to the point, focused.	
Organization	Logically organized, structured, rational, coherent, and reasonable.	
Grammar	Correct grammar usage and construction.	
B. **Problem solving skills**		
Define	Conceptualizes problems in a workable and manageable manner.	
Analyze	Breaks down into critical and significant components	
Formulate	Creates and develops proposed modifications or solutions.	
Evaluate	Validates the effectiveness of the proposed solutions.	

9. REFERENCE

- AICTE Internship Policy.pdf (aicte-india.org)

10. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

No.	Name and Designation	Institute	Email ID
1	Hiteshkumar T. Patel, Lecturer in Civil Engineering	K D Polytechnic, Patan	htpatel20@gmail.com
2	Devendrakumar N. Sheth, Lecturer in Civil Engineering	Government Polytechnic, Palanpur	devendra_civil@yahoo.com
3	Arvindkumar R. Patel, Lecturer in Civil Engineering	Government Polytechnic, Palanpur	arvindpatel19@gmail.com

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Course Title: Advanced Construction Technology
(Course Code: 4350605)

Diploma programme in which this course is offered	Semester in which offered
Civil Engineering	5th Semester

1. RATIONALE

Before taking this course on "Advanced Construction Technology," it is expected that students have already learned some basic concepts, principles, and important aspects of construction materials and technology in the third-semester course (Code: 4330603). This course builds on that knowledge and explores advanced aspects of construction technology to address the demands of the internal and globalized market for quality and faster completion of projects using modern techniques, waste materials, and mechanized construction.

The construction industry is constantly evolving, and today, high-capacity machines with better output and greater efficiency are needed to make the construction process less stressful. This course has been designed to equip diploma engineers with the necessary skills to use advanced construction technology effectively. With the knowledge gained in this course, students will be able to apply modern techniques and use modern and waste materials to improve construction quality and speed up project completion. They will also be able to leverage mechanized construction to reduce manual labour and increase efficiency. Overall, this course will provide students with the tools they need to succeed in today's construction 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:

- **Use advanced construction technologies.**

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) To develop the conceptual knowledge of advanced construction material and concur knowledge of Waste products and Industrial byproducts.
b) Students are able to appreciate various types of advanced and latest construction machineries, equipment, formworks and safety measures involved in construction works.
c) Contribute either as an executioner or Supervisor in the special types of civil engineering construction aided with state of the art technology.

d) Describe important aspects, operations and safety points pertaining to:
   a. Drilling and Blasting
   b. Coffer Dams
   c. Caissons

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	-	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 thesub-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	Draw Sketches With Nomenclature and Short Details in Sketch book. • **Plants and Equipment Used In Construction.** a. Earthmoving machineries b. Equipment for excavation c. Handling equipment d. Hoisting equipment e. Conveying equipment f. Pumping equipment g. Compacting equipment h. Concrete vibrating equipment i. Pile driving equipment j. Plants for Grouting, Guniting. k. Drilling equipment l. Concrete and mixing plant • Different types of coffer dams. • Different types of caisson. • Crib and Trestle • Blast hole	I, II, III, IV and V	Home Assignment

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
	• Tunnel Formwork System		
2	Prepare a report on use of Waste products and Industrial byproducts in bricks, blocks, concrete and mortar.	I	4*
3	Prepare a site visit report regarding your visit in which construction work of Multi storied buildings is going on with advanced Equipments and machineries stating list of it including its selection criteria and its advantages.	II	4*
4	Prepare a report on various admixtures used in Concrete.	III	2*
5	Prepare a report on Under water concreting in Bridge pier and bored pile.	III	2*
6	Prepare a report on 3D Volumetric Construction.	IV	4*
7	Prepare a site visit report regarding your visit in which Equipment and machineries required for Foundation and Super structures of Bridges.	IV	4*
8	Prepare a site visit report regarding your visit in which deep foundation work is going on including type of deep foundation adopted and its selection criteria.	V	2*
9	Prepare a site visit report regarding your visit in which caisson/ cofferdam construction work is going on.	V	2
10	Prepare a site visit report regarding your visit in which drilling/ blasting work is going on.	V	4
11	Prepare a report on blasting process using various types of explosives.	V	2*
12	Topic of Seminar shall be given to a group of students. The students are required to submit and present/ defend the Seminar in presence of students and teachers and report including PowerPoint presentation to be attached with submission.	I, II, III, IV and V	4*
	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	
1	Neatness, Cleanness in Sketch book	10
2	Uniformity in Drawing and line work	10
3	Creating given drawing	40
4	Dimensioning the given drawing and writing text	20
5	Answer the question	10
6	Submission of drawing in time	10
	Total	**100**

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
	For PrOs 3, 7, 8, 9, & 11	
1	Discipline	10
2	Involvement during site visit	20
3	Data collection at site	20
4	Organization of report	20
5	Answer the question	10
6	Timely submission of report	20
	Total	**100**

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
	For PrOs 2, 4, 5, 6, 10	
1	Data collection	20
2	Write up, Grammar etc.	20
3	Organization of report	20
4	Answer the question	20
5	Timely submission of report	20
	Total	**100**

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
	For PrOs 12	
1	Initiative	20
2	Data Collection	20
3	Content of Presentation (Use of multi media)	20
4	Presentation (Body Language- Gesture, Posture etc.)	20
5	Answer the question	20
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	PrO.No.
1	Computer system (An computer system with basic configuration)	20

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 safe practice on site/ lab.
c) Maintain tools and equipment.
d) Follow ethical practices.
e) 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 Advanced Construction Materials	1a. Describe the features of special types of civil engineering materials. 1b.Explain different types of advanced building materials and their uses in construction 1c. Discuss properties of advance materials and by products. 1d. Miscellaneous materials Properties and uses of acoustics materials, wall claddings, plaster boards, Micro-silica, artificial sand, bonding agents, adhesives etc.	1.1 Innovation in building materials is an unceasing reality of our construction industry. 1.2 advanced building materials 1.2.1 Plastics and PVC 1.2.2 Ceramic products 1.2.3 Paints and Varnish 1.2.4 Materials for damp proofing, water proofing 1.2.5 Materials for anti-termite treatment 1.2.6 Glass and fiber 1.2.7.Steel and iron materials 1.2.8 Materials used for false ceiling 1.2.9 Asbestoses 1.2.10 Concrete blocks 1.3 Admixtures and its Classification. 1.3.1.Admixtures and its benefits, Types of Admixtures - Accelerator and Retarder Plasticizer and Super Plasticizer Water roofing and Air entraining admixture 1.4 Use of Waste products and Industrial byproducts in bricks, blocks, concrete and mortar.
Unit – II Miscellaneous machineries and Hoisting, Conveying Equipments	2a. Able to introduce different types of construction machinery, its features and Working.	2.1 Purpose, advantages and disadvantages of Construction machinery. 2.2 Machineries used for earthwork and for other construction works. Mortar – Types & specific uses 2.2.1 Their details, special features, suitable uses, specifications.
Unit– III Advanced Concreting methods and Equipments	3a. Explain about latest Developments in the field of concrete works. 3b. Under water Concreting for bridge piers and bored pile construction.	3.1 Grouting, Guniting, Shotcrete: Terminology, applications, Materials, Proportioning and Properties, Dry-Mix Process, Wet- Mix Process, Auxiliary Equipment, Special Equipment, methods.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at Application and above level)	Topics and Sub-topics
	3c.Ready Mix concrete: Necessity and use of Ready Mix Concrete. Production and equipment's for RMC. 3d.Ready Mix Concrete plant. Conveying of RMC. Transit mixers-working and time of transportation. 3e.Workability and water cement ratio for RMC. Strength of RMC	3.2 Special Concrete: Properties, uses and procedure of Roller compacted concrete. 3.2.1 Properties and uses of High Impact Resisting concrete. 3.2.2 Properties, uses and constituents of Steel fiber reinforced concrete. 3.2.3 Percentage of steel fibers in SFRC. 3.2.4 Effect of size, aspect, ratio and percentage of steel fibers on strength of concrete. 3.3 Flat slab technology. 3.4 Tunnel Formwork System. 3.5 3D Volumetric Construction. 3.6 Hybrid Concrete Construction. 3.7 Tremie method of underwater concreting: Procedure and equipment's required for tremie method. Properties, workability and water cement ratio of the concrete required.
Unit– IV Advanced Technology in Construction	4a. Describe Construction of Bridges and flyover work. 4c. Describe Construction of Multi storeyed buildings work. 4d. Select suitable type of Equipments and machineries for Multi storeyed buildings and Bridges. 4e. Explain 3D Printing in Construction. 4f. Select Geo synthetics for Strengthening of Embankments	4.1 Construction of Bridges and flyover. 4.2 Equipment and machineries required for Foundation and Super structures of Bridges. 4.3 Construction of Multi storeyed buildings. 4.4 Equipments and machineries required for Construction of Multi storeyed buildings such as use of lifts, belt conveyors, pumping of concrete. 4.5 Equipments and machineries used for placing and jointing of pre fabricated elements. 4.6 Use of 3D Printing in Construction. 4.7 Strengthening of Embankments by soil reinforcing technique using geo synthetics
Unit– V Drilling, Blasting	5a. Explain the need of Drilling and blasting. 5b. Select the appropriate	5.1 Drilling: Types, Drilling requirements, Selecting the drilling pattern for blasting

Unit	Unit Outcomes (UOs) (4 to 6 UOs at Application and above level)	Topics and Sub-topics
and Special Construction	Explosive materials and precautions required in storage and in handling of explosives. 5c. Describe drilling and blasting operations 5d. Explain purpose, use, principles of working and features of types of coffer dams. 5e. Describe the selection criteria of types of coffer dams 5f. State the leakage points and suggest leakage prevention in coffer dams. 5g. Describe the uses of caissons and Classify the types of caisson. 5h. Explain method of sinking of caissons. 5i. Differentiate between Cofferdams and caissons	5.2 Effect of air pressure on drilling operation 5.3 Bentonite/ mud slurry in drilling 5.4 Factors affecting the selection of drilling method and equipment 5.5 Blasting: Explosives for blasting (Dynamite, Blasting caps Primeline, Safety fuse, Stemming, Blast hole, Prime detonators etc.) 5.6 Types of blasting: Process of using explosive, Precautions 5.7 Storage of explosives 5.8 Features of magazine building 5.9 Special Construction — Coffer dams: Types, requirements, Selection criteria, Design features, Leakage points and leakage prevention in coffer dams. — Caissons: Materials used, Sinking loading of caissons.

***Note**:TheUOs 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 QUESTIONPAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A	Total Marks
I	Advanced Construction Materials	10	04	06	04	14
II	Miscellaneous machineries and Hoisting, Conveying Equipments	08	04	04	04	12
III	Advanced Concreting methods and Equipments	10	04	06	06	16
IV	Advanced Technology in Construction	08	04	06	06	16
V	Drilling, Blasting and Special Construction	06	02	04	06	12
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 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) Collect the information on Advanced Materials used in construction and prepare a report.
b) Visit a nearby site, where advanced machineries are used and prepare a report.
c) Prepare a report on advanced concreting methods.
d) Explore latest technology adopted globally for Construction and prepare a report on it.
e) Prepare seminar on relevant topic
f) Prepare a report on Explosives used for Blasting in civil engineering projects.
g) Undertake micro project.

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.11***, 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. 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) **Green Solutions:** Prepare a report suggesting replacement of atleast 10 nos. of conventional advanced construction materials with Sustainable and Green Building Materials and justify it in terms of environmental impact.
b) **Safety**: Prepare posters/ charts/ SOPs for the awareness of safety while operating miscellaneous machineries used in various activates of advanced construction.
c) **Foundation**: Prepare a report on pile foundation being executed in any nearby structures.
d) **Advanced Construction Technology**: Collect the information of recent technologies practiced in advanced construction and prepare a report on it.
e) **Drilling and blasting:** Prepare a report on controlled blasting in civil engineering projects, and also describe the procedures to get the permissions of competent authorities along with Performa if any.
f) **Drilling and blasting:** Prepare a report on drilling activity being executed for the work of blasting and also describe any alternative arrangement for the same.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Construction Technology	Atev. S.S.	Mir Publisher.
2	Building construction	S.C. Rangwala	Charotar Publishing House Pvt. Ltd. Anand
3	Building Construction	Arun Kumar Jain, Ashok Kumar Jain, B.C. Punmia	Laxmi Publication, ISBN 10: 8131804283 ISBN 13: 9788131804285
4	Building Repair and Maintenance Management	Gahlot. P.S., Sharma Sanjay	Edition 2005, CVS publication, ISBN 10: 8123912439, ISBN 13: 9788123912431
5	Building Maintenance Management	Paul Wordsworth, Lee	4th Edition, 2000, Wiley-Blackwell, ISBN: 978-0-632-05362-9
6	Construction Dewatering and Groundwater Control: New Methods and Applications	J. Patrick Powers, Arthur B. Corwin, Paul C. Schmall, Walter E. Kaeck	ISBN: 978-0-471-47943-7, Wiley & Sons, Inc., 3rd Edition.
7	Ground Improvement Techniques	Raj Purushothama	Laxmi Publications, and ISBN: 9788131808573, Edition: First, 1999.
8	Ground Improvement	Moseley, M. P	Blackie Academic & Professional, Boca Raton, Florida, USA, ISBN 0751400734, 084937717X, 1993
9	Construction Materials	D.N. Ghose	TATA Mc Graw Hill
10	Pile Foundations	Tomlinson	Longman Group, U. K.

14. SOFTWARE/LEARNING WEBSITES

a) ww.nptel.iitm.ac.in
b) http://www.asce.org/
c) https://www.astm.org/
d) https://www.concrete.org/

15. PO-COMPETENCY-CO MAPPING

Semester V	Advanced Construction Technology (Course Code: 4350603)									
	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	PSO 2	PSO 3 (If needed)
Competency	• **Use advanced construction technologies.**									
Course Outcomes CO a) To develop the conceptual knowledge of advanced construction material and concur knowledge of Waste products and Industrial byproducts.	3	3	3	2	3	-	3	-	-	-
CO b) Students are able to appreciate various types of advanced and latest construction machineries, equipment, formworks and safety measures involved in construction works.	2	-	-	3	2	-	2	-	-	-
CO c) Contribute either as an executioner or Supervisor in the special types of civil engineering construction aided with state of the art technology.	2	2	2	-	3	2	3	-	-	-
CO d) Describe important aspects, operations and safety points pertaining to: a. Drilling and Blasting b. Coffer Dams c. Caissons	3	-	-	3	3	-	3	-	-	-

Legend: '**3'** for high, '**2**' for medium, **'1'** for low or **'-'** for the relevant correlation of each competency, CO, with PO/ PSO

17. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

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3	Smt. D. B. Joshi	G.P. Gandhinagar	079-2328 7433	dbjgpg@gmail.com

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Semester-V

Course Title: Highway Engineering

(Course Code: 4350606)

Diploma programme in which this course is offered	Semester in which offered
Civil Engineering	5th Semester

1. RATIONALE

Road Transportation is the most effective and economical means of transportation in our country. Roads make a crucial contribution to economic development and growth and bring important social benefits. They are of vital importance in order to make a nation grow and develop. Agencies like NHAI, R&B and private organization are intensely involved in improving and building road networks. Construction of road is one of the major areas in which diploma holders in Civil Engineering may get very good opportunities for employment. The diploma holders are deals with construction and maintenance of highway. In order to professionally contribute to the field of highway engineering, the associated engineers must have adequate knowledge and skills relating to technical aspects of geometric design, alignment, quality of materials, construction process of road, new developments in road construction and use of modern and waste materials, techniques, design and maintenance of pavement. This course provides basic concepts regarding highway components, construction and maintenance practice.

2. COMPETENCY

This course is design to help the student to attain the following competency through various teaching learning experiences:

Undertake construction and maintenance of pavements.

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) Explain road development plan and role of various agencies associate in highway engineering.
b) Design of road geometry as per IRC.
c) Understand road construction materials and construction process of highway.
d) Describe use of various road making machineries.
e) Know basic features associate with hill road.
f) Aware about advances in highway engineering.

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	-	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 COs. A*s 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	Draw minimum four sketches showing standard cross section of NH, SH, MDR, in embankment and cutting.	II	02
2	Carry out minor filed project: Take road of minimum of 500 meter length. It should be included site selection, reconnaissance survey, fixing alignment and small cross drainage work, detailed profile survey along with alignment, cross section of the road and Cross drainage work. Prepare computer generated drawing of LS section of the road in cutting and filling.	II, III	06
3	Calculate examples based on road geometry (Minimum 10 examples).	II	04
4	Draw line sketches of various road construction equipments. (Minimum 10 equipments).	IV	02
5	Prepare table for permissible value of various road (WBM/WMM/BC) construction material properties recommended by IRC.	III	02
6	Visit of highway construction site and prepare report (following points should be include) 1) Understanding construction procedure of road. 2) Working of highway construction machineries including hot mix plant. 3) Inspection of road drainage condition. 4) Explore material testing laboratory available on site.	III, IV, V	06
7	Demonstration of pavement evaluation machineries: Bump Integrator and Benkelman Beam (Not required to perform).	VI	02
8	Seminar based on following topics:	-	04

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
	Highway Material testing*, Highway Construction Machineries, Morden Tools and Techniques utilized in road construction, Road Maintenance Techniques, Construction of hill road, Software used in highway engineering and other topics suggested by faculty. *Weightage should be given for highway material testing.		
	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, 3, 4,	
1	Prepare drawing/sketches.	40
2	Neatness, accuracy in work and drawings.	20
3	Notation in the given drawing and writing text.	20
4	Answer the questions.	10
5	Submission of drawing in time.	10
	Total	**100**

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
	For PrOs 2	
1	Calculate numerical based on given data.	50
2	Accuracy in calculation.	20
3	Draw sketches related to the example.	10
4	Answer the questions.	10
5	Submission of example in time.	10
	Total	**100**

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
	For PrOs 5, 6, 7, 8, 9	
1	Participation in the site visit	40
2	Data collection during site visit	30
3	Technical involvement during site visit.	20
4	Preparation and submission of report.	10
	Total	**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

Major equipments must be made available in all institutions across the state for practical performance as prescribed in curriculum of **Basic Transportation Engineering (4340604)**. These equipments are California Bearing Ratio, Impact Testing Machine, Los Angeles Abrasion Testing Machine, Ring and Ball Apparatus, Standard Penetrometer, Flash and Fire Point test. These apparatus utilized for demonstration in highway engineering.

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)	Topics and Sub-topics
Unit – I Highway Developments	1a. Explain Highway Development in India considering future scope. 1b. Explain 20 year road development plan for India. 1c. Describe functions of various agencies involved in highway engineering. 1d. Explain funding system for highway.	1.1. Scope and Importance of Highway in India. 1.2. Road classification in India: Nagpur Plan, Bombay Plan, Lakhnow Plan. 1.3. Concept of Smart Highways. 1.4. Role of various agencies for planning, construction and maintenance of road (IRC, NHAI, R&B, MORTH, CRRI). 1.5. Funding system of state government and central government for the road construction and development.
Unit – II Highway	2a. Explain various terms used in road geometry.	2.1 Cross sectional elements: Right of Way, Width of Carriageway, Road

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
Geometric Design	2b. Explain road alignment. 2c. Draw various cross section of highway in embankment and cutting. 2d. Discuss various sight distance. 2e. Solve numerical based on highway geometry.	Margins, Kerbs, Medians, Formation Width, Camber, Shoulders, Side Slope, Lateral and vertical clearance, Typical Cross-sections. 2.2 Road Alignment a) Horizontal Alignment: Design Speed, Super elevation, Horizontal curve, Widening on horizontal curve, Transition curve. b) Vertical Alignment: Road gradient, Vertical curves 2.3. Standard cross section of national highway in Embankment and Cutting. 2.4. Sight Distance: Stopping Sight Distance, Overtaking Sight Distance, Intermediate Sight Distance. 2.5. Simple Numerical based on sight distances.
Unit– III Highway Construction	3a. To know the road materials and it's characteristics. 3b. Describe road construction method.	3.1 List various highway construction materials, give their characteristics. 3.2 Road pavement: Flexible and rigid pavement, typical cross-sections, functions of various components. Construction of WBM/WMM road, merits and demerits of WBM/WMM road. 3.3 Construction of Flexible pavement, types of bitumen (emulsion, cutback, tar) terms used in bituminous road: prime coat, tack coat, seal coat, merits and demerits of bituminous road. 3.4 Construction of rigid pavements: methods of construction alternate and continuous bay method, construction joints, filler and sealer, merits and demerits of concrete road.
Unit– IV Highway Construction Equipment	4a. Discuss various machineries for road construction.	4.1 Earthwork and transporting equipments: Dozer, Scraper, Grader, Tripper Truck. 4.2 Compaction Equipments:

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
		Shipsfoot Roller, Pneumatic Tyred Roller, Vibratory Roller, 4.3 Bituminous Hot Mix plants: Batch mixing plant, Drum Mixing plant, Cold mix Plant, Paver Finisher. 4.4 Batching and Mixing plant for Cement Concrete road construction.
Unit– V Hill Road	5a. Describe components of hill road. 5b. Discuss drainage and protection work on hill road. 5c. Explain causes of landslide and classification.	5.1 Hill road components and it's function. 5.2 Drainage of hill road, Side drainage, catch water drain, cross drain. 5.3 Landslide: Types, Causes and prevention
Unit– VI Advances In Highway Engineering	6a. Know different highway engineering design software. 6b. Discuss Recycled and innovative materials in pavement construction. 6b. Explain basic concept of Bituminous Mix Design. 6c. Discuss Pavement Evaluation Machineries.	6.1 Brief overview of Highway Design Software: MX ROAD, IIT PAVED, IIT GRID. 6.2 Uses of various Recycled and new innovative materials in pavement construction. 6.3 Brief overview of bituminous mix design and marshal stability test. 6.4 Use of Bump Integrator, Benkelman Beam for pavement evaluation.

***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 Level	Total Marks
I	Highway Developments	04	04	04	00	08
II	Highway Geometric Design	12	02	06	10	18
III	Highway Construction	14	02	08	10	20
IV	Highway Construction Equipments	04	02	02	04	08
V	Hill Road	04	02	04	02	08
VI	Advances In Highway Engineering	04	02	02	04	08
Total		**42**	**14**	**26**	**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 seminar on relevant topic.
b) Collect various drawing and other details related to road construction from R&B/NHAI department and prepare report on it.
c) Undertake micro project related to highway construction.
d) Search the software/freeware on the course content and learn it application.
e) Observe the components of roadway nearby area and draw your observation sketches with necessary details.

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 does not*** means only traditional lecture method, 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) Demonstrate through of video lecture construction work of rigid and flexible pavement.
h) Expert lecture on latest software for highway engineering.

