SIDDHARTHA
ACADEMY OF HIGHER EDUCATION
A DEEMED TO BE UNIVERSITY
(Under Section 3 of UGC Act, 1956)

SCHEME OF INSTRUCTIONS [SU24]

B.Tech. PROGRAMME

CIVIL ENGINEERING

B.Tech. Degree Programs Applicable for the batch of students admitted from the Academic Year 2024-25

VELAGAPUDI RAMAKRISHNA
SIDDHARTHA SCHOOL OF ENGINEERING

Kanuru, Vijayawada - 520 007, Andhra Pradesh
www.vrsiddhartha.ac.in

INSTITUTION VISION

To be a Centre of Excellence in Education, Innovation and Research with Global presence in Arts, Science, Technology, Medicine, Management, Legal Studies and Social Studies in enriching the frontier areas of National and International Importance.

INSTITUTION MISSION

- To create a transformative educational experience for students focused on problem solving skills; communication abilities, and interpersonal relations and leadership.
- To cultivate a vibrant university community for attracting and retaining diverse, world-class talent creating a collaborative environment open to the free exchange of ideas where research, creativity, innovation and entrepreneurship can flourish and ensuring individuals to achieve their full potential.
- To impact society in a pragmatic manner - regionally, nationally and globally - by engaging with industry, outstanding national and international universities and research organizations.
- To be a global University that nurtures excellence in education and innovation for creating a knowledgeable society.

DEPARTMENT VISION

To achieve excellence and quality in civil engineering education, research, innovation, capacity building & training, and industry-academia collaboration, thus contributing to sustainable infrastructure development that serves the society.

DEPARTMENT VISION

- To foster quality education, research, innovation, professional engagement, entrepreneurship and outreach activities through collaboration with Industry and academia, addressing real-world infrastructure challenges.
- To provide ethical values, leadership, environmental sustainability and lifelong learning through an interdisciplinary approach that encourages social responsibility and professional growth in Civil Engineering.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

PEO 1: Professional Competence and Lifelong Learning

Graduates will possess strong technical knowledge and analytical skills in civil engineering, enabling them to plan, design, and execute sustainable infrastructure projects while adapting to emerging technologies and engaging in lifelong learning.

PEO 2: Innovation, Research and Entrepreneurship

Graduates will engage in research, consultancy, innovative and entrepreneurial practices by collaborating with academia, industry in contributing to the development of sustainable engineering solutions.

PEO 3: Social Responsibility and Ethical Leadership

Graduates will demonstrate professionalism, ethical values, effective communication and leadership in multidisciplinary teams, contributing to societal well-being.

SIDDHARTHA ACADEMY OF HIGHER EDUCATION

V R SIDDHARTHA SCHOOL OF ENGINEERING

SCHEME OF INSTRUCTION FOR FOUR YEAR UG PROGRAMME [SU24]

GROUP- B (ECE / EIE / EEE / ME / CE)

SEMESTER I **CONTACT HOURS: 29**

S.No	Course Code	Course Category	Course Name	L	T	P	Credits
1	24MA101	BS	Mathematics – I (Linear Algebra, Series and Calculus)	3	0	2	**4**
2	24CY103	BS	Chemistry for Engineers	3	0	0	**3**
3	24BY101	BS	Biology for Engineers	3	0	0	**3**
4	24CS102	ES	Programming using 'C'	3	0	0	**3**
5	24CS181	ES	Programming using 'C' Lab	0	0	3	**1.5**
6	24ME181	ES	Engineering Graphics	1	0	3	**2.5**
7	24CY181	BS	Chemistry lab	0	0	2	**1**
8	24ME182	ES	Workshop Practice	0	0	3	**1.5**
9	24UC183	MC	Sports and Yoga or NSS/NCC	0	0	3	**0**
			Total	**13**	**0**	**16**	**19.5**

SEMESTER II **CONTACT HOURS: 29**

S.No	Course Code	Course Category	Course Name	L	T	P	Credits
1	24MA102	BS	Mathematics – II (Differential equations & Computational methods)	3	0	2	**4**
2	24PH103	BS	Physics for Engineers	3	0	0	**3**
3	24EN101	HS	Communicative English	3	0	3	**4.5**
4	24ME101	ES	Engineering Mechanics (CE / ME)	3	0	0	**3**
5	24IT103	ES	Problem Solving with Python	2	0	2	**3**
6	24UC181	ES	Design Thinking	0	0	2	**1**
7	24PH181	BS	Physics lab	0	0	2	**1**
8	24UC182	ES	AI Tools and Applications	0	0	2	**1**
9	24UC101	MC	Essence of Indian Knowledge Tradition	2	0	0	**0**
			Total	**16**	**0**	**13**	**20.5**

SEMESTER III **CONTACT HOURS: 24**

S.No	Course Code	Course Category	Course Name	L	T	P	Credits
1	24MA201	**BS**	Probability and Statistics for Engineers	4	0	0	**4**
2	24CE201	**ES**	Mechanics of Solids	3	1	0	**4**
3	24CE202	**PC**	Surveying & Geomatics	3	0	0	**3**
4	24CE203	**PC**	Fluid Mechanics	3	0	0	**3**
5	24CE204	**PC**	Building Materials & Construction Technology	3	0	0	**3**
6	24CE281	**PC**	Strength of Materials Laboratory	0	0	2	**1**
7	24CE282	**PC**	Surveying Laboratory	0	0	2	**1**
8	24UC201	**MC**	Universal Human Values-II	2	1	0	**3**
			Total	**18**	**2**	**04**	**22**

SEMESTER IV **CONTACT HOURS: 28**

S.No	Course Code	Course Category	Course Name	L	T	P	Credits
1	24CE205	**ES**	Engineering Geology	2	0	0	**2**
2	24CE206	**PC**	Environmental Engineering	3	0	0	**3**
3	24CE207	**PC**	Geotechnical Engineering	3	0	0	**3**
4	24CE208	**PC**	Hydraulics & Hydraulic Machines	3	0	0	**3**
5	24CE209	**PC**	Structural Analysis	3	1	0	**4**
6	24CE210	**PC**	Concrete Technology	3	0	0	**3**
7	24CE283	**PC**	Concrete Technology Laboratory	0	0	2	**1**
8	24CE284	**PC**	Fluid Mechanics & Hydraulic Machines Laboratory	0	0	2	**1**
9	24CE285	**PC**	Computer Aided Civil Engg. Drawing	0	0	2	**1**
10	24EN281	**HS**	English for Professionals	0	0	2	**1**
11	24UC202	**MC**	Professional Ethics	2	0	0	**0**
			Total	**19**	**1**	**8**	**22**

SEMESTER V **CONTACT HOURS: 29**

S.No	Course Code	Course Category	Course Name	L	T	P	Credits
1	24CE301	PC	Foundation Engineering	3	0	0	3
2	24CE302	PC	Transportation Engineering	3	0	0	3
3	24CE303	PC	Design of Concrete Structures	3	1	0	4
4	24CE310	PE - I	A) Disaster Preparedness & Planning B) Environmental Pollution & Control C) Sustainable Building Technologies And Energy Management D) Modern Surveying	3	0	0	3
5	24CE360	IE	Inter disciplinary Elective – 1 A) Geospatial Technologies B) Building Services Engineering	3	0	0	3
6	24CE383	PC	Geotechnical Engineering Laboratory	0	0	2	1
7	24CE384	PC	Environmental Engineering Laboratory	0	0	2	1
8	24CE381	PR	EPICS *	0	0	4	2
9	24CE382	PC	Skill Course-I – Building Information Modelling Lab	1	0	2	2
10	24UC302	MC	Environmental Science/ ~~Constitution of India~~	2	0	0	0
			Total	**18**	**1**	**10**	**22**

* The **EPICS** will be carried out during summer vacation for a period of **six weeks after the IV Semester** and the report shall be submitted in the V Semester.

SEMESTER VI **CONTACT HOURS: 28**

S.No	Course Code	Course Category	Course Name	L	T	P	Credits
1		PC	Design of Steel Structures	3	0	0	3
2		PC	Water Resources Engineering	3	0	0	3
3		IE	Inter disciplinary Elective – 2 A) Green Buildings & Sustainability B) Advanced Construction Materials	3	0	0	3
4		PE	Program Elective - 2	3	0	0	3
5		PE	Program Elective - 3	3	0	0	3
6		PE	Program Elective - 4	2	0	0	2
7		PC	Transportation Engineering Laboratory	0	0	2	1
8		PC	Advanced Surveying Lab.	0	0	2	1
9		HS	Advanced Communication Skills Laboratory	0	0	2	1
10		PC	Skill Course-II – Computer Applications in Civil Engineering	1	0	2	2
11		MC	~~Environmental Science~~/ Constitution of India	2	0	0	0
			Total	**20**	**0**	**8**	**22**

Semester-VII **CONTACT HOURS: 21**

S.No	Course Code	Course Category	Course Name	L	T	P	Credits
1		PC	Estimation and Costing	3	0	0	3
2		OE	Open Elective – 1	3	0	0	3
3		PC	AI in Civil Engineering	1	0	2	2
4		PC	Computer Aided Design Laboratory	0	0	2	1
5		HE	Humanities Elective – 1 (HE Basket)	3	0	0	3
6		PR	Summer Internship				2
7		PC	Advanced Skill Course – Computer Aided Construction Management	1	0	2	2
8		PR	Mini Project	0	0	4	2
			Total	**11**	**0**	**10**	**18**

* Mandatory **Summer Internship** for a minimum of **six weeks after the VI semester** of the program.
* **Open Elective–1:** The mandatory NPTEL course must be completed, and the certificate should be submitted before the completion of the VII Semester.

Semester-VIII **CONTACT HOURS: 22**

S.No	Course Code	Course Category	Course Name	L	T	P	Credits
1		HE	Humanities Elective – 2 (HE Basket)	3	0	0	3
2		OE	Open Elective – 2 (OE Basket)	3	0	0	3
3		PR	Major Project	0	0	16	8
			Total	**6**	**0**	**16**	**14**

Humanities Elective Courses
(HE Basket)

Project Management
Engineering Economics & mgmt.
Innovation, IPR& Entrepreneurship
Operations Research
Industrial Psychology
Finance and Accounting
Organizational behavior

(OR)
Any management course offered by SAHE/Online (Swayam / NPTEL) and approved by department

Open Elective Courses
(OE Basket)

Foreign Language
Music
Law
(OR)
Any course offered by SAHE/Online (Swayam / NPTEL) and approved by department

CREDIT DISTRIBUTION - Category wise and Semester wise - (SAHE 24)

	BS	ES	HS/HE	PC	PE+IE	OE	(Skill)	PROJ	Total
Sem-1	11	8.5	0	0	0	0	0	0	**19.5**
Sem-2	8	8	4.5	0	0	0	0	0	**20.5**
Sem-3	3	4	3	11	0	0	1	0	**22**
Sem-4	0	2	0	19	0	0	1	0	**22**
Sem-5	0	0	0	12	6	0	2	2	**22**
Sem-6	0	0	1	8	11	0	2	0	**22**
Sem-7	0	0	3	6	0	3	2	4	**18**
Sem-8	0	0	3	0	0	3	0	8	**14**
Total	**22**	**22.5**	**14.5**	**56**	**17**	**6**	**(8)**	**14**	**160**

Interdisciplinary Electives	**Mandatory Courses (Non-Credit):**
1. Geospatial Technologies	1. Essence of Indian Knowledge Tradition
2. Building Services Engineering	2. Sports and Yoga or NSS/NCC
3. Green Buildings & Sustainability	3. Environmental Science
4. Advanced Construction Materials	4. Constitution of India

List of Program Electives Courses

Program Elective – 1 (V Semester)

1. Disaster Preparedness & Planning
2. Environmental Pollution & Control
3. Sustainable Building Technologies and Energy Management
4. Modern Surveying

Program Elective – 2 (VI Semester)

1. Airport Planning and Design
2. Digital Twin Technology
3. Prestressed concrete
4. Sustainable Water Resources Management

Program Elective – 3 (VI Semester)

1. Advanced Design of Concrete Structures
2. Environmental Impact Assessment
3. Ground Improvement Techniques
4. Railway and Tunnel Engineering

Program Elective – 4 (VI Semester)

1. Construction equipment and automation: 3D printing
2. Environmental Geotechnology
3. Precast & Pre-engineered buildings
4. Repair & Rehabilitation of Structures

LIST OF COURSES OFFERED UNDER MINORS - SU24

GEOSPATIAL ENGINEERING

S.No	Course Code	Course Name	L	T	P	Credits
Fourth Semester						
1	24CE	Introduction to GIS	3	0	0	3
Fifth Semester						
2	24CE	Digital Photogrammetry	3	0	0	3
3	24CE	QGIS – Theory and Applications	3	1	0	4
Sixth Semester						
4	24CE	Geospatial data analytics	3	1	0	4
5	24CE	Environmental Geoinformatics	3	0	0	3
Seventh Semester						
6	24CE	Geodata visualization	3	0	0	3
7		NPTEL/SWAYAM (Course Based on Availability)	3	0	0	3

Guidelines:

- Undergraduate students can earn a minor specialization in a different department/ discipline by securing an additional 20 credits. For example, a Mechanical Engineering student can pursue a Minor degree in Computer Science and receive a degree as B.Tech. Mechanical Engineering with a Minor in Computer Science.
- A student shall be permitted to register for the Minor program at the beginning of IV semester, provided that the student must have acquired ≥ 7.0 CGPA up to the end of II semester without any history of backlogs.
- If a student fails to score the required ≥ 7.0 CGPA without backlogs in subsequent semesters, his/her registration for Minors Program stands cancelled and he/she shall continue with the regular Program.
- Minors must be completed simultaneously with major degree program without exceeding two courses per semester.
- A maximum of 6 credits (two courses of 3 credits each) may be earned through **NPTEL/SWAYAM** towards the Minor programme.

LIST OF COURSES OFFERED UNDER HONORS - SU24

CONSTRUCTION TECHNOLOGY

S. No.	Course Code	COURSE NAME	L	T	P	Credits
FOURTH SEMESTER						
1	24CE	Advanced Construction Techniques	3	0	0	3
FIFTH SEMESTER						
2	24CE	Low Cost Housing	3	0	0	3
3	24CE	Construction Quality and Safety	3	0	0	3
SIXTH SEMESTER						
4	24CE	Formwork Design and Practice	3	1	0	4
5	24CE	Tender and Contract Management	3	1	0	4
SEVENTH SEMESTER						
6	24CE	Site Administration and Control in Construction Projects	3	0	0	3
7		NPTEL/SWAYAM (Course Based on Availability)	3	0	0	3

Guidelines:

- Students of a Department/ Discipline are eligible to opt for Honors Program offered by the same Department /Discipline.
- A student shall be permitted to register for Honors program at the beginning of IV semester provided that the student must have acquired ≥8.0 CGPA without backlogs up to the end of the II semester.
- In addition to fulfilling all the requisites of a regular B.Tech. Program, a student shall earn 20 additional credits to be eligible for the award of B.Tech. (Honors) degree. This is in addition to the credits essential for obtaining the Under Graduate Degree in Major Discipline (i.e.160 credits).
- If a student fails to score the required ≥ 8.0 CGPA without backlogs in subsequent semesters, his/her registration for Honors Program stands cancelled and he/she shall continue with the regular Program.
- Honors must be completed simultaneously with major degree program without exceeding two courses per semester.
- A maximum of 6 credits (two courses of 3 credits each) may be earned through **NPTEL/SWAYAM** towards the Honor's programme.

SYLLABUS

24MA201
PROBABILITY AND STATISTICS FOR ENGINEERS

Course Category:	Basic Science	**Credits:**	4
Course Type:	Theory	**Lecture-Tutorial-Practice:**	4-0-0
Pre-requisites:	10+2 Mathematics	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	40 60 100

Course Description:

An overview of the Multiplication rule of probability, conditional probability, discrete & continuous probability distributions, sampling distribution, Inference concerning one and two means and statistical control, regression and correlation and their applications in solving engineering problems.

Course Objectives:

- Fundamentals of probability, and cover discrete probability distributions such as Binomial and Poisson.
- Teach continuous random variables and continuous probability distributions, including normal, Uniform, Log-normal, Beta, Gamma, Exponential, and Weibull distributions.
- Explain the concepts of sample and population, sampling distribution of mean and sampling distribution of variance.
- Discuss the estimation of mean, point and interval estimations, hypothesis concerning one and two means.
- Introduce statistical process control through control charts, and discuss correlation and regression analysis.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Apply Bayes' theorem to calculate conditional probabilities and use discrete random variables to determine probability distributions like Binomial and Poisson for decision-making	K3
CO2	Apply continuous random variables to the normal distribution, approximate the binomial distribution using the normal distribution, and utilize other probability densities	K3
CO3	Apply sampling distribution to statistical parameter mean of σ known and unknown cases and sampling distribution of variance.	K3
CO4	Implement point and interval estimation methods and testing the hypotheses concerning the one and two means	K3
CO5	Apply control chart limits to analyze statistical control and utilize the regression analysis and assessing correlation between the variables	K3

Course articulation matrix

COs	POs											PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2			1								
CO2	3	2			1								
CO3	3	2			1								
CO4	3	2			1								
CO5	3	2			1								

(1-Low, 2 -Medium, 3–High)

Course Content

UNIT-I

PROBABILITY: Conditional probability, Multiplication rule of probability, Bayes' theorem.

PROBABILITYDISTRIBUTIONS: Discrete Random Variable, Binomial distribution, Poisson approximation to the Binomial distribution, Poisson Process.

UNIT-II

PROBABILITY DENSITIES: Continuous Random Variable, Normal distribution, Normal approximation to the Binomial distribution.

OTHER PROBABILITY DENSITIES: Uniform distribution, Log normal distribution, Gamma distribution, Beta distribution, Weibull distribution.

UNIT-III

SAMPLING DISTRIBUTIONS: Introduction, Populations and Samples, Sampling distribution of mean (σ known), Sampling distribution of mean (σ unknown), Sampling distribution of the variance.

UNIT-IV

INFERENCES CONCERNING MEAN: Point Estimation, Interval Estimation, Test of Hypotheses, Hypotheses Concerning one mean, Relation between Tests and Confidence intervals, Comparisons two treatments (large and small samples).

UNIT-V

REGRESSION ANALYSIS: The method of least squares, Multiple Regression, Correlation.

THE STATISTICAL CONTENT OF QUALITY IMPROVEMENT PROGRAMS: Quality Control, Control Charts for Measurements, Control Charts for Attributes.

Text Books:

[1] Probability and Statistics for Engineers, Eighth edition by Richard A. Johnson Prentice Hall of India.

[1] Probability & Statistics for Engineers & Scientists by R.E. Walpole, R.H. Myers &S.L. Myers, Sixth Edition, Prentice Hall of India / Pearson Education.

[2] Probability and Statistics by Purna Chandra Biswal, Pearson Education Prentice Hall of India 2007.

[3] Probability and Statistics by T.K.V. Iyengar, B. Krishna Gandhi, S. Ranganatham, M.V.S.S.N. Prasad, S. Chand.

Web Resources:

[1] probweb.berkeley.edu/teaching.html

[2] statsci.org/teaching.html

[3] video lectures.nptel.iitm.ac.in

24CE201
MECHANICS OF SOLIDS

Course Category:	Engineering Science	**Credits:**	4
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-1-0
Pre-requisites:	Engineering Mechanics	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	40 60 100

Course Description:

This course provides a fundamental understanding of the behavior of solid materials under various loading conditions. It covers the principles of stress and strain, their relationships, and applications in engineering structures. Key topics include axial stresses and strains, shear force and bending moment diagrams, flexural and shear stresses in beams, torsion of circular shafts, and strain energy concepts. Additionally, the course explores compound stresses, theories of failure, and the stability analysis of columns. Through analytical and problem-solving approaches, students will develop the skills necessary to design and analyze structural and mechanical components effectively.

Course Objectives:

- To provide a strong foundation in the principles of solid mechanics and their applications in engineering.
- To develop analytical and problem-solving skills for evaluating stresses, strains, and deformations in structural and mechanical components.
- To equip learners with the ability to construct and interpret shear force and bending moment diagrams for beams.
- To introduce concepts of flexural and shear stresses, torsion, and strain energy to ensure a comprehensive understanding of material behaviour under different loading conditions.
- To prepare for advanced studies in structural analysis and design by understanding the stability of columns and failure theories.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Explain the fundamental concepts of stress, strain, and material behaviour under different loading conditions.	K2
CO2	Construct shear force and bending moment diagrams for beams subjected to various loading conditions.	K3
CO3	Calculate flexural stresses, shear stresses, and torsional effects in structural elements.	K4
CO4	Apply strain energy concepts to determine deflections and energy storage in solid structures.	K3
CO5	Determine the compound stress conditions and assess the stability of columns under axial loads.	K4

Course articulation matrix

COs	POs											PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1										1
CO2	2	3	2										1
CO3	2	3	2										1
CO4	2	3	2										2
CO5	3	3	2										2

(1-Low, 2 -Medium, 3–High)

Course Content

UNIT-I

STRESSES AND STRAINS: Stress and strain concepts, Hooke's law, Tension, compression, and shear, Lateral strain, Poisson's ratio, and volumetric strain, Elastic moduli and their relationships, Bars of varying sections and composite bars, Temperature stresses and related problems, Concept of principal stresses and strains.

UNIT-II

SHEAR FORCE AND BENDING MOMENT: SFD and BMDDefinitions and sign conventions, Types of supports, beams, and loads, Shear Force and Bending Moment (SF & BM) diagrams for statically determinate beams (Cantilever and Simply Supported Beams).

Unit-III

FLEXURAL STRESSES & SLOPE AND DEFLECTION: Theory of simple bending and assumptions, Bending equation and neutral axis, Bending stresses and section modulus, Relationship between moment, slope, and deflection, Macaulay's method and Moment area method for statically determinate beams (Cantilever and Simply Supported Beams), Castigliano's theorem and its applications

UNIT-IV

SHEAR STRESSES, TORSION, AND STRAIN ENERGY: Derivation of shear stress formula, Shear stress distribution across beam sections, Torsion equation and its assumptions, Application of torsion equation to solid and hollow shafts, Torsional rigidity, Strain energy in uniaxial stress, pure bending, shear stress, and torsion.

UNIT-V

COMPOUND STRESSES AND COLUMNS: Principle of superposition and limitations, Stress distribution due to eccentric, loading, Middle third rule and core of a section, Stability of equilibrium and Euler's formula for columns, Limitations of Euler's formula and generalized buckling formulas.

Text Books:

[1] Er. R.K. Rajput, "Strength of Materials (Mechanics of solids)", S. Chand & Company Ltd, New Delhi.

[2] S. Ramamrutham & R Narayan, "Strength of Materials", DhanpatRai Publishing Co. (P) Ltd, New Delhi.

Reference Books:

[1] Bhavikatti, S.S., 2013. Structural analysis-II. Vikas Publishing House.

[2] S P Timoshenko & D H Young, "Theory of structures".McGraw-Hill College; 2nd edition 2010.

[3] E P Popov, "Mechanics of materials", Prentice-hall of India Pvt. Ltd., New Delhi. 1913

Web Resources:

http://nptel.ac.in/courses/105105108/

24CE202
SURVEYING & GEOMATICS

Course Category:	Professional Core (PC)	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Pre-requisites:	Mathematics	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	40 60 100

Course Description:

Surveying is the specialization within the field of civil engineering that focuses on measurements. It involves the use of specialized tools and techniques to determine distances, angles, and elevations, and it is crucial for creating accurate maps and plans. Surveying is commonly used in construction, engineering, land development, and environmental studies.

Overall, surveying provides the foundational knowledge necessary for measurement and setting out of various elements in structures, roads, bridges and other systems in various fields of engineering, including civil, mechanical and aerospace.

Course Objectives:

- To utilize principles of surveying in linear measurements in various situations.
- To apply height of instrument method and rise and fall methods to evaluate elevation differences.
- To employ angular measurement principles to set out curves.
- To apply various laws and equations to evaluate areas and volumes.
- To determine suitable advanced survey equipment for survey based on their purpose.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Outline the fundamentals of surveying and various methods of linear measurements	K2
CO2	Apply the concept of levelling to prepare sections and contours	K3
CO3	Apply the concept of angular measurements to set out curves	K3
CO4	Survey the areas and volumes in engineering projects	K4
CO5	Understand the functioning and application of advanced survey equipment	K2

Course articulation matrix

	POs											PSOs	
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	2	2	2	1		1							1
CO2	2	2	2	1		1						2	1
CO3	2	2	2	1		1						2	1
CO4	2	2	2	1		1							
CO5	2				3	1					1	2	1

(1-Low, 2 -Medium, 3–High)

Course Content
UNIT-I **FUNDAMENTALS & LINEAR MEASUREMENTS: Surveying:** Definition, Primary divisions, Classification, Principles, Plan and map, Scales used for maps and plans, Accuracy, Precision, Sources of errors, Types of errors; **CHAIN SURVEYING:** Principles, Instruments, ranging out, Chaining a line on a flat ground; Chaining on an uneven or a sloping ground; Chain & Tape corrections.
UNIT-II **LEVELLING:** Basic definitions, Benchmarks, Classification of direct levelling methods, Terms used in Levelling, Theory of differential Levelling, Height of Instrument and rise and fall method, Profile levelling, Cross – sectioning, **CONTOURING:** Contour interval, Characteristics of contours, Methods of locating contours, Interpolation and Sketching of contours, Uses of contour maps.
UNIT-III **ANGULAR MEASUREMENTS: THEODOLITE SURVEY:** Main parts of a Vernier Theodolite; Basic definitions; Fundamental lines; Temporary adjustments; Measurement of a horizontal angle by repetition and reiteration. Measurement of vertical angle; Errors in Theodolite surveying, **CURVES:** Types, Designation of a curve; Relationship between radius and degree of curve, Elements of simple curves, setting out of simple curve (linear methods only).
UNIT-IV **AREAS AND VOLUMES : AREAS:** Introduction, Area of a tract with straight irregular boundaries, Boundaries with offsets at irregular intervals, Planimeter: working only, **VOLUMES:** Volume of a prismoid: Trapezoidal rule, Prismoidal formula, Capacity of a reservoir.
UNIT-V **MODERN FIELD SURVEY SYSTEMS: EDM:** Principle, Types of EDM instruments. + **TOTAL STATION:** Fundamental parameters, Field equipment, Setup, Uses. **GPS:** Functioning, Applications in Civil Engineering.
Text Books: [1] Dr.K.R.Arora, "Surveying Volume-I", Standard Book House, New Delhi, 2019. [2] SatheeshGopi, R. Sathikumar; "Advanced Surveying", 2nded., Pearson Education, 2008
Reference Books: [1] Dr.B.C.Punmia, "Surveying Vol-I", 17thet., Laxmi Publications; New Delhi, 2016.
Web Resources: [1] Dr. Bharat Lohani, IIT/Kanpur – Surveying https://archive.nptel.ac.in/courses/105/104/105104101/

24CE203
FLUID MECHANICS

Course Category:	Professional Core (PC)	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Pre-requisites:	Engineering Mechanics	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	40 60 100

Course Description:

Fluid Mechanics is a fundamental branch of engineering that deals with the behaviour of fluids (liquids and gases) in motion and at rest. The course covers fluid properties, fluid statics, kinematics, dynamics, and fundamental governing equations. The principles of continuity, momentum, and energy conservation are applied to various engineering applications. This course is essential for multiple disciplines, including civil, mechanical, aerospace, and chemical engineering. Overall fluid Mechanics provides the foundational knowledge necessary for analyzing and designing systems involving fluids and helps engineers of various disciplines to understand fluid behavior, optimize flow systems, design efficient pumps and turbines, and solve challenges related to aerodynamics, hydrodynamics, and fluid-structure interactions.

