COURSE SCHEME

FOR

B.E. (CIVIL ENGINEERING)

2023

THAPAR INSTITUTE
OF ENGINEERING & TECHNOLOGY
(Deemed to be University)

Approved in 114th Meeting of Senate held on March 7, 2025

Break-up of Credits

SEMESTER	CREDITS
I	18.0
II	18.0
III	24.5
IV	21.0
V	25.0
VI	22.0
VII	15.0
VIII	23.5
TOTAL	**167.0**

Nature of course and code

Nature of the course	CODE**
Basic Science Courses	BSC
Engineering Science Courses	ESC
Humanities and Social Science Courses	HSS
Professional Core Courses	PCC
Professional Elective Courses	PEC
Open Elective Courses	OEC
Project	PRJ

SEMESTER-I

S. No.	Course Code	Course Name	CODE**	L	T	P	Cr
1.	UPH013	APPLIED PHYSICS	BSC	3	1	2	**4.5**
2.	UES101	ENGINEERING DRAWING	ESC	2	4	0	**4.0**
3.	UHU003	PROFESSIONAL COMMUNICATION	HSS	2	0	2	**3.0**
4.	UES102	MANUFACTURING PROCESSES	ESC	2	0	2	**3.0**
5.	UMA022	CALCULUS FOR ENGINEERS	BSC	3	1	0	**3.5**
		TOTAL		**12**	**6**	**6**	**18.0**

SEMESTER-II

S. No.	Course Code	Course Name	CODE**	L	T	P	Cr
1.	UCB009	APPLIED CHEMISTRY	BSC	3	0	2	**4.0**
2.	UES103	PROGRAMMING FOR PROBLEM SOLVING	ESC	3	0	2	**4.0**
3.	UES013	ELECTRICAL & ELECTRONICS ENGINEERING	BSC	3	1	2	**4.5**
4.	UEN008	ENERGY AND ENVIRONMENT	BSC	2	0	0	**2.0**
5.	UMA023	DIFFERENTIAL EQUATIONS AND LINEAR ALGEBRA	BSC	3	1	0	**3.5**
		TOTAL		**14**	**2**	**6**	**18.0**

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SEMESTER-III

S. No.	Course Code	Course Name	CODE**	L	T	P	Cr
1.	UCE311	FLUID MECHANICS	PCC	3	1	2*	**4.0**
2.	UCE306	ARCHITECTURE DRAWING AND BUILDING CONSTRUCTION	PCC	2	0	2	**3.0**
3.	UCE308	BUILDING MATERIALS	PCC	2	0	2	**3.0**
4.	UCE312	SOLID MECHANICS	ESC	3	1	2*	**4.0**
5.	UMA035	OPTIMIZATION TECHNIQUES	BSC	3	0	2	**4.0**
6.	UES012	ENGINEERING MATERIALS	ESC	3	1	2	**4.5**
7.	UTD003	APTITUDE SKILLS BUILDING	HSS	2	0	0	**2.0**
		TOTAL		**18**	**3**	**10**	**24.5**

*** Lab alternate week**

SEMESTER-IV

S. No.	Course Code	Course Name	CODE**	L	T	P	Cr
1.	UCE303	STRUCTURAL ANALYSIS	PCC	3	1	2	**4.5**
2.	UCE405	SURVEYING	PCC	3	0	3	**4.5**
3.	UCE406	DESIGN OF CONCRETE STRUCTURES	PCC	3	1	2*	**4.0**
4.	UMA012	NUMERICAL AND STATISTICAL COMPUTATIONS	BSC	3	0	2	**4.0**
5.	UTA027	ARTIFICIAL INTELLIGENCE	ESC	2	0	2	**3.0**
6.	UHU050	EVOLUTIONARY PSYCHOLOGY	HSS	1	0	0	**1.0**
		TOTAL		**15**	**2**	**10**	**21.0**

***Lab alternate week**

AFTER SEMESTER IV (DURING SUMMER VACATIONS)

S. No.	Course Code	Course Name	CODE**	L	T	P	Cr
1.		SURVEY PROJECT *	PRJ	0	0	0	**3.0**

***Two weeks survey camp after semester IV during summer vacations; it will be graded in semester V**

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SEMESTER-V

S. No.	Course Code	Course Name	CODE**	L	T	P	Cr
1.	UCE501	SOIL MECHANICS	PCC	3	1	2	**4.5**
2.	UCE401	HYDROLOGY AND GROUND WATER	PCC	3	1	0	**3.5**
3.	UCE511	TRANSPORTATION ENGINEERING-I	PCC	3	0	2*	**3.5**
4.	UCE512	DESIGN OF STEEL STRUCTURES	PCC	3	1	0	**3.5**
5.	UCE513	CONSTRUCTION MANAGEMENT	PCC	3	0	2	**4.0**
6.	UTA025	INNOVATION AND ENTREPRENEURSHIP (3 SELF-EFFORT HOURS)	HSS	1	0	2*	**3.0**
7.	UCE592	SURVEY PROJECT	PRJ	-	-	-	**3.0**
8.	UCE693	GROUP DESIGN PROJECT (START)	PRJ	-	-	2	**-**
		TOTAL		**16**	**3**	**8**	**25.0**