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 is 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) Evaluate camber and gradient of a pavement in nearby area.
b) Prepare model of ground profile of road in cutting and filling.
c) Prepare computer generated drawing of longitudinal section of various road in cutting as well as filling.
d) Generate report/output from the software related to highway engineering.
e) Use and study different types of software related to highway.
f) Prepare a model of smart highway.
g) Draw dimensional cross section of rigid pavement and flexible pavement.
h) Draw different types of road pattern.
i) Prepare organization structure of various agencies related to highway.
j) Prepare a map showing existing location of NH, SH & NE of India.
k) Collect all the details of all types of existing NH, SH, NE across the country.
l) Collect the information of ongoing major road construction across the India.
m) Prepare documentary of WBM and BM road construction.
n) Carryout market survey about alternative materials used in road construction.
o) Prepare chart showing different types of road alignment.
p) Collect typical sample of the drawings and legal documents required for road construction from nearby R & B/NHAI Office.
q) Prepare report on methods of economic evaluation of highway projects.
r) Prepare report on procedure of financing of road projects and administration of roads including road safety audit.
s) Collect accidental data from nearby traffic department/RTO and technically analyse with respect to road design.
t) Study application of different material like: Glass, Fiber, Plastic, Geo-Textiles, and Geo-Membrane in road construction.
u) Explore Advance technique of maintenance and repairs of highway.
v) Case study on landslides causes, prevention and control measure.
w) Report on use of Geo-textile, Geo-grids and Geo-synthetics in construction of hill road.
x) Prepare model of typical cross section showing details of typical hill road partially in cutting and partially in filling.
y) Case study of land subsidence in hill road.
z) Any other micro-project suggested by subject faculty.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Highway Engineering	Khanna S.K, Justo C.E.G and Veeraragavan A.	New Chand and Brothers, Roorkee, 2010, ISBN 978-8185240800
2	Principles and Practices of Highway Engineering	Dr. L. R. Kadyali, Dr. N.B. Lal	Khanna Pulishers, Delhi, 2013, ISBN 8174091653
3	Principles, Practices and Design of Highway Engineering	Dr. S. K. Sharma	S. Chand, & Company Pvt. Ltd., Delhi, 2012, ISBN 8121901316
4	Highway Engineering	Bindra S. P.	Dhanpat Rai Publication Delhi, 2008, ISBN 978-8189929862
5	A Textbook of Highway Engineering	Srinivasa Kumar	Orient Blackswan, 2011, ISBN 978-8173716812
6	Highway Construction and Maintenance	Avinash Gupta	Random Publication, 2017 ISBN 978-9386314055
7	Laboratory Manual in Highway Engineering	Ajay K Duggal, Vijay P. Puri	New Age International Pvt. Ltd. ISBN 978-9386286703
8	IRC:37-2015, IRC:58-2015, MORTH: Manual for maintenance of road.	IRC	--

14. SOFTWARE/LEARNING WEBSITES

a) https://www.cadd.co.in/software/mxroad.php
b) https://iit-pave-software91621.peatix.com
c) https://morth.nic.in/
d) https://nhai.gov.in/
e) http://www.rnbgujarat.org/
f) https://nptel.ac.in/
g) https://swayam.gov.in/
h) https://ts-nitk.vlabs.ac.in/List%20of%20experiments.html

15. PO-COMPETENCY-CO MAPPING

Semester V	HIGHWAY ENGINEERING (Course Code: 4350604)									
	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	PSO 2	PSO 3 (If needed)
Competency	**Undertake construction and maintenance of pavements.**									
(CO a) Explain road development plan and role of various agencies associate in highway engineering.	3	-	-	-	2	2	3			
(CO b) Design of road geometry as per IRC.	3	3	3	2	2	3	2			

(CO c) Understand road construction materials and construction process of highway.	3	2	2	3	3	3	3			
(CO d) Describe use of various road making machineries.	3	2	-	2	3	3	3			
(CO e) Know basic features associate with hill road.	2	2	-	2	2	2	3			
(CO f) Aware about advances in highway engineering.	2	2	2	2	2	2	3			

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

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GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Course Title: Irrigation Engineering
(Course Code: 4350607)

Diploma program in which this course is offered	Semester in which offered
Civil Engineering	5th Semester

1. RATIONALE

Water is intentionally added to crops during irrigation. This agricultural method, especially in arid regions, enables plants to flourish when there is enough rainfall. It is also used in less arid areas to provide plants with the water they require when setting seeds. Agriculture, which continues to use irrigation more and more, uses about 66% of the world's water catchment. When there is a lack of natural water from rain, irrigation is the artificial technique of adding water to the soil to aid in preserving the landscape or growing agricultural products. In addition, irrigation can be used to avoid soil compaction, control weed growth in grain fields, and protect plants from frost, among other purposes in crop production.

Diploma holders in civil engineering are responsible for supervising the development, upkeep, and repair of canals, headworks, river training projects, cross drainage projects, and other projects. Some diploma holders are also employed to prevent waterlogging and tube well irrigation. This course covers hydrology, flow irrigation, storage, and distribution systems, head works construction features, river training works, cross drainage works, causes and mitigation of waterlogging, and tube well construction.

For a diploma civil engineer, basic knowledge of green building-related construction costs will be very useful. This course provides the necessary knowledge and skills to develop competency in the areas mentioned above professionally.

2. COMPETENCY

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

- Impart knowledge about irrigation structures and irrigation systems in different phases.

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)Evaluate water requirement for crops and select suitable irrigation method for given Condition.
(b) Explain methods to determine reservoir capacity.
(c) Classify the components of dams and spillways.
(d) Design most economical section of canal.
(e) Describe process of evaluation of irrigation project.

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	-	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 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
	Draw sketches of:		08
1	Methods of irrigation	II	
2	The layout of drip irrigation	II	
3	The layout of sprinkler irrigation	II	
4	Types of dams	IV	
5	Types of spillways	IV	
6	Cross sections of canal	V	
7	Cross drainage works	V	
	Solve Numerical from Given data to:		12
8	Compute Base period, duty and delta, GCA, CCA*	I	
9	Design of Sprinkler irrigation system*	II	
10	Design of Drip irrigation system*	II	
11	Calculate the reservoir capacity *	III	
12	Design of the most economical section of the canal*	V	
	Field Visit and Prepare Report:		04
13	Arrange Field visit to nearby Irrigation departments or irrigation project		
	Present in a Seminar:		
14	Select one topic of this subject in a group of four to five students and present it using modern teaching aids in Infront of teachers and students.		04
	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	Initiative of students in collecting data and computation	20
2	Use of appropriate methods while work in team/group	20
3	Comprehension and presentation skills in drawing	20
4	Follow up standard steps for design calculations	20
5	Presentation of seminar and Timely submission	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 practice in all institutions across the state.

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	Drawing instruments	1 to 7
2	Computing devices	8 to 12

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 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

Only the major Underpinning Theory is formulated as higher level UOs of *Revised Bloom's taxonomy* in order for the 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 the attainment of COs and competency.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at Application and above level)	Topics and Sub-topics
Unit-I Introduction & water requirement of crops	1a. Justify the necessity and scope of Irrigation engineering. 1b. Understand historical irrigation development in India. 1c. Illustrate various terminology regarding irrigation and soil water plant relationship. 1d. Identify the application of irrigation water and its assessment	2.1 Necessity of Irrigation 2.2 Scope of Irrigation 2.3 Historical development of irrigation in India 2.4 Types of irrigation projects in India. 2.5 Duty, Delta, Base period, Net irrigation requirement, Intensity of irrigation, Gross Command area, Culturable command area, Crop period, Core depth, Soil-water-plant relationship, wilting point. 2.6 Consumptive use of water 2.7 Various methods of application of irrigation water 2.8 Benefits and ill effects of irrigation 2.9 Assessment of irrigation water.
Unit-II Methods of Irrigation	2a. Classify methods of irrigation and their suitability. 2b. Differentiate between Sprinkler and Drip irrigation and its pros and cons	2.1 Classification of irrigation 2.2 Surface and Subsurface Irrigation Methods 2.3 Sprinkler Irrigation and Drip Irrigation, Need, components and layout 2.4 Precautions and Maintenance of Sprinkler and Drip irrigation system
Unit-III Reservoir Planning, Water Logging and Land reclamation	3a. Describe surveys carried out for irrigation project and its data collection 3b. Explain methods of computing capacity and reservoir and its control 3c. State water logging and land reclamation with its effects	3.1 Surveys carried out for irrigation Projects and data collection. 3.2 Methods of calculating capacity of Reservoir 3.3 Area capacity curve 3.4 Silting of the reservoir 3.5 Factors affecting silting 3.6 Waterlogging and its Effects 3.7 Remedial measures of waterlogging 3.8 Land Reclamation and its Effects
Unit-IV Dams and Spillway	4a. Explain various types of dams and its site selection criteria 4b. Distinguish between earthen dam and gravity dam 4c. State the failures of earthen	4.1 classification of dams 4.2 Factors affecting in the selection of site for the dam 4.3 Earthen dam, Gravity dam & its cross sections, components, seepage through embankment and foundation with its control

Unit	Unit Outcomes (UOs) (4 to 6 UOs at Application and above level)	Topics and Sub-topics
	dam and preventive measures 4d. Illustrate different types of spillways and its suitable location	4.4 failures of earthen dam and its preventive measures 4.5 Types and Components of spillways and its suitability Criteria 4.6 Energy dissipators
Unit-V Canal Irrigation & cross drainage works	5a. Classify canals according to alignment and position 5b. Design the most economical section of the canal 5c. Explain canal lining and its purpose 5d. Identify various cross drainage works and canal regulators	5.1 Classification of canals according to alignment and position 5.2 cross-sections of canal in embankment with partially cutting and partially filling. 5.3 Most economical section of canal with its design. 5.4 Canal lining: purpose, material used and its properties, advantages 5.5 cross drainage works: Aqueduct, siphon aqueduct, super passage, level crossing 5.6 canal head regulators and cross regulators.
Unit-VI Evaluation of irrigation projects	6a. Describe the main criteria for the evaluation of the irrigation project 6b. Explain the process of evaluation of the irrigation project 6c. State the case study of the irrigation project.	6.1 theory for water evaluation for farming use 6.2 methodology for Estimation of hydraulic investment 6.3 Result of methodology 6.4 Case study of irrigation project

***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	Introduction and Water requirement of crops	08	4	4	4	12
II	Methods of irrigation	07	2	4	6	12
III	Reservoir planning, water logging, and land reclamation	10	4	6	6	16
IV	Dams and spillways	06	2	4	4	10
V	Canal irrigation and cross-drainage works	07	4	4	4	12
VI	Evaluation of irrigation projects	04	0	4	4	8
Total		**42**	**16**	**24**	**30**	**70**

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

Note*: This specification table provides general guidelines to assist students in 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 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 Model of Dams and Spillways
(b) Prepare model of Cross drainage works

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.11***, 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
g) Expert lecture by practicing valuer on Valuation techniques, methods and criteria of any property.
h) Expert lecture on latest software for Estimating and costing

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) Automated irrigation system using IoT Technology
(b) Design of sprinkler/Drip irrigation system
(c) Analysis of ground water quality for irrigation
(d) Development of Solar powered irrigation system
(e) Optimization of water use for irrigation through crop water requirement Estimation
(f) Development of Smart irrigation system

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year, and ISBN
1	Irrigation theory and practice	A.M. Mitchel	Vikas Pub. House Pvt. Ltd, Delhi. ISBN: 9780706924848, 2008
2	Irrigation, Water Resources, and Water Power Engg.	Dr. P.N. Modi	Standard Book House, Delhi. ISBN: 9788189401290, 2008
3	Hydrology and Water Resources	R.K. Sharma	Dhanpat Rai and Sons, Delhi. 1987
4	Hydrology and Water Resources Engg.	S. K. Garg	Khanna Pub., Delhi. ISBN: 8174090614, 2015 edition
5	Watershed management in India	J.V.S. Moorthy	Willey Eastern Ltd. ISBN: 8122435181, 2017
6	Water Resources Engg-	C. Satyanarayan	New Age International

S. No.	Title of Book	Author	Publication with place, year, and ISBN
	Principles and Practice	Murthy	Ltd., New Delhi ISBN: 9788122413823

14. SOFTWARE/LEARNING WEBSITES

a) www.guj-nwrws.gujarat.gov.in
b) www.swhydrology.gujarat.gov.in
c) www.nptel.ac.in

15. PO-COMPETENCY-CO MAPPING

Semester IV	ESTIMATING, COSTING & VALUATION (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**	**PSO 2**	**PSO 3** (If needed)
Competency	Impart knowledge about irrigation structures and irrigation systems in different phases.									
CO(a) Evaluate water requirements for crops and select suitable irrigation methods for given conditions.	3	3	-	-	1	-	-			
CO(b) Explain methods to determine reservoir capacity.	3	3	-	-	-	-	-			
CO(c) Classify the components of dams and spillways.	3	1	-	-	1	-	-			
CO(d) Design most economical section of canal.	3	3	2	-	-	-	2			
CO(e) Describe process of evaluation of irrigation project.	3	-	-	-	1	1	1			

Legend: '**3'** for high, '**2**' for medium, **'1'** for low or **'-'** for the relevant correlation of each competency, CO, with PO/ PSO

17. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

S. No.	Name and Designation	Institute	Contact No.	Email
1	Shri D. H. Dalal	GPG Ahmedabad	9428858913	dhdalal@gmail.com
2	Shri A. K. Popat	RCTI, Ahmedabad	9825443501	anilkpopat@gmail.com
3	Shri A. R. Desai	Sir BPTI, Bhavnagar	7878246020	desaiakshay1989@gmail.com

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

Course Title: Environment Engineering and Pollution Control
(Course Code: 4350608)

Diploma program in which this course is offered	Semester in which offered
Civil Engineering	5th Semester

1. RATIONALE

After learning basic concepts of Environmental Engineering in second semester, this subject is introduced as an elective subject in 5th semester for all those students who are willing to study some advanced topic related to environment. This subject includes causes and preventive measures of different types of pollution, treatment processes for water and wastewater, solid waste separation and their disposal methods, environmental audits and environmental impact assessment. Environment is a global issue and environmental impact assessment is compulsory for all industries and major infrastructure projects. Therefore, this subject has been designed in such a way that students will have advanced knowledge of land survey, waste management, inspection and testing, environmental audit etc. and they can have career opportunities in this area.

2. COMPETENCY

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

- **Diagnose and manage environment related issues.**

3. COURSE OUTCOMES (COs)

The theory should be taught and the exercises should be done in a way that allows students to illustrate the course objectives by demonstrating various learning outcomes in the cognitive, psychomotor, and affective domains to demonstrate following courses outcomes.

[1] Suggest suitable methods for biodiversity conservation.
[2] Identify sources of pollution and use standards for measurement and prevention of Water, Air & Noise pollution.
[3] Suggest advanced wastewater treatment processes according to the quality of wastewater.
[4] Identify and segregate solid waste and suggest suitable method for proper disposal.
[5] Interpret findings of Environmental Impact Assessment (EIA)and suggest suitable steps for reducing the pollution in the given situation.

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	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 is 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 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	Determine pH value of water sample	II	2*
2	Determine Turbidity of water sample	II	2*
3	Determine B.O.D. of domestic wastewater sample	II	2*
4	Determine concentration of Fine Particulate matter PM(2.5) in ambient air	II	2*
5	Determine concentration of Respirable Suspended Particulate Matter PM(10) in ambient air	II	2*
6	Measurement of noise at different sources using Sound meter	II	2*
	Draw labelled sketch of:	II	4*
7	• Wastewater treatment plant	III	
8	• Membrane filtration	III	
9	• Advanced Oxidation Processes (AOPs)	III	
10	• Biological Nutrient Removal (BNR)	III	
11	• Membrane Bioreactors (MBRs)	III	
12	• Advanced Sludge Treatment	III	
13	• Constructed Wetlands	III	
14	• Mechanical Processing for materials recycling : Magnetic Separation , Optical Sorting, Screening	IV	
15	• Waste Heat recovery from flue gases, Waste heat Recovery boilers.	IV	
	Visits		
16	GPCB Laboratory	II/III	2*
17	Industry where stake-sampling can be carried out.	II	2*
18	Solid waste Management Plant	IV	2*
19	Sewage Treatment Plant	III	2*
20	Seminar		4*
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	Weight age in %
	For PrOs 1 to 6	
1	Identify components	10
2	Prepare experimental setup	20
3	Operate the equipment setup	20
4	Follow safe practices	10
5	Record observations correctly	20
6	Interpret the result and conclude	20
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	PrO. No
1.	Combo PM_{10} and $PM_{2.5}$ sampler with size selective inlet for PM_{10} and automatic volume inflow control, filter jacket, flow measuring device to control the air flow.	**4,5**
2	BOD Incubator: Double walled construction with PUF thermal insulation, 5 degree Centigrade to 60 degree Centigrade Temperature range, Chamber Volume above 200 Liters, Glasswares, Chemicals and D.O.Meter.	**3**
3	Digital pH meter: pH range 0 to 14.00 pH, Resolution 0.01pH,1 mV, LED display with pH electrode (0 to 14pH),buffer tablets , stand and clamp and Glasswares.	**1**
4	Digital Nephelometric Turbidity Meter:90 degree scattered light measurement nephelometer, highest value for turbidity in NTU range 1000, Resolution 0.01 and with glass cells.	**2**
5	Digital Sound Level Meter.	**6**

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) Demonstrate working as a leader/a team member.
b) Follow safety practices on site.
c) Follow ethical practices.
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** Only the major Underpinning Theory is formulated as higher level UOs of *Revised Bloom's taxonomy* in order for the 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)	Topics and Sub-topics
Unit – I Introduction & Environment problems, Emerging Technologies for Environment Engineering	1.a State importance of Environmental Engineering 1.b State components of Environment. 1.c Elaborate Ecology and Ecosystem 1.d Use Ecological "pyramid " concept of numbers , Biomass , Energy 1.e Use Emerging technologies for Environment management	1.1 Importance of Environmental engineering 1.2 Component of Environment i Atmosphere ii Hydrosphere iii Lithosphere iv Biosphere 1.3 Need for public awareness 1.4 Concept of Ecology 1.5 Ecosystem 1.6 Components of Ecosystem i Abiotic ii Biotic 1.7 Balanced Ecosystem 1.8 Ecological Pyramid i Pyramid of Numbers ii Pyramid of Biomass iii Pyramid of Energy 1.9 Biochemical Cycle i Hydrological cycle ii Nitrogen Cycle iii Phosphorus cycle iv Sulphur cycle 1.11 Biodiversity 1.12 Emerging technologies for environment management i Hydrogen fuel cell usage ii Plant your roof 1.13 Ocean thermal energy conversion

Unit -II Environmental Pollution & its remedial measures	2.a Identify sources of land pollution and take preventive measures for reduction 2.b Identify sources of Water pollution and take preventive measures for reduction 2.c Identify sources of Air pollution and take preventive measures for reduction. 2.d Identify sources of Noise pollution and take preventive measures to reduce noise in buildings. 2.e Use standards to measure Water, Air & Noise pollution. 2.f Identify Characteristics of Solid waste, Bio-medical waste & E-waste and segregate them for proper disposal.	2.1 Definition of Pollution, types – Natural and Artificial. 2.2 Land Pollution 2.2.1 Causes 2.2.2 Effects and preventive measures. 2.3 Water Pollution 2.3.1 Sources of water 2.3.2 Water pollutants from different sources, effects on environment. 2.3.3 Preventive measures. 2.3.4 IS Standards for water quality. 2.3.5 Flow diagram of water treatment plant, water conservation. 2.3.6 Determination of pH value & Turbidity of water sample. 2.4 Wastewater 2.4.1 Generation (Domestic and Industrial) 2.4.2 Hazardous effects 2.4.3 Flow diagram of sewage treatment plant. 2.4.4 CPCB and GPCB norms for sewage disposal. 2.4.5 Determination of BOD & COD of domestic wastewater sample. 2.5 Air Pollution 2.5.1 Causes 2.5.2 Effects 2.5.3 Prevention 2.5.4 Air Pollutants: Particulate pollutants, Ambient Air quality standards, Stack and Ambient air sampling 2.5.5 CPCB and GPCB norms for Air Pollution. 2.5.6 Determination of concentration of Fine Particulate matter PM(2.5) & Respirable Suspended Particulate Matter PM(10) in ambient air. 2.6 Noise Pollution 2.6.1 Sources 2.6.2 Effects 2.6.3 Measurement of Noise and Control of Noise Pollution & CPCB and GPCB norms for Noise Pollution. 2.6.4 Measurement of noise at different sources using Sound meter. 2.7 Municipal Solid Waste, Bio-Medical waste and E-waste - sources, generation, characteristics, effects and methods to manage.

Unit– III Advanced Waste Water Treatment Technology	3.a State advanced wastewater treatment. 3.b Identify components of wastewater treatment Process. 3.c Suggest suitable method of wastewater treatment process according to Emerging Technologies and future trends.	3.1 Introduction to Wastewater Management 3.1.1 Definition of wastewater 3.1.2 Importance of wastewater management 3.1.3 Overview of wastewater treatment processes 3.2 Wastewater Treatment Processes 3.2.1 Basic Concept of i Preliminary treatment: ii Secondary treatment: iii Tertiary treatment: nutrient removal 3.3 Methods of Advanced treatment processes: i Membrane filtration, ii Advanced Oxidation Processes (AOPs) iii Biological Nutrient Removal (BNR) iv Constructed Wetlands v Membrane Bioreactors (MBRs) vi Electrochemical Processes vii Advanced Sludge Treatment viii Advanced Monitoring and Control Systems 3.4 Emerging Technologies and Future Trends 3.4.1 Innovative wastewater treatment technologies. 3.4.2 Resource recovery and sustainability in wastewater management. 3.4.3 Challenges and opportunities in the field.
Unit – IV Solid Waste-Separation and Disposal	4.a Differentiate Recycling & Reuse. 4.b State the Heat Recovery from flue gases, Waste heat Recovery boilers. 4.c Identify and segregate different solid wastes considering relevant standards/policies. 4.d Suggest suitable method for proper disposal of solid waste.	4.1 Introduction of Recycling & Reuse of solid waste: 4.1.1 Concept 4.1.2 Application 4.2 Mechanical Processing for materials recycling : 4.2.1 Size Reduction: shredding, grinding, or crushing 4.2.2 Sorting and Separation: i Magnetic Separation ii Eddy Current Separation: iii Air Classification iv Optical Sorting v Screening vi Agglomeration vii Densification viii Washing and Cleaning ix Deinking x Refining and Purification

		4.3 Waste Heat recovery from flue gases, Waste heat Recovery boilers. 4.4 Methods for proper disposal of solid waste - Land fill, Incineration & Vermicomposting
Unit– V Environmental Audit and Environment Impact Assessment (EIA)	5.1 Justify necessity of Environmental audit for the given purposes 5.2 Carry out Environmental audit of the given building. 5.3 Carry out process of EIA for given building. 5.4 Interpret findings of EIA and suggest suitable steps for reducing the pollution in the given situation.	5.1 Environmental Audit 5.1.1 Necessity 5.1.2 Norms. 5.2 Types of Audit 5.2.1 Objective based types i Liabilities audit, ii Management audit, iii Activities audit 5.2.2 Client-driven types i Regulatory external audit ii Independent external audit iii Internal audit and third-party audit 5.3 EIA 5.3.1 Purpose of EIA 5.3.2 Regulations, steps in EIA process 5.3.3 Benefits of EIA 5.3.4 Limitations of EIA 5.3.5 Environmental clearance for the civil engineering projects.