Course Objectives:

- To introduce the basic concepts and properties of fluids, including the analysis of hydrostatic forces on submerged and floating bodies, and their practical significance.
- To apply the principles of fluid kinematics and dynamics in solving engineering problems, with a focus on understanding buoyancy and stability.
- To understand the fundamental equations governing fluid flow and their applications, including the analysis of pressure distribution in static fluids.
- To study different types of flow and their practical implications in engineering systems, including the behaviour of fluids in contact with submerged structures.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Apply fundamental fluid properties and hydrostatic principles to analyse forces on submerged surfaces and floating bodies.	K3
CO2	Analyse fluid motion using kinematic and dynamic principles, including buoyancy, streamlines, and Bernoulli's equation, to evaluate flow behaviour.	K4
CO3	Apply fluid dynamic principles to measure flow rates through pipes, orifices, notches, and weirs, using discharge coefficients.	K3
CO4	Examine energy losses in pipeline systems and analyze laminar flow characteristics using relevant equations and principles.	K4

Course articulation matrix													
	POs											PSOs	
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	3										3
CO2	3	2	3										3
CO3	3	2	3									3	
CO4	3	2	3									3	

(1-Low, 2 -Medium, 3–High)

Course Content

UNIT-I

PROPERTIES OF FLUIDS: Introduction; Properties of Fluid; Units of measurement; Fluid Continuum; Newtonian and Non - Newtonian fluids; Vapour pressure.

FLUID STATICS: Variation of static pressure; Pressure the same in all directions — Pascal's Law; Atmospheric, Absolute and gauge pressure; Hydrostatic pressure on horizontal, vertical and inclined plane surfaces.

UNIT-II

BUOYANCY AND FLOTATION: Buoyancy; Buoyant force and Centre of Buoyancy; Stability of submerged bodies and floating bodes; Metacenter and metacentric height; Determination of Metacentric Height by experimental method.

KINEMATICS OF FLUID FLOW: Methods of describing fluid motion; Classification of flow; Steady, unsteady, uniform and non-uniform flows; Laminar and turbulent flows; Three-, two- and one-dimensional flows; Irrotational and rotational flows; Stream line; Path line; Streak line; Continuity equation; Velocity potential and stream function.

UNIT-III

DYNAMICS OF FLUID FLOW: Euler's equation of motion; Bernoulli's equation; Momentum principle; Application of Momentum equation; Force exerted on a pipe bend.

MEASUREMENT OF FLOW THROUGH PIPES: Measurement of flow through Pipes – methods and various devices; Discharge through Venturi meter; Discharge through orifice meter; Measurement of velocity by Pitot tube.

UNIT-IV

MEASUREMENT OF FLOW THROUGH ORIFICES: Flow through orifices; Determination of coefficients for an orifice; Flow through small orifice and large rectangular orifice.

FLOW OVER NOTCHES AND WEIRS: Introduction; Classification of notches and weirs; flow over a rectangular sharp-crested weir or notch; ventilation of weirs; flow over a triangular weir or triangular notch; flow over a trapezoidal notch or weir; End Contractions; Velocity of approach.

UNIT-V

ANALYSIS OF FLOW THROUGH PIPES: Energy losses in pipelines; Darcy – Weishbach equation; Minor losses in pipelines; Pipes in series and parallel.

LAMINAR FLOW: Relation between shear and Pressure Gradients in Laminar Flow; Reynold's experiment; Critical velocity; Steady laminar flow through a circular pipe – Hagen Poiseuille's Law; Laminar Flow between Parallel Plates – Both plates at rest.

Text Books:

[1] P.N. Modi&S.N. Seth, "Hydraulics & Fluid Mechanics", 18th ed., Standard Book House, New Delhi, 2015.

[2] A.K. Jain, "Fluid Mechanics", 11th ed., Khanna Publishers, New Delhi, 2014.

Reference Books:

[1] R. K. Bansal, "Fluid Mechanics and Hydraulic Machines", 9th et.Laxmi Publications; New Delhi, 2015.

[2] Rajput R.K., "Fluid Mechanics and Hydraulic Machines", 3rd ed., S.Chand and Company Ltd., New Delhi, 2014.

[3] K. Subramanya, "Theory and Applications of Fluid Mechanics", 3rd ed., Tata McGraw Hill Publishing Company, New Delhi, 2013.

Web Resources:

[1] www.nptel.ac.in / courses/ 105101082/

[2] www.nptel.ac.in/courses/105103095/

24CE204

BUILDING MATERIALS & CONSTRUCTION TECHNOLOGY

Course Category:	Professional Core (PC)	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Pre-requisites:	---	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	40 60 100

Course Description:

Building Materials & Construction technology are part of Civil engineering that deals with different types of construction materials used in construction industry and various construction procedures adopted for construction of structural/non-structural elements.

Building materials are the essential components used in construction to create structures like homes, offices, bridges, and roads. They come in various forms, each offering different properties and advantages depending on the project's needs.

Construction technology refers to the innovations and advancements in tools, machinery, techniques, and methods used to build infrastructure and buildings more efficiently, safely, and sustainably. The field of construction technology has evolved significantly, with new trends reshaping how buildings are designed, constructed, and maintained.

Overall, Building Materials & Construction technology provides the foundational knowledge necessary for identify suitable construction materials and construction techniques in the field of civil engineering.

Course Objectives:

- To determine the properties and manufacturing process of various construction materials.
- To identify suitable protective coat required for protecting various construction materials.
- To apply the construction procedures for various structural/non-structural elements.
- To implement the damp proof measures in the buildings.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Outline the manufacturing process and properties of construction materials.	K2
CO2	Understand the properties and uses of various protective coats.	K2
CO3	Illustrate various building elements and their construction methods.	K2
CO4	Explain the methodology involved in damp-proofing of a building.	K2

Course articulation matrix

	POs											PSOs	
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	2					1	1						3
CO2	2					2	1						2
CO3	2					2	1						2
CO4	2					2	1						1

(1-Low, 2 -Medium, 3–High)

Course Content

UNIT-I

STONES AND BUILDING BLOCKS: STONES: Qualities of a good building stone; Stone quarrying; Tools for blasting; Materials for blasting; Process of blasting; Precautions in blasting; Common building stones of India.

BRICKS: General; Composition of good brick earth; Manufacture of bricks; Comparison between clamp burning and kiln burning; Qualities of good bricks; Tests for bricks; Classification of bricks; AAC blocks, Fly ash bricks, Fire bricks.

UNIT-II

TIMBER: Definition; Structure of a tree; Defects in timber; Qualities of good timber; Decay of timber; Preservation of timber; Fire resistance of timber; Seasoning of timber; Storage of timber, Indian timber trees

UNIT-III

STEEL AND PAINTS: STEEL: General; Manufacture of steel; Uses of steel; Market forms of steel; Properties of mild steel; Properties of hard steel.

PAINTS, VARNISHES AND DISTEMPERS: General; Painting; characteristics of ideal paint, Types; Varnishing; Characteristics of an ideal varnish, Types; Distempering; Wall paper; White washing; Colour washing; Emulsion Paints.

UNIT-IV

MASONRY: BRICK MASONRY: Technical terms; types of bonds in brickwork- stretcher, header, English, Flemish.Stone Masonry: Technical terms; classification of stone masonry.

WALLS AND LINTELS: classification of walls, classification of lintels- timber, stone, brick, steel, reinforced concrete lintels.

UNIT-V

FLOORS, ROOFS AND DAMP PROOFING: FLOORS: Technical terms; Types of flooring materials.

ROOFS: Technical terms; Types of roofs; Trusses- king post, queen post, combination of king post & queen post trusses, mansard roof truss; Steel sloping roofs; Roof covering materials; Types of flat roofs.

DAMPNESS AND DAMP PROOFING: Causes of dampness; Methods of preventing dampness; Damp proofing materials and their classification.

Text Books:

[1] S.C.Rangwala, "Engineering Materials", 43rd ed., Charotar Publishing House Pvt. Ltd., 2019.

[2] Dr.B.C.Punmia, Er.Ashok Kumar Jain, Dr.A.K.Jain, "Building Construction", 11th ed., Laxmi Publications; New Delhi, 2016.

Reference Books:

[1] S K Duggal, "Building Materials", 3th et. New Age International (P) Limited, Publishers, 2008.

Web Resources:

[1] Dr. M.Santhanam, Prof. Radha Krishna G. Pillai, IIT/Madras – Basic Construction Materials – https://archive.nptel.ac.in/courses/105/106/105106206/

24CE281
STRENGTH OF MATERIALS LABORATORY

Course Category:	Professional Core Lab (PC)	**Credits:**	1
Course Type:	Practice	**Lecture-Tutorial-Practice:**	0-0-2
Pre-requisites:	Engineering Mechanics	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	60 40 100

Course Description:

The Strength of Materials Lab provides practical applications of the principles of solid mechanics and material behavior under various loads and conditions. The lab emphasizes experimental techniques used to test material properties such as modulus of elasticity, Hardness, ductility, tensile strength, shear strength, tensional and impact resistance.

In this course, students will conduct a variety of experiments using different materials (Steel, wood, aluminum and brass, etc.) and loading conditions. These experiments aim to validate the theoretical principles of stress, strain, and deformation learned in the Strength of Materials lecture course.

Course Objectives:

- To investigate the mechanical properties of materials, including stress-strain characteristics, hardness (Brinnell and Rockwell), and shear strength through various testing methods such as Universal Testing Machine and shear tests.
- To determine the Young's Modulus and Modulus of Rigidity of different materials (Wood, Steel, Aluminum) using bending, torsion, spring tests and ductility to assess material deformation under various loading conditions.
- To evaluate the impact resistance of materials through Charpy test.
- To conduct strain gauge applications for stress evaluation and perform tests on timber to understand the material properties and structural behavior under different loads.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Apply standard testing procedures to determine the mechanical properties of engineering materials including stress-strain behaviour, hardness, ductility, impact strength, and shear strength in accordance with IS Codal provisions.	K3
CO2	Examine elastic constants such as Young's Modulus and Modulus of Rigidity by conducting bending, torsion, and spring tests, and analyze deflection behavior under various loading and support conditions.	K4
CO3	Demonstrate the use of experimental setups and instruments such as strain gauges, beam apparatus to verify theoretical concepts of stress, strain, shear force, and bending moment distribution in structural members.	K2

Course articulation matrix													
COs	**POs**											**PSOs**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	2	3	1	3			2	2					3
CO2	2	3	1	3			2	2					3
CO3	2	2	1	3			1	2					2

(1-Low, 2 -Medium, 3–High)

Course Content

LIST OF EXPERIMENTS:
FOLLOWING IS THE LIST OF EXPERIMENTS:

1. Plot the Stress-Strain Characteristics of Mild Steel/Tor Steel and assess the stress, strain behaviour as per IS codal provisions.
2. Evaluate the shear strength of mild steel in single and double shear conditions, as per IS codal revisions.
3. Assess the hardness of a materials (steel, Brass, Aluminium) by brinnel and Rockwell test apparatus as per IS codal provisions.
4. Determine the elastic modulus (Young's Modulus) of various materials (steel, wood, copper) by conducting bending test on simply supported beams.
5. Determine the Young's Modulus of the Given Material by Conducting a Bending Test on a Cantilever Beam and Propped Cantilever
6. Analyse the impact strength and toughness of materials by Conducting Charpy test under different loading conditions.
7. Measure the material's resistance to twisting (shear modulus) by applying torsional loads to a solid circular shaft as per IS codal provisions.
8. Evaluate the modulus of rigidity of the spring
9. Assess the ductility of a steel wire by measuring its elongation under tensile loading, helping to understand its ability to deform before fracture as per IS codal provisions.
10. Investigate the mechanical properties of timber for use in construction
11. Study the deflection behaviour of a continuous beam under load and determine the effect of different boundary conditions on beam performance.
12. Use strain gauges to measure strain and evaluate stress in materials, providing a practical approach to material testing and analysis. (demo)
13. Demonstrate shear force distribution along a beam under loading, helping to verify theoretical shear force calculations. (demo)

14. Demonstrate bending moments at various points along a beam, and verify theoretical bending moment calculations for different loading conditions. (demo)

15. Study the deflection characteristics of beams under various loading conditions and verify the relationship between load and deformation using Young's modulus and Maxwell's Reciprocal Law.

Text Books:

1. Er. R.K. Rajput, “Strength of Materials (Mechanics of solids)”, S. Chand & Company Ltd, New Delhi.
2. S. Ramamrutham& R Narayan, “Strength of Materials”, DhanpatRai Publishing Co. (P) Ltd,New Delhi.

Reference Books:

1. IS 432-P(I)-1972
2. IS 1500
3. IS 1499
4. IS 1786: 2008
5. IS 1708 (PART 8)- 1986
6 IS 710:2010

Web Resources:

https://home.iitm.ac.in/kramesh/Strength%20of%20Materials%20Laboratory%20Manual.pdf
http://nptel.ac.in/courses/105105108/

24CE282 SURVEYING LABORATORY			
Course Category:	Professional Core Lab	**Credits:**	**1**
Course Type:	Practice	**Lecture-Tutorial-Practice:**	**0-0-2**
Pre-requisites:	Mathematics	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**60** **40** **100**

Course Description:

Surveying is a fundamental aspect of civil engineering that involves the measurement and mapping of the Earth's surface. It is crucial for planning and executing construction projects, determining land boundaries, and understanding terrain characteristics.

This lab provides hands-on training in fundamental surveying techniques using different instruments such as chains, prismatic compasses, theodolites, and levels. Students will learn how to measure distances, angles, elevations, and areas efficiently, applying different surveying methods for real-world applications in civil engineering.

Course Objectives:

- To introduce students to the principles and techniques of land surveying.
- To provide practical experience in using surveying instruments for field measurements.
- To develop the ability to analyse and interpret survey data for engineering applications.
- To enable students to apply appropriate surveying methods for different terrain conditions.
- To help students understand the importance of accuracy and precision in surveying.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Apply the principles of chain surveying to measure the distances and areas.	K4
CO2	Construct a traverse by using the principles of compass surveying.	K3
CO3	Compute the horizontal and vertical angles using theodolite surveying.	K4
CO4	Apply levelling methods to determine elevations and plot contours.	K3

Course articulation matrix

COs	POs											PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2				1	1	2	2			1	2
CO2	3	2				1	1	2	2			1	2
CO3	3	2				1	1	2	2			1	2
CO4	3	2				1	1	2	2			1	2

(1-Low, 2 -Medium, 3–High)

Course Content

LIST OF EXPERIMENTS:

The following experiments are designed to provide hands-on experience in fundamental surveying techniques, essential for students of Civil Engineering. These experiments will enhance practical knowledge and technical proficiency in land measurement and mapping.

List of Experiments:

1. Determine the area of a given parcel of land by using cross staff and chain survey.
2. Determine the distance between two points with obstacles in between.
3. Measurement of bearings of an open traverse with prismatic compass and computation of area correct included angles.
4. Measurement of bearings of a closed traverse with prismatic compass and computation of area.
5. Measurement of horizontal angle by using Repetition method.
6. Measurement of horizontal angles by using Reiteration method.
7. Measurement of vertical angles using a Venire theodolite.
8. Determination of elevations of various points remote from each other (differential leveling).
9. Survey and plot the longitudinal and cross-sections of a given embankment.
10. Prepare a contour map of existing ground using an auto level.

Text Books:

1. Surveying, Volume-1 by K. R. Arora; Standard Book House.
2. Surveying, Volume-1 by B.C.Punmia; McGraw Hill Education (India) Private Limited

Reference Books:

1. Advanced Surveying by SatheeshGopi, R. Sathikumar, N. Madhu; Pearson Education Sons.

Web Resources:

https://nptel.ac.in/courses/105104101.

24UC201 Universal Human Values-II			
Course Category:	Mandatory Course (MC)	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	2-1-0
Pre-requisites:	UHV-I (in Student Induction Program)	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	40 60 100

Course Description:

The course is mandated by AICTE for all B.Tech. Students of all branches, preferably in the second year. It is intended to facilitate the development of a holistic and humane world vision. This course employs an innovative and effective methodology of self-exploration, self-verification on one's own right. It is presented as a systematic set of universal, rational and verifiable proposals about human reality, about the inherent harmony in the human being, the family, society, the entire nature and existence. It draws out the value or role of human being in the harmony at all these levels, which is essentially the scope of ethical human conduct. It further helps to find resolution of present-day challenges. The issues in professional ethics are analysed in the context of the understanding of harmony. While handling the course, the teacher is also a co-explorer along with the students.

Course Objectives:

- Help the students appreciate the essential complementarily between 'values' and 'skills' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
- Facilitate the development of a holistic perspective among learners towards life and profession.
- Facilitate the right understanding of happiness and prosperity based on correct understanding of human reality and the rest of existence.
- Identify that a holistic perspective forms the basis of universal human values and movement towards value-based living in a natural way.
- Highlight plausible implications of holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Apply the right understanding of the concepts of value education and basic human aspirations through self-exploration for the fulfillment of human aspirations**.**	K3
CO2	Analyse various aspects of the human being as the combination of Self and Body for attaining harmony at the level of human being (individual) .	K4
CO3	Apply the knowledge of nine universal values in human-human relationship for harmony at the level of family, and appreciate all the essential factors that help in attaining harmony at the level of society .	K3
CO4	Differentiate the characteristics and activities of various orders of Nature and study the mutual fulfillment among them, and also identify the existence as co-existence at all levels .	K4

CO5	Present sustainable solutions to various challenges in society and Nature, and identify that the solutions are practicable**.**	K3

Course articulation matrix

	POs											PSOs	
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3										3		
CO2	3										3		
CO3	3							2	2		3		
CO4	3							2	2		3		
CO5	3						3	3	3		3		

(1-Low, 2 -Medium, 3–High)

Course Content

UNIT-I

COURSE INTRODUCTION, NEED, BASIC GUIDELINES, CONTENT AND PROCESS FOR VALUE EDUCATION:

Purpose and motivation for the course, recapitulation from UHV-I, Self-exploration: what is it?, its content and process, 'Natural acceptance' and experimental validation – as the process for self-exploration, Continuous happiness and prosperity – a look at basic human aspirations.

Right understanding, relationship and physical facility – the basic requirements for fulfillment of aspirations of every human being with their correct priority, understanding happiness and prosperity correctly – a critical appraisal of the current scenario, method to fulfill the above human aspirations: understanding and living in harmony at various levels.

UNIT-II

UNDERSTANDING HARMONY IN THE HUMAN BEING – HARMONY IN MYSELF:

Understanding human being as a co-existence of the sentient 'I' and the material 'Body'. Understanding the needs of Self ('I') and 'Body' – happiness and physical facility, Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer).

Understanding the characteristics and activities of 'I' and harmony in 'I'. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Health.

UNIT-III

UNDERSTANDING HARMONY IN THE FAMILY AND SOCIETY – HARMONY IN HUMAN-HUMAN RELATIONSHIP :

Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfillment to ensure mutual happiness; Trust and Respect as the foundational values of relationship, Understanding the meaning of Trust; Difference between intention and competence, Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship.

Understanding the harmony in the society (society being an extension of family); Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals, Visualizing a universal harmonious order in society–Undivided Society, Universal Order–from family to world family.

UNIT-IV

UNDERSTANDING HARMONY IN NATURE & EXISTENCE – WHOLE EXISTENCE AS COEXISTENCE :

Understanding the harmony in the Nature, Inter-connectedness and mutual fulfillment among the

four orders of Nature – recyclability and self-regulation in nature, Understanding Existence as Co-existence of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence.

UNIT-V

IMPLICATIONS OF THE ABOVE HOLISTIC UNDERSTANDING OF HARMONY ON PROFESSIONAL ETHICS :

Natural acceptance of human values, Definitiveness of ethical human conduct, Basis for humanistic education, humanistic constitution and humanistic universal order, Competence in professional ethics: a) ability to utilize the professional competence for augmenting universal human order, b) ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, c) ability to identify and develop appropriate technologies and management patterns for above production systems, Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a) at the level of individual: as socially and ecologically responsible engineers, technologists and managers, b) at the level of society: as mutually enriching institutions and organizations.

Text Books:

1. Gaur, R.R., Sangal, R, &Bagaria, G.P. (2010).A Foundation Course in Human Values and Professional Ethics, Excel Books Private Limited, New Delhi.
2. Gaur, R.R., Asthana, R, &Bagaria, G.P. (2019) A Foundation Course in Human Values and Professional Ethics (2nd revised edition). Excel Books Private Limited, New Delhi.

Reference Books:

1. JeevanVidya: EkParichaya, A. Nagaraj, JeevanVidyaPrakashan, Amarkantak (1999).
2. Human Values, A. N. Tripathi, New Age International Publishers, New Delhi (2004).
3. The Story of Stuff: The impact of overconsumption on the planet, our communities, and our health and how we can make it better, Annie Leonard, Free Press, New York (2010).
4. The story of my experiments with truth: Mahatma Gandhi Autobiography, Mohandas Karamchand Gandhi, B. N. Publishing (2008).
5. Small is beautiful: A study of economics as if people mattered, E. F. Schumacher, Vintage Books, London (1993).
6. Slow is beautiful: New Visions of Community, Cecile Andrews, New Society Publishers, Canada (2006).
7. Economy of Permanence, J. C. Kumarappa, Sarva-Seva-SanghPrakashan, Varanasi (2017).
8. Bharat Mein Angreji Raj, PanditSunderlal, PrabhathPrakashan, Delhi (2018).
9. Rediscovering India, Dharampal, Society for Integrated Development of Himilayas (2003).
10. Hind Swaraj or Indian Home Rule, M. K. Gandhi, Navajivan Publishing House, Ahmedabad (1909).
11. India Wins Freedom: The Complete Version, MaulanaAbulKalam Azad, Orient Blackswan (1988).
12. The Life of Vivekananda and the Universal gospel, Romain Rolland, AdvaithaAshrama, India (2010).
13. Mahatma Gandhi: The Man who become one with the Universal Being, Romain Rolland, Srishti Publishers & Distributors, New Delhi (2002).

Web Resources:

- Textbook-1: https://dokumen.pub/a-foundation-course-in-human-values-and-professional-

ethics-firstnbsped-9788174467812.html

- AICTE – SIP Youtube Channel: https://www.youtube.com/channel/UCo8MpJB_aaVwB4LWLAx6AhQ
- AICTE – UHV Teaching Learning Material: https://fdp-si.aicte-india.org/download.php#1

24CE205 ENGINEERING GEOLOGY			
Course Category:	Engineering Science	**Credits:**	2
Course Type:	Theory	**Lecture-Tutorial-Practice:**	2-0-0
Pre-requisites:		**Continuous Assessment:** **Total Marks:**	40 60 100

Course Description:

Engineering geology is a branch of geology that deals with the study of the Earth's materials, their properties, and their behavior in relation to human-made structures. It focuses on understanding the geological factors that affect the design, construction, and stability of civil engineering projects such as buildings, bridges, dams, roads, and tunnels.

Course Objectives:

- To understand the different types of rock and their engineering properties.
- To apply quantitative skills and frame work for solving basic engineering geology
- To understand the importance of geo physical methods making engineering decisions specially site selection of engineering projects.
- To evaluate geological problems for a meaningful solution in the context of major civil engineering projects.
- To understand their influence on environmental impact

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Identify different types of rocks and understand their engineering properties, such as strength, permeability, and stability, for use in construction projects.	K2
CO2	Apply quantitative techniques and frameworks to solve basic engineering geology problems, such as analyzing rock strength or rock stability.	K3
CO3	Apply geophysical techniques to make informed decisions regarding site selection and to assess subsurface conditions for engineering projects	K3
CO4	Explain common geological challenges encountered in major civil engineering projects and apply suitable geological principles to ensure the stability and safety of structures.	K2
CO5	Analyze the influence of geological conditions on environmental aspects and examine potential mitigation measures to reduce the negative impacts of engineering projects.	K4

Course articulation matrix

COs	POs											PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3			2								2	
CO2	2	3		2								3	
CO3	2		3	2		2						3	2
CO4	2	3		3		2						2	2
CO5				2	3	2			2			2	2

(1-Low, 2 -Medium, 3–High)

Course Content

UNIT-I

Introduction To Engineering Geology - Scope of geological studies in various Civil engineering projects; Mineralogy- Introduction to mineralogy, Mineral Identification by Physical properties.Physical properties of rock forming minerals.Petrology-Rock cycle igneous rocks – Formation –Classification and Textures Sedimentary rocks – Formation –Classification and Textures, Metamorphic rocks and metamorphism – Formation –Classification and Texture, Engineering concerns of rocks

UNIT-II

Weathering, engineering classification of weathered rocks: Importance of weathering in Civil Engineering. Earth quakes - Causes and effects of earthquakes Earthquake Magnitude and intensity scales. Seismic zones of India: Landslides -Classification -Preventive measures. Structural geology – Stress –strain behaviour of rock, Concept of rock deformation Rock outcrops- Types- strike and Dip, Folds- Types-Effects on construction; Faults- Types-Effects on construction: Joints-Types-Effects on construction

UNIT-III

Maps and their interpretation, Topographic Map and Geological Map.Geophysical methods-Principles of exploration geophysical Methods. Electrical Resistivity method- Interpretation, Seismic refraction method- Interpretation

UNIT-IV

DAMS - Types and purpose of Dams, Geological investigation methods for dams, Reservoirs-Failure of reservoirs, Reservoir suitable rocks, Reservoir induced seismicity Tunnels- Site selection for tunnels**,** Geological investigation methods for Tunnels

UNIT-V

Introduction to environmental geology, its fundamental concepts, and scope.Water-rock interaction and solubility of minerals; Environmental impact on mining construction materials- aggregate waste disposal, Impact of environment on the construction of dams, reservoirs, and Ground water contamination

Text Books:

[1] F.G. Bell, Fundamental of Engineering Geology , BS Publications PVT Ltd, Hyderabad.

[2] Parbin Singh, " Engineering and General Geology ", Katson Publication House, 1987.

[3] Principals of Engineering Geology by K.V.G.K. Gokhale – B.S publications

[4] Engineering Geology by N.Chennkesavulu, Mc-Millan, India Ltd. 2005.

[5] Environmental Geology by K.SValdia, TaTaMcGraHill, NewDelhi

Reference Books:

[1] Krynine and Judd, " Engineering Geology and Geo techniques " McGraw Hill Book Company, 1990.
[2] Legeet, " Geology and Engineering ", McGraw Hill Book Company, 1998.
[3] Blyth, " Geology for Engineers ", ELBS, 1995.
[4] GoodmanR.F-Introduction to rockmechanics, JohnWiley, Chichestor
[5] S.K Duggal et.al Engineering Geology –McGraw Hill Education, 2002.
[6] E.A Keller-Environmental Geology- Prientice Hall .N.Jercy

Web Resources:[1] https://onlinecourses.nptel.ac.in/noc23_ce107/preview

24CE206 ENVIRONMENTAL ENGINEERING			
Course Category:	Professional Core (PC)	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Pre-requisites:	Engineering chemistry	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	40 60 100

Course Description:

This course covers the fundamentals of water supply and sanitation engineering, including water quantity and quality, standards, and demand forecasting. It introduces water purification and treatment processes such as sedimentation, coagulation, filtration, disinfection, and hardness/fluoride removal. The course also explores distribution systems, plumbing, and sewerage networks, including layouts, reservoirs, and valves. It addresses primary and secondary sewage treatment, including screens, grit chambers, sedimentation, trickling filters, activated sludge, and sludge management. Sewage disposal methods such as river dilution, irrigation, and self-purification are discussed, along with environmental and sustainability considerations. Students will develop the ability to analyze, design, and evaluate water supply and wastewater systems for safe and efficient operation.