***Labs alternate week**

SEMESTER-VI

S. No.	Course Code	Course Name	CODE**	L	T	P	Cr
1.	UCE614	HYDRAULIC ENGINEERING	PCC	3	1	2*	**4.0**
2.	UCE605	TRANSPORTATION ENGINEERING-II	PCC	3	1	0	**3.5**
3.	UCE615	WATER AND WASTE WATER ENGINEERING	PCC	3	1	2*	**4.0**
4.	UCE613	FOUNDATION ENGINEERING	PCC	3	1	2*	**4.0**
5.		ELECTIVE-I	PEC	3	1	0	**3.5**
6	UCE693	GROUP DESIGN PROJECT (2 SELF-EFFORT HOURS)	PRJ	1	-	2	**3.0**
7.	UCE892	CAPSTONE PROJECT (START)	PRJ	1*	-	2	**-**
		TOTAL		**16.5**	**5**	**7**	**22.0**

***Labs alternate week**

SEMESTER-VII

S. No.	Course Code	Course Name	CODE**	L	T	P	Cr
1.	UCE799	PROJECT SEMESTER**	PRJ	-	-	-	**15.0**
		TOTAL					**15.0**

****To be carried out in Industry/Research Institution**

OR

S. No.	Course Code	Course Name	CODE**	L	T	P	Cr
1.	UCE702	ADVANCED CONSTRUCTION TECHNOLOGY	PCC	3	1	0	**3.5**
2.	UCE725	ADVANCED CONSTRUCTION MATERIALSAND TECHNIQUES	PCC	3	1	0	**3.5**
3.	UCE800	PROJECT (06 SELF EFFORT HOURS)	PRJ	-	-	4	**2.0**
4.	UCE796	PRACTICAL TRAINING (6 WEEKS)	PRJ				**4.0**
		TOTAL		**6**	**2**	**4**	**15.0**

OR

S. No.	Course Code	Course Name	CODE	L	T	P	Cr
1.	UCE798	STARTUP SEMESTER***	PRJ	-	-	-	**15.0**
		TOTAL					**15.0**

****Based on hands on work on Innovations and Entrepreneurship**

SEMESTER-VIII

S. No.	Course Code	Course Name	CODE**	L	T	P	Cr
1	UCE809	SEISMIC RESISTANT DESIGN OF STRUCTURES	PCC	3	1	0	**3.5**
2	UHU005	HUMANITIES FOR ENGINEERS	HSS	2	0	2	**3.0**
3		ELECTIVE-II	PEC	3	1	0	**3.5**
4		ELECTIVE-III	PEC	3	1	0	**3.5**
5		GENERIC ELECTIVE	OEC	2	0	0	**2.0**
6	UCE892	CAPSTONE PROJECT	PRJ	-	-	-	**8.0**
		TOTAL		**13**	**3**	**2**	**23.5**

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List of Professional Electives (PEC)

Elective-I

S. No.	Course Code	Course Name	L	T	P	Cr
1	UCE831	Bridge Engineering	3	1	0	**3.5**
2	UCE616	Advanced Concrete Design	3	1	0	**3.5**
3	UCE617	Traffic Engineering and Geometric Design	3	1	0	**3.5**
4	UCE618	Sustainable Construction Practices	3	1	0	**3.5**
5	UCE803	Irrigation Engineering	3	1	0	**3.5**

Elective-II

S. No.	Course Code	Course Name	L	T	P	Cr
1	UCE838	Prestressed Concrete	3	1	0	**3.5**
2	UCE821	Hydraulic Structures	3	1	0	**3.5**
3	UCE822	Urban Transportation Planning	3	1	0	**3.5**
4	UCE823	Climate Change and Impact on Water Resources	3	1	0	**3.5**
5	UCE824	Geotechnices for Underground Structures	3	1	0	**3.5**
6	UCE825	Life Cycle Assessment	3	1	0	**3.5**