***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.*

8. SUGGESTED SPECIFICATION TABLE FOR QUESTIONPAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A	Total Marks
I	Introduction & Environment problems, Emerging Technologies for Environment Engineering.	8	3	3	6	12
II	Environmental Pollution & its remedial measures.	12	3	6	9	18
III	Advanced Waste Water Treatment Technology.	8	3	5	6	14
IV	Solid Waste - Separation and Disposal	8	3	5	8	16
V	Environmental Audit and Environment Impact Assessment (EIA)	6	2	3	5	10
Total		**42**	**14**	**22**	**34**	**70**

***Legends:** R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*
***Note**: This specification table provides general guidelines to assist students in 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 vary slightly from the above table.

9. SUGGESTED STUDENT ACTIVITIES

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

a) Comparative study of RO systems available in nearby shops/dealers with photos.
b) Find the New Emerging technology for Environmental Management.
c) Visit Environment Consultant and carry out environmental audit with him and prepare report.
d) Collect photos and prepare report on segregation of solid/hazardous waste generated in nearby Hospital and their disposal site
e) Prepare report on Case study on Methods of Advanced treatment processes: Membrane filtration, Advanced Oxidation Processes (AOPs) etc.
f) Visit dumping site of solid waste treatment plant and prepare report on material recovery facility of dry waste, Biomethanation plant and organic waste compost machine.
g) Collect photos and prepare report on SCADA (Supervisory Control and Data Acquisition) operated treatment plant.
h) Collect list of NGOs working for environmental protection and prepare a report on their contribution.

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/sub M 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.11***, teachers need to ensure the creation of opportunities and provisions for ***co-curricular activities***.
f) Guide students on how to address issues on environmental and sustainability
g) Expert lecture by water resource engineer about the emerging scenario of this field or industry experts

11. 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 is

group-based. However, in the fifth and sixth semesters, it should preferably be ***individually*** undertaken to build up the skill and confidence in every student to become a 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-bawd, or field-based. Each macro-project should encompass two or more Cos which are in fact, integrations of PrOs, UOs and ADOs. Each student will have to maintain a date work diary consisting of individual contributions to the project work and given seminar presentation of it before submission. The total Duration of the micro-project work should not be less than 16 [sixteen] student engagement hours during the course. The student ought to submit a micro-project by the end 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) Collect sample of raw sewage and treated sewage from sewage treatment plant and find the quality of treated wastewater by performing different tests.
b) Visit any nearby industry and carry out Air sampling and measure particulate pollutants and different gases and make the report for same.
c) Visit nearby PUC Centre and collect data of vehicular pollution.
d) Measure noise pollution using android application at various locations of institute building and city.
e) Collect sample of raw water and treated water from filter plant and find the quality of treated water by performing different tests.
f) Prepare a technical summary of Municipal Solid Waste types, Generation, Collection System, Dumping Methods, Bio degradable waste.
g) Case study of Recycle and Reuses of Mechanical Processes for materials
h) Prepare presentations on emerging topics or from the theory related to environmental engineering.

12. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year, and ISBN
1	New Technologies and Environmental Innovation	Joseph Huber	Edward Elgar ISBN- 9781843767992
2	Environmental Noise pollution, Causes, Evils	Vijendra Mahandiyan	Deep & Deep Publications Pvt. Ltd, Ned Delhi, ISBN: 81-7629-830-1
3	Air Pollution	M N Rao H V N Rao	TATA McGraw Hill Publication ISBN: -10. 9780074518717
4	Water pollution	B.K.Sharma	GOEL Publishing house, Meerut ISBN-10 : 8182831768
5	Text Book of Environmental Engineering	P.Venugopala Rao	PHI Learning Pvt.Ltd. ISBN : 9789390669240
6	Waste water treatment : advanced processes and technologies	D.G Rao R. Senthilkumar J. Anthony Byrne S.Feroz	CRC Press ,Taylor & Francis Group ISBN 13:978-178040-034-1

S. No.	Title of Book	Author	Publication with place, year, and ISBN
7	Environment Engineering: A Design Approach	Acrdio P. Sincero & Gregoria A. Sincero	TATA McGraw Hill Publication ISBN-
8	An Introduction to Global Environmental Issues	Kevin T. Pickering & Lewis A. Owen	Routledge , ISBN: 0 -415-16664-0
9	Solid Waste Management	Surendra Kumar	Northen Book Center New Delhi ISBN:81-7211-278-5
10	Recycling and Resource Recovery Engineering : Principle of waste processing	Richard Ian Stessel	Springer Publication ISBN 13 :978 – 3-642-80221-8
11	Environmental impact assessment	R.R Bathwal	New Age International Publishers ISBN:81-224-1357-9

13. SOFTWARE/LEARNING WEBSITES

1. https://archive.nptel.ac.in/courses/
2. Virtual Lab by Ministry of Education, Government of India https://www.vlab.co.in/
3. https://www.youtube.com/watch?v=2s2b5-EsmV0
4. https://gpcb.gujarat.gov.in/
5. https://www.cpcb.nic.in/
6. https://moef.gov.in/en/

5. PO-COMPETENCY-CO MAPPING

Semester IV	ENVIRONMENT ENGINEERING AND POLLUTION CONTROL (Course Code: 4350608)									
	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**	**PSO 2**	**PSO 3** (If needed)
Competency	• **Diagnose and manage environment related issues.**									
CO a) Suggest suitable methods for biodiversity conservation.	3	--	--	--	3	--	3			
CO b) Identify sources of pollution and use standards for measurement and prevention of Water, Air & Noise pollution.	3	3	--	3	3	---	3			
CO c) Suggest advanced wastewater treatment processes according to the	3	2	2	--	3	--	3			

quality of wastewater.										
CO d) Identify and segregate solid waste and suggest suitable method for proper disposal.	2	3	2	--	3	2	3			
CO e) Interpret findings of Environmental Impact Assessment (EIA) and suggest suitable steps for reducing the pollution in the given situation.	3	---	2	--	3	3	3			

Legend: '**3'** for high, '**2**' for medium, **'1'** for low or **'-'** for the relevant correlation of each competency, CO, with PO/ PSO

17. 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-2021 (COGC-2021)
Semester – V

Course Title: Advance Analysis of Structures
(Course Code: 4350609)

Diploma programme in which this course is offered	Semester in which offered
Civil Engineering	5th Semester

1. RATIONALE

After learning analysis of determinate structures in semester-III, this elective subject is introduced in 5th semester for those students willing to excel in the structural engineering field. This subject incorporates introduction to indeterminate structures and analysis of indeterminate structural members like fixed beam, continuous beam and portal frame. Analysis of column sections, dam and retaining wall subjected to eccentric loading and checking very important parameter of no tension condition is included. Analysis of structural members under the effect of principal stresses & strains is also incorporated to give an exposure of compound stresses to the students. To keep pace with advanced technology, exposure to computer aided structural analysis and hands-on practice on software is included in this subject. After learning this subject, diploma students will develop in-depth understanding in the field of structural engineering and will be able to apply their knowledge and analytical skills in the construction 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:

- **Analyze complex structural engineering problems manually and with the help of software and interpret results.**

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) Identify determinate & indeterminate structures and compute degree of indeterminacy.
b) Analyse a symmetrically loaded fixed beam with moment area method and draw SF & BM diagrams.
c) Analyse a symmetrically loaded continuous beam and portal frame(without any lateral sway) with Moment Distribution Method and draw SF & BM diagrams.
d) Analyse column , dam and retaining wall subjected to eccentric axial loading to draw stress distribution diagram and check for no tension condition

e) Analyse beam, plane truss and plane frame on structural analysis software and interpret output results.

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 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	Determine static and kinematic indeterminacy of Beams, Plane Truss, Plane Frame (At Least two problems each)	I	02*
2	Solve at least 4 problems each of load cases &/or combinations for fixed beams, using moment area method, draw SF & BM diagrams and locate Point of contraflexure.	II	04*
3	Analyse continuous beam, at least 3 problems each for various cases of end conditions and symmetrical loads and its combinations to draw SF & BM diagrams , using Moment Distribution Method.	III	04*
4	Analyse a portal frame at least 1 problem each for various cases of end conditions and loads (No sway condition) and its combinations to draw SF & BM diagrams, using Moment Distribution Method.	III	02*
5	Analyse at least 2 problems for the column section subjected to eccentric loading and draw stress distribution diagram.	IV	02*
6	Analyse Dam and Retaining wall for given loading and draw pressure diagram at base and check the stability.	IV	04*
7	Analyse strained structural material with analytical and graphical (Mohr's circle) methods for all cases.	V	04*
8	Analyse Beam, Plane Truss and Plane frame on structural engineering software (freeware/paid) and interpret its output results.	VI	06*
	Total hours		**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	Understand the problem properly.	20
2	Adopted proper methodology to solve the problem.	20
3	Report writing .	20
4	Answer to questions.	20
5	Timely submission.	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.

Sr. No.	Equipment Name with Broad Specifications	PrO. No.
1	Computer Systems.	06
2	Freeware/Paid Structural analysis software.	06

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 safety practices while using equipment.
c) Realize importance of green energy. (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 **Fundamentals**	1a. Identify types of skeletal structures and continuum structures. 1b. Differentiate determinate and indeterminate structures. 1c. Differentiate stable and unstable structures. 1d. Determine static and kinematic indeterminacy of Beam, Plane Truss and Plane Frame.	1.1 Definition of skeletal structures, types of skeletal structures- Beam, Plane Truss, Plane frame, Grid, Space Truss, Space Frame. 1.2 Definition of continuum structures, types of continuum structures- Plate, Shell, Dams, Retaining Wall, Machine Parts etc. 1.3 Determinate and indeterminate structures. 1.4 Advantages and disadvantages of indeterminate structures. 1.5 Stability of structures- External stability and internal stability. 1.6 Static indeterminacy (External/Internal) of Beam, Plane Truss and Plane Frame only. 1.7 Kinematic indeterminacy of Beam, Plane Truss and Plane Frame only.
Unit – II **Fixed Beams**	2a. Differentiate between fixed beam and simply supported beam. 2b. Analyse a symmetrically loaded fixed beam with uniform flexural rigidity(EI) using the Moment area method. 2c. Draw SF and BM diagrams. 2d. Locate the point of Contra flexure.	2.1 Define a Fixed beam, Advantages of fixed beam over simply supported beam. 2.2 Concept of analysis by Moment area method 2.3 μ and μ' diagram for possible symmetric loading on a fixed beam of span L 2.4 Numericals on calculating SF & BM and drawing SF & BM diagrams for fixed beam with symmetric loading (UDL & Point load only) 2.5 Locate Point of contra flexure.
Unit– III **Moment Distribution Method**	3a. Use fundamentals of Moment Distribution Method in structural analysis problems. 3b. Analyse a symmetrically loaded multi span continuous beam with Moment Distribution Method 3c. Analyse a symmetrical portal	3.1 Define the terms : Stiffness, flexibility, carry over factor, distribution factor, procedure of moment distribution method 3.2 Numerical to analyse two or three span continuous beams having end supports as overhang , fixed and /or hinge and subjected to symmetrical loading (UDL &

	frame (No sway condition) with Moment Distribution Method 3d. Draw SF and BM diagrams, for beams/portals for given load cases and combinations (UDL, point loads only)	Point load only) and draw S.F & B.M Diagram 3.3 Numerical to analyse symmetrical Portal frame (without any lateral sway) having hinged or fixed end supports and subjected to symmetrical vertical loading (UDL & Point load only) and draw S.F & B.M Diagram
Unit– IV **Direct and Bending Stresses**	4a. Analyse Column section for combined direct and bending stresses. 4b. Determine the limit of eccentricity and locate the core of a given section. 4c. Check stability of retaining wall and dam. 4d. Draw stress distribution diagram in column, retaining wall and dam under given types of loads.	4.1 Introduction to axial and eccentric loads on column section. Formulae for combined stresses on sections subjected to eccentric loads considering uniaxial and biaxial eccentricity and stress distribution diagrams. 4.2 Condition for no tension or zero stress at extreme fiber, limit of eccentricity, core of section for rectangular and circular (solid and hollow) cross sections. 4.3 Application of concept of combined stresses to find pressure at base and stability check of rectangular and trapezoidal retaining wall and dam with conditions of stability. 4.4 Numericals based on above topics topics to find combined stresses.
Unit– V **Principal planes and Principal stresses**	5a. Analyse strained structural material for calculation of normal, tangential and resultant stress on a given inclined plane. 5b. Locate the principal plane in a strained structural material. 5c. Compute principal stresses . 5d. Use Mohr's circle method to analyse strained structural material.	5.1 Normal, Tangential & Resultant stresses due to direct orthogonal and shear stresses on a given inclined plane (Only formulae no derivation). Numericals based on this. 5.2 Definition of principal plane and stress. 5.3 Location of principal planes and calculation of principal stresses (Only formulae no derivation) Maximum tangential stress. Numericals based on this. 5.4 Mohr's circle and its application for determination of Normal, Tangential & Resultant stresses due to direct orthogonal and shear stresses on inclined plane. 5.5 Mohr's circle and its application for location of principal planes and determination of principal stresses 5.6 Mohr's circle and its application for determination of maximum tangential stress.

Unit– VI **Introduction to computer aided structural analysis**	6a. Differentiate between static & dynamic structural analysis. 6b. Select suitable structural analysis software. 6c. Prepare input data for static analysis of beam, plane truss and plane frame. 6d. Interpret output result of analysis.	6.1 Difference between static and dynamic analysis, its importance and usefulness. List of static and dynamic loads. (Without Numericals). 6.2 Brief introduction of matrix methods for structural analysis - Stiffness method and Flexibility method for analysis of skeletal structure and suitability of stiffness method for computer programming (Without Numericals). 6.3 Overview of popular structural analysis softwares (Freeware and/or paid). Study of Preprocessor and Postprocessor of software. 6.4 Preparation of input data for static analysis of beam, plane truss and plane frame - Geometry, Supports, Loads and Material properties. 6.5 Interpret output results in the form of - text / diagram /animation for Axial forces, S.F., B.M. and Deflection. 6.6 Study of Stress Contour for continuum structure (Plate/Shell)- (No Analysis)

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	**Fundamentals**	**05**	**02**	**02**	**04**	**08**
II	**Fixed Beams**	**08**	**04**	**04**	**06**	**14**
III	**Moment Distribution Method**	**10**	**04**	**04**	**08**	**16**
IV	**Direct and Bending Stresses**	**07**	**02**	**04**	**06**	**12**
V	**Principal planes and Principal stresses**	**07**	**02**	**02**	**06**	**12**
VI	**Introduction to computer aided structural analysis**	**05**	**02**	**02**	**04**	**08**
Total		**42**	**16**	**18**	**36**	**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 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) Collect photographs of determinate & indeterminate structures from nearby locations.
b) Identify different situations with photographs of structural members where combined direct and bending stresses occur in the field.
c) Identify different situations with photographs of nearby retaining structures.
d) Identify situations where in a plane is subjected to complex stresses.
e) List out various softwares available and submit a review 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.
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 semester, 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 field application based, internet-based, workshop-based, laboratory-based or theory 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 **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) Analyse and compare B.M. and S.F. values at Supports and Mid span for simply supported beam and fixed beam having same span and loading conditions for three different cases.
b) Prepare a spreadsheet computer program or to analyse fixed beams by moment area method.
c) From a real life problem, calculate loads on a continuous beam (from slab, wall etc) and analyse the beam with a Moment Distribution Method or with structural engineering software.
d) Prepare spreadsheet or computer program to determine combined direct and bending stresses for an eccentric loaded column for given data.
e) Prepare spreadsheet or computer program to determine pressure at base for dam or retaining wall and check the stability for given data.
f) Prepare spreadsheet or computer program to analyse strained structural material and compare answer by graphical method (Mohr's Circle) with AutoCAD
g) Analyse a small building with structural engineering software.

13. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1	Theory of Structures(SMTS-II)	Dr. B.C.Punamia Ashokkumar Jain Arunkumar Jain	Laxmi Publications Pvt. Ltd. NewDelhi ISBN: 81-700-861-83
2	A Textbook of Strength of Materials (Mechanics of Solids)	R.S.Khurmi N. Khurmi	S Chand Publishing, Delhi (2019) ISBN: 9789352833979
3	Structural Analysis-I	S.S.Bhavikatti	Vikas Publishing House, New Delhi ISBN: 81-947-519-85
4	Matrix Analysis of Framed Structures	William Weaver,Jr. , James M. Gere	CBS Publisher and Distributor Pvt. Ltd. ISBN : 978-8123911519
5	Matrix methods of Structural Analysis	S.S. Bhavikatti	I.K. International Publishing House, Delhi, ISBN : 978-9381141359

14. SOFTWARE/LEARNING WEBSITES

a) NPTEL Course :- Matrix method of Structural Analysis by IIT, Kharagpur
https://archive.nptel.ac.in/courses/105/105/105105180/
b) Free Structural Analysis Softwares :
https://www.dlubal.com/en/education/students-and-schools/free-structural-analysis-software-for-schools
https://skyciv.com/design/free-design-software/

15. PO-COMPETENCY-CO MAPPING

Semester V	Advance Analysis of Structures (Course Code: 4340602)						
	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	Analyse complex structural engineering problems manually and with the help of software and interpret results.						
Course Outcomes COa)Identify determinate & indeterminate structures and compute degree of indeterminacy	3	2	-	-	-	-	2
COb) Analyse a symmetrically loaded fixed beam with moment area method and draw SF & BM diagrams.	2	3	-	-	2	2	2
COc) Analyse a symmetrically loaded continuous beam and portal frame(without any lateral sway) Moment Distribution Method and draw SF & BM diagrams	2	3	-	-	2	2	2
COd) Analyse column , dam and retaining wall subjected to eccentric axial loading to draw stress distribution diagram and check for no tension condition.	2	3	-	-	2	2	2

COe)Analyse beam, plane truss and plane frame on structural analysis software and interpret output results	2	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

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GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)
Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
VI – Semester
Course Title: Design of Structures
(Course Code: 4360601)

Diploma programme in which this course is offered	Semester in which offered
Civil Engineering	Sixth Semester

1. RATIONALE

After learning Mechanics of rigid bodies in 2nd semester and Mechanics of deformable bodies in 3rd semester, this subject "Design of Structures" introduced in 6th semester, as it deals with the design and analysis of R.C.C. and Steel structures, is the backbone of Civil Engineering Course. The design of prime members like Slabs, Beams, Columns and Footing in R.C.C. and In Steel structures some Introductory topics like design of connections and calculations of various loads on Roof Truss are intended to incorporate in this subject of design of structures.

2. COMPETENCY

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

- **Analyze and Design important structural members of R.C.C. and primary knowledge of bolted and welded connections for Steel structures and various loads for steel structures.**

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. Analyze and Design singly reinforced rectangular beam for flexure and shear.
b. Design One way and Two way slabs for simply supported conditions.
c. Design axially loaded short column and pad footing.
d. Design Bolted and Welded Connections for steel structures.
e. Determine Dead Load, Live Load and Wind Load on Roof Truss

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	4	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.*

Note: Subject related Indian Standard Codes (1) IS:456-2000 (2) IS:800-2007 (3) IS: 875 (Part- I,II,III) (4) SP-16 Design Aid to IS-456 (5) SP-6 Handbook for Steel Structures will be allowed during Examinations.

5. SUGGESTED ASSIGNMENTS/ EXERCISES :

The following practical outcomes (PrOs) are the subcomponents 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	Interpret IS Code provisions for Limit state R.C.C. Design from IS:456-2000 and SP-16	I	02 *
2	Analyse Singly Reinforced Beams for Moment of Resistance from given data (2-Problems).	II	04*
3	Design of singly reinforced beams for flexure and shear and apply necessary checks from given data (1-Problem).	II,III	04 *
4	Design of One way simply supported slabs and apply necessary checks from given data (1-Problem).	IV	04*
5	Draw sketches (not to scale) showing reinforcement details of singly and doubly reinforced beams and one way simply supported slab in longitudinal and cross sectional view.	II,III,IV	02*
6	Draw structural details of the designed beam , simply support a one way slab in A2 size drawing sheet with scale. (Sheet-1)	II,III,IV	04*
7	Design of Two way simply supported slabs and apply necessary checks from given data. (Corners not held down condition only)-(1-Problem)	IV	04*
8	Analyse and design axially loaded short square column and design pad footing of same column from given data.	V	06*
9	Draw sketches (not to scale) showing reinforcement details of axially loaded short rectangular, Circular columns and isolated pad and slope footing in plan and sectional view in longitudinal and cross sectional view.	IV,V	02*
10	Draw structural details of the designed two way slab, column and footing in A2 size drawing sheet with scale. (Sheet-2)	IV,V	04*
11	Interpret IS Code provisions for Limit state Steel Design from IS:800-2007 and SP-6	VI	02 *
12	Draw sketches (not to scale) showing details for standard rolled steel sections, built up sections, Beam to Beam and Beam to Column connections (Bolted and Welded).	VI,VII	02*
13	Design a bolted connection for the given data of steel section as per IS: 800-2007.	VII	04*

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
14	Design a welded connection for the given data of steel section as per IS: 800-2007.	VII	04*
15	Interpret IS provision for dead load, live load and wind load for steel roof truss from IS 875 (Part- I to III)	VIII	02*
16	Draw sketches (not to scale) for types of roof trusses, components of roof truss and important four joints like ridge joint, eave joint, bottom middle joint and intermediate joint.	VIII	02*
17	Calculate dead load, live load and wind load for the given data of steel roof truss with graphical method (sheet-3) and prepare a force table.	VIII	04*
	Total hours		**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	Interpretation of given data and its understanding.	10
2	Selection of sketches/Process of designing of the given structural components using relevant I.S.codes and preparing of report of site visit..	30
3	Presentation of sketches in sketchbook, neatness and cleanliness of sheets and writing reports.	30
4	Individual work, work as a team-member	10
5	Completion and submission of work in time.	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.