Course Objectives:

- To understand water supply systems and demand analysis
- To assess water quality and public health impacts
- To learn water purification and treatment processes
- To study sewerage and wastewater treatment techniques
- To explore sustainable sewage disposal methods

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Apply the principles of water demand estimation and quality assessment to design suitable water supply systems in accordance with standard guidelines and public health requirements.	K3
CO2	Analyze various water purification methods to determine their suitability and efficiency for ensuring safe and potable water supply.	K4
CO3	Develop suitable layouts for water distribution and sewerage systems by selecting appropriate components, pipe fittings, and methods of supply to ensure efficient and hygienic service.	K3
CO4	Select suitable primary treatment units for effective wastewater management by interpreting the characteristics of sewage.	K3
CO5	Examine various secondary treatment processes and sewage disposal methods to determine their performance, operational issues, and environmental suitability for safe wastewater management.	K4

Course articulation matrix

COs	POs											PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PSO1	PSO2
CO1	1	2				2	2						
CO2	1	2	2	2		2	2					2	1
CO3	1	2	2			2	1					2	1
CO4	1	2	2	2		2	2					2	
CO5	1	2	2	2		2	2					2	

(1-Low, 2 -Medium, 3–High)

Course Content

UNIT-I

INTRODUCTION, QUANTITY AND QUALITY OF WATER

Objectives of water supply systems, Per capita consumption; Design period; Types of demands; Fluctuations in demand; Prediction of population. Impurities in water; Routine water analysis - physical, chemical and bacteriological tests; Standards for drinking water; Water borne diseases.

UNIT-II

PURIFICATION OF WATER

Purification of water; Plain sedimentation; coagulation and types of Coagulants; Sedimentation and coagulation tanks; Design aspects; Theory of filtration; Slow sand and rapid sand filters; Construction and Operation; Disinfection methods-chlorination; Miscellaneous treatments - Removal of hardness, De-fluoridation.

UNIT-III

WATER DISTRIBUTION SYSTEMS, INTRODUCTION TO SANITARY ENGINEERING AND QUANTITIES

Methods of water supply; Layouts; Distribution reservoirs; Capacity of balancing tank; Methods of analysis of distribution systems; valves. Plumbing-pipes and fittings; Traps; One pipe and Two pipe systems. Sanitation; Conservancy and water carriage system; Sewerage systems; Relative merits, Sanitary and storm water sewage; Estimation of their quantities. Sewer-types, design, construction and maintenance; sewer appurtenances-types.

UNIT-IV

QUALITY AND PRIMARY TREATMENT OF SEWAGE

Characteristics of sewage-physical, chemical and biological; decomposition cycles; BOD and COD.Primary treatment- theoretical concepts of Screens, Grit chamber; Skimming tanks; design aspects of Sedimentation tanks.Septic tank-Design and effluent disposal.

UNIT-V

SECONDARY TREATMENT AND DISPOSAL OF SEWAGE

Trickling filters and high rate trickling filters at primary level, Principles of action; Recirculation; Operational problems and remedies; Activated sludge process; Principles of action; Methods of aeration; Sludge bulking; Sludge volume index. Sewage disposal methods; Disposal by dilution; Self-purification process; Oxygen sag; Zones of pollution of river; Disposal by irrigation.

Text Books:

[1] Duggal K.N., "Elements of public health engineering", S. Chand &CompanyLtd., New Delhi, 2014.

[2] Birdie G.S. and Birdie J. S., "Water Supply and Sanitary Engineering", 9th ed., DhanpatRai Publishing Company, New Delhi, 2015.

Reference Books:

[1] Garg S. K., "Environmental Engineering Vol. I& II- Water supply engineering", Khanna Publishers, New Delhi, 2017.

[2] Gurucharan Singh, "Water Supply and Sanitary Engineering", Standard Publishers Distributors, Delhi, 2009.

[3] CPHEEO and Ministry of Urban Development, "Manual on Water Supply & Treatment", Govt. Of India, New Delhi, 2005.

Web Resources:

[1] https://nptel.ac.in/courses/103107084 - Environmental Engineering, Dr. V. C. Srivastava, IIT, Roorkee –

[2] www. nptel.ac.in/courses/105105048 - Wastewater management, Dr. M. M. Ghangrekar, IIT, Kharagpur

24CE207 GEOTECHNICAL ENGINEERING			
Course Category:	Professional Core (PC)	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Pre-requisites:	**ENGINEERING GEOLOGY**	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	40 60 100

Course Description:

Geotechnical engineering, also known as geotechnics, is the branch of civil engineering concerned with the engineering behaviour of earth materials. Geotechnical engineering uses the principles of soil mechanics and rock mechanics to solve its engineering problems. It also relies on knowledge of geology, hydrology, and other related sciences. Geotechnical engineering has applications in military engineering, mining engineering, petroleum engineering, coastal engineering, and offshore construction.

Course Objectives:

- To characterize the Index properties of Soils.
- To quantify the seepage loss
- To understand the concept of compaction and consolidation of soils.
- To evaluate the shear strength parameters of soils for engineering applications.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Understand the basic and index properties of soil.	K2
CO2	Apply soil permeability to quantify seepage loss.	K3
CO3	Determine compaction characteristics of soils.	K4
CO4	Understand compressibility behaviour of soils**.**	K2
CO5	Analyse strength characteristics of soils**.**	K4

Course articulation matrix

	POs											PSOs	
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	3											3
CO2	3	3		2									3
CO3	3	3		2	3								3
CO4	3	3		2	3								3
CO5	3	3		2	3								3

(1-Low, 2 -Medium, 3–High)

Course Content
UNIT-I **BASIC DEFINITIONS, INDEX PROPERTIES AND SOIL CLASSIFICATION:** Scope of Geotechnical Engineering; Origin of Soils; Types of soils; Transportation of soils; Major soil deposits of India. Phase diagrams; Volumetric relationships; Weight relationships; Specific gravity of soils; Inter–relationships. Index Properties – Introduction, Particle size distribution curve and its uses, Plasticity of soils, Consistency limits and uses, Plasticity, consistency and liquidity indices; Flow index & toughness index; Activity of soils. Unified soil classification system; Indian standard soil classification system.
UNIT-II **PERMEABILITY OF SOILS, EFFECTIVE STRESS PRINCIPLE &SEEPAGE THROUGH SOILS:** Flow of water in soils; Darcy's law; Validity of Darcy's law; Determination of coefficient of permeability by constant head and variable head methods; Seepage velocity; Factors affecting permeability; Permeability of stratified soil deposits. Effective stress principle; Effect of depth of water table, surcharge loading, and capillarity on effective stress.Quick sand condition; Characteristics of flow net; Uses of flow nets; Seepage through earth dams with horizontal filter.
UNIT-III **COMPACTION OF SOILS:** Introduction; Standard proctor test and modified proctor test; Compaction of clayey soil and sand; Factors affecting compaction; Effect of compaction on properties of soils; Field compaction of soils and field compaction control.
UNIT-IV **CONSOLIDATION OF SOILS:** Introduction; Initial and secondary consolidation; Spring analogy for primary consolidation; Terazaghi's theory of consolidation; Consolidation test; Determination of void ratio at various load increments- height of solids and change in voids ratio methods; Consolidation test results; Determination of coefficient of consolidation-square root of time and logarithmic time fitting methods.
UNIT-V **SHEAR STRENGTH OF SOILS:** Introduction; Mohr – coulomb theory; Different types laboratory of shear strength tests; Different drainage conditions and their field applicability; Mohr - coulomb failure criterion; Shear characteristic of cohesive and cohesionless soils.
Text Books: [1] Soil Mechanics and Foundation Engineering by K.R. Arora; Standard Publishers & Distributors, NaiSarak, New Delhi. [2] Basic and Applied Soil Mechanics by GopalRanjan and A.S.R.Rao; New Age International Ltd., New Delhi.
Reference Books: [1] Geotechnical Engineering by C. VenkataRamaiah; published by New Age International Ltd., New Delhi. [2] Geotechnical Engineering by V. N. S. Murthy; Marcel Dekker Inc., New York. [3] Soil Mechanics and Foundation Engineering by B.C. Punmia; Laxmi Publications, Delhi.
Web Resources: Introduction to Soil Mechanics - http://nptel.ac.in/courses/105103097/ Soil Mechanics - http://nptel.ac.in/courses/105101084/

24CE208
HYDRAULICS & HYDRAULIC MACHINES

Course Category:	Professional Core (PC)	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Pre-requisites:	Fluid Mechanics	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	40 60 100

Course Description:

Hydraulics & Hydraulic Machines is a vital course that explores the principles governing fluid motion in open channels, pipe systems, and hydraulic machinery. The course provides a deep understanding of concepts such as flow dynamics, dimensional analysis, jet impact forces, hydraulic turbines, and pumps. Students will develop analytical skills to evaluate fluid behaviour, design efficient water conveyance systems, and optimize hydraulic machine performance for real-world engineering applications. Overall, this course enables engineers to understand fluid behaviour, optimize flow conditions, design efficient pumps and turbines, and solve challenges related to water resource management, power generation, and hydraulic structures. By integrating principlels of fluid mechanics with real-world applications, students gain expertise in analyzing and improving the performance of hydraulic systems in various engineering fields.

Course Objectives:

- Analyse flow characteristics in open channels and determine the most efficient sections for fluid conveyance.
- Apply principles of gradually varied and rapidly varied flow in designing and evaluating hydraulic systems.
- Utilize dimensional analysis and jet impact principles to assess and optimize fluid behaviour in engineering applications.
- Evaluate the performance of hydraulic turbines and pumps, ensuring efficient energy conversion and fluid transport.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Analyze the flow characteristics in open channels and evaluate the most economical sections.	K4
CO2	Apply the principles of gradually varied and rapidly varied flow to real-world hydraulic systems.	K3
CO3	Utilize dimensional analysis and impact of jets principles to assess fluid behaviour in hydraulic applications.	K3
CO4	Examine the performance of hydraulic turbines and pumps for efficient energy conversion and fluid transport.	K4

Course articulation matrix

	POs											PSOs	
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	3									3	
CO2	3	3	3										3
CO3	3	2	3										3
CO4	3	3	3									3	

(1-Low, 2 -Medium, 3–High)

Course Content
UNIT-I **OPEN CHANNEL FLOW: UNIFORM FLOW**: Introduction, Classification of flows and channels; Chezy's, Manning's, Bazin's, Kutter's Equations; Hydraulically efficient channel sections - Rectangular, Trapezoidal and Circular channels. **NON-UNIFORM FLOW:** Concept of specific energy; Specific energy curves; Critical flow; Critical flow in a rectangular channel; Critical slope; Different slope conditions; Channel transitions.
UNIT-II **GRADUALLY VARIED FLOW**: Dynamic equation; Types of Surface Profiles; Computation of surface profiles by single step method; Back water Curves and Draw down curves. **RAPIDLY VARIED FLOW**: Hydraulic jump; Elements and characteristics of hydraulic jump; Types of hydraulic jumps; Applications of hydraulic jump; Energy loss in a hydraulic jump.
UNIT-III **DIMENSIONAL ANALYSIS AND SIMILITUDE**: Dimensional homogeneity; Rayleigh's method; Buckingham – Pi theorem; Geometric, Kinematic and dynamic similarities; Scale effect. **IMPACT OF JETS**: Force exerted by fluid jet on stationary and moving flat plates and curved plates; Force exerted by fluid jet on series of flat vanes; Angular momentum principle; Torque exerted on a wheel with radial curved vanes.
UNIT-IV **HYDRAULIC TURBINES** – I: Turbines; layout of a hydro-electric power plant; definitions of technical terms; classification of hydraulic turbines; Head and Efficiency of a turbine; Pelton wheel – Components & Working - velocity triangles and work done – Design. **HYDRAULIC TURBINES** - II: Radial flow reaction turbines - Francis turbine - velocity triangle and work done – design; Axial flow reaction turbine - Kaplan turbine; Draft tube - efficiency of draft tube; Concept of Specific speed – Cavitation
UNIT-V **CENTRIFUGAL PUMPS**: Types of pumps, Manometric head; Losses and efficiencies; Working Principle and Work done; Priming; Velocity triangles; Multistage pumps; Specific speed; Cavitation. **RECIPROCATING PUMPS**: Introduction, classification, components, working principle, Coefficient of discharge, Slip and Negative Slip, Power required by a Reciprocating Pump, Indicator Diagram.
Text Books: [1] P.N. Modi&S.N. Seth, "Hydraulics & Fluid Mechanics", 18th ed., Standard Book House, New Delhi, 2015. [2] A.K. Jain, "Fluid Mechanics", 11th ed., Khanna Publishers, New Delhi, 2014.
Reference Books: [1] Jagadhishlal, "Hydraulic Machines",9th ed., Metropoliton Company, New Delhi, 2012. [2] R. K. Bansal, "Fluid Mechanics and Hydraulic Machines", 9thet., Laxmi Publications; New

Delhi, 2015.

[3] Rajput R.K., "Fluid Mechanics and Hydraulic Machines", 3rd ed., S.Chand and Company Ltd., New Delhi, 2014.

[4] K. Subramanya, "Theory and Applications of Fluid Mechanics", 3rd ed., Tata McGraw Hill Publishing Company, New Delhi, 2013.

Web Resources:

[1] www.nptel.ac.in / courses/ 105103096/

[2] www.nptel.ac.in / courses/ 105106114/

24CE209 STRUCTURAL ANALYSIS			
Course Category:	Professional Core (PC)	**Credits:**	4
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-1-0
Pre-requisites:	Mechanics of Solids	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	40 60 100

Course Description:

This course provides a comprehensive study of the analysis of both statically determinate and indeterminate structures. It focuses on advanced analytical techniques essential for understanding structural behavior under different loading conditions. The course covers influence lines for statically determinate structures, energy-based methods for analyzing indeterminate structures, the force and displacement methods for structural analysis, and approximate methods for multi-story frames. These concepts are fundamental for structural engineers in designing safe and efficient structures.

Course Objectives:

- To Construct and interpret influence lines for statically determinate structures.
- To apply energy principles such as virtual work and Castigliano's theorems.
- To identify static redundancies and formulate compatibility equations.
- To analyze continuous beams and rigid frames using Use the slope-deflection and moment distribution methods.
- To apply the portal and cantilever methods for analyzing multi-story buildings.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Apply the concept of influence lines for moving loads on statically determinate structures.	K3
CO2	Compute displacements and internal forces in indeterminate structures using energy methods.	K4
CO3	Solve statically indeterminate structures using the force method and compatibility equations.	K3
CO4	Analyse structural behavior using displacement methods, including slope-deflection and moment distribution techniques.	K4
CO5	Examine the response of multi-story frames using approximate analysis methods such as the portal and cantilever methods	K4

Course articulation matrix

	POs											PSOs	
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	3	2									2	
CO2	3	3	2									2	
CO3	3	3	2									2	
CO4	3	3	2									2	
CO5	3	3	2								1	2	

(1-Low, 2 -Medium, 3–High)

Course Content
UNIT-I **INFLUENCE LINES FOR STATICALLY DETERMINATE STRUCTURES** Influence lines for beam reactions, Influence lines for shearing forces and bending moments, Calculation of maximum and absolute maximum bending moments for rolling loads
UNIT-II **ANALYSIS OF INDETERMINATE STRUCTURES USING ENERGY METHODS** Statically determinate vs. indeterminate structures, Introduction to energy principles, Castigliano's Theorem-II and its applications, Strain energy method for analyzing continuous beams (up to two spans), Analysis of rigid frames up to first-degree redundancy.
UNIT-III **ANALYSIS OF INDETERMINATE STRUCTURES USING FORCE METHOD** Introduction to the force method, Procedure for consistent deformation method, Analysis of propped cantilever beams, Fixed beams: Definition, advantages, and disadvantages, Fixed beam analysis under different loading conditions.
UNIT-IV **ANALYSIS OF INDETERMINATE STRUCTURES USING DISPLACEMENT METHODS** Introduction to displacement methods, Development of slope-deflection equations, Application of slope-deflection method for continuous beams (two-span) and portal frames without side sway, Introduction to moment distribution method, Stiffness of members, carry-over moments, and distribution factors, Application of moment distribution method for continuous beams (two-span) and portal frames without side sway.
UNIT-V **APPROXIMATE METHODS OF ANALYSIS FOR MULTISTORY FRAMES** Introduction to Kani's method, Application of Kani's method to continuous beams and portal frames, Analysis of lateral loads using portal and cantilever methods**.**
Text Books: [1] Structural Analysis by R.Vaidyanathan Volume-I and II, 3rdEdition, Laxmi Publications (P) Ltd, 2012. [2] Structural Analysis by S.S. Bhavikatti, Volume-I and II, 4thEdition, Vikas Publishing house PVT Ltd, 2014.
Reference Books: [1] Theory of structures by S. Ramamrutham, 9thEdition, DhanapatRai Publications, 2014. [2] Analysis of structures by Volume I –17th Edition by Vazirani&Ratwani; & Volume –II 16th Edition by Vazirani&Ratwani, Khanna Publications; Delhi,2015. [3] Theory of structures Vol–I & II by G.S. Pandit and S.P. Gupta and R.Gupta by Tata McGraw Hill Ltd., New Delhi. [4] Structural analysis by Hibbeler, 6thEdition, Pearson India Education Services PvtLtd.2015 [5] Basic Structural Engineering by C.S Reddy, Tata McGraw Hill, Third Edition.
Web Resources: http:// nptel.ac.in/courses/105101085 http://nptel.ac.in/courses/105105166 http://nptel.ac.in/courses/105101086

24CE210
CONCRETE TECHNOLOGY

Course Category:	Professional Core (PC)	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Pre-requisites:	Building Materials & Construction Technology	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	40 60 100

Course Description:

This course introduces the fundamental principles of concrete materials, including their composition, properties, and behavior. It includes mix design, hydration, and strength development, types of cement, durability, testing methods, and improvements in sustainable and high-performance concrete for modern construction.

Course Objectives:

- To explain the composition, types, manufacturing, and hydration process of cement.
- To learn the classification, properties, and grading of aggregates as per IS Code.
- To understand the quality of water and its effects on concrete as per IS Code.
- To analyze the functions, types, and applications of mortar and admixtures.
- To apply the principles of mix design in accordance with IS Code.
- To study the concrete properties, production techniques, durability, and sustainability.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Understand the properties of the constituent materials of concrete and different types of cements.	K2
CO2	Illustrate the manufacturing process of concrete and study the properties of fresh and hardened concrete.	K2
CO3	Explain the durability and sustainability aspects of concrete structures.	K2
CO4	Demonstrate various types of special concretes and appropriate concreting methods for different situations.	K2
CO5	Develop the mix design as per IS Codal provisions.	K3

Course articulation matrix

	POs											PSOs	
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	1				1							2
CO2	3	1											1
CO3	1					1					1		2
CO4	2												2
CO5	3		3		2	2		1			1	2	3

(1-Low, 2 -Medium, 3–High)

Course Content

UNIT-I

CEMENT:

Introduction to concrete as a structural material, Uses of cement, Chemical Composition of Ordinary Portland Cement(OPC), Functions of cement ingredients; Manufacturing process of cement (wet and Dry Processes), Hydration of Cement, Heat of Hydration, Water requirements for hydration, Types of cements -Ordinary, Rapid hardening, low-heat, sulphate resisting, Portland slag, Portland pozzolana, quick setting, low heat cement, High alumina cement, white cement and coloured cement properties and their applications; Storage of cement; Field tests for cement.

AGGREGATES:

Classification of Aggregates; Properties of aggregates Grading of Aggregates; IS: 383 requirements for aggregates; Alkali – Aggregate reaction.

UNIT-II

WATER:

Introduction; Qualities of water; Use of seawater for mixing of concrete; IS:456requirements.

MORTAR:

Functions of sand in mortar; Classification of mortars; Properties of good mortar mix and mortar; Uses of mortar; Selection of mortar.

ADMIXTURES IN CONCRETE:

General; Air–entraining agents; Plasticizers; Accelerators; Retarders; Miscellaneous admixtures for damp proofing and water proofing; Introduction to mineral admixtures (Fly ash, GGBS, silica fume, Rice husk ash and Metakaoline).

UNIT-III

FRESH CONCRETE:

General- introduction;; Water – cement ratio; Properties of Fresh Concrete – Workability, Factors Affecting Workability, Measurement of workability (slump cone & compaction factor); Segregation; Bleeding; Yield of Concrete.

MANUFACTURE OF CONCRETE:

Batching of concrete; Mixing; Transporting Concrete; Placing concrete; Compaction of concrete; Curing of concrete; Finishing.

UNIT-IV

HARDENED CONCRETE:

General; Gel / space ratio; Maturity concept of concrete; Elastic properties of concrete; Relation between modulus of Elasticity and strength; Factors affecting modulus of elasticity; Creep; Factors affecting creep; Shrinkage; Plastic shrinkage; Mechanism of shrinkage; Factors affecting shrinkage; Mechanical properties of hardened concrete - Compressive, flexural, split tensile , effect of height to diameter ratio on strength, comparison between cube and cylinder strength.

DURABILITY OF CONCRETE:

Durability - definition and Significance; Permeability of concrete; Sulphate attack; Methods of controlling Sulphate attack; Durability of concrete in sea water; Corrosion mechanism of reinforcement in concrete, Environmental considerations, concrete durability and sustainability, technology for sustainable development.

UNIT-V

SPECIALCONCRETES& CONCRETING METHODS:

List of special concretes - general; Lightweight concrete and No fines concrete; High strength and high performance of concrete; Fiber Reinforced Concrete and Polymer concrete; Gunite or shotcrete; Ferro cement; Vacuum concrete, Vacuum Dewatered Concrete, Self-compacting concrete.

CONCRETE MIX DESIGN:

Concept of mix design; List of Mix design methods; Indian standard method of mix design (IS10262-2019).

Text Books:

[T1] Concrete Technology by M. S. Shetty; S. Chand & Company (Pvt.) Ltd., New Delhi.
[T2] Properties of Concrete by A. M. Neville; Published by Dorling Kindersley (India) Pvt. Ltd. Licensees of Pearson Education in south Asia, New Delhi.

Reference Books:

[R1] Concrete Technology by A. R. Santhakumar , Oxford University press, New Delhi.
[R2] Concrete Technology by M. L. Gambhir, 5th edition, Tata McGraw – Hill Publishing Company Ltd., New Delhi
[R3] IS Code 10262- 2019 Concrete Mix Design
[R4] Engineering Materials by Rangwala, Charotar publishing House Pvt. Ltd.

Web Resources: http:/nptel.ac.in/courses/105102012

24CE283 CONCRETE TECHNOLOGY LABORATORY			
Course Category:	Professional Core Lab	**Credits:**	1
Course Type:	Practice	**Lecture-Tutorial-Practice:**	0-0-2
Pre-requisites:	Concrete Technology	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	60 40 100

Course Description:

This course provides hands-on training in evaluating the properties of cement, aggregates, fresh concrete, and hardened concrete through standard testing procedures. The course covers fundamental tests on cement, fine and coarse aggregates, workability tests for fresh concrete, strength determination of hardened concrete, and non-destructive testing (NDT) methods to assess in-situ concrete quality.

Students will also learn concrete mix design as per IS 10262:2019 to achieve the desired strength and workability. This course ensures students to develop practical skills, analytical abilities, and quality control knowledge essential for real-world construction projects.

By the end of the course, students will be able to conduct quality assessment of concrete materials, design concrete mixes, and apply NDT techniques for structural evaluation, preparing them for careers in construction, materials testing, and structural engineering.

Course Objectives:

By the end of this course, students will be able to:

- Understand the properties of cement, fine aggregate, and coarse aggregate through laboratory testing.
- Evaluate the workability of fresh concrete using different test methods.
- Analyze the strength characteristics of hardened concrete using destructive and non-destructive testing methods.
- Apply mix design principles to achieve required strength and workability.
- Interpret experimental results to ensure quality control in concrete structures.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Understand the physical properties of cement, fine and coarse aggregates.	K2
CO2	Develop mix design as per IS Codal provisions and measure the workability of fresh concrete using different methods.	K3
CO3	Examine the mechanical properties of hardened concrete using destructive and nondestructive methods.	K4

Course Articulation Matrix

	PO											PSOs	
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PSO1**	**PSO2**
CO1	2	2				1		1					3
CO2	2	3	2			1	1	1					3
CO3	2	3				1		1					3

(1-Low, 2 -Medium, 3–High)

Course Content

1. TESTS ON CEMENT

a. Consistency Test:Determines the standard consistency of cement at which percentage of water content is required to achieve a uniform cement paste.
b. Initial and Final Setting Time: Measures the time taken for cement to start and complete setting.
c. Specific Gravity of Cement: Evaluates the density of cement relative to water.
d. Fineness of Cement (Sieve Analysis / Blaine's Air Permeability Test): Assesses the particle size distribution of cement.
e. Soundness of Cement (Le Chatelier Test): Checks for volume expansion in cement due to unhydrated lime or magnesia.
f. Compressive Strength of Cement: Determines the Compressive strength of cement using cement mortar cubes.

2. TESTS ON FINE AND COARSE AGGREGATES

a. Grading of Fine and Coarse Aggregates (Sieve Analysis): Determines particle size distribution for proper mix design.
b. Specific Gravity and Water Absorption of Aggregates: Measures the density and moisture absorption of aggregates.
c. Bulking of Fine Aggregate: Assesses the increase in volume of sand due to moisture content.

3. TESTS ON FRESH CONCRETE (WORKABILITY TESTS)

a. Slump Cone Test: Measures the consistency and workability of fresh concrete.
b. Compaction Factor Test: Assesses the degree of compaction required for a concrete mix.
c. Vee Bee Consistometer Test: Evaluates the workability of stiff concrete using vibration.

4. TESTS ON HARDENED CONCRETE

a. Compressive Strength of Concrete (Cube and Cylinder Test): Measures the crushing strength of hardened concrete to evaluate the compressive strength of concrete.
b. Split Tensile Strength of Concrete: Determines the indirect tensile strength of concrete.
c. Flexural Strength Test of Concrete: Assesses the ability of concrete to resist flexural forces.
d. Modulus of Elasticity of Concrete: Evaluates the stiffness and deformation characteristics of concrete.

5. NON-DESTRUCTIVE TESTING (NDT) OF CONCRETE AND CONCRETE MIX DESIGN

a. Rebound Hammer Test: Estimates surface hardness and compressive strength of concrete.
b. Ultrasonic Pulse Velocity (UPV) Test: Assesses internal defects and uniformity of concrete.
c. Core Cutting and Strength Determination: Extracts core samples to determine actual concrete strength.
d. Concrete Mix Design using IS 10262:2019: Proportions materials to achieve desired concrete properties.
e. Self-Compacting Concrete Workability Tests (J-Ring, L-Box, U-Box Tests): Evaluates flowability and passing ability of SCC.