Elective-III

S. No.	Course Code	Course Name	L	T	P	Cr
1	UCE854	Advanced Steel Structure Design	3	1	0	**3.5**
2	UCE855	Design of Reinforced Earth Structures	3	1	0	**3.5**
3	UCE856	Advanced Surveying	3	0	2*	**3.5**
4	UCE857	Integrated Watershed management	3	1	0	**3.5**
5	UCE858	Pavement Analysis and Design	3	1	0	**3.5**

***: Lab every alternate week**

GENERIC ELECTIVE (GE)

S. NO.	COURSE NO.	TITLE	L	T	P	CR
1	UHU016	INTRODUCTORY COURSE IN FRENCH	2	0	0	2.0
2	UCS002	INTRODUCTION TO CYBER SECURITY	2	0	0	2.0
3.	UTD002	EMPLOYABILITY DEVELOPMENT SKILL	2	0	0	2.0
4.	UHU017	INTRODUCTION TO COGNITIVE SCIENCE	2	0	0	2.0
5.	UHU018	INTRODUCTION TO CORPORATE FINANCE	2	0	0	2.0
6.	UEN006	TECHNOLOGIES FOR SUSTAINABLE DEVELOPMENT	2	0	0	2.0
7.	UPH064	NANO SCIENCE AND NANO-MATERIALS	2	0	0	2.0
8.	UMA069	GRAPH THEORY AND APPLICATIONS	2	0	0	2.0
9.	UMA070	ADVANCED NUMERICAL METHODS	2	0	0	2.0
10.	UBT510	BIOLOGY FOR ENGINEERS	2	0	0	2.0

Focus Areas (over and above the basic course scheme)

Focus Elective-I in Vth Sem

Focus Electives-II and III in VIIIth Sem

	FOCUS AREAS		
Electives	**Structural Engineering, Smart and Sustainable Materials**	**Smart Cities**	**Infrastructure Development and Management**
Focus Elective-I	Bridge Engineering (UCE831)	Design of Smart Transportation Systems (UCE851)	Infrastructure Planning & Design (UCE861)
Focus Elective-II	Sustainable & Smart Materials (UCE837)	Internet of Things (IoT) & Smart Cities (UCE852)	Building Infrastructures & Construction Practices (UCE862)
Focus Elective-III	Prestressed Concrete Structures (UCE838)	Sustainable & Smart Materials (UCE837)	Infrastructure Contracts & Risk Management (UCE863)

The students of BE Civil Engineering can do a specialization in a focus area by studying courses of that particular focus area over and above the normal BE Civil Engineering courses

1. Students must choose any one focus area at the start of Semester V
2. The students who clear all courses of a particular focus area will be awarded a certificate of specialization in addition to BE Civil Engineering.

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Table 3: Total Credit Score for specific Nature of course/s

Nature of the course	CODE	Total Credits	Semester and Course Name
Basic Science Courses	BSC	*30.0*	Applied Physics, Semester I Mathematics-I, Semester I Applied Chemistry, Semester II Electrical and Electronics Engineering, Semester II Energy and Environment, Semester II Mathematics-II, Semester II Optimization Techniques, Semester III Numerical and Statistical Computations, Semester IV
Engineering Science Courses	ESC	*22.5*	Engineering Drawing, Semester I Manufacturing Processes, Semester I Programming for Problem Solving, Semester II Solid Mechanics, Semester III Engineering Materials, Semester III Artificial Intelligence, Semester IV
Humanities and Social Science Courses	HSS	*12.0*	Professional Communication, Semester I Aptitude Skills Building, Semester III Evolutionary Psychology, Semester IV Innovation and Entrepreneurship, Semester V Humanities for Engineers, Semester VIII
Professional Core Courses	PCC	*61.0*	Fluid Mechanics, Semester III Architectural Drawing and Building Construction, Semester III Building Materials, Semester III Structural Analysis, Semester IV Surveying, Semester IV Design of Concrete Structures, Semester IV Soil Mechanics, Semester V Hydrology and Ground Water, Semester V Design of Steel Structures, Semester V Transportation Engineering-I, Semester V Construction Management, Semester V Hydraulic Engineering, Semester VI Transportation Engineering-II, Semester VI Water and Waste Water Engineering, Semester VI Foundation Engineering, Semester VI Seismic Resistant Design of Structures, Semester VIII

Nature of the course	CODE	Total Credits	Semester and Course Name
Professional Elective Courses	PEC	*10.5/21.0**	Elective-I, Semester V Elective-II, Semester VIII Elective-III, Semester VIII *: Focus Area Elective-I, Semester V *: Focus Area Elective-II, Semester VIII *: Focus Area Elective-III, Semester VIII
Open Elective Courses	OEC	*2.0*	Generic Elective, Semester VIII
Project	PRJ	*29.0*	Survey Project, End of Semester IV and to be graded in Semester V Group Design Project, Semesters V & VI Project Semester, Semester VII Capstone Project, Semester VIII