Sr. No.	Drawing tools and other design aids (for all PrOs)
1	Drawing boards and drawing instruments.
2	Scientific calculator and all relevant IS codes.
3	Computers and Printers.
4	Available CAD software(Not mandatory)

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 safety practices while using equipment.
c) Realize the importance of green energy. (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 Fundamentals of R.C.C. Design	1a. Identify components and their characteristics for RCC structures. 1b. Use limit states conditions for analysis and design of RCC structures. 1c. Use IS Code provisions for General Design Consideration.	1.1 Reinforced Cement Concrete, necessity of steel in concrete, normal location of steel in beams, slabs, column & footing. 1.2 Limit State, Limit State of Collapse-Flexure, Shear, Compression, Torsion, Limit State of Serviceability-deflection and Cracking. 1.3 Characteristic Strength of concrete and steel, partial safety factor of concrete and steel and partial safety factors for loads. 1.4 Nominal Cover, Effective depth, Effective span.
Unit – II Singly Reinforced Beam	2a. Differentiate types of RC beams. 2b. Calculate moment of resistance for given type of section. 2c. Design a singly RC beam section for given condition. 2d. Apply check for deflection 2e. Draw reinforcement detailing for the designed beam section as per IS provision.	2.1. Types of beam: Singly reinforced beam, Doubly reinforced beam, T-beam, L-beam. Difference among various beams. 2.2. Stress-strain diagram for singly RC section. Under reinforced, over reinforced and balanced section. 2.3. Analysis of Singly RC beam: Determination of lever arm, total tension, total compression, percentage area of reinforcement and Moment of resistance. Numerical based on this.

		2.4. Design and detailing of Singly RC beam: Determination size of section, area and number of reinforcement bars. Combination of different diameters of reinforcement bars. Check for spacing and cover. Numerical based on this with checking design for deflection.
Unit– III **Shear and Development Length**	3a. Identify the pattern of shear failure in beams and slabs. 3b. Design shear reinforcement in beams as per given Conditions. 3c. Calculate development length as per given conditions. 3d. Check for development length in R.C.C. Design	3.1 Shear: Definition of shear, IS code specifications, single legged and two legged shear reinforcement. 3.2 Vertical stirrups, Incline stirrups, benefit of bent up of main tension reinforcement. Spacing of stirrups. Numerical based on this. 3.3 Effect of shear in slabs. IS code provision. 3.4 Development Length: Definition of development length, IS provision for determination of development length for tension and compression zone. Numerical based on this.
Unit– IV **Slabs**	4a. Suggest types of slab for given support conditions. 4b. Design one way and two way simply supported slabs as per given data. 4c. Examine suitability of designed slab by applying deflection and cracking criteria. 4d. Draw reinforcement detailing for the designed slab as per IS provision.	4.1 Slab: Types of slabs. One way simply supported slab. Two way slab and one way continuous slab. 4.2 IS provision for main reinforcement, distribution reinforcement, minimum and maximum steel area, effective span, effective depth, effective cover. 4.3 Depth of Slab from deflection criteria, Dead Load, Live Load and Floor finish load on Slab. Bending moment due to loads. 4.4 Design and detailing of one way simply supported and cantilever slabs. Check limit state of serviceability. Numerical based on this. 4.5 Design and detailing of two way simply supported slab (only corners not held down condition). Check the limit state of serviceability. Numerical based on this.
Unit– V **Axially loaded short column and pad footing.**	5a. Identify the type of column based on load condition. 5b. Analyze and Design axially loaded short columns. 5c. . Design Isolated Pad Footing for column. 5d. Draw reinforcement details of column and footing.	5.1 Column: Types of column, Long Column, Short column, Axially loaded column, uniaxially loaded column and biaxially loaded column. 5.2 Limit state of collapse: Compression, assumptions, effective length, slenderness ratio, minimum eccentricity. IS provision for reinforcement in

		column, lateral reinforcement as tie only for column, 5.3 Load analysis of axially loaded short columns. 5.4 Design of axially loaded short columns. Check for minimum eccentricity. 5.5 Footing: Types of isolated footing, pad and sloped footing. IS specification for reinforcement in pad footing only. 5.6 Design of isolated pad footing. Check for bending, one way shear and two way shear, check for development length in footing. Numerical based on this with reinforcement details.
Unit– VI Fundamental of Steel Design	6a. Identify relevant steel structure from given condition. 6b. Identify the components of the given steel structure. 6c. Choose properties of the given steel section.	6.1 Steel versus RCC as a building material. Advantages and disadvantages of steel. Types of steel sections normally in use. 6.2 Characteristic strength and design strength, Stress-strain curve for mild steel. Partial safety factors for load and materials as per IS provision. 6.3 Limit state of strength and serviceability.
Unit– VII Bolted and Welded connections	7a. Select type of connection for the given steel structure. 7b. Compute the strength of bolted and welded connection for the given condition. 7c. Design bolted and welded connection for given condition.	7.1 Types of connections in steel structures Bolted connection: Types of bolts, Black Bolts, Turned Bolts, HSFG Bolts, Grade of Bolts Lap and Butt Joint, Minimum and Maximum Pitch, Tack Bolting, Edge Distance, Gauge Distance, Bolt Hole. 7.2 Shear Capacity of Bolt – Vdsb, Bearing Capacity of Bolt – Vdpb as per IS-800-2007, Bolt Value, Efficiency of Joint. 7.3 Analysis and design of bolted connection of plate and Angle sections. Numericals based on this. 7.4 Welded connection: Types of weld, Fillet Weld and its symbol, tack welding, minimum and maximum size of weld, effective throat thickness, end returns. 7.5 Analysis and design of Fillet weld in plate and angle section as per IS-800-2007. Numericals based on this.
Unit– VIII Load Calculation for Roof Truss	8a. Identify the type of steel roof truss. 8b. Compute dead load, live load and wind load per panel point	8.1 Types of Truss for various spans, Pitch of Truss, Rise, Spacing of Truss, Members of Truss: Purlin, Principal Rafter, Main Tie, Sag Tie. Joints: eave

	as per given condition. 8c. Derive design load and check load from different load combinations.	joint, ridge joint, intermediate joint and middle bottom joint. Roofing material- GI and AC Sheets. 8.2 Types of load and load combinations for roof truss as per IS 875 codal provisions. 8.3 Dead Load of Truss per panel point: self weight ,weight of Purlin , Wind Bracing , and weight of Roofing Material . 8.4 Live Load per panel point on purlin and Truss. 8.5 Wind Load per panel point on roof truss 8.6 Numericals on dead load, live and wind load for roof truss.

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	**Fundamentals of R.C.C. Design**	**02**	**00**	**02**	**02**	**04**
II	**Singly Reinforced Beam**	**08**	**02**	**04**	**06**	**12**
III	**Shear and Development Length**	**04**	**02**	**02**	**04**	**08**
IV	**Slabs**	**08**	**02**	**04**	**06**	**12**
V	**Axially loaded short column and pad footing.**	**06**	**02**	**04**	**04**	**10**
VI	**Fundamentals of Steel Design**	**02**	**00**	**02**	**02**	**04**
VII	**Bolted and Welded connections**	**06**	**02**	**02**	**06**	**10**
VIII	**Load Calculation for Roof Truss**	**06**	**02**	**02**	**06**	**10**
Total		**42**	**12**	**24**	**34**	**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 conventional teaching and 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) Collect different photographs of nearby structures (RCC or Steel) showing different components clearly to create a self site visit.
b) Collect the photographs of different types of footings/foundations being constructed nearby with their primary details.
c) Collect different photographs of steel structural members (by visiting railway station, warehouse or industrial sheds) where connections can be shown actually implemented at site.
d) Collect the photographs of five different types of rolled steel sections.
e) Collect the information with photographs of structural failure of RCC components due to any reason.
f) Collect the information with photographs of world famous steel structures from journals or websites.
g) Collect the information with photographs of structural members having well known structures of India.

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 ***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-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 field application based, internet-based, workshop-based, laboratory-based or theory (analysis or design) 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 **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) Determine the moment of resistance of different cross sections for beams having the same area and different grades of concrete.
b) Compare the price of different grades of steel bars by actual market survey and prepare the report.
c) Prepare spreadsheet or computer program to determine moment of resistance of singly reinforced beam for three grades of steel and concrete.
d) Prepare spreadsheet or computer program to determine development length for different grades of steel , concrete, dia. of bar in tension and compression.
e) Prepare spreadsheet or computer program to calculate load carrying capacity of axially loaded short RC column.
f) Prepare drawing in Autocad for Dead load, Live load and Wind Load for given roof truss and compare answers with manual drawing.
g) Carry out market survey for steel sections which are available in market but not included in steel table or SP:6.

13. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1	Design of Reinforced Concrete Structures	N Krishna Raju	CBS Publishers & Distribution Pvt. Ltd. NewDelhi ISBN: 9789385915369
2	Design of Reinforced Concrete Structures	N Subramanian	Oxford Publisher ISBN: 0198086946
3	Reinforced Concrete Vol.I	Dr.H.J.Shah	Charotar Publication ISBN: 9789385039478
4	Design of Steel Structures By Limit State Method as per IS:800-2007	S.S.Bhavikatti	Dreamtech press New Delhi ISBN:9389307058
5	Limit State design of Steel structures	S.K.Duggal	Mc Graw Hill ISBN: 9353164877
6	Limit State design of Steel structures As per IS:800-2007	S.Kanthimathinathan	Dreamtech press New Delhi ISBN:9389447577
7	IS:456-2000- Plain and Reinforced concrete code of practice.	BIS, New Delhi	BIS, New Delhi
8	IS:800-2007-Indian Standard Code of practice for use of structural steel in general building	BIS, New Delhi	BIS, New Delhi

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
	construction.		
9	IS: 875 part 1 to 5, Indian Standard Code for Loading Standards	BIS, New Delhi	BIS, New Delhi
10	SP:16-Design Aids for reinforced concrete to IS:456	BIS, New Delhi	BIS, New Delhi
11	SP:6-Handbook for Structural Engineers(Structural Steel Sections)	BIS, New Delhi	BIS, New Delhi
12	SP:34-Handbook on Concrete Reinforcement and Detailing	BIS, New Delhi	BIS, New Delhi

14. SOFTWARE/LEARNING WEBSITES

a) NPTEL Course :-Reinforced Cement Concrete by IIT, Kharagpur
https://archive.nptel.ac.in/courses/105/105/105105105/

b) NPTEL Video series for Steel design by IIT, Kharagpur
https://archive.nptel.ac.in/courses/105/105/105105162/

15. PO-COMPETENCY-CO MAPPING

Semester III	Design of Structures (Course Code: 4360601)						
	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	Analyze and Design important structural members of R.C.C. and primary knowledge of bolted and welded connections for Steel structures and various loads for steel structures.						
Course Outcomes COa) Analyze and Design singly reinforced rectangular beam for flexure and shear.	3	3	3	2	3	2	2
COb) Design One way and Two way slabs for	2	3	3	2	2	2	2

simply supported conditions.							
COc) Design axially loaded short column and pad footing.	2	3	3	2	2	2	2
COd) Design Bolted and Welded Connections for steel structures.	2	3	3	3	2	2	2
COe) Determine Dead Load, Live Load and Wind Load on Roof Truss.	2	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

Sr. No.	Name and Designation	Institute	Contact No.	Email
1.	Shri P.V. Rayjada, HOD Applied Mechanics	L.E. College (Diploma), Morbi	9824281646	satwikpr@gmail.com
2.	Dr. J.B.Oza, I/C HOD Applied Mechanics	G.P.Rajkot	9429048253	jiteshboza@gmail.com
3.	Shri S.M.Kondhiya, Sr. Lecturer Applied Mechanics	G.P. Rajkot	9825764005	sharadkondhiya@gmail.com
4.	Shri R.R. Makwana, Sr. Lecturer Applied Mechanics	L.E. College (Diploma), Morbi	9824128087	rrm.applied@gmail.com

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Course Title: Water Supply & Sanitary Engineering

(Course Code: 4360602)

Diploma program in which this course is offered	Semester in which offered
Civil Engineering	6th Semester

1. RATIONALE

Water is very important element in civilization. Social life developed on the bank of Water-source. If society wants to make remarkable growth, the mental as well as social health play vital role. For that purpose, Pure, potable and palatable water to be supplied to the society and to maintain the hygiene of it, the used water must be collected and disposed of in nature by giving proper treatment, so the natural flora and fauna will not get affected by sewage disposal. In present time, solid waste also wants more attention. The technician must know about the quality as well as quality of domestic water to be supplied to the society. Similarly, technician should be conversant with the collection, conveyance, treatment and disposal of waste water.

2. COMPETENCY

The course content should be taught and the curriculum should be implemented with the aim to develop different types of skills so that students are able to acquire following competency:

1. Selection of suitable treatment to raw water based on its quality useful for domestic purpose.
2. Maintain the efficiency of pipe-network for water supply and Sewage disposal effectively.

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 to demonstrate following course outcomes.

1. Understanding of importance of Water Supply and sanitary Engineering.
2. Calculate and Estimate the impurities present in water used for Domestic as well as construction works.
3. Laying and maintenance of water distribution system and sewer-networks.
4. Decide the requirement of treatment to make water potable and the treatment require for sewage to safely dispose off.
5. Effective implementation of house plumbing work.

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	-	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 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 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'.*

No	*Exercise*	*Hours*
1.	Examples of prediction of future population by various methods. Examples of calculation of hardness of water for a given samples.	***Home Assignment***

2.	**Sketches** 1 Layout of Water treatment plant 2 Layout of Sewage treatment plant 3 Pipe Joints 4 Distribution System 5 Pipe fittings & sanitary fittings. 6 Activated sludge process 7 Trickling Filter 8 House Drainage Plan	***Home Assignment***
3.	**Design:**	**02**
	Design of septic tank (Student will be given data, I.S. 2470(II) and handouts on septic tank, and should be asked to design the septic tank.)	
4.	**Laboratory Experiments**	**10**
	1. Determine pH value of given water sample. 2. Determine turbidity of given water sample. 3. Determine Residual chlorine from given sample of water 4. Determine B.O.D. of wastewater sample. 5. Determine C.O.D. of wastewater sample.	
5.	**Visits**	**08**
	1. Water Treatment Plant 2. Sewage Treatment Plant 3. Maintenance work of water supply mains and sewage system **Note: submit detailed report on visits carried out**	

6.	**Seminar**	***08***
	The topic for the seminar should be given to the group of three to five students and they shall be asked to defend the seminar in presence of teacher and other students**.** Detailed report of seminar should be submitted at the end.	

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	Initiative of students in collecting data and computation	20
2	Use of appropriate methods while work in team/group	20
3	Comprehension and presentation skills in drawing	20
4	Follow up standard steps for design calculations	20
5	Presentation of seminar and Timely submission	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 practice in all institutions across the state.

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	1. 2. Spectrophotometer 3. 4. Water Analysis Kit 5. B.O.D. Incubator Reflux apparatus Various model of Fitting and Fixtures	4

7. AFFECTIVE DOMAIN OUTCOMES

The following ***sample*** Affective Domain Outcomes (ADOs) are embedded in many of the abovementioned 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 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

Only the major Underpinning Theory is formulated as higher level UOs of *Revised Bloom's taxonomy* in order for the 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 the attainment of COs and competency.

Unit	***Major Learning Outcomes (Course Outcomes in Cognitive Domain according to NBA terminology)***	***Topics and Sub-topics***
Unit-I Introduction	1.a *Discuss Importance of Water supply engineering* 1.b *Identify sources of water for potable use*	1.1 *Importance and necessity of water supply Engineering* 1.2 *Sources of water* 1.3 *Suitability of water* 1.4 *Choice of source*
Unit-II Quantity and Quality of Water	2.a *Calculate water demand for future population* 2.b *Enlist factor affecting water demand* 2.c *Determine various impurities found in water source*	2.1 *Types of demand* 2.2 *Population forecast* 2.3 *Computation of quantity of water* 2.4 *Fluctuation in demand* 2.5 *Factors affecting demand* 2.6 *Impurities in water* 2.7 *Collection of water sample* 2.8 *Physical Chemical and Biological tests* 2.9 *Standards of quality of water*

Unit-III Treatment of Water	3.a *Discuss objectives of water Treatment* 3.b *Discuss principles used in water treatment.* 3.c *Discuss various units used for treatment of water*	3.1 *Objects of water treatment* 3.2 *Location of water treatment plant* 3.3 *Layout of water treatment plant* 3.4 *Basic principles of working of treatment plant* 3.5 *Functioning of Coagulation treatment plant*
		3.6 *Sedimentation* 3.7 *Filtration* 3.8 *Disinfection* 3.9 *Water Softening*
Unit-IV Conveyance of Water	4.a *Enlist various materials used for pipe* 4.b *Discuss various pipe joints in Distribution system* 4.c *Enlist different valves and fittings used in pipe network*	4.1 *Types of pipes used for conveyance* 4.2 *Pipe joints* 4.3 *Laying of Pipes* 4.4 *Distribution system* 4.5 *Types of valves* 4.6 *Types of Meters* 4.7 *Pipe fittings and fixtures*
Unit-V Maintenance of Water Supply Mains	*5.a Discuss necessity of maintenance of water supply mains*	5.1 *Necessity* 5.2 *Methods to prevent leaks* 5.3 *Measures for conservation of water*

Unit-VI Sanitation System	6.a *Discuss objectives of sewage disposal* 6.b *Discuss methods of sewage collection*	6.1 *Related terms* 6.2 *Objective of sewage disposal* 6.3 *Methods of sewage collection* 6.4 *Conservancy system* 6.5 *Water carriage system*

Unit-VII ***Drains and Sewers***	7.a *Discuss sewer appurtenances* 7.b *Discuss Testing and maintenance of sewer*	7.1 *Classification of Drains* 7.2 *Sewer section* 7.3 *Sewer joint* 7.4 *Manhole* 7.5 *Flushing tank* 7.6 *Catch basin* 7.7 *Laying of sewer* 7.8 *Appurtenances and its locations* 7.9 *Hydraulic testing of sewer pipe* 7.10 *Maintenance of sewer*
Unit-VIII ***Sewage Treatment and Disposal***	8.a *Discuss Characteristics of sewage* 8.b Discuss sewage treatment process	8.1 *Characteristics of sewage* 8.2 *Sampling of sewage* 8.3 *Treatment of sewage*
	8.c Explain methods of sewage disposal	8.4 *B.O.D. Test, C.O.D. test* 8.5 *Methods of sewage disposal*
Unit-IX ***House Plumbing***	9.a *Explain house plumbing system* 9.b *Discuss plumbing practice and safety precautions* 9.c *Enlist sanitary fittings used in house plumbing*	9.1 *Related terms* 9.2 *Plumbing tools* 9.3 *Pipes and pipe fittings* 9.4 *Fixing and jointing pipes and accessories* 9.5 *Traps* 9.6 *House drainage plant* 9.7 *Plumbing practice and operations* 9.8 *Safety and precautions* 9.9 *Sanitary fittings*

Unit-X Maintenance of Sewage System	10.a *Explain procedure for maintenance of sewerage system* 10.b *Explain functions of maintenance equipments and tools*	10.1 *Procedure for maintenance of sewerage system* 10.2 *Causes of trouble and odor* 10.3 *Sewer cleaning operations* 10.4 *Requirements of maintenance* 10.5 *Functions of each maintenance equipments and tool* 10.6 *Selection of equipment for given maintenance job.* 10.7 *Explosives in sewers.* 10.8 *Safety measures for sewer-men*
Unit-XI ***Recycling of Waste Water and Solid Waste***	11.a *Discuss different methods of recycling waste water* 11.b *Discuss management and utilization of solid waste generated from society*	11.1 *Different method with respect to quality of waste water* 11.2 *Utilization and management of solid waste*

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

Uni t	***Unit Title***	***Teaching Hours***	***Distribution of Theory Marks***			
			R Level	***U Level***	***A Level***	***Total Marks***
I	*Introduction to Water Supply Engineering*	*2*	*1*	*1*	*0*	*4*
II	*Quantity and Quality of Water*	*4*	*1*	*1*	*2*	*7*
III	*Treatment of Water*	*7*	*1*	*2*	*4*	*12*
IV	*Conveyance of Water*	*5*	*2*	*2*	*1*	*9*
V	*Maintenance of Water Supply Means*	*2*	*1*	*1*	*0*	*4*

VI	*Sanitation System*	*3*	*2*	*1*	*0*	*5*
VII	*Drains and Sewers*	*4*	*1*	*2*	*1*	*7*
VIII	*Sewage treatment and Disposal*	*7*	*2*	*2*	*3*	*10*
IX	*House Plumbing*	*3*	*1*	*1*	*1*	*4*
X	*Maintenance of Sewage System*	*2*	*1*	*1*	*0*	*4*
XI	*Recycling of Waste Water and Solid Waste*	*3*	*1*	*1*	*1*	*4*
	Total:	*42*	*14*	*15*	*13*	*70*

Legends: *R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*
Note*: This specification table provides general guidelines to assist students in 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 vary slightly from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested studentrelated ***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 a model of septic tank.

(b) Prepare model of Water/ wastewater treatment plant.

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.11***, 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

g) Expert lecture by practicing valuer on Valuation techniques, methods and criteria of any property.

h) Expert lecture on latest software for Estimating and costing

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, workshopbased, 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 industryoriented 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) Water quality analysis of given sample

(b) Design of water treatment plant

(c) sanitation survey of given building

(d) Evaluation of present water distribution system of given area.

(e) Evaluation of factory/industry sample with respect to dispose off in environment.

(f) Study of water borne diseases in your area in last 20 years.

(h) Solid waste management required for given site.

13. SUGGESTED LEARNING RESOURCES

Name of book	Author	Publisher
water supply & Sanitary Engg.	S.K.Hussain	Oxford & IBH
Elements of Public Health Engineering	K.N.Duggal	S.Chand & Co.
Water supply & Sanitary Engg.	Vazirani & Chandola	Khanna Publishers

A Text book of water supply & Sanitary Engg.	S.K.Garg	Khanna Publishers
Water supply & Sanitary Engineering	Birdie G.S.	Dhanpatrai &Sons
A Text book of water supply engineering	V.N. Gharpure	Allied Book Stall, Baroda
A Text book of sanitary engineering	V.N. Gharpure	Allied Book Stall, Baroda
Water pollution & Disposal of Waste Water on Land	U.N.Mahida	Tata McGraw Hill
Municipal and Rural Sanitation	Ehlers & Steel	Mc Graw hill book
Water and Waste water Engineering	Gorden ,Fair& Gayer Okun	John willey& Sons

14. SOFTWARE/LEARNING WEBSITES

a) www.nptel.ac.in

15. PO-COMPETENCY-CO MAPPING

Semester VI	**WATER SUPPLY & SANITARY ENGINEERING (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**	**PSO 2**	**PSO 3** (If needed)
Competency	Impart knowledge about irrigation structures and irrigation systems in different phases.									
CO(1) Importance of Water Supply and sanitary Engineering. .	3	3	-	-	1	-	-			

CO(2) Calculate and Estimate the impurities present in water used for Domestic as well as construction works.	2	3	3	3	1	-	-			
CO(3) Laying and maintenance of water distribution system and sewer-networks	3	3	3	-	1	2	1			
CO(4) Decide the requirement of treatment to make water potable and the treatment require for sewage to safely dispose off.	3	3	3	3	2	-	2			
CO(5) Effective implementation of house plumbing work.	3	3	2	-	1	1	1			

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. D. H. Dalal	GPG Ahmedabad	9428858913	dhdalal@gmail.com
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GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

COURSE TITLE: CONSTRUCTION PROJECT MANAGEMENT
(COURSE CODE: 4360603**)**

Diploma programme in which this course is offered	Semester in which offered
Civil Engineering	six

1. RATIONALE:

The construction project has numerous necessities that include a thorough understanding of the design/planning and the entire construction process, as well as modern business managementtools/methods.Projectmanagementskillsareimportantforoverallplanning,coordination,andc ontrolofaproject from commencement to accomplishment of the project efficiently and effectively. The awareness ofvariousprojectmanagementtechniquesisveryessentialtoensurethatconstructionprojectsare completed within time and budget which is a biggest challenge. To overcome this challenge, project managementteamhastomanagevariousresourceswiththeobjectivetocompletetheconstruction project with predetermine scope, cost, time and quality, and the constraints imposed on human, materialandfinancialresources.Thiscourseisthereforedesignedinsuchawaythatafterlearning this course the students will be able to plan, organize and control construction operations by using various management techniques and software. Thus, students would be able to complete the project in time &within the allocated budget and as per desired quality. This course is therefore very important course for diplomaholdersincivilengineeringsincetheyhavetomanageconstructionprojectsontheirown.