Text Books:

1. Shetty, M. S., & Jain, A. K. (2019).Concrete Technology: Theory and Practice (8th ed.). S. Chand Publishing.
2. Gambhir, M. L. (2013). Concrete Technology: Theory and Practice (5th ed.). Tata McGraw-Hill Education.

Reference Books:

1. IS 4031 (Part 1 to 15):1988 – Methods of physical tests for hydraulic cement.
2. IS 269:2015 – Ordinary Portland Cement (OPC) specifications.
3. IS 1489 (Part 1 & 2):2015 – Portland Pozzolana Cement (PPC) specifications.
4. IS 2386 (Part 1 – 5):1963 – Methods of test for aggregates.
5. IS 383:2016 – Specification for coarse and fine aggregates for concrete.
6. IS 1199:1959 – Methods of sampling and analysis of fresh concrete.
7. IS 516 (Part 1/Sec 1, Sec 2, Sec 3):2021 – Compressive strength of concrete (Cube and Cylinder), Flexural strength of concrete, Split tensile strength of concrete.
8. IS 13311 (Part 2):1992 – Rebound hammer test for strength estimation.
9. IS 13311 (Part 1):1992 – Ultrasonic pulse velocity (UPV) test for concrete quality assessment.
10. IS 1199 (Part 5):2018 – Core cutting and strength determination.
11. IS 456:2000 – Code of practice for plain and reinforced concrete (includes NDT guidelines).
12. IS 10262:2019 – Guidelines for concrete mix proportioning.

Web Resources:

1. Concrete Technology – Prof. B. Bhattacharjee (IIT Delhi): https://nptel.ac.in/courses/105102012
2. Advanced Concrete Technology – Prof. DevdasMenon (IIT Madras): https://onlinecourses.nptel.ac.in/noc23_ce109/preview
3. Strength of Materials – Prof. K. Ramesh (IIT Madras): https://nptel.ac.in/courses/112106247

24CE 284
FLUID MECHANICS & HYDRAULIC MACHINES LAB

Course Category:	Professional Core Lab (PC)	**Credits:**	1
Course Type:	Practice	**Lecture-Tutorial-Practice:**	0-0-2
Pre-requisites:	Fluid Mechanics and Hydraulics & Hydraulic Machines	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	60 40 100

Course Description:

The Fluid Mechanics Lab is designed to provide hands-on experience in understanding the fundamental principles of fluid behavior, flow dynamics, and hydraulic machinery. This course complements theoretical knowledge by allowing students to conduct experiments that demonstrate key fluid mechanics concepts. The primary objective of this lab is to bridge the gap between theoretical learning and practical application. While classroom lectures provide the fundamental equations and principles governing fluid motion, the lab allows students to visualize, measure, and analyze these phenomena in action. By performing experiments, students can observe fluid behavior under controlled conditions and develop an intuitive grasp of fluid mechanics principles. This lab is essential for engineering students specializing in Mechanical and Civil engineering, providing a strong foundation for real-world fluid mechanics applications.

Course Objectives:

- To measure and analyze basic fluid properties such as density, viscosity, and pressure.
- To verify fundamental fluid mechanics principles, including Bernoulli's theorem
- To study various types of fluid flow (laminar, turbulent) and measure flow rates using different flow measurement devices.
- To analyze pressure losses in pipes and fittings due to friction and minor losses.
- To understand the characteristics and performance of hydraulic machines such as pumps and turbines.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Examine the fluid properties, pressure and flow measurements using venturi - meter, orifice meter, mouth piece and notches.	K4
CO2	Identify the fluid flow regimes using Reynolds number and experimentally verify Bernoulli's theorem.	K3
CO3	Analyze major and minor losses in pipe flow due to friction and fittings.	K4
CO4	Distinguish the performance of hydraulic machines such as pumps and turbines.	K4

Course articulation matrix

	POs											PSOs	
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	2	3	2					1	1			3	
CO2	2	2						1	1			2	
CO3	2	3						1	1			2	
CO4	2	3	2		2			1	1			3	

(1-Low, 2 -Medium, 3–High)

Course Content

1. BERNOULLI'S EXPERIMENT

a. Validate Bernoulli's energy principle experimentally along a conduit.
b. Signify the variation of the pressure and velocity along a converging-diverging pipe section.

2. VENTURIMETER& ORIFICE METER

a. Determine the coefficient of discharge for a Venturimeter.
b. Determine the coefficient of discharge for a Orifice meter.

3. ORIFICES & MOUTHPIECES

a. Workout the flow rate of a liquid using orifice for steady flow in water tanks.
b. Workout the flow rate of a liquid using mouthpiece for steady flow / unsteady flow.

4. REYNOLD'S EXPERIMENT

a. Characterize the state of fluid flow by Reynolds's Number

5. NOTCHES

a. Determination of flow-rate in an open channel using V Notch / Trapezoidal Notch.

6. ESTIMATION OF FRICTION FACTOR AND MAJOR HEAD LOSS FOR A GIVEN PIPE SYSTEM.

7. DETERMINATION OF MINOR LOSS OF HEAD IN PIPES

a. Due to bends
b. Sudden contractions
c. Sudden expansion.

8. HYDRAULIC MACHINES

a. Measurement of force due to impact of jet on Flat/Curved vanes used in Hydropower projects
b. I) Find the overall efficiency of single stage centrifugal pump.
   II) Study the Performance characteristics of Multistage centrifugal pump
      i) When pump is in series
      ii) When pump is in parallel.
c. Study the Performance characteristics for Multistage Submersible pump.
d. Determine the hydraulic efficiency for Impulse turbine (Pelton).
e. Conduct Performance test for Reaction turbine (Kaplan / Francis) at constant head and determine efficiency.

Text Books:

1 .P.N. Modi&S.N. Seth, “Hydraulics & Fluid Mechanics”, 18th ed., Standard Book House, New Delhi, 2015.
2. A.K. Jain, “Fluid Mechanics”, 11th ed., Khanna Publishers, New Delhi, 2014.

Reference Books:

1. Jagadhishlal, “Hydraulic Machines”,9th ed., Metropoliton Company, New Delhi, 2012. Books
2. R. K. Bansal, “Fluid Mechanics and Hydraulic Machines”, 9th ed., Laxmi Publications; New Delhi, 2015.
3. Rajput R.K., “Fluid Mechanics and Hydraulic Machines”, 3rd ed., S.Chand and Company Ltd., New Delhi, 2014.
4. K. Subramanya, “Flow in Open Channels” – 3rd ed., Tata McGraw Hill Publishing Company, New Delhi, 2013.

Web Resources:

1. https://nptel.ac.in/courses/112105171.
2 .http://nptel.ac.in/ / courses/ 105106114.
3. http://web.mit.edu/hml/ncfmf.html.

24CE285 COMPUTER AIDED CIVIL ENGG. DRAWING			
Course Category:	Professional Core Lab (PC)	**Credits:**	1
Course Type:	Practice	**Lecture-Tutorial-Practice:**	0-0-2
Pre-requisites:	Engineering Graphics	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	60 40 100

Course Description:

The Computer-Aided Civil Engineering Drawing Lab aims to provide students with practical skills in creating and interpreting architectural and structural drawings, combining manual and digital techniques to bridge theoretical principles with real-world engineering applications, develop proficiency in AutoCAD, ensure compliance with building codes, and enhance their competence in professional design documentation

Course Objectives

- Understand and apply building planning principles, bye-laws, and local authority guidelines in preparing residential and public building drawings.
- Develop proficiency in manual architectural drawings following standard symbols.
- Implement accuracy in representing architectural components by creating detailed plans, elevations, and sectional views using AutoCAD.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Understand the principles of architectural planning and building bye-laws.	K2
CO2	Develop drawings for residential and public buildings ((Plan, elevation and section) using AUTOCAD.	K3

Course articulation matrix

	POs											PSOs	
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	2		2									1	
CO2	2		2		3							2	2

(1-Low, 2 -Medium, 3–High)

Course Content

LIST OF EXPERIMENTS:

1. INTRODUCTION TO THEORY CONCEPTS

a) Principles of architectural planning as per NBC and Building bye-laws.

b) Plan, Elevation, Section of a Building and site plan

2. CONVENTIONAL SYMBOLS – MANUAL DRAWING

a) Drawing practice of conventional signs and symbols used in architectural and structural drawings.

b) Representation of building components using standard symbols.

3. ARCHITECTURAL COMPONENTS – MANUAL DRAWING

a) Drawing practice of Doors, Windows, and Ventilators (Plan and Elevation views with

Standard dimensions).

b) Sectional drawing of a wall, including foundation and material specifications.

4. RESIDENTIAL BUILDING DRAWINGS – MANUAL & AUTOCAD

a) Develop a plan, elevation, and section by using line diagrams for 1BHK residential building (Load-bearing structure).

b) RCC two-storied (framed structure) building with staircase

5. PUBLIC BUILDING DRAWINGS USING AUTOCAD

a) Planning of a single-storied rural hospital or school building.

b) Preparation of floor plans, elevation, and sectional views.

Text Books:

1. Gurucharan Singh &Jagdish Singh, Building Planning, Designing, and Scheduling, Standard Publishers, Delhi, 2019.
2. M.G. Shah, C.M. Kale &S.Y. Patki, Building Drawing (4th Edition), Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2020.
3. John Willis, AutoCAD 2023 for Architectural Design, CADCIM Technologies, 2023.

Reference Books:

1. Bureau of Indian Standards, National Building Code, New Delhi, 2005.
2. Yashwant S. Sane, Planning & Designing Buildings, Allies Book Stall, Pune, 2018.
3. Maureen Mitton& Courtney Nystuen, Residential Interior Design: A Guide to Planning Spaces (3rd Edition), Wiley, 2021.
4. Edward J. Muller, Philip A. Grau& Charles George Ramsey, Architectural Drawing and Light Construction (8th Edition), Pearson, 2017.GeorgeOmura& Brian C. Benton, Mastering AutoCAD 2023 and AutoCAD LT 2023 (14th Edition), Sybex, 2023

Web Resources:

1. https://nptel.ac.in/courses/112104172 – Introduction to CAD and Engineering Drawing
2. https://nptel.ac.in/courses/105108082 – Architectural Graphics and Drawing
3. https://onlinecourses.nptel.ac.in/noc20_me79/preview – Engineering Drawing and Computer Graphics
4. https://nptel.ac.in/courses/105104135 – Building Planning and Drawing

24EN281
ENGLISH FOR PROFESSIONALS

Course Category:	HS	**Credits:**	1
Course Type:	LAB	**Lecture-Tutorial-Practice:**	0-0-2
Pre-requisites:	Intermediate English	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	60 40 100

Course Description:

English for Professionals course covers functional English grammar, elocution, extempore speaking, short story writing, storytelling, debating, vocabulary building, biographical sketches, the Versant test, blog writing, etiquette, team building, and leadership. It emphasizes practical exercises, voice modulation, articulation, quick thinking, effective communication, cultural importance, and developing an online presence and confidence in professional settings. This comprehensive curriculum aims to enhance students' linguistic abilities, interpersonal skills, and leadership qualities for success in diverse professional environments.

Course Objectives:

- Explain the fundamentals of language interms ofgrammar & lexical resource in communication.
- Familiarizelisteningandspeakingwhilecommunicatingwithothers.
- Introduce language skills, Etiquettes, Team Building and Leadership in professional and social contexts with clarity and accuracy.
- Teach coherence, cohesion and precision informal written communication.
- Illustrategrammar andvocabularybyintroducingversant test.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Recall the fundamentals of language in terms of grammar and lexical resource in communication.	K1
CO2	Understand how to listen, reflect and speak while communicating with others.	K2
CO3	Apply language skills, Etiquettes, Team Building and Leadership in professional and social contexts with clarity and accuracy.	K3
CO4	Analyze ideas with coherence ,cohesion and precision informal written communication.	K4
CO5	Evaluate grammar and vocabulary using Versant Test.	K5

Course articulation matrix

	POs											PSOs	
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	2							2	3		2		
CO2	2							2	3		2		
CO3	2							2	3		2		
CO4	2							2	3		2		
CO5	2							2	3		2		

(1-Low, 2 -Medium, 3–High)

Course Content
UNIT-I **VERSANT TEST:** OverviewoftheVersantTest –Purposeand Importance–FormatoftheTest–Typesof Questions–Practice.(2 Hours)
UNIT-II **ELOCUTION:** Define–Discuss theImportance– KeyComponents–Voice Modulation –Articulation –PostureandGestures–Practice.(2Hours)
UNIT-III **EXTEMPORE:** Introduction–Significance–DevelopingQuickThinking–CommunicationSkills– Confidence –StrategiesforEffectiveSpeaking–Practice.(2 Hours)
UNIT-IV **STORYTELLING:** Definition–NarrativesthroughSpokenWords – GesturesandExpressions – Importanceof Culture–StoryTellingTechniques–VocalModulation–Pacing–GesturesandFacial Expressions – Practice. (2 Hours)
UNIT-V **DEBATE:** Introduction–UnderstandingtheStructure –PurposeofaDebate–DevelopingBasic Debating skills–Do'sandDon'ts – Practice.
UNIT-VI **SHORTSTORYWRITING:** Introduction–KeyCharacteristics–Brevity–Theme–Types–CreatingRelatableCharacters. (2 Hours)
UNIT-VII **BLOGWRITING:** Introduction–PurposeinDigitalWorld –DifferenttypesofBlogs –Benefits –BuildingOnline Presence– SharingKnowledge – Connectingwith Others.(2 Hours)
UNIT-VIII **BIOGRAPHICALSKETCH:** Purpose– OverviewofPerson'sLife–KeyEvents – Conclusion.(2 Hours)
UNIT-IX **VOCABULARY:** IdiomaticExpressions –IdiomswithBodyParts –Animal Idioms–ColourIdioms –Phrasal Verbs–One-wordSubstitutes –Analogies–Practice. (2Hours)
UNIT-X **FUNCTIONALENGLISH GRAMMAR:** ModalVerbs–Subject-VerbAgreement–Active&PassiveVoice–ReportedSpeech– Question Tags – Practice Exercises. (2 Hours)
UNIT– XI **TEAMBUILDING &LEADERSHIP :** Team Building traits: Forming – Storming – Norming – Performing – Adjourning. Leadershiptraits:Vision–Integrity–Decisiveness–Confidence–Empathy–Flexibility–
Innovation. (2 Hours)
UNIT– XII **CORPORATE ETIQUETTE :** Social Etiquette – Business Etiquette – Telephone Etiquette – Dining Etiquette – Summary. (2 Hours)
LAB MANUAL 1) English for Professionals Lab Manual

References:

1) Wren & Martin.(2023). English Grammar and Composition. S. Chand & Company.
2) Dale Carnegie. (2016). The Quick and Easy way to Effective Speaking.Rupa Publications,
3) Richard A. Spears. (2005). McGraw-Hill's Dictionary of American Idioms and Phrasal Verbs.McGraw Hill.
4) Jon M. Ericson, James J. Murphy, Raymond Bud Zeuschner. (2003). The Debater's Guide.(Third Edition). Southern Illinois University Press, Carbondale.
5) S. P. Dhanavel. (2010). English and Soft Skills.Orient Blackswan.

Barun K. Mitra. (2011). Personality Development and Soft Skills.Oxford University Press.

Reference Books:

[R1] Concrete Technology by A. R. Santhakumar , Oxford University press, New Delhi.

[R2] Concrete Technology by M. L. Gambhir, 5th edition, Tata McGraw – Hill Publishing Company Ltd., New Delhi

[R3] IS Code 10262- 2019 Concrete Mix Design

[R4] Engineering Materials by Rangwala, Charotar publishing House Pvt. Ltd.

Web Resources:

1) https://www.pearson.com/languages/hr-professionals/versant.htmlSoftx

AI Tools

1. Grammar and Syntax Mastery: Wordvice, Bussu
2. Speaking Fluency and Clarity: Forvo, ELSA Speak
3. Communication Strategies: Speechace, Rosetta Stone
4. Story Telling Techniques: Plot Generator, Narrativa
5. Vocabulary Acquisition: Quizlet, Anki

Writing Proficiency: EAngel, Scribens, Grammarly

24UC202
PROFESSIONAL ETHICS

Course Category:	Mandatory course (MC)	**Credits:**	0
Course Type:	Theory	**Lecture-Tutorial-Practice:**	2-0-0
Pre-requisites:	---	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	100 --- 100

Course Description:

Through this course, students are exposed to ethical principles, professional responsibilities, and social dimensions of engineering practice. It emphasizes moral reasoning, ethical decision-making, and the development of professional integrity in engineering contexts. Through case studies and theoretical frameworks, students explore the ethical challenges engineers face in technology development, safety, environmental sustainability, and global practice.

Course Objectives:

- To understand the scope and significance of engineering ethics and moral values in professional life.
- To develop skills for analyzing moral dilemmas and applying ethical theories to real-world engineering problems.
- To recognize the importance of professional responsibility, safety, rights, and risk management in engineering projects.
- To gain awareness of global and societal issues, including environmental and computer ethics, intellectual property, and corporate responsibility.
- To understand the basic principles of contract management and the legal framework governing engineering practice.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Explain the moral and ethical theories related to engineering practice.	K2
CO2	Apply ethical reasoning for professional dilemmas and responsibilities.	K3
CO3	Analyze case studies to evaluate ethical decision-making and safety practices.	K4
CO4	Assess global and environmental issues affecting engineering ethics.	K4
CO5	Apply and interpret the principles of the Indian Contract Act in professional contexts.	K3

Course articulation matrix

COs	POs											PSOs	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	2						3						
CO2					3		3						
CO3			3			3	3						
CO4							3			2	2		
CO5							3			2			

(1-Low, 2 -Medium, 3–High)

Course Content
UNIT-I **ENGINEERING ETHICS:** Senses of 'Engineering Ethics', variety of moral issues, types of inquiry, moral dilemmas, moral autonomy : Kohlberg's theory ;Gilligan's theory, consensus and controversy, Models of Professional Roles, Theories about right action, Self-interest- customs and religion, Use of ethical theories.
UNIT-II **ENGINEERING AS SOCIAL EXPERIMENTATION:** Engineering as experimentation, Learning from past, Engineers as responsible experimenters, Codes of ethics, A balanced outlook on law, The challenger disaster a case study.
UNIT-III **SAFETY, RESPONSIBILITIES AND RIGHTS:** Safety and risk, Assessment of safety and risk, Risk benefit analysis, reducing risk, The three mile island and Chernobyl case studies, Collegiality and loyalty, Respect for authority, Collective bargaining, Confidentiality, Conflicts of interest, Occupational crimes, Professional rights, Employee rights, Intellectual Property Rights (IPR), Discrimination.
UNIT-IV **GLOBAL ISSUES:** Multinational corporations, Environmental ethics, Computer ethics, Weapons development, Engineers as managers, Engineers as Professionals, Managing Conflicts, Consulting engineers, Engineers as expert witnesses and advisors, Moral leadership, Sample code of Ethics (Specific to a particular Engineering Discipline).
UNIT-V **GENERAL PRINCIPLES OF CONTRACTS MANAGEMENT:** Indian contract act, Contract, Essential elements of a valid contract, Types of contract – valid contract; invalid contract; other types of contracts, Offer – types of offer; legal rules for offer, Acceptance – legal rules for acceptance, Consideration – legal rules as to consideration, Stanger to contract, Capacity to contract.
TEXT BOOKS: 1. Mike Martin and Roland Schinzinger, "Ethics in engineering", McGraw Hill, New York (1996). 2. Govindarajan M, Natarajan S, Senthil Kumar V. S., "Engineering Ethics", Prentice Hall of India, New Delhi (2004).
REFERENCE BOOKS: 1. Baum, R.J. and Flores, A., "Ethical Problems in Engineering, Center for the study of the Human Dimensions of Science and Technology", Rensellae Polytechnic Institute, Troy, New York, 335 pp. eds. (1978) 2. Beabout, G.R., Wennemann, D.J. , "Applied Professional Ethics: A Developmental Approach for Use with Case Studies", University Press of America Lanham, MD, 175 pp (1994). 3. Dutt(1994) Indian Contract Act, Eastern Law House.
Web Resources: • https://www.scribd.com/document/552528071/professional-development-with-applied-ethics-module-1-docx • https://grace.unodc.org/grace/uploads/documents/academics/Integrity_and_Ethics_Module_14_Professional_Ethics.pdf • https://onlineethics.org/cases/three-mile-island-nuclear-accident • https://www.tutorialspoint.com/engineering_ethics/index.htm • https://www.slideshare.net/slideshow/indian-contract-act-1872-14444088/14444088

Introduction to GIS			
Course Category:	**MINORS**	**Credits:**	**3**
Course Type:	**Theory**	**Lecture-Tutorial-Practice:**	**3-0-0**
Pre-requisites:	**-**	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**40** **60** **100**

Course Description:

This course introduces the basic concepts and applications of Geographic Information Systems (GIS). It covers spatial data models, data sources, map projections, and basic spatial analysis, enabling students to create and interpret maps for real-world applications.

Course Aims and Objectives:

- To understand basic concepts, components, and functions of GIS
- To learn spatial data models, data sources, and map projections
- To perform basic spatial analysis and visualization
- To introduce practical applications of GIS in various fields

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Explain the fundamental concepts, components, and functions of Geographic Information Systems (GIS)	K2
CO2	Distinguish between spatial and attribute data and describe vector and raster data Models.	K4
CO3	Theory Concept of management and Preprocessing of spatial data files in DBMS	K2
CO4	Performing vector and spatial analysis on shape files.	K3
CO5	Understanding of digital elevation modelling.	K2

Course articulation matrix

COs	POs											PSOs	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	2	1					2						
CO2	2	1			1		2						1
CO3	2												
CO4		2											2
CO5	2	1					2		3				1

(1-Low, 2 -Medium, 3–High)

Course Content
UNIT-I : Introduction to GIS Definition and scope of GIS, applications of GIS, hardware components of GIS, software components of GIS, spatial and attribute data, people and methods in GIS, evolution of maps and cartography, early development of GIS, modern trends in GIS Concept of spatial data, spatial data models, vector data model, types of vector data (point, line and polygon), raster data model, types of raster data (discrete and continuous), raster resolution and scale, desktop GIS architecture, client–server and web GIS architecture, attribute queries in GIS, and spatial queries in GIS.
UNIT–II: Vector and Raster Data Models Characteristics, advantages, disadvantages, and applications of vector, raster, and TIN data models; concept of non-spatial (attribute) data, types of attributes (nominal, ordinal, interval, ratio), and attribute tables Raster data compression techniques such as run-length encoding, block coding, and quad-tree methods; commonly used raster data file formats including Geo TIFF, IMG, ASCII Grid, and Net CDF; concept of spatial database systems and their types, including file-based and DBMS-based spatial data storage systems.
UNIT–III: Spatial database management system GIS data file management, layered GIS concept, GIS data storage systems, hybrid data models, spatial data organization and indexing, metadata standards, pre-processing of spatial datasets including data cleaning, transformation, and geo referencing Map projections and their classification, datum and coordinate systems, spatial interpolation techniques, types of resolution (spatial, spectral, temporal, and radiometric), and accuracy and error assessment in spatial data.
UNIT–IV: Geospatial analysis Geospatial data analysis concepts, integration and modelling of spatial data, geospatial data analysis methods, vector and raster data query operations, vector and raster overlay operations, proximity and buffer analysis, Spatial statistics and autocorrelation, suitability and multi-criteria analysis, network analysis including network tracing, routing, and allocation, surface analysis, and applications of geospatial analysis in planning, resource management, and decision support systems.
UNIT–V: Digital elevation modelling Digital Elevation Model (DEM), Digital Surface Model (DSM), and Digital Terrain Model (DTM) concepts and comparison, TIN data model and construction methods, sources of elevation data such as satellite, LiDAR, and photogrammetry, quality assessment and accuracy evaluation of freely available DEMs, terrain derivatives (slope, aspect, curvature) Hydrological applications of DEMs, applications of DEMs in environmental and engineering studies, errors and uncertainties in GIS, map accuracy and scale, key elements of a map, map layout and design principles, and cartographic generalization.

Text Books:

[1]. Anji Reddy M., Remote Sensing & Geographical Information Systems, BPS Publications, Hyderabad, 4th Edition, 2011.

[2]. Basudeb Bhatta, Remote Sensing & GIS, Oxford University Press, New Delhi, 2011.

[3]. Burrough P.A. and McDonnell R.A., Principles of Geographical Information Systems, Oxford University Press, New York, 2nd Edition, 1998.

[4]. Kang-Tsung Chang, Introduction to Geographic Information Systems, McGraw-Hill Education, New York, 7th Edition, 2016.

[5]. Longley P.A., Goodchild M.F., Maguire D.J., and Rhind D.W., Geographic Information Systems and Science, John Wiley & Sons,4th Edition, 2015.

Reference Books:

[1]. Lillesand TM ., Kiefer RW., Remote sensing and Image interpretation ; John Willey and sons. 7th edition, 2015

[2]. Chandra AM ., Ghosh SK Remote sensing and Geographical Information System ; Narosa Publishing House, Second Edition New Delhi, 2015

[3]. Heywood I., Cornelius S., and Carver S., An Introduction to Geographical Information Systems; Pearson Education, 4th Edition, 2011.

[4]. Burrough P.A. and McDonnell R.A., Principles of Geographical Information Systems; Oxford University Press, 2nd Edition, 1998.

[5]. Longley P.A., Good child M.F., Maguire D.J., and Rhind D.W., Geographic Information Systems and Science; John Wiley & Sons, 4th Edition, 2015.

Web Resources: NPTEL: https://nptel.ac.in/courses/105/102/105102015

Digital Photogrammetry			
Course Category:	**Minors**	**Credits:**	**3**
Course Type:	**Theory**	**Lecture-Tutorial-Practice:**	**3-0-0**
Pre-requisites:	**Introduction to GIS**	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**40** **60** **100**

Course Description:
This course covers fundamental principles of photogrammetry, geometric models of aerial and satellite imagery, orientation procedures, stereo-vision, DEM generation, and mapping applications.

Course Aims & Objectives

- To understand fundamental principles of image geometry and camera models.
- To introduce aerial photography, interior/exterior orientation, and stereoscopic vision.
- To develop skills in deriving elevation information and generating DEMs and orthophotos.
- To explore applications of digital photogrammetry in mapping, engineering, and geosciences.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Explain the fundamentals of photogrammetry, imaging geometry, and camera systems.	K2
CO2	Apply interior and exterior orientation principles for accurate geometric correction.	K3
CO3	Perform stereoscopic measurements and derive height information using parallax.	K4
CO4	Generate DEMs and orthophotos from aerial and satellite imagery.	K4
CO5	Evaluate the quality, accuracy, and reliability of photogrammetric products.	K4

Course articulation matrix

COs	POs											PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	2	2	1	0	0	1	1	1	3	3
CO2	3	3	3	3	2	1	0	0	1	1	1	3	3
CO3	3	2	3	3	3	1	0	0	1	1	1	3	3
CO4	3	2	3	3	3	1	0	1	1	2	2	3	3
CO5	2	3	3	3	3	2	1	2	1	2	3	3	3

(1-Low, 2 -Medium, 3–High)

Course Content

Unit–I: Introduction to Photogrammetry

Fundamentals of Photogrammetry, Definition and scope, Principles and applications in mapping and surveying, Types of photogrammetry: aerial and terrestrial, Photogrammetric Camera Systems and Image Geometry, Types of cameras and camera components

Image scale and factors affecting scale, Relief displacement and its significance, Stereoscopy and Height Measurement, Concept of stereoscopic vision, Parallax and stereoscopic overlap, Applications of stereoscopy in terrain and height determination

Unit–II: Geometry of Aerial Photographs

Collinearity Equations and Coordinate Systems, Image, ground, and camera coordinate systems; mathematical basis of photogrammetry, **Interior and Exterior Orientation**, Camera calibration, focal length, principal point, position and orientation of the camera in space.