***: These credits include the additional focus area electives, over and above the standard scheme**

SEMESTER-I

Approved in 109th Meeting of Senate held on March 16, 2023

UPH013: Physics

L	T	P	Cr
3	1	2	4.5

Course Objective: To introduce the student to the basic physical laws of oscillators, acoustics of buildings, ultrasonics, electromagnetic waves, wave optics, lasers, and quantum mechanics and demonstrate their applications in technology. To introduce the student to measurement principles and their application to investigate physical phenomena

Syllabus

Oscillations and Waves: Oscillatory motion and damping, Applications - Electromagnetic damping – eddy current; ***Acoustics:*** Reverberation time, absorption coefficient, Sabine's and Eyring's formulae (Qualitative idea), Applications - Designing of hall for speech, concert, and opera; ***Ultrasonics:*** Production and Detection of Ultrasonic waves, Applications - green energy, sound signaling, dispersion of fog, remote sensing, Car's airbag sensor.

Electromagnetic Waves: Scalar and vector fields; Gradient, divergence, and curl; Stokes' and Green's theorems; Concept of Displacement current; Maxwell's equations; Electromagnetic wave equations in free space and conducting media, Application - skin depth.

Optics: ***Interference:*** Parallel and wedge-shaped thin films, Newton rings, Applications as Non-reflecting coatings, Measurement of wavelength and refractive index. ***Diffraction:*** Single and Double slit diffraction, and Diffraction grating, Applications - Dispersive and Resolving Powers. ***Polarization:*** Production, detection, Applications – Anti-glare automobile headlights, Adjustable tint windows. ***Lasers:*** Basic concepts, Laser properties, Ruby, HeNe, and Semiconductor lasers, Applications – Optical communication and Optical alignment.

Quantum Mechanics: Wave function, Steady State Schrodinger wave equation, Expectation value, Infinite potential well, Tunneling effect (Qualitative idea), Application - Quantum computing.

Laboratory Work

1. Determination of damping effect on oscillatory motion due to various media.
2. Determination of velocity of ultrasonic waves in liquids by stationary wave method.
3. Determination of wavelength of sodium light using Newton's rings method.
4. Determination of dispersive power of sodium-D lines using diffraction grating.
5. Determination of specific rotation of cane sugar solution.
6. Study and proof of Malus' law in polarization.
7. Determination of beam divergence and beam intensity of a given laser.
8. Determination of displacement and conducting currents through a dielectric.
9. Determination of Planck's constant.

Micro Project:

Students will be given physics-based projects/assignments using computer simulations, etc.

Course Learning Objectives (CLO)

The students will be able to:

1. understand damped and simple harmonic motion, the role of reverberation in designing a hall and generation and detection of ultrasonic waves.
2. use Maxwell's equations to describe propagation of EM waves in a medium.
3. demonstrate interference, diffraction and polarization of light.
4. explain the working principle of Lasers.
5. use the concept of wave function to find probability of a particle confined in a box.
6. perform an experiment, collect data, tabulate and report them and interpret the results with error analysis.

Text Books

1. Beiser, A., Concept of Modern Physics, Tata McGraw Hill (2007) 6th ed.
2. Griffiths, D.J., Introduction to Electrodynamics, Prentice Hall of India (1999) 3rd ed.
3. Jenkins, F.A. and White, H.E., Fundamentals of Optics, McGraw Hill (2001) 4th ed.

Reference Books

1. Wehr, M.R, Richards, J.A., Adair, T.W., Physics of The Atom, Narosa Publishing House (1990) 4th ed.
2. Verma, N.K., Physics for Engineers, Prentice Hall of India (2014)1st ed.
3. Pedrotti, Frank L., Pedrotti, Leno S., and Pedrotti, Leno M., Introduction to Optics, Pearson Prentice HallTM (2008) 3rd ed.

Evaluation Scheme

Sr. No.	**Evaluation elements**	**Weightage (%)**
1	MST	25-30
2	EST	40-45
3	Sessional: (May include the following) Assignment, Regular Lab assessmentand Quizzes, Project (Including report, presentation etc.)	30

UES101: Engineering Drawing

L	T	P	Cr
2	4	0	4.0

Course Objective: This module is dedicated to graphics and includes two sections: 2D drafting and 3D modelling of solid objects. This course is aimed at making the student understand the concepts of projection systems, learn how to create projections of solid objects using first and third angle orthographic projection as well as isometric and auxiliary projection, concept of sectioning, to interpret the meaning and intent of toleranced dimensions and to create/edit drawings using drafting software. In addition, this course shall give an insight on the basic 3D modelling concepts like extrude, revolve, sweep, construction of complex solids.