2. COMPETENCY:

The course content should be taught and with the aim to develop different types of managerial skills so that students are able to acquire following competencies.

- **This course provides an understanding of construction management, including contracts, subcontracting, tendering and scheduling, cost control, claims, safety and quality and project closeout.**
- **Manage various resources and activities, effectively and efficiently using appropriate techniques and software to complete the construction project within stipulated time and allocated budget according to desired quality.**

3. COURSE OUTCOMES (COs)

The theory should be taught and exercises 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.

a) Describe construction project management and roles of various construction agencies.
b) Explain contracts and tendering process.

c) Develop the CPM and PERT network of various construction activities.
d) Show leadership skills required to manage various construction resources and achieve targets.
e) Apply safety measures and legal aspects at various construction works.

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	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 LIST OF EXERCISES/PRACTICAL

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'. Following is the list of practical exercises for guidance.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1.	Prepare the list of roles and responsibilities of various personnel in any Private Construction organization.	1	2*
2.	List the reasons of project failure from a given case study.	1	2*
3.	Study given tender documents and formulate report containing terms and conditions.	2	2*
4.	Study given contract document & analysis its strengths and weaknesses and write a report on it. (Given contraction documents should be comprehensive covering all terms and conditions).	2	2*
5.	Prepare tender notice for given construction work.	2	2*
6.	Prepare a Bar Charts and prepare CPM and PERT for Project scheduling for given project data.	3	4*
7.	Carry out cost optimization for given project.	3	2*
8.	Prepare material and labor schedule for given project data.	4	2*
9.	Prepare the organization chart of any one government/public sector organization executing any major civil engineering projects.	4	2*

10.	Prepare the action plan to reduce the accident on given construction project.	5	2*
11.	Prepare the chart/ power point Presentation on various safety devices used at construction site.	5	2
12.	Study different labor laws applicable for construction project and prepare a report.	4	2*
13.	To visit nearby constructions site and to prepare a report on investment and operating cost, output of various equipment.	5	2
14.	Prepare a presentation on relevant topic and present a seminar.	1,2,3,4,5	4*
		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, 2,3, 4,5,6,7,8,9,10,11	
1	Collecting information	10
2	Interpretation of data collected	10
3	Preparing the drawing/report/chart	40
4	Answer the question	10
5	Submission of drawing/report/chart in time	20
6	Attendance and punctuality	10
	Total	**100**

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
	For PrOs12,13	
1	Discipline	10
2	Involvement during site visit	20
3	Data collection at site	20
4	Organization of report	20
5	Answer the question	10
6	Timely submission of report	20
	Total	**100**

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
	For PrOs 14	
1	Initiative	20
2	Data Collection	20
3	Content of Presentation (Use of multi media)	20
4	Presentation (Body Language- Gesture, Posture etc.)	20
5	Answer the question	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 practical's in all institutions across the state.

S. No.	Equipment Name with Broad Specifications	PrO. No.

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 team member/ individual.
b) Follow ethical practices.
c) Follow safe practice on site/ lab.
d) Practice good housekeeping.
e) Maintain tools and equipment.

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 (UO's)	Topics and Sub-topics
UNIT-I **Construction Industry and Management**	**1a.** Project Management **1b.** Identify the roles of different agencies in the given construction industry with justification **1c.** Identify the functions of specified personnel in the given organization with justification.	1.1 Project Definition and formulation. 1.2 Construction Project Management.: objective and Functions 1.3 Causes of Project failure. 1.4 Agencies associated with construction work-owner, promoter, builder, designer, architects. 1.5 Qualities, role and responsibilities of project manager, Role of Project Management Consultants.

UNIT-II **Tendering**	**2a.** Explain various features of Contract document. **2b.** Prepare a Tender document for the construction project **2c.** Describe standard tendering process in Government. **2d.** Explain various technical terms used in governmentorganizations.	2.1 Contract-Introduction, requirement and types. 2.2 Contract documents and conditions of contract, Contract agreement 2.3 Tender-Types, Termsand Conditions, Tendering procedure, Scrutiny, Acceptance, Rejecting. 2.4 Prepare tender notice. 2.5 Technical terms-Administrativeapproval, Technical Sanction, Issue rate, Competent Authority, Earnest money deposit (EMD) and Security deposit(SD). 2.6 Standard Bidding Process in state government.
UNIT-III **Time Management Methods and Tools in Construction**	**3a.** Project Scheduling. **3b.** Draw the bar chart for the given construction project. **3c.** DrawCPM and PERT network for construction work. **3d.** Describe the features of construction planning software.	3.1 Method of Construction Scheduling, Development of bar chart, Merits and limitations of bar chart. 3.2 Elements of Network: Event, activity, dummy activities, Precautionsin drawing Network, Numbering the events. 3.3 Workbreakdown structure, activity cost and time estimation in CPM and PERT techniques. Type of Floats and their significance. 3.4 Critical path method-Important terms, Basic Rules, Advantages and disadvantages. 3.5 Examples of CPM and PERT network. 3.6 PERT analysis-Important terms, Advantages and disadvantages. 3.7 Cost optimization. 3.8 Introduction to Project Management software.

UNIT-IV **Construction Resourceman agement**	**4a.** Describe features of material, labor and equipment management. **4b.** Prepare Job layout. **4c.** Prepare material, labour and equipmentschedule.	4.1 Material management-Purpose, Objective, material Scheduling, material handling, Storage, safety precautions, Economy Order Quantity. 4.2 Job layout 4.3 Equipment Management : Equipment Scheduling, Factors affecting selection of equipment. 4.4 Various costs associated with equipment, Maintenance Management, Replacement of Equipment, Economic life of Equipment. 4.5 Manpower Management : Objectives, Labour schedule, output. 4.6 Suitable organization structure for construction industry. 4.7 Information Management : MIS – its concept and need.
UNIT-V **Safety Aspect and Legal aspects in Construction Industry.**	**5a.** Identify causes of accidents at construction site in the given situation with justification. **5b.** Suggest safety measures to avoid accidents for the given construction site. **5c.** Apply relevant labor law/s in the given situation of a construction industry.	5.1 Concept of Safety in Construction Industry, Importance of Construction Safety. 5.2 Safety Benefits to Employers, Employees and Customers, Construction Safety Problems, Approaches to improve Construction Safety. 5.3 Safety measures in construction as per IS code 5.4 Workers Compensation 5.5 Labor laws related to construction industry.

***Note**:TheUOs 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 WITH HOURS&MARKS(Theory)

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Construction Industries and Management	03	02	03	02	07
II	Tendering.	06	04	04	04	12

III	Time Management Methods and Tools in Construction	08	06	07	08	21
IV	Construction Resource management	07	04	10	08	22
V	Safety Aspect and Legal aspects in Construction Industry.	04	02	04	02	08
Total		**28**	**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 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 LIST OFEXERCISES/PRACTICAL

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) Give seminar on relevant topic.
b) Undertake micro-projects.
c) Collect organizational set up of various departments.
d) Collect and interpret the bar charts or networks from construction sites.
e) Solve the numerical on bar chart, CPM, PERT and cost optimization.
f) Collect and interpret various store forms from PWD, WRD and MIP.
g) Download the labour laws documents from internet and write a brief summary on it.
h) Compile various safety slogans displayed at various sites with sources and write a brief summary on it.

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.11***, 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 is 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 orientedCOs.

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) Use any software of Construction Management to prepare the scheduling of a project.
b) Use any software of Construction Management to determine the critical path for the given construction project.
c) Interpret the network figures used in given civil engineering projects.
d) Prepare a report on different forms of inventory storage along with your interpretation.
e) Collect the information about latest safety measures adopted at construction project.
f) Compare various construction management software.
g) Use relevant software to collect information about modern techniques of material management like JIT/SAP/ERP.
h) Prepare a report on “Site planning and mobilization” for a given site.
i) Study of BOT Road Project.
j)Study of standard Bidding process in State Government.
k)Study of procurement policies and procedures for a given construction company.
k) Collect the information about labour management practices in construction industry.
l) prepare a report on owing and operating cost of the given construction equipments.

13. SUGGESTED LEARNINGRESOURCES

No.	Title	Author	Publisher
1	Construction Project Management	K.K.Chitkara	Tata McGraw-Hill
2	Project Planning and Controlling with PERT And CPM	Dr. B.C.PunmiaK.K.K handelwal	Laxmi Publications (P)Ltd.
3	Construction Management and accounts	Harpalsingh	Tata McGraw-Hill
4	Construction of Structures and Management work	S.C.Rangwala	Charotar Publication
5	Construction Management practice	V.K.Raina	Tata McGraw-Hill

6	Project Planning, Scheduling and Control in Construction: An Encyclopedia of Terms and Applications	Calin M.Popescu, ChotchaiCharoenngam	Wiley, New York, 1995
7	Construction Equipment and its Management	S.C.Sharma	Khanna Publication, New Delhi,1988.
8	Construction Planning and Management	P.S.Gahlot B.M.Dhir	Willey Eastern Ltd
9	Construction Project planning & Scheduling	Charles Patrick, Pearson	-
10	Construction Management and Planning	Sengupta and Guha	Tata McGraw Hill publication
11	Project Management-Planning and Control	Rory Burkey	Wiley,India 4th ed
12	Construction Planning, Equipment and Methods	Peurifoy, L., Schexnayder, C.J. and Shapira, A	McGraw Hill, New Delhi, 8th Edition, 2010
13	Construction Project Management Planning, Scheduling and Controlling	Chitakara	Tata McGraw Hill, New Delhi
14	Construction Engineering and Management	Seetharaman.S	Umesh Publication
15	Construction Equipment and its planning and Application.	Dr.Mahesh Varma	Metropolitan Book Company, New Delhi. 1983.

14. LIST OF SOFTWARE/LEARNING WEBSITES

- PrimaveraP6b
- www.slideshare.net
- www.civil.iitm.ac.in

15. PO-COMPETENCY-CO MAPPING

Semester VI	CONSTRUCTION PROJECT MANAGEMENT(Course Code: 4360603)									
	POs and PSOs									
Competency & Course Outcomes	PO 1Basic& Discipline specific knowledge	PO 2 Problem Analysis	PO 3Design/ development of solutions	PO 4Engineering Tools, Experimentation &Testing	PO 5Engineering practices for society, sustainability & environment	PO 6 Project Management	PO 7Life-long learning	PSO 1	PSO 2	PSO 3 (If needed)
Competency	• This course provides an understanding of construction management, including contracts, subcontracting, tendering and scheduling, cost control, claims, safety									

	and quality and project closeout. • **Manage various resources and activities, effectively and efficiently using appropriate techniques and software to complete the construction project within stipulated time and allocated budget according to desired quality.**									
Course Outcomes CO a) Describe construction project management and roles of various construction agencies	3	2	2	-	3	3	3	-	-	-
CO b) Explain contracts and tendering process	2	2	2	-	2	3	3	-	-	-
CO c) Develop the CPM and PERT network of various construction activities.	2	3	3	2	2	3	3	-	-	-
CO d) Show leadership skills required to manage various construction resources and achieve targets	2	2	2	2	3	3	3	-	-	-
CO e) Apply safety measures and legal aspects at various construction works.	2	3	1		3	2	3	-	-	-

17. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

Sr. No.	Name and Designation	Institute	Contact No.	Email
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GUJARATTECHNOLOGICALUNIVERSITY,AHMEDABAD,GUJARAT

Competency-focusedOutcome-basedGreenCurriculum-2021
(COGC-2021)

CourseTitle:Project-II
(CourseCode: 4360604)

Diploma Programme in which this course is offered	Semesterinwhichoffered
CivilEngineering	6thSemester

1. RATIONALE

In order to help the studentsdevelopment, live project challenges should be offered to them as often as possible. For the students to be able to use and apply engineering-based knowledge and skills to address real world challenges, they must have first-hand experience and confidence. The selected pursuits should be relevant to student's academic interests and of professional relevance to organizations in the industrial sphere. So as to participate and manage a large civil engineering projects in future.

The Project and Seminar are both combined with the goal of developing a specific set of communication skills (report preparation, survey report writing, lab experiment results writing, participating in group discussions, verbally defending the project in the form of Seminar, etc.).

2. COMPETENCY

Thegoal of this project is to enhance capabilities among the students for comprehensive analysis and practices in a systemic way todevelopdifferenttypesof skills sothat students areableto acquirefollowingcompetencies:

1. Apply the theoretical and practical knowledge and abilities which have learned in disciplines and courses to a project that will work in a real-world working context, ideally one that is industrial
2. Describe the functioning of the industrial setting and its working practices.
3. Explain what entrepreneurship is and how to become an entrepreneur
4. Determine and compare the gap between the technical knowledge gained through the curriculum and the real industrial requirement and to make up for it by acquiring additional knowledge as needed
5. Field computing and gaining practical experience in the planning, designing and execution of civil engineering projects.

3. COURSEOUTCOMES

Upon successful completion of this course, students will be able to;

CO.1 Apply principles of basic science and engineering fundamental in analysis, design and

operation of civil engineering systems.

CO.2 Assess societal needs and plan suitable infrastructure

CO.3 Analyze and design components of civil engineering projects

CO.4 Develop team spirit and inter-personal dynamics for effective execution and management of projects

CO.5 Engage in lifelong learning and adapt to changing professional and societal needs

4. TEACHINGANDEXAMINATIONSCHEME

TeachingScheme (In Hours)			TotalCredits (L+T/2+P/2)	ExaminationScheme				
				TheoryMarks		PracticalMarks		Total Marks
L	T	P	C	E	M	I	V	
0	0	6	3	0	0	60	40	100

Legends: L-Lecture; **T**–Tutorial, **P**–Practical, **E**–Theory External, **M** - Theory Internal, **I**–Practical Internal, **V** - Practical External

5. COURSEDETAILS

The project is offered to the students of 5th and 6th semester in order to inculcate innovation and attitude to develop skills. A group of four to eight students (maximum of fifteen students) work as a team for major project work.
The project should be selected such that it could be completed within 5th and 6th semester.

Project work should be distributed in below mentioned phases (6th Sem)

1. Approval of PRC (6th Sem) :- At commencement of 6th semester students should get approval to continue the ongoing project work of 5th semester form PRC.
2. There should be at least two review for project work during semester

Note: Students should continue their 5th semester project in the 6th semester.

6. GUIDELINEFORTHEPROJECT–II, FORDIPLOMAENGINEERING

Project–II: 6th Semester (Marks:100), L:T:P – 0:0:6, Credits:3

- Out of 100 marks, 60 marks are to be given as Practical Internal as per scheme suggested.
- The college through internal assessment will assess the User Defined Problems (UDP)/Industry Defined Problems (IDP), submitted by students as per time limit prescribed by the university in the sixth semester.
- The remaining 40 marks are for the Practical External which shall be conducted by the GTU.
- Each defined project needs to be from Industry /Research organization/ Govt.organization/ socio-technical issues and according to the need of time for

solving reallifeproblems.

- There should be one Project Review Committee(PRC) in consists of following members
  - Head of Department (HOD)
  - Faculty member from the department-Project In charge
  - Internal faculty/Industry resource person

7. PROJECT GUIDELINE FOR STUDENT:

- After getting approval student should assign to the project guide in the beginning of 6th semester and students may work on areas approved under the supervision of allotted supervisorsame as per 5th semester. In exceptional cases if it is required to be changed then it should be duly approved by PRC.
- There should be at least two project review presentation during the semester against PRC.The suggestions given by PRC have to be incorporated before completingthe project.
- They may have to show their progress periodically to their supervisor as per directions given by supervisor.
- The students may submit their final project report as per specified formats as provided in this syllabus and duly signed/approved by their supervisor to the department at the end of semester.
- The internal assessment marks will be evaluated based on progressive evaluation and oral presentation by the internal supervisor

8. ROLE OF PROJECT REVIEW COMMITTEE:

- There should be one Project Review Committee(PRC),whichconsists of following members
  - Head of Department (HOD)
  - Faculty member from the department-Project In charge
  - Internal faculty/Industry resource person
- PRC will arrange two reviews for the project in semester
  - One review for finalizing project titles/proposals and allotment of supervisor for each group of students
  - One midterm review.
- The PRC will give suggestions for improving quality of each project.

9. ROLE OF SUPERVISOR/GUIDE:

- The supervisor will supervise/guide the group of students allotted to him throughout the semester.
- He/she will assess the students individually as per stipulated assessment guidelines and keep record of it.
- Suggest resources to the students.
- Guide students on how to address issues on environmental and sustainability. Environment friendly and having low or zero carbon emission projects will be given priority.
- Motivate continuously students allotted to him for doing best projects.

10. ASSESSMENTCRITERIAFOREFFECTIVEEVALUATION OFTHEPROJECT:

The Diploma 6th Semester student's project-II will be evaluated as per the scheme suggested below.
60 Marks are for Progressive Assessment to be evaluated by Institute concern Faculty / Supervisor for the Project-II only based on following criteria.

Sr.No.	Description	Marks
1	Identification of problem and Framing of Problem Statement	5%
2	Problem Analysis	10%
3	Feasibility of proposed solution	10%
4	Adherence to Action plan	10%
5	Content appropriateness	5%
6	Technical knowledge and awareness related to the project	10%
7	Project Report and Presentation	5%
8	Question-Answer Technique	5%
	TOTAL	**60**

11. PO-CO MAPPING:

Semester: V	**Project-II (Course Code: 4350603)**									
	POs and PSOs									
Competency &Course Outcomes	**PO:1** Basic & Discipline 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**	**PSO: 2**	**PSO: 3**
CO:1	3	3	3	3	3	3	3	-	-	-
CO:2	-	3	3	2	3	2	-	-	-	-
CO:3	3	3	3	3	2	2	3	-	-	-
CO:4	-	-	-	-	3	3	3	-	-	-
CO:5	-	-	3	3	3			-	-	-

Legend: '3' for high,'2' for medium, '1' for low or '-'for the relevant correlation of each competency, CO, with PO/ PSO

Note: These is suggested mapping, supervisor should change these mapping according to the type of project and assess accordingly.

12. SAMPLE EVALUATION RUBRICS:

Title and Feasibility (Problem Identification)

Parameters	Excellent	Adequate	Average	Satisfactory
Identification of problem & Framing of Problem Statement	Detailed and extensive explanation of the purpose and need of the project	Good explanation of the purpose and need of the project	Average explanation of the purpose and need of the project	Moderate explanation of the purpose and need of the project
Problem Analysis	Compete explanation of the key concepts , strong descriptions of the technical requirements of the projects	Compete explanation of the key concepts , Insufficient description of the technical requirements of the projects	Compete explanation of the key concepts but little relevance to literature , Insufficient description of the technical requirements of the projects	All key concepts are not explain and very little relevance to literature , Insufficient description of the technical requirements of the projects
Feasibility of proposed solution	Detailed and extensive explanation/ analysis of content	Collects a great deal of information and good study of the content	Collects a great deal of information and moderate study of the content	Collects information and satisfactory study of the content
Adherence to Action plan	Strictly adhered to the Action Plan prepared in advance and achieved all the mile stones within specified time limit.	Adhered to the Action Plan prepared in advance and achieved all the mile stones within time limit.	Followed the Action Plan prepared in advance but delayed in achieving one or two of them but ultimately completed the project within time limit.	Carried out the activities randomly without following the Action Plan but ultimately completed the project within time limit.

Abstract and Depth of Knowledge/Analysis & Result / Implementation & Execution

Parameters	Excellent	Adequate	Average	Satisfactory
Content appropriateness	Appropriate Content and also presented in a logical sequence	Content is moderately relevant, but presented in a logical sequence	Content is moderately relevant, but presented randomly without logical concern	Presented content was partially relevant and also not in logical concern.
Technical knowledge and awareness related to the project	Extensive knowledge related to the project	Adequate knowledge related to the project	Average knowledge related to the project	Lacks sufficient knowledge
Project Report	Project report is according to specified format, reference included	Project report is according to specified format, but reference not included	Project report is partially as per specified format	Project report is not as per specified format

Presentation and viva

Parameters	Excellent	Adequate	Average	Satisfactory
Presentation	Presentations are appropriate and well delivered, Proper eye contact with audience and clear voice with good spoken language	Presentations are appropriate and well delivered, clear voice with good spoken language but less eye contact with audience	Presentations are appropriate but not well delivered, eye contact with few audience and unclear voice	Content of Presentations are not appropriate, eye contact with few audience and unclear voice
Question-Answer Technique	Answered all the questions satisfactorily.	Answered some questions satisfactorily.	Answered 1 or 2 questions satisfactorily.	Unable to answer the questions satisfactorily.

13. ARRANGEMENT OF CONTENTS IN PROJECT REPORT:

The sequence in which the project report material should be arranged as follows:

1) Cover Page
2) Title Page
3) Certificate
4) Abstract
5) Table of Contents
6) List of Tables
7) List of Figures
8) List of Abbreviations and Nomenclature
9) Chapters
   i. Introduction
   ii. Exhaustive Literature Survey/Review of Literature
   iii. Define the problem.
   iv. Body of project (Developing the main theme of the present investigation project work)
   v. Analysis/Results and Discussions
   vi. Conclusions
   vii. Future Enhancements / Recommendations
10) References
11) Appendices

Each chapter should be given an appropriate title. Tables and figures in a chapter should be placed in the immediate vicinity of the reference where they are cited. Footnotes should be used sparingly. They should be typed single space and placed directly underneath in the very same page, which refers to the material they annotate.

14. ARRANGEMENT OF PARAGRAPH IN A CHAPTER:

- Each paragraph in a chapter should be properly numbered for example, 1.1, 1.2 etc., where first digit represents the Chapter Number and second digit the paragraph number. There is no need to indicate the number for the first paragraph in a chapter.
- Sub-paragraphs, if any indicated as 1.1.1, 1.1.2 etc. i.e. first digit representing the chapter, the second representing the paragraph and third representing the sub-paragraph.
- **Don't underline the headings or subheadings or side heading**. Instead use the bold letters.