Ground Control Points (GCPs) and Fiducial Marks, Role of GCPs in accuracy and geometric correction, fiducial marks for image referencing.

Unit–III: Stereoscopic Viewing & Measurements

Stereo-pair Geometry and Parallax**,** Parallax concept, absolute and differential parallax, relation to height measurement, Height Determination using Stereoscopy**,** Parallax-height relationship and terrain elevation estimation.

Stereoscopic Instruments and Digital Stereo-Plotters, Analog vs. digital systems, modern stereo-plotting workflows

Unit–IV: DEM and Orthophoto Generation

DEM Creation and Interpolation Techniques**,** Point, grid, and TIN-based DEMs, interpolation methods,

Ortho rectification and Accuracy Assessment**,** Removal of relief and tilt distortions, positional accuracy, Mosaicking and Radiometric Corrections**,** Seamless image generation and radiometric normalization.

Unit–V: Satellite Photogrammetry & Applications

High-Resolution Satellite Photogrammetry and RPC Models**,** Rational Polynomial Coefficients (RPCs) for sensor modelling, LiDAR and UAV Photogrammetry, Data acquisition, point clouds, and high-precision surface modeling.

Mapping and Real-World Applications**,** Urban mapping, terrain analysis, infrastructure and environmental applications.

Text Books:

[1] Wolf & Dewitt, Elements of Photogrammetry, McGraw-Hill.
[2] McGlone (Ed.), Manual of Photogrammetry, ASPRS.
[3] Kraus, Photogrammetry: Geometry from Images, Taylor & Francis.

Reference Books:

[1] Kasser & Egels, Digital Photogrammetry.
[2] Mikhail, Bethel & McGlone, Introduction to Modern Photogrammetry.
[3] Colomina & Molina, UAV Photogrammetry, ISPRS Review Articles.

- Web Resources: https://www.usgs.gov,
- https://www.isprs.org
- Open Drone Map Documentation
  ESA Earth Observation Learning Portal

QGIS - THEORY AND APPLICATIONS			
Course Category:	**Minors**	**Credits:**	**4**
Course Type:	**Theory**	**Lecture-Tutorial-Practice:**	**3-1-0**
Pre-requisites:	**Introduction to GIS**	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**40** **60** **100**

Course Description:

This course introduces students to the theoretical foundations and practical applications of Geographic Information Systems (GIS) using QGIS, an open-source GIS software. The course covers fundamental GIS concepts including spatial data models, coordinate reference systems, map projections, data acquisition, and spatial analysis techniques. Students will learn how geographic data is created, managed, analyzed, and visualized within the QGIS environment.

Course Aims & Objectives

- To understand the fundamentals and architecture of QGIS as an open-source GIS platform.
- To learn the concepts of spatial data models and data management in QGIS.
- To understand coordinate reference systems and map projections used in QGIS.
- To study theoretical aspects of spatial analysis and geoprocessing in QGIS.
- To develop knowledge of cartographic principles and thematic mapping using QGIS

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Explain the fundamentals and architecture of QGIS as an open-source Geographic Information System platform	K2
CO2	Identify and manage vector and raster spatial data concepts using QGIS.	K3
CO3	Understand and apply processing tools for vector data analysis in QGIS.	K3
CO4	Interpret spatial analysis and geoprocessing concepts used in QGIS for solving real-world problems.	K4
CO5	Digitize transportation networks and water bodies using point and line features in QGIS.	K3

Course articulation matrix

COs	POs											PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	1	1				2							1
CO2	1	1				2							1
CO3	1	1		1	3	2	2						1
CO4													
CO5		1				2							

(1-Low, 2 -Medium, 3–High)

Course Content
Unit–I: Introduction to QGIS Getting familiar with the QGIS user interface including menus, toolbars, map canvas, layer panel, and browser panel; concept and use of plugins in QGIS, plugin installation, configuration, and management; project creation and management in QGIS; georeferencing concepts and step-by-step procedure in QGIS; raster and vector layer loading; Concept of geographic and projected coordinate systems; datum and ellipsoid; ground truth data collection and its importance; Universal Transverse Mercator (UTM) coordinate system; map scale and coordinate reference system (CRS) handling in QGIS; basic map navigation and measurement tools.
Unit–II: Attribute data in QGIS Point and line feature extraction in QGIS, vectorization techniques, creation of shapefiles for simple vector data, digitization methods, manipulation and editing of attribute data, polygonize operation Topology rules and topology checker, labeling of vector data, map preparation and layout design, conversion of scale in vector files, spatial indexing, and modification of layer properties.
Unit–III: Vector analysis using QGIS Application of QGIS processing tools for vector analysis including buffering, overlay, clipping, union, and spatial queries; interpolation techniques such as Inverse Distance Weighting (IDW), spline, and nearest neighbor; application of processing tools for network analysis including shortest path, service area, and closest facility analysis Demonstration of data management tools for layer organization, merging, dissolving, and file format conversion; use of geometry tools for feature correction, simplification, and validation; application of analysis tools for proximity, extraction, and spatial statistics; handling coordinate reference systems during analysis; and interpretation of analysis results for decision-making and planning.
Unit–IV: Introduction to advanced QGIS concepts Introduction to advanced QGIS functionalities; concepts of model building using the Graphical Modeler; creation and execution of automated workflows; introduction to spatial databases and PostGIS architecture; connecting QGIS with PostGIS databases Basics of QGIS Processing Toolbox and algorithm management; batch processing of geoprocessing tasks; introduction to Python scripting and PyQGIS (theory only); automation of repetitive GIS tasks; workflow optimization and reproducibility; overview of plugin development concepts; and handling large spatial datasets in QGIS.
Unit–V: Applications of QGIS Multidisciplinary applications of QGIS in urban planning, environmental studies, transportation, water resources, agriculture, and disaster management; introduction to Google Earth interface; extracting geographic coordinates and KML/KMZ data of an area; digitization of transportation networks and water bodies using QGIS Extraction of contour lines and DEM from Google Earth data; integration of Google Earth and other open-source datasets with QGIS; basic terrain analysis using DEMs; visualization, cartographic representation, and map preparation for real-world applications; and preparation of

thematic maps for reporting and decision support.

Text Books

[1]. Sherman G.E., Sutton T., Blazek R., Holl S., and Dassau O., Quantum GIS User Guide, Open Source Geospatial Foundation (OSGeo), Latest Edition.
[2]. Kang-Tsung Chang, Introduction to Geographic Information Systems, McGraw-Hill Education, 7th Edition, 2016.
[3]. Basudeb Bhatta, Remote Sensing & GIS, Oxford University Press, New Delhi, 2011.

Reference Books

[1]. Burrough P.A. and McDonnell R.A., Principles of Geographical Information Systems, Oxford University Press, 2nd Edition, 1998.
[2]. Longley P.A., Goodchild M.F., Maguire D.J., and Rhind D.W., Geographic Information Systems and Science, John Wiley & Sons, 4th Edition, 2015.
[3]. Heywood I., Cornelius S., and Carver S., An Introduction to Geographical Information Systems, Pearson Education, 4th Edition, 2011.
[4]. Lillesand T.M. and Kiefer R.W., Remote Sensing and Image Interpretation, John Wiley & Sons, 7th Edition, 2015.

Web Resources:NPTEL: nptel.ac.in/courses/107105088

Geospatial Data Analytics			
Course Category:	**Minors**	**Credits:**	**3**
Course Type:	**Theory**	**Lecture-Tutorial-Practice:**	**3-1-0**
Pre-requisites:	**Introduction to GIS**	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**40** **60** **100**

Course Description:

This course introduces analytical techniques and computational approaches used to explore, model, and interpret geospatial data. It covers spatial statistics, geostatistics, machine learning, spatial data mining, and big geodata processing.

Course Objectives:

- To introduce the foundations of spatial data analytics and spatial statistics.
- To provide knowledge of data pre-processing, transformation, and quality assessment.
- To train students in applying machine learning techniques to geospatial datasets.
- To develop skills in spatial data mining, pattern detection, and cluster analysis.
- To expose students to big geospatial data platforms and real-world analytical applications.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Explain the concepts of spatial data, spatial relationships, and exploratory spatial data analysis.	K2
CO2	Apply spatial statistical methods to model spatial patterns and relationships.	K3
CO3	Implement machine learning algorithms for geospatial prediction and classification.	K4
CO4	Analyze spatial clusters, hotspots, and anomalies using spatial data mining techniques.	K4
CO5	Utilize big geospatial data platforms for solving environmental and urban analytics problems.	K4

Course articulation matrix

COs	POs											PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	1	1	1					1	1	2	2
CO2	2	3			2					1		3	2
CO3	2	2			3					1		3	3
CO4	2	3	3	3	2	1	2	2	1	1		3	3
CO5	1	2	2	2	3	2	3	2	1	2	2	3	3

(1-Low, 2 -Medium, 3–High)

Course Content
Unit–I: Introduction to Geospatial Data Analytics Spatial vs. non-spatial data: definition and characteristics. Types of spatial data (vector and raster). Coordinate systems and georeferencing concepts. Definition and characteristics of non-spatial (attribute) data. Linking spatial and attribute data in GIS. Introduction to Exploratory Spatial Data Analysis (ESDA), concept and objectives, difference between EDA and ESDA, visualization techniques, statistical tools, and the role of ESDA in spatial modelling and decision-making.
Unit–II: Spatial Relationships and Spatial Autocorrelation Concept of spatial relationships in GIS. Topological relationships (adjacency, containment, overlap, connectivity). Proximity analysis and distance-based relationships. Directional relationships. Neighborhood and contiguity concepts. Applications of spatial relationships in spatial analysis. Spatial autocorrelation: concept of spatial dependence and Tobler's First Law of Geography. Types of spatial autocorrelation. Global and local measures of spatial autocorrelation and their significance in spatial analysis.
Unit–III: Spatial Statistics and Geostatistical Modelling Spatial regression: limitations of classical (OLS) regression for spatial data, spatial dependence and spatial heterogeneity, types of spatial regression models, model assumptions and diagnostics, applications in environmental and regional studies. Geographically Weighted Regression (GWR): global vs. local regression, principles of GWR, kernel functions and bandwidth selection, interpretation of local coefficients, advantages and applications. Variogram analysis: spatial continuity and variability, variogram and semivariogram concepts, experimental vs. theoretical variograms, common variogram models, and role of variogram in spatial prediction. Fundamentals of geostatistics: stationarity and isotropy, spatial random functions, point data vs. area data, kriging techniques and applications in earth and environmental sciences.
Unit–IV: Machine Learning for Geospatial Data Supervised learning algorithms for geospatial analysis: principles of supervised classification. Working concepts of Support Vector Machine (SVM), Decision Trees, and Random Forest. Comparative strengths and applications in GIS and Remote Sensing. Feature engineering: feature extraction and feature selection. Spectral, spatial, and textural features. Importance of feature engineering in improving model performance. Accuracy assessment: confusion matrix, error analysis, producer's accuracy, user's accuracy, overall accuracy, Kappa coefficient, and validation methods. **Unit–V: Spatial Data Mining and Pattern Analysis** Clustering techniques for spatial data mining: principles of clustering and unsupervised learning. k-means and DBSCAN algorithms, working methodology, and differences between centroid-based and density-based clustering. Applications of clustering in spatial and geospatial data analysis. Hotspot analysis: concept of spatial hotspots and cold spots, methods of hotspot identification. Anomaly and outlier detection: concepts and importance in spatial datasets. Association rule mining: concept and applications in spatial data mining.

Text Books:

[1] Mitchell, Andy. The ESRI Guide to GIS Analysis, Volumes I–III.
[2] O'Sullivan & Unwin. Geographic Information Analysis.
[3] Stein et al. Spatial Statistics for Remote Sensing.

Reference Books:

[1] Waller & Gotway. Applied Spatial Statistics for Public Health Data.
[2] Gérard Biau & Scornet. Statistical Learning with Big Data.
[3] Chan & Paelinck. Spatial Econometrics: Data, Models and Applications.
[4] Liang-Chieh Ma et al., Geospatial Data Science Techniques.

- Web Resources: Google Earth Engine Developer Guide: https://developers.google.com/earth-engine
- Scikit-learn Documentation: https://scikit-learn.org
- QGIS Documentation for Spatial Analysis: https://docs.qgis.org
- Esri Spatial Statistics Tools: https://www.esri.com/analytics

Environmental Geoinformatics			
Course Category:	Minors	Credits:	3
Course Type:	Theory	Lecture-Tutorial-Practice:	3-0-0
Pre-requisites:	Introduction to GIS	Continuous Assessment: Summative Assessment: Total Marks:	40 60 100

Course Description:

This course explores the application of Geoinformatics, GIS, remote sensing, spatial modelling, and analytical tools—for environmental monitoring, assessment, and management. Students learn how geospatial data supports evaluation of land degradation, hydrological processes, climate variability, environmental pollution, and biodiversity loss.

Course Objectives:

- To introduce geospatial tools and datasets used for environmental assessment.
- To understand environmental indicators and spatial modelling approaches.
- To develop skills in using GIS and remote sensing for land, water, and atmospheric analysis.
- To provide knowledge for decision-making in environmental management and sustainability planning.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Explain the role of Geoinformatics in environmental studies	K2
CO2	Analyze land, water, and atmospheric environmental datasets.	K3
CO3	Apply remote sensing techniques to assess environmental change.	K4
CO4	Perform spatial modelling for environmental risk assessment.	K4
CO5	Recommend environmental management strategies using GIS outputs.	K4

Course articulation matrix

COs	POs											PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
2	2				1	2			1		2	2	2
2	3				1	2			1		3	2	2
2	2				1	2			1		3	3	2
2	3				1	2		1	1		3	3	2
1	2				2	3		1	2		3	3	1

(1-Low, 2 -Medium, 3–High)

Course Content
Unit–I: Introduction to Environmental Geoinformatics Components of Environment, Abiotic components, atmosphere, hydrosphere, lithosphere Biotic components, flora, fauna, and ecosystems, Interaction among environmental components, Role of Geoinformatics in Environmental Studies Integration of Remote Sensing, GIS, and GPS, Environmental monitoring and change detection, Resource management and environmental planning, Spatial Data Types and Sources, Spatial data types: vector and raster, Primary and secondary data sources
Unit–II: Land Environment Monitoring Land-Use / Land-Cover (LULC) Mapping, Concept and importance, Remote sensing data and classification methods, Change detection and applications in environmental monitoring, Land Degradation and Soil Erosion (RUSLE), Types and causes of land degradation Soil erosion processes and impacts, RUSLE model factors and GIS integration, Deforestation and Urbanization, Causes and impacts of deforestation, Urban growth, sprawl, and land transformation, Environmental consequences and spatial assessment using GIS
Unit–III: Water & Atmospheric Applications Hydrological Modelling and Watershed Analysis, Concept and objectives of hydrological modelling, Watershed delineation and morphometric analysis, Applications in runoff estimation and water resource management, Flood and Drought Assessment, Flood hazard zonation and inundation mapping Drought indices and spatial assessment, Role of remote sensing and GIS in disaster management, Environmental Quality Modelling (Water and Air), Water quality mapping using GIS and spatial interpolation, Air quality monitoring and dispersion modelling, Applications in environmental impact assessment and policy planning.
Unit–IV: Environmental Impact Assessment (EIA) GIS-based Environmental Impact Assessment (EIA), Role of GIS in EIA studies, Spatial analysis for impact identification and prediction, Advantages of GIS in environmental decision-making, Buffer and Overlay Analysis, Concept and types of buffer analysis, Overlay techniques Applications in impact assessment and site suitability analysis, Ecological Sensitivity Mapping and Environmental Zoning, Identification of ecologically sensitive areas, Criteria-based spatial modeling, Environmental zoning for sustainable land-use planning.
Unit–V: Environmental Modelling & Decision Support Multi-Criteria Decision Analysis (MCDA) using AHP, Concept of MCDA and need in spatial decision-making, Analytical Hierarchy Process (AHP), hierarchy, pairwise comparison, weights,

Consistency ratio and suitability mapping applications, Risk Modelling and Climate Vulnerability Mapping

Components of risk, hazard, exposure, and vulnerability, Spatial risk modelling using GIS, Climate vulnerability indicators and mapping approaches, Sustainability Indicators, Concept of sustainability and indicators, Environmental, social, and economic indicators.

Text Books:

[1] Jensen, Remote Sensing of the Environment.
[2] Burrough & McDonnell, GIS and Environmental Modelling.

Reference Books:

[1] Chang, Introduction to GIS.
[2] Schowengerdt, Remote Sensing: Models and Methods for Image Processing.
[3] Heywood et al., An Introduction to Geographical Information Systems.
[4] Tomlin, GIS and Cartographic Modelling.

- Web Resources: https://bhuvan.nrsc.gov.in
- https://earthdata.nasa.gov
- https://www.ipcc-data.org
- USGS Earth Explorer

Geodata Visualization			
Course Category:	**Minors**	**Credits:**	**3**
Course Type:	**Theory**	**Lecture-Tutorial-Practice:**	**3-0-0**
Pre-requisites:	**Introduction to GIS**	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**40** **60** **100**

Course Description:

This course introduces concepts, techniques, and tools for visualizing geospatial data using modern GIS, cartographic design principles, web mapping platforms, and interactive dashboards. Students will learn symbology, color theory, map composition, 3D visualization, and storytelling with spatial data.

Course Aims & Objectives

- To provide knowledge of geovisualization principles and cartographic communication.
- To introduce visual analytics for spatial datasets.
- To enable students to design effective thematic maps and interactive visualizations.
- To familiarize students with 3D visualization and web-based geodata presentation.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Explain fundamental principles of cartographic design and geovisualization	K1
CO2	Apply symbology, color schemes, visual variables, and map elements to create thematic maps.	K3
CO3	Develop interactive and time-enabled geospatial visualizations using GIS tools.	K4
CO4	Create web maps and dashboards for spatial storytelling and decision support.	K4
CO5	Evaluate geovisualization outputs based on clarity, accuracy, usability, and communication effectiveness.	K4

Course articulation matrix

COs	POs											PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3								3	3		
CO2	3	3	3		2							3	3
CO3	3		3	3	2							3	3
CO4	3		3	2	2				3	3		3	3
CO5		3		2	2	3	3	2		3		3	3

(1-Low, 2 -Medium, 3–High)

Course Content

Unit–I: Fundamentals of Geodata Visualization

Cartographic Principles and Visual Variables, Map purpose, visual perception, symbol size, shape, colour, texture, and orientation. Types of Spatial Data and Symbology

Vector vs. raster data and appropriate symbolization techniques, Scale, Generalization, and Map Layout, Scale effects, generalization methods, map composition, and color theory basics.

Unit–II: Thematic Mapping Techniques

Thematic Map Types, Choropleth, proportional symbols, dot density, and isarithm maps, Data Classification Methods, Equal interval, quantile, natural breaks (Jenks), and their impact on interpretation.

Temporal and Raster vs. Vector Visualization, Time-series mapping and differences in visualizing raster and vector datasets.

Unit–III: Advanced Visualization Tools

Interactive Visualization and Dashboards, User interaction, filters, linked views, and decision support. Multivariate and Temporal Visualization, Representing multiple variables and time-enabled GIS

Data Quality and Uncertainty Visualization, Representing accuracy, reliability, and uncertainty in maps.

Unit–IV: Web-based Geovisualization

Web GIS Basics and Web Mapping Services, WMS, WFS, tile services, and client–server architecture, Story Maps and Online Mapping Platforms

ArcGIS Online, Mapbox, storytelling with maps, Open-source Web Visualization Tools, Leaflet and Mapbox for interactive web mapping.

Unit–V: 3D Geovisualization

3D Scenes and Terrain Visualization, DEM-based visualization, hill shading, and viewpoints, Volumetric and Point-cloud Visualization,

LiDAR data, 3D point clouds, and subsurface visualization, Virtual Reality (VR) Concepts, Immersive visualization and applications in planning and analysis.

Text Books:

[1] Terry A. Slocum, Robert B. McMaster, Fritz C. Kessler & Hugh H. Howard, Thematic Cartography and Geovisualization, Pearson Education.
[2] Menno-Jan Kraak & Ferjan Ormeling, Cartography: Visualization of Spatial Data, CRC Press / Taylor & Francis Group.
[3] Cynthia A. Brewer, Designing Better Maps: A Guide for GIS Users, Esri Press.

Reference Books:

[1] Paul M. Mather, Computer Processing of Remotely Sensed Images, John Wiley & Sons.
[2] Robert Roth, Cartographic Design: Theoretical and Practical Perspectives, Map Studies Press.
[3] Mary H. Gilmartin & Nina Fedorov, Geospatial Visualization: Concepts, Tools and Applications, Springer.
[4] H. Miller & J. Han, Geospatial Data Mining and Visualization, CRC Press.

Web Resources: [1] Esri Cartography and Visualization Resources: https://www.esri.com/en-us/arcgis/products/arcgis-pro/resources/cartography
[2] QGIS Documentation — Symbology, 3D, and Visualization Tools: https://docs.qgis.org
[3] ColorBrewer 2.0 – Map Color Scheme Selection Tool:https://colorbrewer2.org
[4] Leaflet Web Mapping Library: https://leafletjs.com

24CEXXX
ADVANCED CONSTRUCTION TECHNIQUES

Course Category:	**Honour**	**Credits:**	**3**
Course Type:	**Theory**	**Lecture-Tutorial-Practice:**	**3-0-0**
Pre-requisites:	**Construction Technology**	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**40** **60** **100**

Course Description:

This course introduces advanced construction methods and modern execution techniques adopted for complex sub-structure and super-structure works, special structures, earthquake-resistant buildings, and steel–composite systems. Emphasis is placed on construction planning, sequencing, equipment usage, safety, and quality considerations for large-scale and challenging projects.

The course further focuses on constructability aspects, selection of appropriate construction techniques, coordination of resources, and compliance with structural and safety requirements. It equips students with technical knowledge required to handle complex construction conditions, innovative systems, and evolving practices in the construction industry

Course Objectives:

- To familiarize students with advanced sub-structure and underground construction techniques.
- To understand modern construction practices for tall buildings and large-span structures.
- To expose learners to construction methods of special and heavy structures.
- To develop awareness of earthquake-resistant construction practices.
- To introduce steel, composite, prefabricated, and industrialized construction systems.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Explain advanced sub-structure construction techniques used in challenging site conditions.	2
CO2	Describe super-structure construction methods for tall and large-span buildings.	2
CO3	Analyze construction sequences and erection methods for special structures.	3
CO4	Apply principles of earthquake-resistant construction in building practices.	3
CO5	Interpret steel, composite, prefabricated, and modular construction methods.	3

Course articulation matrix

COs	POs											PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	2	1		2				-	1		1
CO2	2	2	2	2		2				-	1		2
CO3	2	2	2	2		2				-	2	1	2
CO4	2	2	2	2		2	2				2	2	2
CO5	2	2	2	1		2					3	2	2

(1-Low, 2 -Medium, 3–High)

Course Content

Unit-I

Sub-Structure Construction:

Box jacking, pipe jacking, underwater construction of diaphragm walls and basements, tunneling techniques, piling techniques, driving well and caisson, sinking cofferdam, cable anchoring and grouting, driving diaphragm walls and sheet piles, laying operations for built-up offshore systems, shoring for deep cutting, large reservoir construction, well points, dewatering for underground open excavation.

Unit-II

Super-Structure Construction for Buildings:

Vacuum dewatering of concrete flooring, concrete paving technology, techniques of construction for continuous concreting operations in tall buildings of various shapes and varying sections, erection techniques of tall structures and large-span structures, launching techniques for heavy decks, in-situ prestressing in high-rise structures, post-tensioning of slabs, aerial transporting, handling and erecting lightweight components on tall structures, metal deck concrete flooring and roofing systems.

Unit-III

Construction of Special Structures:

Erection of lattice towers, rigging of transmission line structures, construction sequence in cooling towers, silos, chimneys, skyscrapers, bowstring bridges, cable-stayed bridges, launching and pushing of box decks, construction of jetties and breakwater structures, construction sequence and methods in domes, support structures for heavy equipment and machinery in heavy industries, erection of articulated structures and space decks, precast concrete erection, temporary propping, and connections.

Unit-IV

Construction of Earthquake-Resistant Buildings:

Planning of earthquake-resistant buildings, construction of walls with provision of corner reinforcement, construction of beams and columns, base isolation, expansion joints and construction joints in buildings.

Unit-V

Steel And Composite Construction Methods:

Fabrication and erection of steel structures including heavy structures, prefabricated construction, industrialized construction, modular coordination, steel–concrete composite construction systems.

Text Books:

[1] Roy Chudley and Roger Greeno, Advanced construction techniques, Pearson

[2] Mir, S. S. Atev. Construction Technology**,**Mir Publishers.

Reference Books:

1. Formwork for concrete, M. K. Hurd, Detroit American Concrete Institute
2. Chew Yit Lin, Michael, Construction Technology for Tall Buildings, Singapore University Press, World Scientific
3. Beer, G., Technology innovation in underground construction. CRC Press
4. Richardson, J.G., Pre-cast concrete Production, Cement and Concrete Association
5. Gerwick, B., Construction of marine and offshore structures. CRC Press
6. Levitt , Precast concrete – Materials, manufacture properties and usage, Applied Science
7. Powers, J. Patrick; Corwin, Arthur B.; Schmall, Paul C.; and Kaeck, Walter E. Construction Dewatering and Groundwater Control: New Methods and Applications 3rd Edition, John Wiley & Sons Inc.ISBN: 978-0-471-47943-7.
8. Earthquake Resistant Design of structures,2006 – Pankaj Agarwal and Manish Shrikhande, Prentice Hall of India Pvt. Ltd..

Web Resources:

[1] https://nptel.ac.in/domains/discipline/113?course=113_0

24CEXXX
LOW COST HOUSING

Course Category:	**Honors**	**Credits:**	**3**
Course Type:	**Theory**	**Lecture-Tutorial-Practice:**	**3-0-0**
Pre-requisites:	**Building Materials & Construction Technology**	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**40** **60** **100**

Course Description:

This course focuses on the concepts, planning, technologies, and materials related to low cost housing with special reference to urban poor, rural housing, and disaster-prone areas. It covers housing scenario in India, housing finance, land use planning, innovative and cost-effective construction technologies, alternative building materials, low cost infrastructure services, and housing safety in disaster-prone regions. The course aims to develop the ability to plan, design, and evaluate affordable housing solutions that are economical, sustainable, and structurally safe.

Course Objectives:

- To understand the housing scenario and housing finance systems in India
- To study land use planning and housing strategies for urban poor
- To learn innovative low cost housing technologies and alternative materials
- To understand low cost infrastructure services and rural housing practices
- To assess housing performance and safety in disaster-prone areas

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Explain the housing scenario in India, housing finance mechanisms, and government role in housing development.	2
CO2	Analyze land use planning, building regulations, and housing strategies for urban poor and slum development.	3
CO3	Evaluate low cost housing technologies, prefabrication systems, and alternative building materials.	3
CO4	Assess low cost infrastructure services and rural housing technologies for sustainable development.	3
CO5	Examine housing safety requirements and rehabilitation measures in disaster-prone areas.	3

Course articulation matrix

COs	POs											PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	2	1		2				-	1		1
CO2	2	2	2	2		2				-	1		2
CO3	2	2	2	2		2				-	2	1	2
CO4	2	2	2	2		2	2				2	2	2
CO5	2	2	2	1		2					3	2	2

(1-Low, 2 -Medium, 3–High)

Course Content

Unit-I

Housing Scenario and Housing Finance in India:

Housing scenario in India; Status of urban housing; Status of rural housing; Housing finance – introduction; Existing housing finance systems in India; Role of government as facilitator; Rural housing finance status; Impediments in housing finance and related issues.

Unit-II

Land Use Planning and Housing for Urban Poor:

Land use and physical planning for housing; Planning of urban land; Urban Land Ceiling and Regulation Act; Efficiency of building bye-laws; Residential densities; Housing for urban poor; Living conditions in slums; Approaches and strategies for housing urban poor.

Unit-III

Low Cost Housing Technologies and Alternative Materials:

Development and adoption of low cost housing technologies; Innovative cost-effective construction techniques; Partial prefabrication using precast elements; Total prefabrication for mass housing in India; Precast roofing and flooring systems; Economical wall systems; Single brick thick load bearing walls; 19 cm thick load bearing masonry walls; Half brick thick load bearing walls; Fly ash and gypsum based masonry; Stone block masonry; Precast RCC plank and joist systems.

Alternative building materials – substitutes for scarce materials; Ferrocement; Gypsum boards; Timber substitutes; Industrial waste based materials; Agricultural waste based materials.

Unit-IV

Low Cost Infrastructure Services and Rural Housing:

Low cost infrastructure services – present status and technological options; Low cost sanitation; Domestic waste disposal; Water supply and energy options; Rural housing – traditional practices; Mud housing technologies; Mud roofs; Characteristics of mud; Fire resistant treatment for thatched roofs; Soil based construction materials..

Unit-V

Housing in Disaster Prone Areas:

Housing in disaster prone areas; Earthquakes – damage to houses; Traditional houses in disaster prone areas; Types of damage and behavior of non-engineered buildings; Repair and restoration of earthquake damaged non-engineered buildings; Recommendations for future construction;

Structural safety requirements of thin precast roofing units against earthquake forces; Status of research and development in earthquake strengthening measures; Housing safety against floods and cyclones; Future safety considerations.

Text Books:

[1] International Council for Building Research, Studies and Documentation (CIB), Building Materials for Low-Income Houses.
[2] Madhava Rao, A. G., Ramachandra Murthy, D. S., and Annamalai, G., Modern Trends in Housing in Developing Countries..
[3] Rudnai, G., Light Weight Concrete, Publishing House of the Hungarian Academy of Sciences, 1963.

Reference Books:

[1] Jain, Ashok Kumar, Building Systems for Low Income Housing, Management Publishing House, 1992.
[2] Mathur, Guru Charan, Low Cost Housing in Developing Countries, Oxford & IBH Publishing Company, 1993.

Web Resources:

[1] **HUDCO** – Affordable housing and infrastructure development https://hudco.org

24CEXXX
CONSTRUCTION QUALITY AND SAFETY

Course Category:	**Honors**	**Credits:**	**3**
Course Type:	**Theory**	**Lecture-Tutorial-Practice:**	**3-0-0**
Pre-requisites:	**Building Materials and Construction Technology**	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**40** **60** **100**

Course Description:

This course addresses the principles and practices of quality management and safety in construction projects. It covers quality control, quality assurance, inspection and testing procedures, certification systems, and total quality management (TQM) concepts applied to construction. The course also emphasizes construction safety management, including legislative requirements, accident analysis, safety planning, personal and structural safety, and modern site safety practices. The integration of quality and safety systems prepares students to manage construction projects in compliance with national and international standards.

Course Objectives:

- To understand quality concepts, inspection, testing, and certification systems in construction
- To study total quality management principles and their application in construction projects
- To analyze construction safety legislation, standards, and contractual requirements
- To develop safety programmes and accident prevention strategies in construction sites
- To apply systematic quality and safety management practices in construction projects

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Explain construction quality concepts, inspection procedures, and certification systems.	2
CO2	Apply total quality management tools and benchmarking techniques in construction projects.	3
CO3	Analyze construction safety principles, legislation, and contractual safety provisions.	3
CO4	Develop safety programmes and accident prevention measures for construction activities.	3
CO5	Evaluate site safety performance using accident indices, investigations, and continuous improvement tools.	3

Course articulation matrix

COs	POs											PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	1	1		2	2			2	1		1
CO2	2	3	2	2		2	2			2	1	1	1
CO3	2	2	2	2		2	2			2	2	1	
CO4	3	3	3	2		3	3			2	3	2	2
CO5	2	2	2	2		2	2			2	3	2	2

(1-Low, 2 -Medium, 3–High)

Course Content

Unit-I

Construction Quality Management and Certification:

Construction quality concepts; Inspection and testing procedures; Quality control and quality assurance; Quality certification systems for companies and laboratories; ISO certification; NABL accreditation.

Unit-II

Total Quality Management in Construction:

Total Quality Management (TQM); Critical success factors of TQM; Application of TQM in construction projects; Benchmarking; Quality policy; Quality standards; Quality manuals and documentation.

Unit-III

Third Party Certification and Construction Safety Framework:

Third party certification; Construction safety – meaning and scope; Safety in construction – technological, organizational, and behavioural aspects; Safety legislation and standards; Contract conditions related to safety in civil engineering projects.

Unit-IV

Construction Safety Practices and Accident Management:

Safety in construction; Causes and classification of accidents; Cost and measurement of accidents; Safety programmes for construction sites; Personal protective equipment (PPE); Accident reporting; Safety measures for storage and handling of materials, construction of building elements, and demolition works; Safety lacunae in the Indian construction scenario.

Unit-V

Advanced Safety Planning and Site Safety Systems:

Types of injuries; Factors affecting safety; Strategic planning for safety provisions; Personal and structural safety; Safety considerations during construction, demolition, and equipment use; Recording injuries and accident indices; Method statements; Standard operating procedures (SOPs); PPE management; Inspections and investigations; Site safety programmes – Job Safety Analysis (JSA), Job Hazard Analysis (JHA), Root cause analysis; Safety meetings; Safety policy; Manuals; Training and orientation; Safety legislation related to violations.

Text Books:

[1] Logothetis, N., Management for Total Quality, Prentice Hall.
[2] Goldsmith, D., Safety Management in Construction and Industry, McGraw Hill.

Reference Books:

[1] Rajendra Prasad, D. S., Quality Management System in Civil Engineering, Sapna Book House, Bangalore.
[2] Joseph, B. and Joseph, S., Total Quality Management, Excel Books, New Delhi, 1995.
[3] Juran, J. M. and Gryna, F. M., Quality Planning and Analysis, Tata McGraw Hill, 2002.
[4] O'Brian, J. J., Construction Inspection Handbook – Quality, 2009.

Web Resources:

[1] https://nptel.ac.in/courses/105102206
[2] https://www.youtube.com/watch?v=ypTiYyh7YT0

24CEXXX
FORMWORK DESIGN AND PRACTICE

Course Category:	**Honors**	**Credits:**	**4**
Course Type:	**Theory**	**Lecture-Tutorial-Practice:**	**3-1-0**
Pre-requisites:	**Building Materials and Construction Technology**	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**40** **60** **100**

Course Description:

This course provides in-depth knowledge of formwork and falsework systems used in modern concrete construction. It covers the principles of planning, selection, materials, and classification of formwork systems under site and construction constraints. The course emphasizes the design of conventional and proprietary formwork for structural elements such as foundations, columns, walls, slabs, beams, and decks, considering loads, stability, and relevant IS code provisions. Advanced formwork systems for special and bridge structures, precast construction, and high-rise buildings are also discussed. Issues related to formwork failure, construction sequence, safety, and managerial aspects of formwork operations are addressed to equip students with professional competence in safe, economical, and efficient formwork design and practice.

Course Objectives:

- To understand the concepts, requirements, and classification of formwork and falsework systems
- To analyse formwork materials, shoring towers, and scaffold systems
- To design conventional and proprietary formwork for various structural components
- To study advanced formwork techniques for special, bridge, and precast structures
- To develop awareness of formwork safety, failure mechanisms, and management practices

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Explain the fundamentals, requirements, planning aspects, and classification of formwork and falsework systems under site constraints.	2
CO2	Analyze formwork materials, shoring towers, and scaffold systems for suitability and performance in construction projects.	3
CO3	Design conventional and proprietary formwork systems for foundations, walls, columns, slabs, beams, and decks considering loads and IS code provisions.	4
CO4	Evaluate formwork systems for special structures, bridge structures, and precast concrete construction.	3
CO5	Assess formwork failures, construction sequence, safety practices, and management issues in multi-storey building construction.	3

Course articulation matrix

	POs											PSOs	
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	2	1	1	1		2	-	-	-	-	1	2	
CO2	3	2	2	2		2	-	-	-	-	1	2	2
CO3	3	3	3	2		2	-	-	-	-	2	2	
CO4	2	2	2	2		2	-	-	-	-	2	2	
CO5	2	2	2	2		2	2	-	-	-	3	2	2

(1-Low, 2 -Medium, 3–High)

Course Content

Unit-I

Introduction to Formwork and Temporary Structures

Introduction to formwork and falsework; Temporary work systems; Requirements of formwork; Construction planning and site constraints; Selection criteria; Classification and types of formwork systems.

Unit-II

Formwork Materials, Shoring, and Scaffolding Systems

Formwork materials – timber, plywood, steel, aluminum, and plastic; Shoring towers; Scaffolding systems; Design considerations; Stability and safety aspects.

Unit-III

Design of Conventional and Proprietary Formwork Systems:

Design of timber and steel formwork for foundations, walls, columns, slabs, and beams; Design of decks and falsework; Effects of dead, live, wind, and construction loads; Load combinations; Bending moments and deflection of formwork; IS code provisions.

Unit-IV

Formwork for Special and Bridge Structures:

Formwork for shells, domes, folded plates, overhead water tanks, natural draft cooling towers, nuclear reactors, tunnels, and lift shafts; Formwork for bridge structures; Case studies on failure of temporary support structures in bridges.

Unit-V

Advanced Formwork Systems, Safety, and Management:

Flying formwork systems – table forms, tunnel formwork, column-mounted shoring systems, gang forms, slipform; Formwork for precast concrete construction; Formwork failure causes; Construction sequence; Safety in use of formwork and falsework; Pre-award and post-award formwork management issues; Formwork issues in multi-storey building construction.

Text Books:

[1] Jha, K. N., Formwork for Concrete Structures, McGraw Hill, 2012.
[2] Peurifoy, R. L. and Oberlender, G. D., Formwork for Concrete Structures, McGraw Hill, 2010.

Reference Books:

[1] Dinescu, T. and Radulescu, C., Slip Form Techniques, Abacus Press, 2004.
[2] Austin, C. K., Formwork for Concrete, Cleaver-Hume Press Ltd., London, 2010.

Web Resources:

[1] https://www.youtube.com/watch?v=p5lzixbac6k
[2] https://www.youtube.com/watch?v=xSCYsb_d3Ao

24CEXXX
TENDER AND CONTRACT MANAGEMENT

Course Category:	**Honors**	**Credits:**	**4**
Course Type:	**Theory**	**Lecture-Tutorial-Practice:**	**3-1-0**
Pre-requisites:	**-**	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**40** **60** **100**

Course Description:

This course provides a comprehensive understanding of tendering procedures, contract formulation, contract administration, specifications, measurements, and accounts in construction projects. Emphasis is placed on legal aspects of contracts, types of construction contracts, dispute resolution mechanisms, tender evaluation, payment procedures, and public works department practices. The course equips students with professional competence required for effective tender and contract management in construction projects.

Course Objectives:

- To understand legal principles and essentials of construction contracts
- To study various types of construction contracts and tendering systems
- To learn tender preparation, submission, evaluation, and award procedures
- To develop skills in drafting specifications, measurements, and accounts
- To understand payment procedures, claims, disputes, and contract administration

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Explain legal issues, essentials, and administration of construction contracts.	2
CO2	Distinguish between different types of construction contracts and tendering systems.	2
CO3	Apply tendering procedures, bid evaluation, and contract formation processes.	3
CO4	Prepare specifications, measurements, and maintain construction accounts.	3
CO5	Analyze payment procedures, disputes, claims, and public works department practices.	4

Course articulation matrix

	POs											PSOs	
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	2	2	2	1		2				-	1		1
CO2	2	2	2	2		2				-	1		2
CO3	2	2	2	2		2				-	2	1	2
CO4	2	2	2	2		2	2				2	2	2
CO5	2	2	2	1		2					3	2	2

(1-Low, 2 -Medium, 3–High)

Course Content

Unit-I

Construction Contracts and Legal Aspects :

Introduction to contracts; Definition and legal issues in construction contracts; Essential requirements of a valid contract; Characteristics of a good contract; Legal enforceability of contracts; Termination of contracts; Stakeholders in construction contracts; Overview of activities in contract management.

Conditions of contracts – general and special conditions; Contract conditions related to payments, time delays, scope changes, extra claims, termination, and subcontracting; Disputes and arbitration; Legal requirements of a valid contract

Unit-II

Types of Construction Contracts and Contract Formation:

Types of construction contracts – lump sum contracts, fixed price contracts, percentage rate contracts, cost plus contracts, target contracts, design–build contracts, turnkey contracts, BOT contracts; Parties to a contract; Contract formation process.
Common contract divisions – notice to proceed; Rights, duties, and responsibilities of various parties; Contract duration and contract price.

Unit-III

Tendering Process and Performance Parameters:

Tendering – types and process of tendering; Tender notice; Bid security; Prequalification process; Bidding strategy; Tender submission and evaluation; Tender rejection; Security deposits; Contract agreement and contract documents.
Performance parameters – delays, penalties, and liquidated damages; Suspension and termination of tender.

Unit-IV

Specifications, Measurements, and Accounts:

Specifications – definition, objectives, and importance; Principles of drafting specifications; Types of specifications; Drafting general and detailed specifications for various civil engineering works; Specifications of materials and workmanship.
Measurements and accounts – various account forms and their uses; Measurement book; E-measurement book (E-MB); Completed measurements; Nominal muster roll (NMR); Issue and write-off of muster roll; Imprest cash; Indent; Invoice; Bills; Vouchers; Hand receipt; Cash book; Temporary advance.

Unit-V

Payments, PWD Procedures, and Indigenous Practices:

Mode of payment to contractors and its necessity – interim payment, advance payment, secured advance, petty advance, mobilization advance; First and final bill; Final bill; Running account bill; Retention money; Reduced rate payment.
Public Works Department (PWD) stores procedure.

IKS perspective – traditional remuneration systems where builders and artisans were paid through grain, land, royal patronage, or goods instead of cash.

Text Books:

[1] Civil Engineering Contracts and Estimates - B. S. Patil – Universities Press- 2006 Edition, reprinted in 2009.

[2] Standard General Conditions for Domestic Contracts- 2001 Edition- Published by Ministry Of Statistics and Program Implementation, Government of India,

Reference Books:

1. Keith Collier, "Construction Contracts" Reston Publishing Company, Inc, Reston,Verginia.
2. Patil, B.S., "Building and Engineering Contracts" Mrs. S.B. Patil, Pune.
3. John Murdoch & Will Hughes, Construction Contracts - Law and Management" Spon Press, Taylor & Francis Group.
4. Gajerai, G.T., "Law relating to Building and Engineering Contracts in India" Butterworths.
5. Govt of India, Central Public Works Department, "CPWD Works Manual 2003."
6. Govt of India, Central Public Works Department, "CPWD 7/8: General Conditions of Contracts."
7. V. K. Raina, Raina's Construction and Contract Management Vol.1 (Second Edition), SPD Publishers, 2009

Web Resources:

[1] https://nptel.ac.in/courses/129106006

24CEXXX

SITE ADMINISTRATION AND CONTROL IN CONSTRUCTION PROJECTS

Course Category:	**Honors**	**Credits:**	**3**
Course Type:	**Theory**	**Lecture-Tutorial-Practice:**	**3-0-0**
Pre-requisites:	**-**	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**40** **60** **100**

Course Description:

This course provides comprehensive knowledge of construction site administration and control practices required for effective execution of construction projects. The course covers project organization, site layout planning, administration, documentation, resource management, safety, quality integration, and adoption of digital technologies. Emphasis is placed on practical site-level decision-making, coordination, monitoring, and control to achieve project objectives of time, cost, quality, safety, and sustainability.

Course Objectives:

- To understand construction project organization, stakeholders, and site administration functions
- To develop skills in planning, operating, and controlling construction sites
- To learn documentation, record keeping, billing, and contract administration practices
- To understand principles of site resource management and productivity improvement
- To explore digital tools and technologies for effective site administration and control

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Explain construction project organization, life cycle, contracting, and ethical responsibilities of engineers.	2
CO2	Plan and manage construction site layout, temporary facilities, safety, quality, and site operations.	3
CO3	Apply documentation, record keeping, scheduling, billing, and contract administration practices at site level.	3
CO4	Analyze and manage construction site resources, productivity, subcontractors, and project closeout activities.	3
CO5	Evaluate and apply digital technologies for site administration, monitoring, and control.	3

Course articulation matrix

COs	POs											PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	2	1		2				-	1		1
CO2	2	2	2	2		2				-	1		2
CO3	2	2	2	2		2				-	2	1	2
CO4	2	2	2	2		2	2				2	2	2
CO5	2	2	2	1		2					3	2	2

(1-Low, 2 -Medium, 3–High)

Course Content

Unit-I

Introduction to Construction Project Organization and Management:

Importance of construction and construction industry; Overview of Indian construction industry; Construction management and its relevance; Participants and stakeholders of a construction project; Project life cycle; Ethical conduct for engineers; Project contracting; Contract administration and coordination.

Unit-II

Construction Site Administration:

Importance of effective site administration for project success; Challenges of on-site management; Site layout – objectives and components; Planning and execution of temporary facilities, site offices, storage areas, utilities, access roads, and initial site surveys; External and internal factors influencing site layout; Integration of health, safety, environment (HSE) and quality in daily operations; Site budgeting; Project communication, meetings, and reviews; Measurement and billing of materials; Maintaining safety during construction.

Unit-III

Site Documentation and Control:

Documentation and record keeping at the jobsite; Submittals – shop drawings, samples, mock-ups and their importance and tracking; Management of construction schedule, budget, and conformance; Important site documents – Daily Progress Reports (DPR), Monthly Progress Reports (MPR), Requests for Information (RFI), change orders, Running Account (RA) bills, reconciliation statements, permits, and approvals

Unit-IV

Advancement in Construction Site Resource Management:

Fundamental principles of site resource management; Goals of effective resource management; Development of resource distribution plans; Site waste management; On-site labour relations and control; Resource productivity and factors affecting productivity; Problems in resource productivity; Supervision and control of resources; Subcontractor management; Project closeout activities; Commissioning reports and documents; Project handover process and handover documentation.

Unit-V

Digital Solutions to Site Administration and Control:

Use of fixed cameras for site monitoring; GPS applications; RFID and drone usage for site

administration and control; Visual site layout using BIM and AR/VR/MR technologies; Use of site administration and control software systems.
Text Books: [1] K.K. Chitkara, Construction Project Management, Tata McGraw Hill. [2] Peurifoy, R.L., Schexnayder, C.J., and Shapira, A., Construction Planning, Equipment, and Methods, McGraw Hill.
Reference Books: [1] Harris, F. and McCaffer, R., Modern Construction Management, Wiley-Blackwell. [2] CIOB, Code of Practice for Project Management for Construction and Development.
Web Resources:

24CE301 FOUNDATION ENGINEERING			
Course Category:	Professional Core	**Credits:** 3	
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3–0–0
Pre-requisites:	24CE207 – Geotechnical Engineering	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	40 60 100

Course Description:

This course introduces principles of soil exploration, stress distribution, lateral earth pressures, slope stability, and design of shallow and deep foundations. It emphasizes analytical, design-oriented, and field-based approaches to solve complex geotechnical engineering problems considering safety, sustainability, and practical constraints.

Course Objectives:

- To understand subsoil exploration techniques and stress distribution in soils
- To analyse lateral earth pressure and slope stability problems
- To evaluate bearing capacity and settlement of shallow foundations
- To design deep foundations such as piles and well foundations

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Explain soil investigation methods and stress distribution in soils	2
CO2	Analyse lateral earth pressures and slope stability	4
CO3	Evaluate bearing capacity and settlement of shallow foundations	4
CO4	Assess and design pile foundations considering load transfer mechanisms.	5
CO5	Analyse and design well foundations	5

Course articulation matrix

COs	POs											PSOs	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2			2							2	2
CO2	3	3		2		2						2	2
CO3	3	3	3	2		2						3	2
CO4	3	3	3	2	2	2						3	3
CO5	3	3	3	2		2						3	3

(1-Low, 2 -Medium, 3–High)

Course Content

UNIT-I

SUB-SOIL INVESTIGATION AND SAMPLING: Introduction and planning of sub-surface exploration, Stages and methods of exploration, Soil sampling techniques and samplers, Water table determination, Depth and number of boreholes, Borehole logging.

IN-SITU TESTS: Standard Penetration Test (SPT), Static Cone Penetration Test (CPT), Dynamic Cone Penetration Test (DCPT), Vane Shear Test.

UNIT-II

SOIL RESPONSE & CONTACT PRESSURE: Stress-strain behaviour of soils, Vertical and horizontal stress distribution.

STRESS DISTRIBUTION IN SOILS: Boussinesq theory, Westergaard theory, Isobars and pressure bulbs, Influence diagrams, Newmark's influence charts, Contact pressure distribution.

UNIT-III

EARTH PRESSURE: Types of lateral earth pressure, Rankine's earth pressure theory, Coulomb's earth pressure theory, Types and design concepts of retaining walls.

SLOPE STABILITY: Types of slopes and failures, Factor of safety, Culmann's method, Method of slices, Friction circle method, Taylor's stability charts, Methods of improving slope stability

UNIT-IV

SHALLOW FOUNDATIONS: Bearing capacity theories, Types of shear failures, Effects of inclined load, eccentric load, and water table, Bearing capacity from in-situ tests, Plate load test,

SETTLEMENT ANALYSIS: Immediate and consolidation settlement, Allowable settlement, Foundation design based on settlement criteria

UNIT-V

DEEP FOUNDATIONS: Pile Foundations, Necessity and classification of piles, Construction methods, Load carrying capacity (static, dynamic, in-situ methods), Pile load tests, Pile group efficiency and settlement, Negative skin friction, Under-reamed piles.

WELL FOUNDATIONS: Well Foundations, Components and forces acting on wells, Types and shapes, Analysis and design, Sinking methods, Rectification of tilts and shifts.

Text Books:

1. Gopal Ranjan & A.S.R. Rao, Basic and Applied Soil Mechanics, New Age International Publishers, 2018.
2. K.R. Arora, Soil Mechanics and Foundation Engineering, Standard Publishers Distributors, 2011.

Reference Books:

1. V.N.S. Murthy, Advanced Foundation Engineering, CBS Publishers & Distributors Pvt. Ltd., New Delhi.
2. Joseph E. Bowles, Foundation Analysis and Design, McGraw-Hill Book Company (also published in later editions by McGraw-Hill, New York).
3. Relevant Indian Standard Codes

Web Resources:

- https://nptel.ac.in/courses/105107120
- https://nptel.ac.in/courses/105101083

24CE302 TRANSPORTATION ENGINEERING			
Course Category:	Professional Core	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Pre-requisites:	NIL	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	40 60 100

Course Description:

This course provides a comprehensive understanding of transportation engineering principles with emphasis on highway planning, geometric design, traffic engineering, and pavement design. Students will learn to analyze traffic behavior, design highway elements based on IRC standards, and develop pavement systems considering load and environmental conditions. The course integrates theoretical concepts with practical design methodologies relevant to modern transportation infrastructure.

Course Objectives:

- To understand highway planning and alignment principles.
- To apply geometric design standards for safe and efficient highways.
- To analyze traffic characteristics and design control systems.
- To design flexible & Rigid Pavement using IRC guidelines.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Understand transportation systems, highway classification, and principles of highway planning and alignment.	2
CO2	Apply geometric design principles to determine sight distances and design highway cross-sectional elements.	3
CO3	Design horizontal and vertical alignment elements such as super elevation, transition curves, gradients, and vertical curves.	4
CO4	Analyze traffic characteristics using traffic studies and evaluate traffic control devices including signal design.	3
CO5	Design flexible and rigid pavements using IRC codal provisions considering loading and environmental factors.	4

Course articulation matrix

	POs											PSOs	
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	2									2	
CO2	3	3	3	2	1							3	
CO3	3	3	3	3	2							3	
CO4	3	3	3	3	2				2			3	
CO5	3	3	3	3	2	2	1		3	3		3	

(1-Low, 2 -Medium, 3–High)

Course Content

UNIT-I

TRANSPORTATION SYSTEMS

Introduction to Transportation Systems, Modes of Transportation, Characteristics and Comparison Role in Economic Development.

HIGHWAY PLANNING

Highway Planning & Alignment, Road Classification & Road Patterns, 20-Year Road Development Plans, Highway Alignment, Requirements, Factors Controlling, Engineering Surveys.

UNIT-II

HIGHWAY CROSS SECTION ELEMENTS

Camber, Width of carriage way, Shoulders ,Right of Way, Kerb, Side Slopes in Embankment and cutting sections on 2 lane undivided roadway.

SIGHT DISTANCE

Introduction to Sight Distance(SD), Stopping Sight Distance (SSD),Overtaking Sight Distance (OSD) Intermediate Sight Distance (ISD).

UNIT-III

HORIZONTAL ALIGNMENT

Introduction to Horizontal Alignment, Super Elevation –Derivation, Types of Transition curves, Ideal Transition Curve, Principle of Setting out Transition curve, Extra Widening of Pavement, Mechanical Widening, and Physiological Widening.

VERTICAL ALIGNMENT

Introduction to Vertical Alignment, Gradients, Grade Compensation, Types of Vertical Curves.

UNIT-IV

TRAFFIC STUDIES & CHARACTERISTICS

Traffic Studies, Road User & Vehicle Characteristics, Traffic Volume Studies,Speed & Delay Studies ,Traffic Flow Characteristics ,Capacity & Level of Service.

TRAFFIC CONTROL SYSTEM MANAGEMENT

Traffic Control Devices, Traffic Signs, Traffic Signals, Signal Systems, IRC method of signal design.

UNIT-V

FLEXIBLE PAVEMENT DESIGN

Introduction to Flexible Pavement Design, component Layers, Types of Pavements, Design Factors,IRC:37 Method.

RIGID PAVEMENT DESIGN

Introduction to Rigid Pavement Design, component structure Wheel Load Stress, Temperature Stress, Frictional Stress, IRC:58 Method.

Text Books:

1. S.K. Khanna, C.E.G. Justo & A. Veeraragavan, Highway Engineering, Nemchand Publishers,2017 , 10^{th} edition.
2. L.R. Kadiyal, Principles and Practice of Highway Engineering, Khanna Publications, 2013, 8^{th} edition.