15. APPENDICES:

- Appendix showing the detailed data, design calculations, derivation etc
- Appendices are provided to give supplementary information, which is included in the main text may serve as a distraction and cloud the central theme.
- Appendices should be numbered using Arabic numerals, e.g. Appendix 1, Appendix 2, etc. Appendices, Tables and References appearing in appendices should be numbered and referred to as appropriate places just as in the case of chapters.
- Appendices shall carry the title of the work reported and the same title shall be made in the contents page also.

16. LIST OF REFERENCES:

- References should be numbered from 1st chapter to the last chapter in ascending order and should be shown in square brackets.
- The bibliography list should be made strictly in alphabetical order of the name of the authors.
- The listing of references should be typed 4 spaces below the heading
- **References**in alphabetical order in single spacing left – justified.
- The reference material should be listed in the alphabetical order of the first author.
- The name of the author/authors should be immediately followed by the year and other details.
- A typical illustrative list given below relates to the citation example quoted above.

[Chapter]Author Name, „Title of the book or paper", Publisher name, (year), Page No

17. References:

1. [1] Ariponnammal, S. and Natarajan, S. 'Transport Phenomena of SmSel – X Asx', Pramana (1994) – Journal of Physics Vol.42, No.1, pp.421-425.

18. TABLE AND FIGURES:

- In the references by the word Table, is meant tabulated numerical data in the body of the project report as well as in the appendices.
- All other non-verbal materials used in the body of the project work and appendices such as charts, maps, photographs and diagrams may be considered as figures.

19. TYPING INSTRUCTIONS:

- The impression on the typed copies should be black in colour.
- The project report should be submitted in **A4** size (29 cm x 20 cm).
- Good quality or Bond paper should be used for the preparation of the project report.
- Typing should be done on one side of the paper with character font in **size 12** of **Times New Roman.**
- 1.5 line spacing should be used for typing the general text.
- Subheading should be typed in bold Font size 12 and heading bold Font size 14.
- The layout should provide a margin of 1.50 Inches on the left, 1.00 Inches on the top, bottom and right.
- The page numbers should be indicated at the top-middle or bottom-middle of the each page.
- Heading s should be in bold should not underline the heading/subheadings and should not put colons (:) in headings or subheadings.

APPENDIX:1(Coverpage)

(AtypicalSpecimenofCoverPage)<FontStyleTimesNewRomanBold>

TITLEOF PROJECTREPORT

<FontSize18><1.5line spacing>

APROJECTREPORT

<FontSize14>

Submittedby
<FontSize14><Italic>

NAMEOFTHE CANDIDATE(S)
<FontSize16>

In partial fulfillment for the award of the diplomain

<FontSize14><1.5linespacing><Italic>

CIVILENGINEERINGPROGRAMME
<FontSize16>

IN
DEPARTMENTOFCIVILENGINEERING
Font size(14)
logo

NAMEOFTHECOLLEGE
<FontSize14>

GUJRAT TECHNOLOGICAL UNIVERSITY
<FontSize16>
<1.5line spacing>

Yearofsubmission:(MONTH&YEAR)
<FontSize14>

APPENDIX: 2(Titlepage)

(AtypicalSpecimenofTitlePage)<FontStyleTimesNewRoman –Bold>
A
Project
Reporton

<TITLEOF THEPROJECTWORK>

Submitted for partial fulfilment of the requirements for the
award of the

DIPLOMAIN CIVIL

ENGINEERING

IN

CIVILENGINEERINGPROGRAMME

BY BATCH

<Mr./Ms.NameoftheStudent(RollNo.)>
<Mr./Ms. Name oftheStudent(RollNo.)>
<Mr./Ms. Name of the Student(RollNo.)>
<Mr./Ms. Name of the Student(RollNo.)>
<Mr./Ms. Name of the Student(RollNo.)>

Undertheguidanceof

<NameoftheStaff with designation>

Civil Engineering Department
.

Departmentof CivilEngineering
<<**NAMEOFINSTITUTE**>>
<<**ADDRESSOFINSTITUTE**>>

APPENDIX: 3(Certificate)

(AtypicalspecimenofBonafideCertificate)
<FontStyleTimesNewRoman>

COLLEGE NAME

<FontStyleTimesNew Roman –size-18>

CERTIFICATE

<FontStyleTimesNew Roman –size-16>

<FontStyleTimesNew Roman –size-14>

It is certifiedthatthisproject report**"…….TITLEOFTHEPROJECT… ....."**

Isthebonafideworkof**"……..NAMEOFTHECANDIDATE..... "**

who has carried out the project work under my supervision.

<<SignatureoftheHeadofthe Department>><<SignatureoftheProjectSupervisor>>

SIGNATURE *SIGNATURE*

<<Name>> <<Name>>

HEADOFTHE DEPARTMENTPROJECTSUPERVISOR

<<AcademicDesignation>>

<<Department>>DepartmentofCivilEngineering

<<Fulladdressofthe Dept &College>><<FulladdressoftheDept&College>>

External Examiner .....<<Signature,Name,Designation&Address>>.....

20. COURSE CURRICULUM DEVELOPMENT COMMITTEE:

GTU Resource Persons

No.	Name and Designation	Institute	Email ID
1	H. T. Patel, Lecturer in Civil Engineering	K D Polytechnic, Patan	htpatel20@gmail.com
2	D. N. Sheth, Lecturer in Civil Engineering	Government Polytechnic, Palanpur	devendra_civil@yahoo.com

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Course Title: Building Services
(Course-4360605)

Diploma programme in which this course is offered	Semester in which offered
Civil Engineering	6th Semester

1. RATIONALE

The building services encompass a wide range of systems, including electrical, mechanical and civil engineering services. They are essential for various types of buildings, such as residential, industrial, high-rise, hotels, motels, and monumental structures; and they ensure the efficient and effective operation of buildings for their intended purposes

No building can be effectively utilized without these services. Additionally, the current need for ecofriendly and sustainable designs, including green building principles and grey-water management. Therefore, it is expected for civil engineering students to know about the basic principles, installation procedures, and the operation and maintenance of these building services. It is here clarified that some services like plumbing and sanitary services have already been taken care of in a separate course, so they are not included in this particular curriculum.

2. COMPETENCY

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

1. **Plan various types of services required for different types of buildings.**
2. **Supervise the execution of installation of services such as lift, fire protection, elevators, escalators, acoustic and sound insulations, lightings, air conditioning and allied services for creating human comfort in the buildings.**

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) Manage building services provisions in big construction sites.
b) Synchronize the installation of building services as per the sequence of construction activities.
c) Select the suitable electrical as well mechanical services for particular requirements of buildings.
d) Ensure Fire Protection, Acoustics and Sound insulation along with green building applications to the new constructions.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T/2+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total
L	T	P	C	CA	ESE	CA	ESE	Marks
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) 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	Prepare Lighting plan for a commercial complex	1	2*
2	Prepare electrical layout plan for given building.	2	2*
3	Prepare Lift standards as per norms.	3	2*
4	Identify proper locations for Lift/ Escalator/ Elevator in a given commercial complex.	3	2*
5	Suggest noise control methods for a given commercial complex.	4	2*
6	Prepare a case study for the fire fighting services for commercial building in the nearby area.	4	4*
7	Compute space requirement for Rooftop rain water harvesting system and Prepare rain water harvesting layout plan for a building.	5	2*
8	Prepare a report on implementing the reuse of grey water of an existing hotel building in a nearby area.	5	4*
9	Visit a residential building & commercial building under construction and prepare layout for electrical, water supply, sanitary and related allied services of civil engineering and prepare site visit detailed report	1, 2, 3, 4, & 5	4*

10	Topic of seminar shall be given to a group of students not more than three. The students are required to submit report including power point presentation and present/ defended the seminar in the presence of students and teachers.	1, 2, 3, 4, & 5	4*
	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, 2	
1	Neatness, Cleanness in Sketch book/ Drawing Sheet	10
2	Uniformity in Drawing and line work	10
3	Creating given drawing	40
4	Dimensioning the given drawing and writing text	20
5	Answer the question	10
6	Submission of drawing in time	10
	Total	**100**

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
	For PrOs 9	
1	Discipline	10
2	Involvement during site visit	20
3	Data collection at site	20
4	Organization of report	20
5	Answer the question	10

6	Timely submission of report	20
	Total	**100**

S. No.	**Sample Performance Indicators for the PrOs**	**Weightage in %**
	For PrOs 3, 4, 5, 6, 7, 8	
1	Data collection	20
2	Calculation, Write up, Grammar etc.	20
3	Organization of report	20
4	Answer the question	20
5	Timely submission of report	20
	Total	**100**

S. No.	**Sample Performance Indicators for the PrOs**	**Weightage in %**
	For PrOs 10	
1	Initiative	20
2	Data Collection	20
3	Content of Presentation (Use of multi media)	20
4	Presentation (Body Language- Gesture, Posture etc.)	20
5	Answer the question	20
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

These major equipments with broad specifications for the PrOs is a guide to procure them by the administrators to usher in uniformity of practical 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 safe practice on site/ lab.
c) Maintain tools and equipment.
d) Follow ethical practices.
e) 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 Introduction	**1a.** Describe basics of building services. **1b.** Apply various types of services as per needs of building. **1c.** Apply Lighting and Ventilation provisions	1.1 Definitions 1.2 Objective and uses of services 1.3 Applications of services for different types of building 1.4 Classification of building services 1.5 Types of services and selection of services 1.6 Natural and artificial lighting: principles and factors 1.7 Arrangement of luminaries, Distribution of illumination, Utilization factors 1.8 Necessity of Ventilation Types – Natural and Mechanical Factors to be considered in the design of Ventilation

Unit– II Electrical Services	**2a.** Prepare electrical services requirement and Layout of a given building	2.1 electrical services in the building: Technical terms and symbols for electrical installations and Accessories of

Unit	**Unit Outcomes (UOs)** (4 to 6 UOs at Application and above level)	**Topics and Sub-topics**
and Layout	**2b.** Conceptualise Smart Home **2c.** Provide Rooftop Solar Power plants	wiring 2.2 Systems of wiring like wooden casing, cleat wiring, CTS wiring, conduit wiring 2.3 Types of insulation 2.4 Electrical layout for residence, small work shop, show room, school building, etc. 2.5 Smart Home: Uses, Smart Electrical Appliances, Smart Security systems 2.6 Rooftop Solar PV Power plant: overview of Solar PV Technology, overview of Rooftop Solar Sector in India, type of Rooftop Solar PV Power Plants and operating principles.

Unit – III Mechanical Services in Buildings	**3a.** Identify the services like lift, elevators, conveyors and escalators, etc. **3b.** Plan various types of mechanical services as per requirements of building **3c.** Select the right type of air conditioning and the position of air conditioning	3.1 Introduction of mechanical services 3.2 Lift 3.2.1 Definition, Types of Lifts, Design Considerations, Location, Sizes, Component parts- Lift Well, Travel, Pit, Hoist Way, Machine, Buffer, Door Locks, Suspended Rope, Lift Car, Landing Door, Call Indicators, Call Push 3.3 Elevators & Escalators 3.3.1 Different types of elevators and Escalators, Freight elevators, Passenger elevators, Hospital elevators, 3.3.2 Uses of different types of elevators Escalators. 3.4 Dumbwaiters 3.4.1 Different types of Dumbwaiters 3.4.2 Uses of different types of Dumbwaiter. 3.5 Air Conditioning 3.5.1 Definition, Purpose, Principles, Temperature Control, Air Velocity Control, Humidity Control, Air Distribution system, Cleaners, Filters, Spray washers, Electric precipitators,
Unit	**Unit Outcomes (UOs)**	**Topics and Sub-topics**
	(4 to 6 UOs at Application and above level)	
		3.5.2 Types of Air Conditioners

Unit – IV Fire Protection, Acoustic and Sound Insulations	**4a.** Identify the services of Fire **4b.** Apply various types of fire services as per requirements of building **4c.** Select the suitable type of Fire protection. **4d.** Provide Acoustic and sound insulation as per needs	4.1 Introduction 4.2 Causes of fire and Effect s of fire 4.3 General Requirements of Fire Resisting building as per IS and NBC 2005 4.4 Characteristics of Fire resisting materials 4.5 Maximum Travel Distance 4.6 Fire Fighting Installations for Horizontal Exit, Roof Exit/ Fire Lifts, External Stairs 4.7 Requirement of good Acoustic 4.8 Various sound absolvent 4.9 Factors to be followed for noise control in residential building
Unit – V Miscellaneous Services & Green Buildings Provision	**5a.** Plan for Rain Water Harvesting in the new buildings **5b.** Apply Green Building technology aspects	**5.1.** Rain water Harvesting for buildings 5.1.1 Rooftop rainwater harvesting **5.2.** Grey water reuse 6.2.1 Significance of Grey water reuse 6.2.2 Components of Grey water system & its management. **5.3.** Concept of GREEN buildings. **5.4.** Components of GREEN building.

***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 QUESTIONPAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A	Total Marks
I	Introduction	6	2	4	4	10
II	Electrical Services and Layout	12	4	8	8	20
III	Mechanical Services in Buildings	10	4	8	8	20
IV	Fire Protection, Acoustic and Sound Insulations	8	2	4	4	10
V	Miscellaneous Services and Green Buildings Provision	6	2	4	4	10
Total		**42**	**14**	**28**	**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 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 studentrelated ***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) Visit of construction sites to observe the current services practices and prepare a report.

b) In a group of 4-5 students prepare an internet/ library-based presentation for each of above topics considering recent practices prevailing across the world.

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.11***, 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. 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, workshopbased, 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) **Green Solutions:** Prepare a report suggesting replacement of/ augmenting atleast 10 nos. of items to convert it into a Green Building and justify it in terms of environmental impact.

b) **Green Solutions:** Prepare a report on implementing recycling of grey water for your Institute.

c) **Mechanical Services:** Collect the relevant information of recent technologies in elevators and prepare a report on it.

d) **Mechanical Services:** Suggest the type of mechanical services to be provided in a building as per its functional requirements and compute the space requirements for it as per guidelines of national building code.

e) **Miscellaneous Services:** Prepare a report on BMS including a case study.

f) **Miscellaneous Services:** Collect the relevant information of different techniques for RWH and submit a report on it.

g) **Miscellaneous Services:** Prepare a report on enhancing the Building services of an existing building in nearby area.

h) **Lighting and Ventilation:** Prepare a summary report with reference to lighting, ventilation and acoustic system of a building.

i) **Air Conditioning:** Plan and draw in detail ventilation and air-conditioning for a given building

j) **Safety**: Prepare a report on modern Fire Safety, Detection and Protection systems.

k) **Acoustic and Sound Insulations:** Prepare a report on executing the requirements of any sound proof room.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	The A to Z of Practical Building Construction and its Management	Sandeep Mantri	Satya Prakashan, New Delhi ISBN-139351922629-978 :
2	Plumbing Design and Practice	Deolalikar, S. G.	McGraw-Hill, New Delhi, 2004 ISBN: 9780074620694
3	Fire Services in India: History, Detection, Protection, Management, Environment, Training and Loss Prevention	Bag, S. P.	Mital Publications, New Delhi, 1995, ISBN-13: 978-8170995982
4	Principles of Fire Safety Engineering: Understanding Fire and Fire Protection	Akhil Kumar Das	Prentice Hall India Learning Private Limited, New Delhi, 2014, ISBN-13: 978-8120350380

5	National Building Code of India - 2005	Bureau of Indian Standards	BIS, New Delhi
6	Building Services	S. M. Patil	Seema Publication, Mumbai Revised edition
7	A text book on Building Services	R. Udaykumar	Eswar Press, Chennai
8	Green Building Fundamentals	G Harihara Iyer	Notion Press, Vanagaram ,
S. No.	**Title of Book**	**Author**	**Publication with place, year and ISBN**
			Chennai ISBN-13: 979-8886416091

14. SOFTWARE/LEARNING WEBSITES

a) https://www.bis.gov.in/
b) https://bmsbuildingservice.com/
c) https://plumbingservices.com/
d) http://www.asce.org/
e) https://www.astm.org/

15. PO-COMPETENCY-CO MAPPING

Semester V	**Building Services (Course Code: 4*****)**									
	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** Lifelong learning	**PSO 1**	**PSO 2**	**PSO 3** (If needed)
Competency	**3. Plan various types of services required for different types of buildings. 4. Supervise installation and testing of services such as lift, fire protection, elevators, escalators, acoustic and sound insulations, lightings, air conditioning and allied services. 5. Execute the building services for creating human comfort in the buildings.**									
Course Outcomes CO a) Manage building services provisions in big construction sites .	3	2	-	-	3	-	3	-	-	-

CO b) Synchronize the installation of building services as per the sequence of construction activities.	3	3	3	-	3	2	3	-	-	-
CO c) Select the suitable electrical as well mechanical services for particular requirements of buildings.	3	2	2	-	3	-	3	-	-	-
CO d) Ensure Fire Protection, Acoustics and Sound insulation along with green building applications to the new constructions.	3	2	2	-	3	-	3	-	-	-

Legend: '**3'** for high, '**2**' for medium, **'1'** for low or **'-'** for the relevant correlation of each competency, CO, with PO/ PSO

17. 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-VI

Course Title: Traffic Engineering
(Course Code: 4360606)

Diploma programme in which this course is offered	Semester in which offered
Civil Engineering	6th Semester

1. RATIONALE

Traffic engineering is a branch of civil engineering that uses engineering techniques to achieve the safe and efficient movement of people and goods on roadways. Knowledge and understanding of the basic concept of traffic Engineering is highly essential for the engineers designing and executing the road laying projects in order to make road. Traffic engineering plays a pivotal role in all facets of transportation, and given the ever-expanding population and infrastructure developments. This includes the planning and implementation of traffic control elements such as traffic sings, signals, and road markings to enhance safety for both drivers and pedestrians. The course aims to cultivate expertise in conducting diverse traffic surveys, deciphering and making sense of the collected data, and proposing solutions in the form of traffic control devices. At diploma level, students are expected to perform various traffic surveys, analyse traffic data and interpret the results appropriately in order to apply their knowledge in designing good road transport systems.

2. COMPETENCY

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

- **Execute the working and control of traffic engineering elements.**
- **Determine traffic requirements for road design after conducting the traffic surveys.**

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) Analyze the road traffic characteristics.
b) Undertake various types of road traffic studies.
c) Use the relevant road traffic control devices.
d) Interpret traffic management system.

e) Suggest preventive measures to avoid accidents by analyzing the traffic conditions at site and maintain the road environment.

f) Aware about advanced technology in traffic engineering.

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	-	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 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 the road traffic characteristics for any existing road.	I	02*
2	Perform traffic volume study at intersection.	II	04*
3	Carry out O-D Survey within area of your town/city.	II	04*
4	Calculate at least eight examples based on spot speed study and signal cycle time.	II, IV	02*
5	Measure the spot speed on corridor of road way to analyze the percentile speed graphically.	II	02
6	Prepare a report of a field visit to any major road intersection in your locality to identify the type, working of traffic signals along with your recommendations if any.	III	02

7	Suggest the relevant vehicle parking system for your campus along with your recommendations in the form of a report.	II	02*
8	Prepare sketches for Traffic Sign-Regulatory, Warning and Informatory sign.	III	02*
9	Prepare sketches for Road marking - Pavement marking, Kerb marking, Object Marking and Reflector marking.	IV	02*
10	Prepare a report of a field visit to any urban road way to identify the road signs, corresponding markings on road, traffic island, road intersection and existing street lighting system.	IV, V	04*
11	Draw the collision diagram for any case study of road accident. Locate the points of conflicts in the diagram of a busy intersection on a road in your locality.	V	02*
12	Seminar	-	04*
	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 8,9,11		
1	Prepare drawing/sketches	40
2	Neatness, accuracy in work and drawings.	20
3	Notation in the given drawing and writing text.	20
4	Answer the questions.	10
5	Submission of drawing in time	10
	Total	**100**

S. No.	**Sample Performance Indicators for the PrOs**	**Weightage in %**

For PrOs 4		
1	Calculate numerical based on given data.	40
2	Accuracy in calculation.	30
3	Answer the questions	20
4	Submission of example in time.	10
	Total	**100**

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
For PrOss1, 2, 3, 5,6,7,10		
1	Participation in site visit/perform survey	30
2	Data collection during site visit/survey	20
3	Technical involvement during site visit/survey	20
4	Preparation and submission of report/survey data	20
5	Timely submission of report	10
	Total	**100**

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
For PrOs 12		
1	Initiative, topic selection	20
2	Data Collection, preparation of presentation	30
3	Content of Presentation (Use of multi media)	20
4	Presentation (Body Language- Gesture, Posture etc.)	20
5	Answer the question	10
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	PrO.No.
1	Computer system - with basic configuration	-

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 safe practice on site.
c) Follow ethical practices.
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

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)	Topics and Sub-topics

Unit – I Fundamental of Traffic Engineering	1a Describe the characteristics of road users in 1b the given situation. Describe the vehicular 1c characteristics for the given situation. 1d Calculate reaction time of driver in the given situation. Explain the factors affecting the reaction time for the given situation.	1.1 Traffic engineering- Definition, objects, scope 1.2 Road user's characteristicsphysical, mental, emotional factors. Vehicular characteristics-width, 1.3 length, height, weight, speed, efficiency of breaks. Road characteristics-gradient, curve of a road, design speed, 1.4 friction between road and tyre surface. Reaction time-factors affecting reaction time. PIEV 1.5 Theory.

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
Unit - II Traffic Studies	2a Measure the traffic volume for the given 2b section of road. Analyze Traffic volume 2c count data collected for the given road. Analyze spot speed study 2d data collected for the given road. Design, develop and suggest the improvement for the parking system at the given situation.	2.1 Traffic Studies-types, purpose, Information required for traffic 2.2 studies. Traffic volume study-definition, purpose, Methods of collection of traffic volume count data (manual, automatic recorders, 2.3 moving car method), representation and 2.4 analysis of traffic data. 2.5 Necessity of Origin and Destination study and its methods. Speed studies-spot speed studies, and its presentation Need and method of parking study.