Reference Books:

1.C.J. Khisty & B.K. Lall, Transportation Engineering: An Introduction, PHI, 3rd Edition, 2003

2.Yang H. Huang Pavement Analysis and Design, Pearson, 2nd Edition, 2004

Web Resources:

1.https://swayam.gov.in

2.https://nptel.ac.in

3. https://morth.nic.in

4.https://www.irc.nic.in

24CE303 DESIGN OF CONCRETE STRUCTURES			
Course Category:	Professional Core	**Credits:**	4
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3–1–0
Pre-requisites:	24CE210 – Concrete Technology	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	40 60 100

Course Description:

This course introduces the principles and practices of reinforced concrete design using the Limit State Method as per relevant Indian Standards. It covers the behavior and properties of concrete and steel, loading standards, and design concepts such as characteristic strength, partial safety factors, and serviceability requirements. The course focuses on the design and analysis of structural elements including beams, slabs (one-way and two-way), staircases, columns, and foundations such as isolated footings and pile caps. Emphasis is given to understanding load transfer mechanisms, structural behavior, and proper reinforcement detailing to ensure safety and durability. By the end of the course, students will be able to apply codal provisions to design safe and efficient reinforced concrete structural components for practical engineering applications.

Course Objectives:

- To understand basic concepts of reinforced concrete, loads, material behaviour, and to learn how to design beams.
- To develop the ability to analyze and design flanged beams (T and L beams) and one-way slabs using codal provisions and appropriate design procedures.
- To enable students to understand the behavior and design of two-way slabs under different boundary conditions and to design staircase elements such as dog-legged staircases.
- To provide knowledge on the behaviour of short and long columns and to enable the design of columns subjected to axial load and combined axial load with uniaxial bending using codal guidelines.
- To introduce the concepts of shallow and deep foundations and to develop skills in designing isolated footings and pile caps based on load transfer mechanisms and soil conditions.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Explain the fundamental concepts of reinforced concrete design including loading standards, material properties, stress–strain behavior, and principles of the Limit State Method as per IS 456:2000 and IS 875.	2
CO2	Apply Limit State Method principles to design reinforced concrete beams (singly and doubly reinforced), flanged beams, and one-way slabs for flexure, shear, and serviceability requirements.	3
CO3	Design two-way slabs and staircases by applying codal provisions, moment coefficients, and detailing requirements for safe structural performance.	3
CO4	Analyze and design reinforced concrete columns subjected to axial load and combined axial load with uniaxial bending using interaction principles and codal guidelines.	4
CO5	Design isolated footings and pile caps by applying load transfer mechanisms, soil bearing capacity concepts, and reinforcement detailing principles.	3

Course articulation matrix

COs	POs											PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2									1	1	2
CO2	3	3	3	2		1					1	3	3
CO3	3	2	3	1		1					1	3	3
CO4	3	3	3	2		1					1	3	3
CO5	3	3	3	2		2					1	3	3

(1-Low, 2 -Medium, 3–High)

Course Content

UNIT I:

GENERAL:

Loading standards as per IS 875, Grades and properties of steel and concrete as per IS 456:2000 , Stress- Strain characteristics of concrete and steel, Introduction to working stress method and Limit State Method (L.S.D.) of design. Characteristic load and strengths, Design values, Partial safety factors, Factored loads and load combinations, all designs in Limit State Method.

DESIGN OF BEAMS

Design of singly reinforced and Doubly reinforced rectangular sections. Design of R. C. beams for Flexural and Shear, Check for development length, deflection and cracking.

UNIT II:

DESIGN OF FLANGED BEAM

Introduction to flanged beams (L and T-Beams), Analysis and Design of singly reinforced flanged sections.

DESIGN OF ONE WAY SLABS

Classification of slabs, Design of one-way slabs (simply supported and continuous), Detailing as per code provisions.

UNIT-III

DESIGN OF TWO WAY SLABS

Behavior and load transfer mechanism, design of two-way slabs with corners not held down and corners held down - use of moment coefficients.

DESIGN OF STAIRCASE

Types of staircases, design of doglegged staircase and reinforcement detailing.

UNIT-IV

DESIGN OF COLUMNS FOR AXIAL COMPRESSION

Introduction to short and long columns, effective length of a column, Code requirements on slenderness limits, minimum eccentricity and reinforcement. Design of short columns under axial compression with lateral ties and helical reinforcement.

DESIGN OF UNIAXIAL MOMENT COLUMNS

Introduction to interaction diagrams, Design of short columns subjected to combined axial load and uniaxial Moment - Use of interaction diagrams.

UNIT-V

DESIGN OF ISOLATED FOOTINGS

Types of shallow and deep foundations. General aspects of footings. Design and detailing of Isolated Column footings (square/rectangular – pad &sloped) - Reinforcement detailing.

PILE FOUNDATIONS AND PILE CAPS

Introduction to pile foundations, Load transfer mechanism, Design of two and three pile caps.

Text Books:

1.Shah H.J., "Reinforced Concrete Vol-1", 11th ed., Charotar Publication House, Gujarat, 2016.

2.Jain AK, "Reinforced Concrete (Limit State Design)", 7th ed. Nern Chand & Bros., Roorkee Uttarakhand, 2012.

Reference Books:

1. Varghese P.C, "Limit state designed of reinforced concrete", 2nd et. Printice Hall of lndia; New Delhi, 2004.
2. Arther H. Nilson, "Design of concrete structures", 1st ed., Tata McGraw-Hill Publishing Co. Ltd, New Delhi, 2017.
3. IS 456-2000 Plain and reinforced concrete code of practice

Web Resources:

www.nptel.ac.in/courses/105105105 (Dr.Dhang. N, IIT/ Kharagpur - Design of Reinforced Concrete Structures)
www.nptel.ac.in/courses/105105104 (Dr. J.N. Bandopadhyay, IIT/ Kharagpur - Design of Reinforced Concrete Structures)

24CE310/A DISASTER PREPAREDNESS & PLANNING			
Course Category:	Professional Elective- I	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Pre-requisites:	---	**Continuous Assessment:** **Semester end Evaluation:** **Total Marks:**	40 60 100

Course Description:

This course provides a comprehensive understanding of disasters, their classification, impacts, and management strategies with a focus on Disaster Risk Reduction (DRR). It emphasizes environmental sustainability, institutional frameworks, and disaster-resilient development approaches relevant to civil engineering practices.

Course Objectives:

- To introduce the basic concepts, classifications, and impacts of disasters and hazards.
- To understand disaster risk reduction strategies, disaster management cycle, and emergency response procedures.
- To study disaster policies, institutional frameworks, and stakeholder roles in disaster management.
- To analyze the influence of environmental changes and developmental activities on disaster vulnerability.
- To promote sustainable recovery, reconstruction, and disaster-resilient development practices.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Explain disaster concepts, classifications, and hazard profiles of India.	2
CO2	Discuss environmental, social, economic, health, and demographic impacts of disasters.	2
CO3	Apply disaster risk reduction measures, disaster management cycle concepts, SOPs, and risk assessment methods.	3
CO4	Explain stakeholder roles, institutional mechanisms, disaster management policies, and legislation in India.	2
CO5	Apply sustainable recovery and disaster-resilient development practices for vulnerability reduction.	3

Course articulation matrix

	POs											PSOs	
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	1					1						1	
CO2	1											1	
CO3	2		1		1	1		1				1	
CO4	1	1	1					1					1
CO5	2	1	1	1	1	1		1		1	1		1

(1-Low, 2 -Medium, 3–High)

Course Content

UNIT-I

BASIC CONCEPTS AND TERMINOLOGY OF DISASTERS

Concepts and definitions: disaster, hazard, vulnerability, resilience, risk, severity, frequency, capacity, impact, prevention, and mitigation.

DISASTER CLASSIFICATION AND HAZARD PROFILE OF INDIA

Classification of disasters: natural disasters (floods, droughts, cyclones, earthquakes, tsunami, landslides, coastal erosion, soil erosion, forest fires) and man-made disasters (industrial pollution, urban flooding, nuclear hazards, chemical spills, transportation accidents, terrorism).Hazard and vulnerability profile of India; ecological fragility in mountain and coastal regions.

UNIT-II:

MULTIDIMENSIONAL IMPACTS OF DISASTERS

Environmental, physical, social, ecological, economic, and political impacts of disasters.

HEALTH, DEMOGRAPHIC ASPECTS AND DISASTER TRENDS

Health impacts, psycho-social issues, demographic aspects (gender, age, special needs), hazard zonation, Global and national disaster trends; climate change and urban disasters.

UNIT-III

DISASTER RISK REDUCTION, MANAGEMENT CYCLE AND SOPs

Disaster Risk Reduction (DRR) concepts; Disaster management cycle: prevention, mitigation, preparedness, response, and recovery; Standard Operating Procedures (SOPs) for disaster preparedness, evacuation, emergency response, communication and coordination during disasters.

RISK ASSESSMENT AND POST-DISASTER MANAGEMENT SYSTEMS

Risk analysis, vulnerability assessment, and capacity assessment. Early warning systems and post-disaster environmental management (water, sanitation, food safety, waste management, disease control, communication, and security).

UNIT-IV

STAKEHOLDERS AND THEIR ROLES IN DISASTER MANAGEMENT

Roles and responsibilities of government, community, local institutions, and NGOs.

POLICIES, LEGISLATION AND INSTITUTIONAL MECHANISMS

National policies and legislation for disaster management in India; Disaster Management Act, National Policy on Disaster Management (NPDM), Disaster Risk Reduction programmes, institutional mechanisms and role of National Disaster Management Authority (NDMA).

UNIT-V

ENVIRONMENTAL CHANGES AND DISASTER VULNERABILITY

Impact of developmental activities and environmental modifications (dams, land-use changes, urbanization) on vulnerability.

SUSTAINABLE RECOVERY AND RESILIENT DEVELOPMENT PRACTICES

Sustainable and environmentally friendly recovery approaches, Reconstruction and disaster-resilient development methods.

Text Books:

1. **Coppola, D. P. (2020).** Introduction to International Disaster Management (3rd ed.). Elsevier.

2. **Carter, W. N. (2018).** Disaster Management: A Disaster Manager's Handbook. Asian Development Bank.
3. **Kelman, I. (2022).** Disaster by Choice: How Our Actions Turn Natural Hazards into Catastrophes (2nd ed.). Oxford University Press.

Reference Books:

1. Wisner, B., Gaillard, J. C., & Kelman, I. (2021). Handbook of Hazards and Disaster Risk Reduction. Routledge.
2. Alexander, D. (2019). Natural Disasters (2nd ed.). Springer.
3. UNDRR (2023). Global Assessment Report on Disaster Risk Reduction (GAR 2023). United Nations Office for Disaster Risk Reduction.
4. Smith, K., & Petley, D. N. (2022). Environmental Hazards: Assessing Risk and Reducing Disaster (7th ed.). Routledge.
5. Shaw, R., Mallick, F., & Islam, A. (2013). Disaster Risk Reduction Approaches in Bangladesh. Springer.
6. Guha-Sapir, D., Hoyois, P., & Below, R. (2020). Annual Disaster Statistical Review. CRED.
7. Pelling, M. (2011). Adaptation to Climate Change: From Resilience to Transformation. Routledge.
8. Government of India (2019). National Disaster Management Plan (NDMP). National Disaster Management Authority.

Web Resources:

1. NDMA: https://ndma.gov.in
2. UNDRR: https://www.undrr.org
3. IMD: https://mausam.imd.gov.in

24CE310/B ENVIRONMENTAL POLLUTION AND CONTROL

Course Category:	Professional Elective -1	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Pre-requisites:	----	**Continuous Assessment:** **Semester end Evaluation:** **Total Marks:**	40 60 100

Course Description:

This course introduces the fundamentals of environmental pollution, including air, noise, water, solid waste, and hazardous waste pollution. It covers sources, characteristics, effects, and control measures of pollutants along with treatment and waste management practices. The course also discusses Environmental Impact Assessment (EIA) and Sustainable Development Goals (SDGs) in Civil Engineering applications.

Course Objectives:

- To explain the sources, characteristics, effects, and control measures of air pollution and air pollution control equipment.
- To describe the sources, effects, assessment methods and control measures of noise pollution in different environments.
- To provide knowledge on water pollution, wastewater treatment methods and Environmental Impact Assessment (EIA) in civil engineering projects.
- To discuss the types, impacts, and management practices of solid waste including collection, treatment, recycling and disposal methods.
- To summarize hazardous waste characteristics, management techniques, regulatory aspects, and Sustainable Development Goals (SDGs) related to environmental engineering.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Describe the sources, characteristics, effects, and control measures of air pollutants and different air pollution control technologies.	3
CO2	Discuss the sources, impacts, measurement methods, and control techniques of noise pollution in different environments.	3
CO3	Illustrate the characteristics and impacts of water pollutants, wastewater treatment processes, and Environmental Impact Assessment (EIA) concepts in civil engineering projects.	3
CO4	Identify different types of solid wastes and describe suitable solid waste management practices including collection, treatment, recycling, and disposal methods.	3
CO5	Summarize the characteristics, environmental impacts, and management techniques of hazardous wastes and the role of SDGs in environmental protection and civil engineering applications.	3

Course articulation matrix

COs	POs											PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	2	1		2	2				2	2	
CO2	2	2	2	1		2	2				2	2	
CO3	2	2	2	1		2	2				2	2	
CO4	2	2	2	1		2	2				2	2	
CO5	2	2	2	1		2	2				2	2	

(1-Low, 2 -Medium, 3–High)

Course Content

Unit I

Air Pollution

Sources, characteristics and effects, definition and classification of air pollutants, natural and anthropogenic sources, physical and chemical characteristics of pollutants, effects on human health, vegetation, materials, climate, and ambient air quality standards.

Air Pollution Control Measures

Control strategies for particulate and gaseous pollutants, including cyclones, bag filters, electrostatic precipitators, scrubbers, adsorption, absorption, and control of SO_2, NOx, CO, and hydrocarbons.

Unit II

Noise Pollution

Sources of noise pollution such as industrial operations, transportation systems, construction activities, and community noise; fundamentals of sound, measurement of noise levels, noise indices, and effects on human health and environment.

Noise Pollution Control Measures

Methods of noise control at source, transmission path, and receiver level; silencers, acoustic enclosures, sound insulation, sound barriers, green belts, building acoustics, and environmental noise standards.

Unit III

Water Pollution

Sources of water pollution, classification of pollutants, physical, chemical, and biological characteristics of wastewater, oxygen-demanding wastes, nutrients, toxic substances, and impacts on aquatic life and public health.

Wastewater Treatment and Control Measures

Wastewater sampling and analysis, primary, secondary, and tertiary treatment processes, biological treatment methods, sludge treatment, disposal practices, and resource recovery. Introduction to Environmental Impact Assessment **(EIA)** - Screening, Scoping, Impact prediction, Mitigation measures, Environmental management plan, and monitoring in various Civil Engineering projects.

Unit IV:

Solid Waste Pollution

Sources and Effects, Types and sources of municipal, industrial, biomedical, and agricultural solid wastes, composition and characteristics, and environmental and health impacts.

Solid Waste Management and Control

Waste collection, segregation, storage, transportation, recycling, composting, incineration, sanitary landfilling, and resource recovery techniques**.**

Unit V:

Hazardous Waste Pollution

Nature and Environmental Impacts, Definition, classification, characteristics such as ignitability, corrosivity, reactivity, and toxicity; sources of hazardous wastes and their risks to environment and human health.

Hazardous Waste Management and Control Measures

Waste minimization, treatment technologies, stabilization, and incineration, secure landfilling, monitoring, and regulatory compliance frameworks. UN Sustainable Development Goals (**SDGs**) – Introduction, necessity and applications in Civil Engineering.

Text Books:

1. Environmental Pollution Control Engineering, by C. S. Rao – New Age International (P) Limited Publishers, New Delhi, 2006.
2. Environmental Pollution and Control in Chemical Process Industries, by S. C. Bhatia – Khanna Publishers, New Delhi, 2003.

Reference Books:

1. Environmental Engineering, by Ruth F. Weiner and Robin Matthews – 4th Edition Elesevier.
2. Environmental Science and Engineering by J.G. Henry and G.W. Heinke – Pearson Education.
3. Environmental Engineering by Mackenzie.

Web Resources:

1. http://digimat.in/nptel/courses/video/123105001/123105001.html.
2. https://onlinecourses.nptel.ac.in/noc22_ch45/preview.

24CE310/C SUSTAINABLE BUILDING TECHNOLOGIES AND ENERGY MANAGEMENT

Course Category:	**Professional Elective - I**	**Credits:**	3
Course Type:	**Theory**	**Lecture-Tutorial-Practice:**	3-0-0
Pre-requisites:	Building Materials & Construction Technology	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	40 60 100

Course Description:

This course introduces students to the technology, design principles, and management of Intelligent/Smart Building Systems. It covers automation, communication, security, materials science, indoor air quality, occupational safety, financial assessment of building systems, and energy management.
Students will understand how modern building systems integrate mechanical, electrical, and electronic subsystems with the building envelope to achieve sustainability, comfort, safety, and energy efficiency.

Course Objectives:

- Understand the fundamental concepts of building automation, communication, and security systems.
- Analyze materials used in built environments from physical, chemical, and performance perspectives.
- Evaluate indoor air quality issues, ventilation strategies, and thermal comfort in intelligent buildings.
- Perform financial analysis and life-cycle cost assessment of intelligent building technologies.
- Apply energy management principles and audit techniques for sustainable buildings.

Course Outcomes:
At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Explain the principles of building automation, communication, and security subsystems and describe their integration with the building envelope.	2
CO2	Identify the physical, chemical and thermal properties of construction materials and their impact on indoor environmental performance.	2
CO3	Analyze indoor air quality parameters, ventilation strategies and occupational safety requirements in intelligent buildings.	3
CO4	Evaluate the financial feasibility and life-cycle cost of intelligent building systems using modern analytical tools.	4
CO5	Apply energy management techniques and audit procedures to achieve sustainability in domestic and non-domestic buildings.	3

Course articulation matrix

	POs											PSOs	
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	1			1	2					3	2
CO2	2	3	2	1		2	1					2	2
CO3	2	2	3	2		2	2	1				2	3

CO4	1	2	2	3	2	1		2	1			2	2
CO5	2	2	2	2	3	3	2	1		1		3	3

(1-Low, 2 -Medium, 3–High)

Course Content

UNIT-I

INTRODUCTION TO SUSTAINABLE BUILDING SYSTEMS

Concept of sustainable buildings and green infrastructure; Evolution from intelligent buildings to sustainable building technologies; Principles of energy-efficient building design; Sustainability indicators and green building concepts.

UNIT-II

MATERIALS IN BUILT ENVIRONMENT

Materials issues in indoor environment – structural and environmental performance; Organic sources of pollution from building materials; Physical, chemical and thermal properties of construction materials – U-values and R-values; VOCs, off-gassing and material toxicity; Case studies on thermal and environmental performance.

UNIT-III

INDOOR AIR QUALITY & OCCUPATIONAL SAFETY

Air contaminants and transport phenomena; Sick Building Syndrome (SBS) and Building Related Diseases (BRD); Thermal comfort – ASHRAE 55, PMV and PPD; Natural, mechanical and mixed-mode ventilation systems; IAQ assessment and mitigation; Fire and life safety, exhaust ventilation and hazardous material management.

UNIT-IV

FINANCIAL ASSESSMENT OF BUILDING SYSTEMS

Life Cycle Cost Analysis (LCCA); Simple Payback Period (SPP) and Return on Investment (ROI); Net Present Value (NPV) and Benefit-Cost Ratio (BCR); Financial viability of intelligent building technologies; Investment decision-making for sustainable buildings.

UNIT-V

ENERGY MANAGEMENT IN BUILDINGS

Renewable and non-renewable energy resources; Solar PV, solar thermal and wind energy conversion; Energy economics – tariffs, load factor and power factor; Standards – ECBC, LEED and ASHRAE 90.1; Energy auditing – preliminary and detailed audit procedures.

Text Books:

1. Anil Ahnja M/E — Integrated Design Building Systems Engineering, Chapman & Hall, New York, NY, 2010
2. Albert Ting-pat So — Intelligent Building System, Boston: Kluwer Academic, 1999
3. Carlson, Reinhold A — Understanding Building Automation Systems, Kingston, MA: R.S. Means Co., 1991
4. O. Gassmann, H. Meixer — Sensors in Intelligent Building, Weinheim, Singapore: Wiley-VCH, 2001

Reference Books:

1. ASHRAE Standard 55 — Thermal Environmental Conditions for Human Occupancy
2. ASHRAE Standard 90.1 — Energy Standard for Buildings
3. Energy Conservation Building Code (ECBC) — Bureau of Energy Efficiency (BEE), India
4. LEED Reference Guide for Building Design and Construction — US Green Building Council

Web Resources:

1. HKUST Intelligent Building Technology & Management:

2. http://www.sengpp.ust.hk/programs/ibtm/en/curriculum.html#IBTM5050
3. GRIHA Rating System Documentation — www.grihaindia.org

24CE310/D MODERN SURVEYING			
Course Category:	Professional Elective- I	**Credits:**	
Course Type:	Theory	**Lecture-Tutorial-Practice:**	0
Pre-requisites:	Basic Surveying	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	40 60 100

Course Description:

This course introduces advanced surveying techniques used in modern civil engineering practices. It covers principles and applications of EDM, Total Station, Photogrammetry, Remote Sensing, GNSS, GPS, and Geodesy.

Course Objectives:

- Understand advanced surveying instruments and applications
- Learn principles of EDM and Total Station
- Introduce photogrammetry and mapping
- Understand remote sensing techniques
- Gain knowledge of GNSS, GPS and geodetic systems

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Apply advanced surveying techniques in civil engineering projects	3
CO2	Select appropriate modern surveying instruments	3
CO3	Demonstrate photogrammetric data interpretation	3
CO4	Explain remote sensing concepts	2
CO5	Apply GPS and geodetic principles	3

Course articulation matrix

	POs											PSOs	
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	2	2	2	1	2							2	2
CO2	2	2	1	1	2							2	2
CO3	2	2	2	2	2							2	2
CO4	2	1			1							1	1
CO5	2	2	2	2	2							2	2

(1-Low, 2 -Medium, 3–High)

Course Content

UNIT-I

EDM PRINCIPLES AND INSTRUMENTS

Introduction to Electronic Distance Measurement (EDM), Electromagnetic Waves and Measurement Principles, Methods of EDM, Types of EDM Instruments, EDM Instruments and Their Features, Applications of EDM

TOTAL STATION AND DIGITAL LEVELING

Introduction to Total Station, Components of Total Station, Principles and Working of Total Station, Total Station Surveying Operations, Data Collection and Processing, Introduction to Digital Levels, Working Principle of Digital Levels, Digital Levelling Procedures, Applications of Total Station and Digital Leveling.

UNIT-II

FUNDAMENTALS OF PHOTOGRAMMETRY

Introduction to Photogrammetry, Types of Photogrammetry, Fundamentals of Terrestrial and Aerial Photogrammetry, Photogrammetric Mapping, Errors in Photogrammetry, Applications.

PHOTOGRAMMETRIC ELEMENTS

Introduction, Basic Elements of Photogrammetry, Photographic Geometry, Orientation Elements, Photographic Overlaps, Relief and Tilt, Applications.

UNIT-III

REMOTE SENSING CONCEPTS AND SYSTEMS

Introduction to Remote Sensing, Electromagnetic Radiation (EMR), Remote Sensing Platforms, Sensors and Sensor Systems, Resolution Concepts, Satellite Remote Sensing Systems, Applications of Remote Sensing.

REMOTE SENSING APPLICATIONS

LiDAR Technology and Applications, LiDAR Data Products, Applications of LiDAR, Introduction to RADAR, Characteristics of RADAR, Applications of RADAR, Introduction to SONAR, SONAR Surveying Techniques, Applications of SONAR, Integration and Modern Applications..

UNIT-IV

GNSS FUNDAMENTALS

Introduction to Satellite Navigation, History and Evolution of GNSS, Basic Principles of Satellite Positioning, Segments of GNSS, Space Segment, Control Segment, User Segment, Applications of GNSS in Civil Engineering.

DGPS SURVEYING METHODS AND MAPPING

GPS working principles, signals, and receiver types; DGPS concepts and error correction, Static, Kinematic, RTK, and PPK methods; data processing and topographic mapping.

UNIT-V

FUNDAMENTALS OF DRONE SURVEYING AND FLIGHT PLANNING

Introduction to Drone Surveying, Components of UAV System and types, Fundamentals of Aerial Mapping, flight planning, and sensors, Drone Survey Operations, Applications.

DRONE DATA ACQUISITION AND IMAGE PROCESSING

Introduction to Drone Data Acquisition, Drone Sensors and Payloads, Image Acquisition Techniques(orthophotos, DEM/DSM), Photogrammetric Principles, Aerial data collection, Drone Image Processing, Accuracy Assessment and Quality Control, Applications.

Text Books:

1. Satheesh Gopi and Rasheed S., Pearson Education India, New Delhi, 1st Edition, 2007
2. S. K. Duggal, McGraw Hill Education India, New Delhi, 4th Edition, 2013
3. B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, Laxmi Publications, New Delhi, Revised Editions (Vol. I, II & III), 2016–2020.

Reference Books:

1. K. R. Arora, Standard Book House, New Delhi, (Vol. I, II & III).

Web Resources:

- https://www.isro.gov.in/index.html
- https://nptel.ac.in/courses/105104100
- https://surveyofindia.gov.in

24CE360 /A GEOSPATIAL TECHNOLOGIES			
Course Category:	Inter disciplinary Elective – 1	**Credits:**	3-0-0
Course Type:	Theory	**Lecture-Tutorial-Practice:**	Lecture
Pre-requisites:	NIL	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	40 60 100

Course Description:

This course introduces Geographic Information Systems (GIS), focusing on fundamental concepts, spatial data handling, and real-world applications. It covers the evolution of GIS, map concepts, coordinate systems, projections, and Georeferencing techniques. The course also emphasizes spatial database management, data models (vector and raster), and data structures used in GIS.

Students will gain practical knowledge in spatial data acquisition, editing, and integration of spatial and attribute data. Advanced topics such as Web GIS, Mobile GIS, 3D/4D GIS, and terrain modeling techniques including Digital Elevation Models (DEM), Digital Terrain Models (DTM), Digital Surface Models (DSM), and Triangular Irregular Networks (TIN) are also introduced. The course highlights multidisciplinary applications of GIS in areas such as urban planning, waste management, land use/land cover analysis, watershed management, and groundwater studies, enabling students to solve real-world engineering problems.

Course Objectives:

- To provide fundamental knowledge of GIS concepts, history, components, and map interpretation including map scales and types.
- Develop understanding of coordinate systems, map projections, Georeferencing techniques, and spatial transformations and introduce spatial database management systems.
- Familiarize students with GIS data models, including vector and raster structures, geodatabases, and metadata concepts.
- Enable students to apply GIS tools and techniques to solve real-world problems in civil engineering and multidisciplinary domains.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Apply recent advances in GIS technology in various engineering fields.	3
CO2	Understand the spatial Data base management	2
CO3	Analyse vector maps through digitization	3
CO4	understand latest emerging technologies in GIS	2
CO5	Assess opportunities and methods for integrating GIS in engineering applications.	3

Course articulation matrix

	POs											PSOs	
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3				1						2		
CO2	3										2		
CO3	3		3		1						2		
CO4	3										2		3
CO5	3				1	2					2		

(1-Low, 2 -Medium, 3–High)

Course Content

UNIT-I

INTRODUCTION TO GIS

Introduction to GIS, History of GIS, Early developments in GIS, Applications of GIS.

MAP AND MAP SCALES

Introduction to Maps, History of Maps, Map Scales, Types of Maps, Map and Globe.

UNIT-II

GEOREFERENCING AND PROJECTION

Understanding Earth, Coordinate System, Map Projection, Transformation, Geo referencing.

SPATIAL DATABASE MANAGEMENT SYSTEMS

Introduction, Data Storage, Database Structure Models, Database Management system, Entity Relationship.

UNIT-III

DATA MODELS AND DATA STRUCTURES

Introduction, GIS Data Model, Vector Data Structure, Raster Data structure, Geo database and metadata.

SPATIAL DATA INPUT AND EDITING

Primary Data, Secondary Data, Data Editing, Data types – Spatial and Non Spatial (attribute) data.

UNIT-IV

MODERN TECHNOLOGIES

Introduction to Web GIS, 4D GIS, MOBILE GIS,3D GIS, VIRTUAL GIS.

MODELLING IN GIS

Digital Terrain Modelling, Digital Elevation Modelling, DSM, Triangular Irregular Network.

UNIT-V

PLATFORMS & VISUALIZATION TOOLS IN GIS

GIS in Navigation, Google Earth Engine, Google Earth Pro, USGS Explorer.

APPLICATIONS OF GIS

Urban waste management applications, land use land cover applications, water shed management applications, Ground water management applications, Road Network and Utility management.

Text Books:

1. Anji Reddy M., Remote Sensing & Geographical Information Systems by, BPS Publications-Hyderabad,4th edition 2011.
2. Basudeb Bhatta., Remote Sensing & GIS, Oxford University Press, New Delhi 2011.

Reference Books:

1. Lillesand TM ., Kiefer RW., Remote sensing and Image interpretation ; John Willey and sons.7th edition, 2015.
2. Chandra AM ., Ghosh SK Remote sensing and Geographical information System ;Narosa Publishing House, Second Edition New Delhi,2015.

Web Resources: nptel.ac.in/courses/107105088

24CE360 /B BUILDING SERVICES ENGINEERING			
Course Category:	Inter disciplinary Elective – 1	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Pre-requisites:		**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	40 60 100

Course Description:

This course provides a comprehensive understanding of the principles and practices involved in building planning, design, and services. It introduces students to different types of building structures, functional requirements of residential and public buildings, and the fundamental concepts of space planning and building components. The course also covers essential building services such as ventilation, air-conditioning, plumbing, electrical installations, and thermal insulation.

Further, it emphasizes safety aspects including fire protection systems and anti-termite treatments, ensuring durability and sustainability of structures. The course equips students with the necessary knowledge to plan safe, comfortable, and efficient buildings by integrating structural, environmental, and service considerations.

Course Objectives:

- To understand the principles of building planning, building components, ventilation, air conditioning, plumbing, electrical installations, acoustics, fire safety, thermal insulation, and anti-termite treatment in buildings.
- To develop the ability to analyze functional requirements and design considerations of residential, public, institutional, and commercial buildings with emphasis on safety, comfort, economy, and sustainability.
- To familiarize students with modern building planning practices including Building Information Modelling (BIM), building services coordination, and fire and safety management systems.
- To apply engineering knowledge in planning building services such as ventilation, air conditioning, plumbing, electrical systems, thermal insulation, acoustics, and fire protection measures for efficient building performance.
- To understand construction practices and preventive measures related to building durability, environmental comfort, and safety for occupants including elderly and physically challenged persons.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Explain building types, planning principles, building components, regulations, and BIM applications.	2
CO2	Illustrate ventilation, air conditioning, acoustics, and thermal insulation systems in buildings.	2
CO3	Apply plumbing systems, sanitary fittings, drainage, and thermal insulation methods in buildings.	3
CO4	Apply electrical installations, lighting, Earthing, lightning protection, and sound	3

	insulation in buildings.	
CO5	Apply fire safety measures, fire fighting systems, evacuation procedures, and anti-termite treatments in buildings.	3

Course articulation matrix

	POs											PSOs	
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	3			2						3	3
CO2	2	2	3			3						3	2
CO3	2	2	3			2						3	3
CO4	2	2	3			2						2	3
CO5	2	3	2			3	2					3	2

(1-Low, 2 -Medium, 3–High)

Course Content

UNIT I:

BASICS OF BUILDINGS:

Types of structures: Load bearing walled structures & Framed structures, Different types of buildings: Residential, Public, Assembly, Hospitals, Institutional etc; Building height regulations; Floor space index.

BASIC BUILDING PLANNING, ELEMENTS AND BIM:

Factors affecting the Selection of Site for residential building; Space requirement – Establishing areas for different units - Grouping, Circulation, Orientation, Aspect and prospect, Privacy, Elegance and economy; Basic building elements: Doors and windows - Guidelines for selecting doors and windows; Staircase - Guidelines for staircase planning; Introduction to Building Information Modelling (BIM), advantages of BIM in planning and design, BIM applications in architectural, structural and MEP coordination, clash detection and project visualization.

UNIT-II:

VENTILATION:

Necessity of Ventilation, Functional Requirements; Types of ventilation: Natural Ventilation, Artificial Ventilation.

AIR CONDITIONING:

Air Conditioning – Definition, Purposes; Essentials of Comfort Air Conditioning; Systems of Air Conditioning; Essentials of Air Conditioning systems.

UNIT-III:

PLUMBING SERVICES:

Types of plumbing; Plumbing fittings and accessories; Water Meters; Drainage – Sanitary Fittings: Bathtubs, washbasins, sinks, flushing cisterns, water closets; Principles governing design of building drainage.

THERMAL INSULATION:

Heat transfer: Thermal Insulating Materials; Thermal Insulation Methods; Insulation of Walls, Roofs, Doors & Windows.

UNIT-IV

ELECTRICAL INSTALLATION IN BUILDINGS:

Electrical Considerations for Office Buildings, School Buildings & Residential Buildings; Lighting, Fannage, Earthing; Lightening arrestors.

ACOUSTICS AND SOUND INSULATION:
Introduction, Behaviour Of Sound In Enclosures, Requirements of a good acoustic material; Sound Insulation: Introduction, Effects of Noise, Sound Insulating Materials, Wall Insulation;

UNIT-V

FIRE SAFETY:
Causes of fire in buildings; Planning considerations for fire resistance: Non-combustible materials in construction, fire escapes, Special features required for physically handicapped and elderly people; Heat and smoke detectors, Fire alarm system, snorkel ladder, Firefighting pump; Dry risers and wet risers, Automatic sprinklers; Firefighting practice (Mock drill) including emergency evacuation procedures, handling of fire extinguishers, safety precautions and coordination during fire emergencies.

ANTI-TERMITE TREATMENT:
Introduction- Definition and Need for Anti-Termite Treatment, Causes and Effects of Termite Attack in Buildings, Materials Used for Anti-Termite Treatment, Preconstruction treatment, Post construction treatment, Construction of anti-termite groove in buildings for termite prevention.

TEXT BOOKS:

1. Building Construction by B. C. Punmia; Ashok Kumar Jain; Arun Kumar Jain, 2005; Laxmi Publications, New Delhi
2. Building Construction by Janardhan Jha; S.K. Sinha; 2007; Jain Book Agency, New Delhi.

REFERENCE BOOKS:

1. National Building Code, 2015
2. Building Construction by P. C. Varghese, 2005, PHI Publications, New Delhi
3. Building Services Engineering by David V.Chatterton, sixth Edition, 2013, Routledge Publications.

Web Resources: https://nptel.ac.in/courses/105102176.

24CE381 EPICS			
Course Category:	Project	**Credits:**	2
Course Type:	Practice	**Lecture-Tutorial-Practice:**	0 – 0 -4
Pre-requisites:	-	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	60 40 100

Course Description:

This course provides experiential learning through community engagement, enabling students to identify and analyse real-world engineering problems via field visits. It emphasizes the design of sustainable solutions using engineering principles, modern tools, and ethical considerations. Students develop professional skills through documentation, teamwork, and effective presentation of community-based solutions.

Course Objectives:

- Expose students to real community problems through field interaction.
- Develop their ability to analyze and understand these problems.
- Encourage practical and sustainable engineering solutions.
- Build awareness of social, environmental, and ethical responsibilities.
- Improve communication, teamwork, and reporting skills.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Identify and analyze real-world community problems through field visits, stakeholder interaction, and review of relevant literature.	4
CO2	Analyze and propose appropriate and sustainable solutions using engineering principles and modern engineering tools for identified community problems	5
CO3	Evaluate the social, environmental, and ethical implications of proposed engineering solutions in community contexts	5
CO4	Apply effective communication and teamwork skills in documenting, presenting, and implementing community-based solutions	3

Course articulation matrix

	POs											PSOs	
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	2	3		1		3		1			1	2	2
CO2	2	2	3	1	2	2		1		1		3	2
CO3			1			3	3				1	2	2
CO4			1		1			3	3	2	1	2	2
CO5													

(1-Low, 2 -Medium, 3–High)

Course Content

Engineering Project in Community Services (EPICS): The Engineering Project for community services will be carried out during summer vacation for a period of **Four** weeks after the IV Semester and the report shall be submitted in the V Semester. Students will go to the society (Villages/ Hospitals/Towns, etc.) to identify the problem, survey the literature and discuss with the community for a feasible solution. The students are encouraged to solve real-life problems.

Text Books:

Reference Books:

Web Resources:

NPTEL – https://nptel.ac.in

1. (Online courses on environmental engineering, sustainability, and community-based projects)
   American Society of Civil Engineers (ASCE) – https://www.asce.org
2. (Technical resources, case studies, and professional guidelines)
   ASCE Library – https://ascelibrary.org
3. (Journals, conference papers, and technical publications)
4. SWAYAM – https://swayam.gov.in
5. (MOOCs on engineering and interdisciplinary topics)
6. YouTube (Educational Channels)
7. (Civil engineering field practices, case studies, and project demonstrations)

24CE382 BUILDING INFORMATION MODELLING LAB			
Course Category:	Skill Course - 1	**Credits:**	2
Course Type:	Lab	**Lecture-Tutorial-Practice:**	1-0-2
Pre-requisites:	24CE285-Computer Aided Civil Engg. Drawing	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	60 40 100

Course Description:

This course introduces students to Building Information Modeling (BIM) concepts using Autodesk Revit. It focuses on the development of 2D drawings, 3D modeling, and visualization of architectural and structural components. The course also covers the integration of BIM tools for quantity take off, scheduling, and project planning. Emphasis is given to practical exposure through modeling real-world structures and generating construction documentation.

Course Objectives:

- To introduce the fundamentals of Building Information Modeling (BIM) and its applications using Autodesk Revit
- To develop skills in 2D drafting, 3D modeling, and visualization of architectural and structural components
- To enable students to generate construction drawings, quantity takeoffs, and project schedules using BIM tools

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Develop 2D drawings and 3D architectural models using Autodesk Revit	3
CO2	Model structural components and generate BIM-based drawings	3
CO3	Extract quantities, Bills and prepare construction schedules using BIM tools	4

Course articulation matrix

	POs											PSOs	
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	2	2	3		3		2	1				2	2
CO2	2	3	3		3		2	1				3	2
CO3	2	3	2		3			1		2		3	3

(1-Low, 2 -Medium, 3–High)

Course Content

PART-A:

ARCHITECTURAL COMPONENTS

1. Setting up Levels and Grids
2. Drawing of 2D Plans
3. Modelling of Architectural Components for a structure using Revit Architecture.
4. Generating the walkthrough for the structure.
5. Convert AutoCAD 2D drawing to 3D model using Autodesk Rivet

PART-B:

STRUCTURAL COMPONENTS

1. Modelling of Structural Components for a structure using Revit Structures.
2. Detailing and creation of Drawings for a structure as per IS Code.
3. Extraction of Bill of Materials from a Model (BOM).
4. Extraction of Bill of Quantities from a Model (BOQ).
5. Preparing a schedule for construction of the structure with model.

Text Books:

1. Auto desk Rivet structures manual.
2. Exploring Autodesk Revit 2020 for structures,10th edition, by Prof. Sham Tickoo, Purdue University Northwest, USA
3. MS Excel user manual.

Reference Books:

1. Autodesk Revit 2021 Structure Fundamentals by ASCENT publications Published August 10, 2020, ISBN: 978-1-63057-358-4 | ISBN 10: 1630573582

Web Resources:

https://www.coursera.org/learn/autodesk-revit-for-structural-design-exam-prep

24CE383 GEOTECHNICAL ENGINEERING LABORATORY			
Course Category:	Professional Core Lab	**Credits:**	1
Course Type:	Practice	**Lecture-Tutorial-Practice:**	0-0-2
Pre-requisites:	Geotechnical Engineering	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	60 40 100

Course Description:

The Geotechnical Engineering Laboratory provides students with practical training in essential soil testing methods that underpin geotechnical analysis and design. The course is structured into two cycles: the first covers index properties such as moisture content, specific gravity, Atterberg limits, and grain size distribution, which aid in soil classification and preliminary behaviour assessment; the second focuses on engineering properties including permeability, compaction, shear strength, and consolidation, which reveal soil performance under loads and guide safe foundation design. Conducted in accordance with Indian Standards (IS codes), the laboratory equips students with hands-on testing experience, data interpretation skills, and the ability to connect laboratory results with field performance, thereby bridging theory and practice for real-world geotechnical applications.

Course Objectives:

- To determine index properties of soils (such as moisture content, specific gravity, Atterberg limits, grain size distribution) for classification and preliminary assessment of soil behaviour.
- To evaluate engineering properties of soils (such as permeability, compaction, shear strength, and consolidation) that governs their performance under structural loads.
- To provide hands-on experience in conducting standard soil tests in accordance with Indian Standards (IS codes) and other relevant specifications.
- To enable students to interpret laboratory test results and correlate them with soil behaviour in the field for safe and economical foundation design.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Understand the basic and index properties of soil for Classification as per the Indian Standards	2
CO2	Evaluate the permeability of soil as per the Indian Standards	3
CO3	Evaluate the compaction characteristics of soil as per Indian Standards	3
CO4	Analyze the shear characteristics of soil using various laboratory shear tests as per Indian Standards	4

Course articulation matrix

COs	POs											PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3			3					3	3			3
CO2	3			3					3	3			3

CO3	3			3					3	3			3
CO4	3			3					3	3			3

(1-Low, 2 -Medium, 3–High)

Course Content

1. MINERALOGY AND PETROLOGY OF ROCKS

a. Study of Physical properties of minerals - Color, Streak, Lustre, Hardness, Cleavage, Fracture, Specific Gravity
b. Identification of rock forming silicate minerals - Quartz, Feldspar, Mica, Hornblende, Augite, Olivine
c. Identification of ore minerals - Hematite, Magnetite, Galena, Chalcopyrite, Bauxite, Pyrite

2. BASIC PROPERTIES OF SOILS

a. Moisture Content
b. Specific Gravity
c. Field Density to find the natural density of soil at a given place

2. INDEX PROPERTIES OF SOILS

a. Gradation to find particle size distribution
b. Consistency Limits to find Liquid and Plastic limits
c. Free Swell Index to find swelling of soil

3. ENGINEERING PROPERTIES TO DETERMINE SOIL BEHAVIOUR-PERMEABILITY OF SOILS

a. Constant Head Permeability test
b. Falling Head Permeability test

4. ENGINEERING PROPERTIES TO DETERMINE SOIL BEHAVIOUR-COMPACTION OF SOILS

a. Compaction Test to determine compaction characteristics of soil.

5. ENGINEERING PROPERTIES TO DETERMINE SOIL BEHAVIOUR-SHEAR STRENGTH OF SOILS

a. Direct Shear Test
b. Unconfined Compression Test
c. Vane shear Test

6. ENGINEERING PROPERTIES TO DETERMINE COMPRESSIBILITY BEHAVIOUR-CONSOLIDATION OF SOILS

a. Consolidation Test to determine rate and magnitude of soil settlement under loads [Demonstration]

Text Books:

1. Soil Mechanics and Foundation Engineering by K.R. Arora; Standard Publishers & Distributors, Nai Sarak, New Delhi.

Reference Books:

1. SP 36-1: Compendium of Indian Standards on Soil Engineering: Part-1 Laboratory Testing of Soils for civil Engineering Purposes.

Web Resources:

1. nptel.ac.in/courses/105101160

24CE384 ENVIRONMENTAL ENGINEERING LABORATORY			
Course Category:	Professional Core Lab	**Credits:**	1
Course Type:	Practice	**Lecture-Tutorial-Practice:**	0-0-2
Pre-requisites:		**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	60 40 100

Course Description:

This laboratory course provides hands-on training in the analysis of water and wastewater quality parameters essential for environmental engineering practice. Students perform standard tests to determine physical and chemical characteristics such as pH, electrical conductivity, turbidity, solids, alkalinity, acidity, hardness, chlorides, sulphates, dissolved oxygen, BOD, and COD. The course emphasizes sampling procedures, experimental techniques, data interpretation, and comparison with water quality standards. It equips students with practical skills required for monitoring, evaluation, and design of water and wastewater treatment systems.

Course Objectives:

- To develop practical skills in sampling and analyzing water and wastewater quality parameters.
- To understand the principles and procedures involved in standard laboratory tests for physical and chemical characteristics of water.
- To determine important water quality indicators such as pH, turbidity, hardness, alkalinity, dissolved oxygen, BOD, and COD.
- To interpret experimental results and compare them with permissible water quality standards.
- To enhance technical competency in handling laboratory instruments and preparing analytical reports.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Perform standard laboratory tests to determine physical and chemical characteristics of water and wastewater samples.	3
CO2	Analyze and interpret experimental results related to water quality parameters such as pH, turbidity, hardness, dissolved oxygen, BOD, and COD.	3
CO3	Evaluate water and wastewater quality by comparing test results with prescribed environmental standards.	3

Course articulation matrix

	POs											PSOs	
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2		3	2	2	1	1	1	1		2	
CO2	3	3		3	2	1	2	1		2		2	
CO3	3	3	1	2	1	2	3	2		2	1	2	

(1-Low, 2 -Medium, 3–High)

Course Content

LABORATORY TESTS:

1. Measure the pH, temperature, and electrical conductivity (salinity) of water samples.

2. Determine the total suspended solids (TSS) and total dissolved solids (TDS) in water samples.
3. Estimate the alkalinity of water samples.
4. Estimate the acidity of water samples.
5. Measure the turbidity of water samples.
6. Determine the optimum dosage of coagulant for water treatment.
7. Determine the temporary and permanent hardness of water samples.
8. Estimate the chloride concentration in water samples.
9. Determine the sulphate content in water samples.
10. Estimate the dissolved oxygen (DO) content of water samples.
11. Determine the biochemical oxygen demand (BOD) of wastewater samples..
12. Determine the chemical oxygen demand (COD) of wastewater samples.

Text Books:

1. Standard Methods for the Examination of Water and Wastewater, APHA.
2. K.V.S.G. Murali Krishna, Chemical Analysis of Water and Soil, ReemmPublications, New Delhi

Reference Books:

1. Reference Book(s) 1. Relevant IS Codes for Water and Wastewater Analysis and Treatment.
2. C.N. Sawyer, P.L. McCarty and G.F. Parkin, Chemistry for Environmental Engineering and Science, McGraw-Hill.
3. Environmental Engineering Lab Manual by Dr.G.Kotaiah and Dr.N.Kumara Swamy, Charotar Publishers, Anand.

Web Resources:

1. https://nptel.ac.in/courses/105104102
2. https://nptel.ac.in/courses/1051050

24UC 302 Environmental Studies			
Course Category:	Mandatory course (MC)	**Credits:**	**0**
Course Type:	Theory	**Lecture-Tutorial-Practice:**	**2-0-0**
Pre-requisites:		**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**100** **-** **100**

Course Description:

The course is designed for B.Tech. Learners, providing essential and applied knowledge of Environmental Science. It explains how the protection of our environment and ecological balance are linked with the development process. It makes them understand that key to development of the future of mankind is the sustenance of "Nature". Furthermore, the course emphasizes the duty and responsibility of each one to protect "Nature". This course enables the study of environment as an integral part of the education process so as to apply wherever relevant in their fields. The course motivates the students to conduct programs, research, and engage in outreach activities to meet Sustainable Development Goals (SDGs). Further it creates awareness on various Environmental issues among learners of the Campus for One Earth, One Family, One Future, drawing upon the age-old belief of Vasudhaiva Kutumbakam.

Course Objectives:

1. Adopt an interdisciplinary approach by integrating concepts from biology, chemistry, physics, geology, geography and social sciences to understand the complex environmental problems and natural resource degradation
2. Impart knowledge about various environmental systems, including ecosystems, biodiversity, atmosphere, hydrosphere, and lithosphere and their interaction.
3. Develop analytical and problem – solving skills required addressing environmental challenges such as pollution, climate change, resource management and their conservation and natural disasters management
4. Promote awareness of sustainable development principles and practices, including sustainable agriculture, renewable energy, waste management and environmental policy.
5. Foster an understanding of ethical considerations and social responsibilities related to environmental decision-making and management.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Examine various factors causing degradation of natural resources	**K3**
CO2	Explain various ecosystems and need for biodiversity	**K3**
CO3	Analyze problems related to environmental pollution and disaster management and	**K4**

	propose solutions	
CO4	Explore the importance of ethics, sustainable development, and acts associated with environment	**K4**
CO5	Demonstrate use of information and technology to solve social issues and human rights challenges	**K3**

Course articulation matrix

	POs											PSOs	
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	-	-	-	-	2	-	-	-	-	-		
CO2	-	3	2	-	-	2	2	-	2	-	-		
CO3	-	3	2	-	-	3	-	-	-	-	2		
CO4	-	-	-	-	-	2	3	3	-	2	2		
CO5	-	-	-	-	-	2	3	3	-	2	2		

(1-Low, 2 -Medium, 3–High)(WK1)

Course Content

UNIT-I

Introduction and Natural Resources

- Definition, scope, importance, multidisciplinary nature, and need for public awareness about environment.
- Forest resources
- Water resources
- Mineral resources
- Food resources
- Land resources
- Energy resources

UNIT-II

Ecosystems and Biodiversity Structure and function of ecosystem

- Energy flow on the ecosystem
- Ecological succession
- Food chain food web ecological pyramids
- Characteristic features of ecosystems
- Biodiversity types, value, threats and conservation
- Biodiversity at local, national and global levels
- Hot-spots of biodiversity, endangered and endemic species of India.
- Bio-geographical Classification of India

UNIT-III

Environmental Pollution and Disaster management

- Air Pollution
- Water pollution
- Noise pollution
- Soil pollution
- Marine pollution
- Thermal pollution
- Nuclear pollution
- Solid waste management: municipal solid waste, biomedical waste and E-waste.
- Disaster management: floods, cyclones, Earthquakes and landslides.

UNIT-IV

Social Issues and the Environment From unsustainable to sustainable development

- Urban problems related to energy
- Water conservation, rainwater harvesting and watershed management
- Environmental ethics
- Climate change
- Environmental protection acts
- Environment Impact Assessment: E.I.A.

UNIT-V

Human Population and the Environment

- Population growth variation among nations.
- Population explosion family welfare program.
- Environment and human health.
- Human rights.
- Value education.
- HIV/AIDS
- Women and child welfare.
- Role of I.T.in Environment and human health.

Text Books:

1. Erach Bharucha, (2005). Environmental Studies for undergraduate courses (2nd ed.). University Grants Commission, New Delhi, Bharati Vidyapeeth Institute of Environment Education and Research.
2. Benny Joseph, (2005). Environmental Studies. Tata McGraw- Hill publishing company limited, New Delhi.
3. VenuGopalaRao,P.(2006).PrinciplesofEnvironmentalScience&Engineering.Prentice- Hall of India Pvt. Ltd., New Delhi..

Reference Books:

1. De, A.K.(2018) Environmental Chemistry(9thed.).New Age India.
2. Bharucha Erach,(2002)Biodiversity of India. Mapin Publishing.
3. Anjaneyulu,Y.(2004)Introduction to Environmental sciences. B S Publications, Hyderabad.
4. Anjireddy,M.(2005) Environmental science &Technology. BSPublications, Hyderabad.
5. CunninghamWillam,P.&CunninghamMaryAnn(2017)EnvironmentalScience:A Global Concern (14th ed.).Mc Graw Hill.
6. Kurian Joseph & Nagendran,R.(2005) Essentials of Environmental Studies. Pearson Education.

Web Resources:

- https://www.ugc.gov.in/oldpdf/modelcurriculum/chapter2.pdf
- https://www.ugc.gov.in/oldpdf/modelcurriculum/chapter4.pdf
- https://www.britannica.com/science/pollution-environment
- https://www.supersummary.com/the-snow-leopard/summary/
- https://www.gov.nl.ca/ecc/waterres/waste/water-conservation/
- https://theberkey.com/pages/a-guide-to-water-conservation
- https://www.mppcb.mp.gov.in/RWH.aspx
- https://www.cseindia.org/understanding-eia-383
  https://www.drishtiias.com/to-the-points/paper3/environmental-impact-assessment-1
- https://www.drishtiias.com/to-the-points/paper3/wetlands-1
  https://odphp.health.gov/healthypeople/objectives-and-data/browse-objectives/environmental-health
- https://www.who.int/health-topics/environmental-health#tab=tab_1
  https://www.unep.org/

PROGRAM OUTCOMES (PO'S):

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion: adhere to national & international laws.

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language and learning differences.

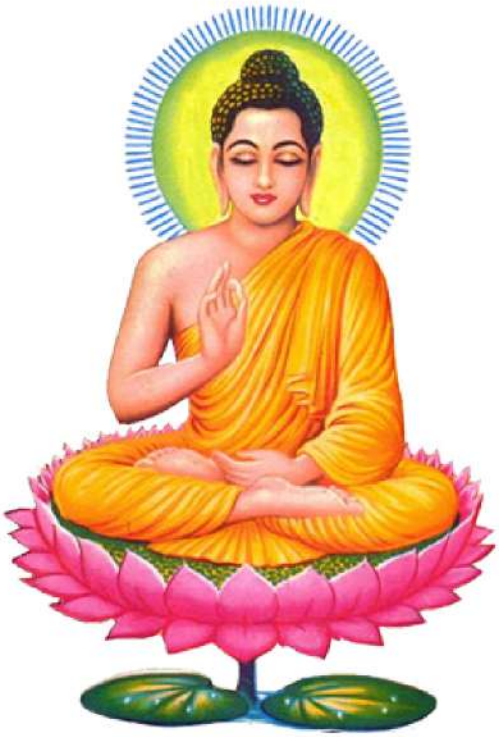
PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSO'S):

PSO1: Graduates will have an ability to design and develop sustainable civil infrastructure by applying engineering principles to address environmental, social and economic considerations.

PSO2: Graduates will have an ability to analyze and understand materials, construction processes and technologies across various civil engineering domains to provide efficient, durable and practical solutions.



Department of Civil Engineering

VELAGAPUDI RAMAKRISHNA SIDDHARTHA SCHOOL OF ENGINEERING

SIDDHARTHA

ACADEMY OF HIGHER EDUCATION

An Institution **DEEMED TO BE UNIVERSITY**

(Under Section 3 of UGC Act, 1956)

(Sponsored by Siddhartha Academy of General & Technical Education),

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