Unit– III Traffic Control Devices	3a Classify traffic control devices. 3b Interpret traffic Signs. 3c Design traffic signals for 3d given intersection of road. Classification of road marking	3.1 Importance and general principal of traffic control devices. 3.2 Different types of traffic sign as per 3.3 IRC recommendation. Traffic Signals – Types of traffic signals with merit and demerits, 3.4 phasing of traffic signals. Design of signal cycle time by Fix time cycle, IRC method, Approximate method, Webster's method. 3.5 Road marking - Pavement marking, Kerb marking, Object Marking, Reflector marking.
Unit – IV Traffic Management	4a Describe Traffic management policy and 4b measures. 4c Discuss street furniture. Explain traffic regulations and traffic Geometrics.	4.1 Basic principles of traffic 4.2 management. Street furniture types - Roadway delineators, Hazard marker, Object marker, Speed breaker, Rumble strips, Guard Rails, Safety Barriers, 4.3 Traffic Attenuators, Barricades and channelizes 4.4 Traffic Regulations - Basic principle, Scope, Traffic lows. Traffic Geometrics - Intersection at grade, Interchange, Traffic Island, Terminal Facilities.
Unit	**Unit Outcomes (UOs)**	**Topics and Sub-topics**

Unit – V Road Accident and Environment	5a Analyze the causes of accident occurred and Suggest preventive measures to avoid the 5b accidents on the given road section. 5c Create awareness about the traffic rules and laws at selected location. 5d Suggest the street lighting system for the given road section. 5e Recommend the relevant type of trees for road side plantation. 5f Justify the need of protecting the road side plantation. Describe the methods of protecting the road side plantation.	5.1 Road accidents-Definition, types (Collision and non-collision accidents), Causes, Prevention of road accidents. 5.2 Reporting and recording of an accident. 5.3 Collision and condition diagram. 5.4 Considerations regarding road safety. 5.5 Legislation and law enforcement education and propaganda. 5.6 Street lighting-definition, sources necessity, types-luminaire, foot candle, lumen, factors affecting their utilization and maintenance. 5.7 Factors affecting visibility at night. 5.8 Arboriculture- definition, objectives, factors affecting selection of type of trees. 5.9 Maintenance of trees-protection and care of road side trees.
Unit – VI Advancement in Traffic Engineering	6a Discuss the role of information 6b technology in improving traffic system. Know technology used in traffic 6c management system. Discuss future of traffic management	6.1 Brief overview of Highway Traffic Management System (HTMS), Intelligent Transportation System 6.2 (ITS). 6.3 Smart Traffic Management System (STMS) – Objective, Benefits. Brief overview of technology used in traffic management system - IoT sensor.

***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 QUESTIONPAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Fundamentals of Traffic Engineering	04	04	-	-	04
II	Traffic Studies	08	02	04	08	14

III	Traffic Control Devices	10	04	08	06	18
IV	Traffic Management	10	04	06	08	18
V	Road Accident and Environment	06	02	06	04	12
VI	Advancements in Traffic Engineering	04	04	-	-	04
Total		**42**	**20**	**24**	**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 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 studentrelated ***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 journals based on practical performed in laboratory.
b) Group discussion on traffic jams and related probable solutions in the city.
c) 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.11***, 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-projects 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, workshopbased, 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) Prepare a model of traffic controlling devices.

b) Make posters showing traffic safety and awareness.

c) Prepare the charts showing different types of road signs.

d) Measure the spot speed on corridor of road way to analyze the percentile speed graphically.

e) Prepare a report of a field visit to any major road intersection in your locality to identify the type, working of traffic signals along with your recommendations.

f) Prepare a report of a field visit to any urban road way to identify the road signs and corresponding markings on road.

g) Prepare a report on advanced road marking machinery and materials.

h) Perform traffic survey of busy road junction of city in groups and to suggest measures for improvement.

i) Prepare a report of a field visit to any urban road to identify the traffic island along with its sketch.

j) Undertake the process of planting, protecting and maintaining the trees along the road.

k) Identify the existing street lighting system of any two types of roads.

l) Locate the points of conflicts in the diagram of a busy intersection on a major urban road in your locality.

m) Identify the existing type of trees to suggest any relevant maintenance required.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN

1	Transportation Engineering	Arora, N. L.,	Khanna Publishers, Delhi, 1996.ISBN: 817319-0933.
2	Traffic Engineering and Transport Planning	Kadiyali, L.R.	Khanna Publishers, Delhi, 2001,ISBN:10: 8185240779:
3	Transportation Engineering Vol. I & II	Vazirani, VN Chaondola, SP	Khanna Publishers. Delhi, 2016 ISBN: 9780128038185; 9780128038895
4	Traffic planning and design	Saxsena. SC	Dhanpat Rai & Sons Delhi. 2016 ISBN-10: 8123913500
5	Indian Highways- IRC Journal	Journalmonthly issue	IRC (Indian Road Congress), India, 1973, ISSN: 0376-7256
6	IRC:67-2022,IRC:SP:552014, IRC:SP-044, IRC:53-2012	IRC	--

14. SOFTWARE/LEARNING WEBSITES

1. https://nptel.ac.in
2. https://www.mhi.com/products/transport/intelligent_transport_system_htms.html
3. https://morth.nic.in/sites/default/files/Finalized_Draft_AIS_140_regarding_Intelligent_Transportation_Systems_.pdf
4. https://indiaai.gov.in/article/role-of-iot-in-road-safety-and-traffic-management 5. https://your.visum.ptvgroup.com/vision-traffic-suite-students-en

15. PO-COMPETENCY-CO MAPPING

Semester V		**Traffic Engineering (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** Lifelong learning	**PSO 1**	**PSO 2**	**PSO 3** (If needed)
Competency		• **Execute the working and control of traffic engineering elements.** • **Determine traffic requirements for road design after conducting the traffic surveys.**									
COa)	Analyze the road traffic characteristics.	3	-	-	-	2	2	3			

COb)	Undertake various types of road traffic studies.	3	3	2	2	3	3	3			
COc)	Use the relevant road traffic control devices.	3	2	2	3	3	2	3			
Cod)	Interpret traffic management system	3	2	-	2	3	3	3			
COe)	Suggest preventive measures to avoid accidents by analyzing the traffic conditions at site and maintain the road environment.	3	2	-	3	2	2	3			
COf)	Aware about advanced technology in traffic engineering.	2	2	2	2	2	2	3			

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

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GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)
Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
Semester-VI
Course Title: Ground Water Engineering
(Course Code: 4360607)

Diploma programmer in which this course is offered	Semester in which offered
Civil Engineering	Six

1. RATIONALE:

Groundwater engineering, is a branch of engineering which is. concerned with groundwater movement and design of wells, pumps, and drains. Including prevention of sea water intrusion .The main. concerns in groundwater engineering include groundwater contamination, conservation of. supplies, and water quality. Due to over exploitation and pollution of surface water, ground water is the only remaining source to satisfy different types of water demands. However, the ground water table is decreasing due to excess utilization and lack of recharging. In this scenario it is must for civil engineers working in the area of water resource management as well as all civilian to take measures to improve ground water recharging and avoid contamination. This course attempts to provide knowledge and skills for effective ground water management.

2. COMPETENCY

The course content should be taught and implemented with the aim to develop required skills in the students so that they are able to acquire following competencies:

- Take steps to enhance ground water recharge and prevent its contamination

3. COURSE OUTCOMES (COs)

The theory should be taught and exercises 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.

- Interpret different terms related to ground water and process of ground water survey.
- Find suitable method of artificial recharge of ground water for given conditions.
- Design a tube well for given condition.
- Interpret mechanism of sea water intrusion & controlling measures for sea water intrusion.

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	70	30	25	25	150

Legends: L- Lecture; T- Tutorial/Teacher Guided Student Activity ;P - Practical; C –Credit; ESE-End Semester Examination; PA- Progressive Assessment

5. COURSE CONTENT

Unit	Major Learning Outcomes (in Cognitive Domain)	Topics and Sub-topics
UNIT-I Introduction	1.1 Explain the sources of Groundwater 1.2 Define various terms related to groundwater 1.3 Define various terms related to aquifer 1.4 Explain Aquifers 1.5 Define various terms related to permeability 1.6 Describe causes of changes in ground Water quantity	1.1 Sources of water 1.2 Groundwater scenario of Gujarat and India 1.3 Origin of Groundwater 1.4 Groundwater Characteristics 1.5 Terms related to Ground water Engineering - Hydraulic conductivity - Specific Retention - Transmissibility - Coefficient of transmissibility - Yield - Specific yield - Storage coefficient 1.5 Aquifer-Types of aquifer, aquiclude, aquifuge, porosity of aquifer. 1.6 Permeability- Darcy's permeability, coefficient of permeability 1.7 Causes of changes in ground water quantity

UNIT-II Ground water - Survey and Quality	2.1 Describe various surface and subsurface surveys for ground water exploration 2.2 Describe groundwater Quality parameters 2.3 Describe reasons for ground Water quality degradation 2.4 Explain steps for Improvement of Groundwater quality.	2.1 Surface Methods for ground water exploration Esoteric Methods – Geomorphologic methods – Geological & structural Methods – Soil and Micro-Biological Methods – Remote Sensing Techniques – Surface Geophysical Methods 2.2 Sub surface methods for ground water exploration 2.3 Geophysical survey of ground water - Surface Geophysical techniques -Electric logging & Radioactive logging Method 2.4 Ground water quality - Factors affecting ground water quality - Classification of ground water quality -Types of water quality -Physical characteristics of ground water quality -Various test for ground water quality

		2.5 Parameters of ground water quality 2.6 Groundwater quality degradation 2.7 Reasons of groundwater quality degradation 2.8 Effects of changes in ground water quality 2.9 Importance of ground water quality

UNIT-III Artificial Recharge	3.1 Describe methods of Artificial recharging 3.2 Describe suitability of recharging methods 3.3 Explain Identification of areas for artificial recharge. 3.4 Explain Artificial recharge structures	3.1 Conceptual introduction -Ground water development 3.2 Stages of ground water development 3.3 Social, economical and overall national benefits of ground water development 3.4 Artificial Recharge-Objectives and Importance 3.5 Development of Artificial recharging 3.6 Methods of artificial recharge 3.7 Suitability , advantages and dis advantages of artificial recharge methods 3.8 Identification of areas for artificial recharge. 3.9 Artificial recharge structures 3.10 Rain water harvesting
UNIT-IV Wells and Tubewells	4.1 Differentiate between wells and tubewells 4.2 Describe well losses 4.3 Describe terms related 4.4 Explain method of construction of wells Design the wells	4.1 Introduction 4.2 Difference between wells and tubewell 4.3 Types of wells - Open wells - Tube wells - Shallow, deep and Medium well 4.4 Benefits of well and tube well irrigation 4.5 Well losses 4.5 Specific capacity 4.6 Interference among wells 4.7 Gravity well - Fully penetrating gravity wells - Partially penetrating gravity wells 4.8 Safe yield of well 4.9 Construction Method of wells 4.10 Selection of pump sets - Plunger pump - Jet pump - Submersible pump - Air lift pump

		4.11 Design of Tube well -Steps, features -Structure -Size -Basis -Principles -Data required -Methods
UNIT-V Sea Water Intrusion	5.1 Explain causes of sea Water intrusion 5.2 Describe ill-effects of Sea water intrusion 5.3 Explain remedial measures to prevent sea water intrusion a. Explain with examples sea water intrusion	5.1 Introduction 5.2 Causes of sea water intrusion 5.3 Ill-effects of sea water intrusion 5.4 Mechanism of sea water intrusion 5.5 Ghyben -Herzberg fresh watersea water Interface 5.6 Remedial measures to control sea water intrusion a. Related examples

6 SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS(Theory)

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction	06	05	05	00	10
II	Ground water Survey and quality	08	06	04	04	14
III	Artificial Recharge	08	05	05	04	14
IV	Wells and Tubewells	12	04	04	10	18
V	Sea water Intrusion	08	04	04	06	14
Total		42	24	22	24	70

Legends: R = Remember , U = Understand , A= Apply and above Level (Bloom's revised 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 EXERCISES/PRACTICAL

The practical/exercises should be properly designed and implemented with an attempt to develop different types of skills (outcomes in psychomotor and affective domain) so that students are able to acquire the competencies/programme outcomes. Following is the list of practical exercises for guidance.

Note: Here only outcomes mainly in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of certain outcomes in affective domain which would in turn lead to development of Course Outcomes related to affective domain. Thus over all development of Programme Outcomes (as given in a common list at the beginning of curriculum document for this programme) would be assured.

Faculty should refer to that common list and should ensure that students also acquire outcomes in affective domain which are required for overall achievement of Programme Outcomes/Course Outcomes.

Sr. No.	Unit No.	Practical/Exercise	Approx. Hrs. Required
1		Drawings and Illustrations	08
	I.II.III.IV ,V	Prepare drawing of Sources of water, Representation of coefficient of storage of ground water Illustration of aquifers Various types of wells Various types of tubewells Artificial recharge structures Mechanism of Sea water intrusion Rain water harvesting	
2		Practical	04
	I	Determine the TDS, Electrical Conductivity (ES) of groundwater sample	
	II	Determine the pH and Hardness of groundwater sample	
3		Solve numerical from given data :	04
	IV	Examples related to well hydraulics	
	V	Examples related to sea water intrusion	
4		Field visit and Report :	08
	I	Visit to Water resources department/Irrigation department for collecting existing groundwater data of the district with respect to importance & necessity of ground water management.	
	II	Visit to various storage works and collect data pertaining to quality.	
	III	Visit to nearby rain water harvesting structure and prepare a report.	

5		Seminar :	04
	I to VII	Select a topic as a seminar and present it using modern teaching aids.	
Total Hours	28		

8 SUGGESTED LIST OF STUDENT ACTIVITIES

8.1 Prepare a model/prototype of groundwater recharging structure in the college/ suggested Premises.

8.2 Prepare a model/prototype of tube well in the suggested premises.

8.3 Explore internet to study different issues related to ground water level and Contamination and prepare a report.

8.4 Prepare a report on Remote Sensing Method for ground water Survey

8.5 Motivate owners of some building/housing society being constructed to install ground water recharging system and design system for them.

9 SPECIAL INSTRUCTIONAL STRATEGIES (If Any)

a. Show video films of sea water intrusion and its effects
b. Arrange expert lectures of Engineers working in ground water department/geological survey of India.
c. Present case studies of success and failures of ground water recharge projects being carried out by some NGOs of national/state repute.

10 SUGGESTED LEARNING RESOURCES

A BOOKS

Sr. No.	Title	Author	Publisher
1	Groundwater Hydrology	Raghunath H. M	Willy Eastern Ltd-2000
2	Groundwater Hydrology	Todd D.K.	John Willey & Sons
3	Groundwater Engineering	Abdel-Aziz	Mc-graw Hill book company
4	Ground Water Assessment, Development & Management	K.R. Karanth	Tata Mc Graw Hill Co. Ltd., New Delhi
5	Hydrogeology	K.R. Karanth	Tata Mc Graw Hill Pub Co. Ltd., New Delhi
6	Groundwater Hydrology	Herman Bower	McGraw-Hill,Kogakusha Ltd. Int.Student Edn.1978
7	Related I S Codes		BIS, New Delhi

A. LIST OF RECOMMENDED I.S. PUBLICATIONS:

B. List of Major Equipment/Materials

i. Working models of recharging works.
ii. Models of rain water harvesting structures
iii. Models of tube well.

C List of Software/Learning Websites

i. www.nptel.ac.in
ii. www.ocw.mit.edu
iii. www.ngwa.org/ iv. www.groundwaterinternational.co
v. www.cgwb.gov.in
vi. wrmin.nic.in
vii. www.cwc.nic.in
viii. www. cgwb.gov.in/Research_and_Development.html

11. PO-COMPETENCY-CO MAPPING:

Semester VI	Ground Water Engineering (Course Code:)						
	POs						
Competency & Course Outcomes	Basic Discipline specific knowledge	Problem Analysis	Design/ Development of Solutions	Engineering tools, Experimentation and Testing	Engineering Practices for society, Sustainability and Environment	Project Management	Life-long Learning
Competency	Take steps to enhance ground water recharge and prevent its contamination.						
Course Outcomes CO1 Interpret different terms related to ground water and process of ground water survey.	**2**	**0**	**0**	**2**	**3**	**0**	**2**
CO2 Find suitable method of artificial recharge of ground water for given conditions.	**3**	**2**	**2**	**0**	**3**	**0**	**3**
CO3 Design a tube well for given condition.	**3**	**2**	**2**	**2**	**3**	**0**	**2**
CO4 Interpret mechanism of sea water intrusion & controlling measures for sea water intrusion.	**3**	**0**	**0**	**0**	**3**	**0**	**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

Sr. No.	Name and Designation	Institute	Contact No.	Email
1.	Shri Anil K Popat Senior Lecturer (Civil)	R C Technical Institute, Sola, Ahmedabad	9825443501	anilkpopat@gmail.com
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GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Course Title: Construction Quality Control & Monitoring
(Course Code: 4360608)

Diploma program in which this course is offered	Semester in which offered
Civil Engineering	6th Semester

1.RATIONALE

In rapidly developing countries like India, where infrastructure projects are booming, ensuring quality control and monitoring in construction is crucial for achieving durable and sustainable structures within planned timeframes. For any civil engineering project, regular day-to-day inspections and monitoring play a vital role in maximizing lifespan and minimizing environmental impact. Implementing robust quality control measures can extend the life of civil structures by its design life without significant cost increases. This becomes especially vital considering the depletion of construction resources and the growing emphasis on sustainability. Therefore, for diploma students aspiring to a career in civil engineering, understanding green building concepts and thorough quality control practices is indispensable. Their future roles will likely involve supervisory positions, making them directly responsible for upholding construction quality. Thus, mastering these skills equips them to perform their duties efficiently, effectively, and with environmental responsibility in mind.

2.**COMPETENCY**

The course content should be taught and implemented with the aim to develop required skills in the students so that they are able to acquire following competency:

- Effectively& efficiently control and supervise Civil construction materials & activities.

3.**COURSE OUTCOMES (COs**)

The theory should be taught and exercises 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. Apply total quality management in civil construction.
ii. Check the quality in civil construction works. iii. Identify the variations in quality of civil works. iv. Use various standard codes in civil construction works.
v. Study various policies and do green audit of the building.
vi. Design energy efficient buildings.

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	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 is 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 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 &Perform Power Point Presentation highlighting key features of TQM like principles, Aims, Short notes on TQM models, Mantras, building block of TQM, Driving forces & other relevant definitions	I	6*
2	Prepare Various Quality Check lists of the following Construction materials and activities, a) Masonry b) Plastering c) Flooring d) Concreting of various building elements e) Formwork& Scaffolding f) Steel Fabrication g) Door & Windows h) Plumbing & Drainage i) Water Proofing – Terrace and Bathroom sunk j) External and Internal Painting k) Building materials – Brick, Cement, Sand, Aggregate, Concrete, Steel	II	6*
3	Conduct field visit to perform quality checks of various construction activities and building materials.	II	4*
4	Solve minimum 8(eight) examples related to the Statistical Quality Control and Statistical Process Control.	III	8*

5	Prepare Power Point Presentation on the important clauses of IS, ISO and NBC	IV	Home* assignment
6	Prepare Power Point Presentation explaining systematic process of green building audit through GRIHA.	V	Home* assignment
7	Prepare Power Point Presentation explaining systematic process of green building audit through IGBC.	V	Home* assignment
8	Conduct physical field visit of nearby green building or virtual/video tour of green building and make comparative report with non-green building.	V	4*

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.

6.MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

Sr. No.	Equipment Name with Broad Specifications	PrO. No
1	File papers, Charts &Drawing instruments	2,3 & 4
2	Computing Devices, Computer	1, 5,6,7,8
3	Projector	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) Demonstrate working as a leader/a team member.
b) Follow safety practices on site.
c) Follow ethical practices.
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 Only the major Underpinning Theory is formulated as higher level UOs of *Revised Bloom's taxonomy* in order for the development of the COs and competency is not missed out by the students and teachers. If required, more such higherlevel UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Major Learning Outcomes (in Cognitive Domain)	Topics and Sub-topics

Unit-I **Total Quality Management (TQM) in Construction**	1.a Explain features of TQM 1.b Apply various quality checks. 1.c Distinguish between quality control and quality assurance. 1.d Explain Quality assurance techniques 1.e List precision in observation in data and information 1.f Explain continuous improvement and innovation 1.g Describe employee Involvement and Training.	1.1 Concept of 1.1.1 Quality control, 1.1.2 Quality Assurance, 1.1.3 Quality management. 1.2 Aims of TQM 1.3 Importance of quality 1.4 Elements of quality – Quality assurance techniques (inspection, testing, sampling) 1.5 Use of manuals and checklists for quality control 1.6 Development and design Concept of TQM 1.7 Accuracy and precision in observation, reading, calibration, testing, measurements, recording of data and information etc. 1.8 Quality Improvement Techniques CONQUAS- Construction Quality Assessment System 1.9 Continuous Improvement and Innovation 1.9.1 Continuous improvement models (e.g., PDCA cycle) in construction 1.9.2 Encouraging innovation and improvement within construction projects 1.10 Employee Involvement and Training • Importance of employee involvement in TQM • Training programs for construction personnel to ensure quality 1.11 Case Studies and Best Practices Analyzing • Successful TQM implementations in construction • Learning from real-world examples and best practices.

Unit-II **Construction Quality Control Inspection Program**	2.a Explain Fundamental Concepts& principles of quality control (QC) and quality assurance (QA) in construction, including the roles and responsibilities of various stakeholders. 2.b Apply various inspection methods and procedures suited for different construction materials, systems, and stages of the project. 2.c Make use of skills in collecting accurate and consistent quality inspection data, employing statistical analysis tools for quality control, and reporting findings effectively. 2.d Utilize construction QC software for data management, reporting, and communication. 2.e Develop high ethical standards in inspections and reporting, ensuring objectivity and accuracy.	2.1 Concept of QA & QC 2.2 Benefits of effective QA & QC 2.3 Roles & responsibilities of stakeholders. 2.4 Check lists for 2.4.1 Masonry 2.4.1 Plastering 2.4.1 Flooring 2.4.1 Concreting of various building elements 2.4.1 Formwork & Scaffolding 2.4.1 Steel Fabrication 2.4.1 Door & Windows 2.4.1 Plumbing & Drainage 2.4.1 Water Proofing – Terrace and Bathroom sunk 2.4.1 External and Internal Painting 2.4.1 Building materials – Brick, Cement, Sand, Aggregate, Concrete, Steel 2.5 Orientation of the basic construction QC software. 2.6 Ethical Standards in Inspections and Reporting 2.6.1 Understanding Ethical Principles 2.6.2 Objectivity in Inspections 2.6.3 Accuracy and Completeness in Reporting

Unit-III **Statistical Quality Control& Monitoring**	3.a Describe statistical quality principles and Importance. 3.b Explain variables and attributes related to control charts. 3.c Explain SPC methods 3.d Describe different types of Attributes-sampling plans. 3.e Explain acceptance sampling. 3.f Interpret different type of charts.	3.1 Introduction to Statistical Quality Control in Construction 3.1.1 Overview of Statistical Quality Control (SQC) principles 3.1.2 Importance of SQC in building construction 3.2 Quality Measurement: Attributes and Variables 3.3 Statistical Process Control (SPC) Methods 3.4 Control Charts for Attributes: 3.4.1 p-Charts - Proportion Defective 3.4.1 c-Charts - Number of Defects Per Unit 3.5 Control Charts for Variables 3.6 Other Types of Attribute-Sampling Plans 3.7 Acceptance Sampling
Unit-IV **Quality Standards**	4.a Explain Importance of Construction Quality Standards 4.b Describe Benefits of Construction Industry Quality Standards 4.c Explain key features of National Building Code of India 2016 (NBC 2016) 4.d Explain key features of ISO Standards for the Construction Industry	4.1 Quality standards of various building materials and construction activities. 4.2 Study of Indian Standard Code for Civil Engineering (a) Orientation of the mostly used IS codes as far as the building quality is concerned 4.3 Study of National Building code (NBC 2016) Part 0 to 12 (a) Objectives (b) Basic Content of each part (c) Application 4.4 Study of ISO 9001 - the international standard for quality management 4.5 Study of ISO 14001 - the international standard for environmental management systems 4.6 Study of ISO 50001 - the international standard for energy management systems 4.7 Study of ISO 45001 - the international standard for health and safety management. 4.8 Study of ISO 44001 - the international standard for collaborative working

Unit-V Green Building& Sustainable Construction Development	5.a Describe existing Building construction scenario in India 5.b Explain - 'Sustainable Buildings' in India. 5.c Explain - Net Zero emission buildings List Government incentives for green building, Emerging policy, regulatory tools and	5.1 Sustainable buildings & construction 5.2 Zero net emissions in existing and new buildings: 5.3 Definition – Green Building, Green Construction, Objectives of Green building 5.4 Green building case studies 5.5 Energy conservation act 2001 5.6 National Water Policy, 2002 5.7 Integrated Energy Policy 2006
	opportunities 5.d Explain in detail – "Building Rating systems"	5.8 Missions under the national climate action plan 5.9 Energy conservation building code (ECBC-2007) 5.10 Appliance standards and labeling 5.11 Building certification: Green Rating for Integrated Housing Assessment (GRIHA) 5.12 Leadership in Energy and Environmental Design (LEED) 5.13 EDGE: green building certification system 5.14 IGBC rating system 5.15 GEM rating system 5.16 Eco Niwas Samhita 2018 5.17 National Mission on Sustainable Habitat (NMSH)

Unit-VI Life Cycle Assessment for Building Products	6.a Explain - Life Cycle Assessment 6.b Describe about Efficient life cycles for buildings 6.c Explain Green Building Guide to Reducing Waste 6.d Explain Procedure of Implementing construction waste management (CWM) in India	6.1 Introduction to Life cycle assessment (LCA) 6.2 Siting and structure design efficiency 6.3 Energy efficiency 6.4 Water efficiency 6.5 Materials efficiency 6.6 Occupant health and safety 6.7 Indoor environmental quality enhancement 6.8 Operations and maintenance optimization 6.9 Waste reduction 6.10 Planning Deconstruction 6.11 Reusing and Repurposing Materials 6.12 End of Life Options for Common Building Materials 6.13 Quantum & composition of Construction & demolition (C&D) waste generation 6.14 Initiatives in promoting C & D waste products by GoI 6.15 Introduction to Guidelines on Environmental Management of C&D Wastes

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 QUESTIONPAPER DESIGN

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Total Quality Management (TQM) in Construction	7	4	3	4	**11**
II	Construction Quality Control Inspection Program	8	3	5	5	**13**
III	Statistical Quality Control & Monitoring	8	4	4	5	**13**
IV	Quality Standards	7	4	3	4	**11**
V	Green Building & Sustainable Construction Development	7	3	5	5	**13**
VI	Life Cycle Assessment for Building Products	5	2	3	4	**9**

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 in 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 vary slightly from the above table.*

10. SUGGESTED STUDENT ACTIVITIES

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

a) Undertake micro project
b) Prepare checklists of various construction activities
c) Prepare lists of various IS codes with their application domain
d) Prepare drawings and calculations
e) Prepare presentations
f) Prepare Site visit reports
g) Study various processes for green building audit
h) Visit the nearby green buildings
i) Conduct expert lectures of quality experts and green building auditors

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-M 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.11***, teachers need to ensure the creation of opportunities and provisions for ***co-curricular activities***.
f) Guide students on how to address issues on environmental and sustainability
g) Expert lecture by water resource engineer about the emerging scenario of this field or industry experts

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 is group-based. However, in the fifth and sixth semesters, it should preferably be ***individually*** undertaken to build up the skill and confidence in every student to become a 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-bawd, or field-based. Each macro-project should encompass two or more Cos which are in fact, integrations of PrOs, UOs and ADOs. Each student will have to maintain a date work diary consisting of individual contributions to the project work and given seminar presentation of it before submission. The total Duration of the micro-project work should not be less than 16 [sixteen] student engagement hours during the course. The student ought to submit a micro-project by the end the semester to develop the industry-oriented Cos.

1. Site Visit:

a. Choose a project showcasing diverse quality control methods: Opt for a site with construction elements like concrete pouring, foundation inspection, material testing, and steel structure assembly.
b. Pre-brief students: Prepare specific questions and areas of focus for students to observe during the visit. This ensures active engagement and targeted learning.
c. Post-visit discussion: Facilitate a panel discussion with project engineers or quality control supervisors to delve deeper into challenges, successes, and future trends in quality control.

2. Video Films:

a. Go beyond basic material testing: Showcase innovative techniques like drone-based inspection, thermal imaging for detecting thermal bridges, and non-destructive testing methods.
b. Curate diverse materials: Include videos testing not just basic materials like concrete and steel, but also specialized elements like waterproofing membranes, geosynthetics, and prefabricated components.
c. Interactive viewing: Pause at key points to ask students questions, solicit predictions, and highlight important details they might miss.

3. Expert Lectures:

a. Focus on specific areas: Invite experts specializing in crucial aspects like soil testing, concrete mix design, quality control for sustainable materials, or digital tools for quality monitoring.
b. Interactive format: Encourage Q&A sessions, panel discussions, and student case presentations to ensure a dynamic learning experience.
c. Case study integration: Ask the experts to discuss real-world projects they've handled, highlighting both successes and lessons learned from quality control failures.

4. Case Studies:

a. Select diverse failures: Show examples of structural collapses, material degradation, fire safety issues, and environmental impacts caused by quality control problems.

b. Emphasize root causes: Go beyond just showcasing failures. Analyze the technical and human factors that led to them, encouraging critical thinking and risk identification.
c. Integrate with other activities: Use case studies as discussion points after site visits, expert lectures, or video screenings to solidify learning and connect theory with practical application.

13. SUGGESTEDLEARNINGRESOURCES

A. BOOKS:

No.	TITLE	AUTHOR	PUBLISHER
1	Total Quality Management	G.Kanji	Springer Science & Business Media
2	Fundamentals of Quality Control and Improvement	Amitva Mitra	Wiley India Private Limited
3	Construction Project management, Theory & Practice	Kumar Neeraj Jha	Pearson Education India
4	Project Planning with PERT and CPM	B. C. Punmia, K. K. Khandelwal	Laxmi Publications
5	Construction Planning and Management	P. S. Gehlot and B. M. Dhir	Wiley Eastern Ltd.
6	Construction of Structures and Management of Works	S. C. Rangwala	Charotar Publications
7	Manual on Quality Control	--	Gujarat Engineering Research Institute
8	Ambuja Technical Literature Series	--	Ambuja Cements
9	Construction Project Management	K. K. Chitkara	Tata McGraw-Hill Education
10	NationalBuildingCode,ISO9000/14000andother standards		

14. Learning Website:

List of Readings for each Chapter including and not limited to

i. www.nptel.ac.in
ii. http://ndrfandcd.gov.in/Cms/NATIONALBUILDINGCODE.aspx
iii. http://en.wikipedia.org/wiki/Green_building_in_India iv. https://edge.gbci.org/
v. https://www.teriin.org/
vi. https://www.cseindia.org/greening-our-buildings-what-is-the-government-doing-2731
vii. https://igbc.in/
viii. https://www.niua.org/csc/assets/pdf/key-documents/phase-2/CSCAF-2.0-
ix. https://www.niua.org/csc/assets/pdf/CSCAF_2_Booklet.pdf
x. https://heyzine.com/flip-book/31ddf6adfe.html#page/1
xi. Climate Smart Cities Assessment 2.0. Process Video
xii. https://www.youtube.com/watch?v=WHq7ZTtPrsk
xiii. https://edgebuildings.com/wp-content/uploads/2021/11/IFC0060-EDGEBrochure-India-2021-11-03-FIN.pdf xiv. https://gbci.org/press-kit-edge
xv. https://www.grihaindia.org/about-griha
xvi. https://www.youtube.com/watch?v=ugGPJ0QYs1A
xvii. https://www.beeindia.gov.in/sites/default/files/ECBC_BOOK_Web.pdf
xviii. https://www.cseindia.org/india-manages-to-recover-and-recycle-only-about-1-per-cent-ofits-construction-and-demolition-10326
xix. https://www.indiawaterportal.org/articles/implementing-construction-waste-management-india
xx. https://cpcb.nic.in/openpdffile.php?id=TGF0ZXN0RmlsZS8xNTlfMTQ5NTQ0NjM5N19tZWRpYXBob3RvMTkyLnBkZg xxi. https://cpcb.nic.in/openpdffile.php?id=TGF0ZXN0RmlsZS8xNTlfMTQ5NTQ0NjM5N19tZWRpYXBob3RvMTkyLnBkZg xxii. https://www.bis.gov.in/wp-content/uploads/2022/08/Booklet-Guide-for-Using-NBC-2016.pdf xxiii. https://www.bis.gov.in/standards/technical-department/national-building-code/ xxiv. https://law.resource.org/pub/in/bis/S03/is.sp.21.2005.pdf
xxv. https://www.grihaindia.org/case-study xxvi. https://igbc.in/igbc-rating-systems.php

15. PO-COMPETENCY-CO MAPPING

Semester IV	Construction Quality Control & Monitoring (Course Code: 4350602)									
	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	PSO 2	PSO 3

Competency	• **Impart the fundamental skills and knowledge necessary to comprehend the practice of Construction Quality Control & Monitoring**									
CO a.	3	-	-	2	3	3	3			
Total Quality Management (TQM) in Construction										
CO b. Construction Quality Control Inspection Program	3	2	-	2	3	3	3			
CO c. Statistical Quality Control & Monitoring	-	2	-	2	-3	2	3			
CO d. Quality Standards		2	1	2	1	2	3			
CO e. Green Building & Sustainable Construction Development	1		3	3	3	2	3			
CO f. Life Cycle Assessment for Building Products	1		3	2	2	2	3			

Legend: '**3'** for high, '**2**' for medium, **'1'** for low or **'-'** for the relevant correlation ofeach competency, CO, with PO/ PSO

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

S. No.	Name and Designation	Institute	Contact No.	Email

1	Shri. Rahul S. Oza	Government Polytechnic, Jamnagar	9426994979	rahuloza.engg@gmail.com
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GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

VI – Semester

Course Title: Advance Design of Structures

(Course Code: 4360609)

Diploma program in which this course is offered	Semester in which offered
Civil Engineering	Sixth Semester

1. RATIONALE

After learning advance analysis of structures in fifth semester, this elective subject is introduced in 6th semester for those students willing to excel in the structural engineering field. This subject incorporates in depth knowhow for design of structural elements pertaining to Steel structures and Reinforced Concrete structures. In Steel structures, design of Tension member, Compression member and flexural member is included. Slab base foundation for steel column and under advance RCC design topics i.e. Doubly reinforced beam, T - Beam and Continuous slab are also incorporated. After learning this subject, diploma students will develop enhanced , in-depth, understanding of analysis and design of the structural members in the field of structural engineering and will be able to apply their knowledge ,design and analytical skills in the construction 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:

- **Analyse and Design important structural elemental members of R.C.C. and Steel structures.**

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) Analyse and Design Tension and Compression members of Truss .
b) Design axially loaded steel column and slab base foundation.
c) Design Laterally restrained steel beam and purlin.
d) Analyse RC T-Beam & Doubly reinforced beam and design Doubly Reinforced rectangular beam.
e) Design a three span one way continuous RC slab.

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.*

Note: Subject related Indian Standard Codes (1) IS 456-2000 (2) IS 800-2007 (3) SP-16 Design Aid to IS-456 (4) SP-6 Handbook for Steel Structures will be allowed during Examinations.

5. SUGGESTED PRACTICAL EXERCISES

The following practical outcomes (PrOs) are the subcomponents 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	Analyse and Design Axially Loaded Tension Member made up of Angle Section Specify Equal or Unequal, ISA or 2ISA (1-Problem Each)	I	02*
2	Analyse and Design Strut made up of Angle Section (1-Problem Each)	II	02 *
3	Design Axially Loaded Steel Column (One ISHB Section) and Slab Base Foundation for that. (1-Problem)	II, IV	04*
4	Design laterally restrained steel beam and purlin.(1-Problem Each)	III	02*
5	Draw longitudinal and sectional view designed Tension Member , Compression member and Laterally restrained beam. Draw Plan and c/s Elevation of Slab Base Foundation under column made up of H section. Sheet No:01 – A2 Size	I, II, III, IV	02*
6	Analyse and Design Doubly reinforced rectagular beam.(1-Problem Each)	V	04*
7	Analyse T-Beam (1-Problem)	VI	02*
8	Design three span one way continuous slab (1-Problem)	VII	04 *
9	Draw longitudinal and sectional view of designed doubly reinforced beam. Draw designed three span One Way Continuous Slab in Plan and in Longitudinal cross section Sheet No:02 – A2 Size	VI,VII	02*
10	Hands on Practice session/ Interactive Seminar for design , Analysis of Structural components (steel and/or RCC) on relevant software	I TO VII	04 *
	Total hours		**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	Interpretation of given data and its understanding.	10
2	Selection of sketches/Process of designing of the given structural components using relevant I.S.codes and preparing of report of site visit..	40
3	Presentation of sketches in sketchbook, neatness and cleanliness of sheets and writing reports.	20
4	Individual work, work as a team-member	15
5	Completion and submission of work in time.	15
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.

Sr. No.	Drawing tools and other design aids (for all PrOs)
1	Drawing boards and drawing instruments.
2	Scientific calculator and all relevant IS codes.
3	Computers and Printers.
4	Available CAD software(Not mandatory)

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 safety practices while using equipment.
c) Realize importance of green energy. (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 **Tension Member**	1a. Suggest the type of steel section to be used as tension member for given data. 1b. Compute the load carrying capacity of given tension member with given condition. 1c. Design given tension member for given data and condition.	1.1 Types of sections used as Tension Members in Steel Structures. 1.2 Design strength of Tension Member governed by Yielding, rupture of critical section and Block shear in Angle section according to provision of IS: 800-2007 1.3 Analysis and Design of Axially loaded tension members - Single and Double angle section with Bolted and welded connections. 1.4 Numerical of Analysis and design of tension members for single and double angle sections with bolted and welded connections.
Unit – II **Compression Member (Strut & Column)**	2a. Suggest the type of steel section to be used as compression member for given data. 2b. Compute the load carrying capacity of given compression member with given end conditions. 2c. Design the compression member for given data and condition.	2.1 Type of sections to be used as compression members in steel structures. Calculation of effective length, radius of gyration, slenderness ratio and its permissible value as per IS:800-2007. 2.2 Cross section classification, Buckling class, Imperfection factors as per IS:800-2007 2.3 Design compressive strength of (i) Axially loaded compression members (ii) Single angle struts (iii) Double angle struts as per IS:800-2007 2.4 Numerical of Analysis and design of compression members for single angle section, double angle section, with bolted and welded connections. 2.5 Numericals for Analysis and Design of Column (made up of single H section i.e. ISMB,ISHB only No Built Up Section)
Unit– III **Laterally Restrained Beam and Purlin**	3a. Design laterally restrained simply supported beams(only ISHB or ISMB 3b. Design Purlin made up of Unequal Angle Section	3.1 Main Beam , Secondary Beam , Standard I Sections , Laterally restrained and unrestrained beam (only) symmetrically loaded with UDL and/or point load. 3.2 Plastic Section Modulus – Annexure –H , IS-800-2007 , Section classification as per Table 2 – IS-800-2007 , Shear buckling , Shear Strength and Bending

		Strength of Section as per Cl. 8.4.1 and Cl. 8.2.1.2 of IS-800-2007 , Deflection as per Table-6 of IS-800-2007 , Shear Leg Effect , Web Crippling
Unit– IV **Slab Base Foundation**	4a. Identify different types of column bases foundation. 4b. Design of Slab Base Foundation for Axially Loaded Column made up of Indian Standard Heavy Beam Section	4.1 Schematic comparison of various Slab Bases for Axially loaded columns. 4.2 Procedure to design Slab Base Foundation for axially loaded column made up of ISHB Section with bolted connection only. 4.3 Numerical to design slab base foundation for given data.
Unit– V **Doubly Reinforced Beam**	5a. Differentiate types of RC beams. 5b. Calculate moment of resistance of doubly reinforced beam. 5c. Design a Rectangular Doubly reinforced beam. 5d. Draw reinforcement detailing for the designed doubly reinforced beam section as per IS provision.	5.1 Requirements and conditions for providing doubly reinforced sections. 5.2 Stress diagram for doubly reinforced beam. Stress in compression reinforcement (f_{sc}) in doubly reinforced beams for different values of d'/d ratio. 5.3 Analysis and design of doubly reinforced section using IS:456-2000 method, SP:16 table method and SP: 16 chart method. 5.4 Numerical of Moment of resistance and Area of steel (tension and compression) for doubly reinforced beam.
Unit– VI **T-Beam**	6a. Identify importance of reinforced concrete flanged beams. 6b. Analyze T-beam for Flexure.	6.1 Concept of flanged beam-T-beam & L-beam. Requirement and advantage of T-beam. Effective width of flange. 6.2 Conditions for the beam to act as T-Beam i.e. (i) Neutral axis lies in flange[$X_u < D_f$] (ii) Neutral axis lies in web [$X_u > D_f$] Stress strain diagram of T- beam. 6.3 Numerical to find Limiting Moment of Resistance of Tee Beam using IS:456-2000 and SP-16.
Unit– VII **One-Way Continuous Slab**	7a. Identify conditions to use one way continuous slab. 7b. Design one way continuous slab as per given data and condition. 7c. Draw reinforcement details for the designed one way continuous slab as per IS provision.	7.1 Definition and requirement to use one way continuous slab. 7.2 IS 456:2000 provisions for three span one way Continuous Slab. Various coefficients of Bending moment and shear force for dead load and imposed load. 7.3 Numerical to design three span one way continuous slab only.

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	**Tension Member**	**08**	**02**	**04**	**06**	**12**
II	**Compression Member (Strut & Column)**	**10**	**02**	**04**	**08**	**14**
III	**Laterally Restrained Beam and Purlin**	**06**	**02**	**04**	**04**	**10**
IV	**Slabs Base Foundation**	**04**	**02**	**02**	**02**	**06**
V	**Doubly Reinforced Beam**	**05**	**02**	**04**	**04**	**10**
VI	**T-Beam**	**04**	**02**	**02**	**04**	**08**
VII	**One-Way Continuous Slab**	**05**	**02**	**04**	**04**	**10**
Total		**42**	**14**	**24**	**32**	**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 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 different situations with photographs of steel structural members where tensile force is predominant in the field.(bridge, Railway station)
b) Identify different situations with photographs of steel structural members connection (Bolted & welded connection)
c) Identify different situations with photographs of steel structural members where compressive force is predominant in the field.(Suspension bridge, Railway bridge)
d) Identify different situations with photographs of RCC Structural components such as column ,doubly beams , continuous slabs etc..
e) List out various softwares available for steel and RCC design and submit a review report.
f) Use of computer program (software or excel worksheets) to compare the results of design and analysis problems solved manually

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 ***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.9***, 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-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 field application based, internet-based, workshop-based, laboratory-based or theory 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 **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) Compare the design and analysis done manually with computer software or excel worksheets for at least one of the list below
    a. Steel Design and analysis for Axially loaded Tension member, Axially loaded compression member,Simply Supported laterally restrained beams, Purlins and Slab base Foundation.
    b. RCC Design and analysis of Doubly reinforced rectangular beam, 3 span one way continuous slab,T beam.
b) Prepare a spreadsheet computer program to design at least one of the following
    a. Steel Design for Axially loaded Tension member, Axially loaded compression member, Simply Supported laterally restrained beams, Purlins and Slab base Foundation.
    b. RCC Design of Doubly reinforced rectangular beam, 3 span one way continuous slab.
c) Prepare a spreadsheet computer program for at least one of the following
    a. Steel Design for Axially loaded Tension member, Axially loaded compression member,Simply Supported laterally restrained beams, Purlins and Slab base Foundation.
    b. Doubly reinforced rectangular beam, 3 span one way continuous slab.

d) Analyse and design a steel roof truss or a residential block building with structural engineering software.

13. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1	Design of Reinforced Concrete Structures	N Krishna Raju	CBS Publishers & Distribution Pvt. Ltd. NewDelhi ISBN: 9789385915369
2	Design of Reinforced Concrete Structures	N Subramanian	Oxford Publisher ISBN: 0198086946
3	Reinforced Concrete Vol.I	Dr.H.J.Shah	Charotar Publication ISBN: 9789385039478
4	Design of Steel Structures By Limit State Method as per IS:800-2007	S.S.Bhavikatti	Dreamtech press New Delhi ISBN:9389307058
5	Limit State design of Steel structures	S.K.Duggal	Mc Graw Hill ISBN: 9353164877
6	Limit State design of Steel structures As per IS:800-2007	S.Kanthimathinathan	Dreamtech press New Delhi ISBN:9389447577
7	IS:456-2000- Plain and Reinforced concrete code of practice.	BIS, New Delhi	BIS, New Delhi
8	IS:800-2007-Indian Standard Code of practice for use of structural steel in general building construction.	BIS, New Delhi	BIS, New Delhi
9	SP:16-Design Aids for reinforced concrete to IS:456	BIS, New Delhi	BIS, New Delhi
10	SP:6-Handbook for Structural Engineers(Structural Steel Sections)	BIS, New Delhi	BIS, New Delhi
11	SP:34-Handbook on Concrete Reinforcement and Detailing	BIS, New Delhi	BIS, New Delhi

14. SOFTWARE/LEARNING WEBSITES

a) NPTEL Course :-Reinforced Cement Concrete by IIT, Kharagpur https://archive.nptel.ac.in/courses/105/105/105105105/

b) NPTEL Video series for Steel design by IIT, Kharagpur https://archive.nptel.ac.in/courses/105/105/105105162/

15. PO-COMPETENCY-CO MAPPING

Semester VI	Advance Analysis of Structures (Course Code: 4360609)						
	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	Analyse and Design important structural elemental members of R.C.C. and Steel structures.						
Course Outcomes COa) **Analyse and Design Tension and Compression members of Truss**	2	3	3	2	2	2	2
COb) **Design Axially loaded steel column and slab base foundation.**	2	3	3	2	2	2	2
COc) **Design laterally restrained steel beam and purlin.**	2	3	3	2	2	2	2
COd) **Analyse RC T-beam and Doubly reinforced beam and Design doubly reinforced rectangular beam**	2	3	3	2	2	2	2
COe) **Design a three span one way continuous RC slab.**	2	3	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

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