Syllabus

Engineering Drawing Concepts

1. Introduction to Engineering Drawing
2. Projection systems: First angle and third angle projection system
3. Orthographic Projection: Points, Lines, Solid objects
4. Isometric Projections
5. Auxiliary Projections
6. Development of surfaces
7. Section of solids
8. Limits, fits and tolerances

2D Drafting

1. Management of screen menus commands
2. Creating basic drawing entities
3. Co-ordinate systems: Cartesian, polar and relative coordinates
4. Drawing limits, units of measurement and scale
5. Layering: organizing and maintaining the integrity of drawings
6. Design of prototype drawings as templates.
7. Editing/modifying drawing entities: selection of objects, object snap modes, editing commands,
8. Dimensioning: use of annotations, dimension types, properties and placement, adding textto drawing

3D Modelling

1. Management of screen menus commands
2. Introduction to basic 3D modelling commands such as extrude, revolve, sweep etc.
3. Creation of 2D drawings from a 3D model

Micro Projects /Assignments:

1. Completing the views - Identification and drawing of missing lines and views in the projection of objects

2. Projects related to orthographic and isometric projections Using wax blocks/soap bars/any soft material to develop three dimensional object from given orthographic projections

3. a. 3D modelling of complex machine components
   b. Development of production drawings of individual components from the model

Course Learning Objectives (CLO)

The students will be able to:

1. creatively comprehend the geometrical details of common engineering objects
2. draw dimensioned orthographic and isometric projections of simple engineering objects
3. interpret the meaning and intent of limits, fits and tolerances in the drawing
4. create/edit the engineering drawings for simple engineering objects using 2D drafting software
   create/edit 3D models of engineering components using 3D modelling software

Text Books

1. Jolhe, D.A., Engineering Drawing, Tata McGraw Hill, 2008
2. Davies, B. L., Yarwood, A., Engineering Drawing and Computer Graphics, Van Nostrand Reinhold (UK), 1986

Reference Books

1. Gill, P.S., Geometrical Drawings, S.K. Kataria & Sons, Delhi (2008).
2. Gill, P.S., Machine Drawings, S.K. Kataria & Sons, Delhi (2013).
3. Mohan, K.R., Engineering Graphics, Dhanpat Rai Publishing Company (P) Ltd, Delhi (2002).
4. French, T. E., Vierck, C. J. and Foster, R. J., Fundamental of Engineering Drawing & Graphics Technology, McGraw Hill Book Company, New Delhi (1986).
5. Rowan, J. and Sidwell , E. H., Graphics for Engineers, Edward Arnold, London (1968).
6. Mastering AutoCAD 2021 and AutoCAD LT 2021, Brian C. Benton, George Omura, Sybex - John Wiley and Sons, Indiana (2021).

Evaluation Scheme

Course Component	**Weightage**
AutoCAD tutorials/SolidWorks/Project work*	35
MST (1.5 hours-CAD based)**	20
EST (2 hours-CAD based)**	45

***Students are required to bring their personal computers for the** tutorial work.*

**Availability of institute server resources for sharing the software licences with the student community.*

***Institute computational resources in collaboration with other academic units / departments for conducting the mid semester and end semester test.*

UHU003: Professional Communication

L	T	P	Cr
2	0	2	3.0

Course Objective: The course is designed to develop the interpersonal, written, and oral as well as the non- verbal communication skills of the students. The course begins by building up on the theoretical concepts and then practicing on the applicability of the various elements. Since the course has very high applicability content, the students are advised to practice in class as well as off class. A very high level of interaction is expected of the students in the class.

Syllabus

Fundamentals of Communication: Meaning, Types and Characteristics of communication, Applicability of Transactional Analysis and Johari Window for enhancing interpersonal communication skills. Seven Cs of Effective Communication, Barriers to Effective Communication.

Effective Oral Communication: Understanding Principles of Oral communication, Formal and Informal Oral Communication, Oral Communication and Behavioral Patterns, Advantages and Disadvantages of Oral Communication.

Effective Listening: Listening vs Hearing, Active Listening techniques, Barriers to Listening.

Effective non-verbal communication: Meaning and Importance of Non-Verbal Communication, Different Types of Non-verbal Communication, Interpretation of Non-verbal Cues.

Effective written Communication: Characteristics of Good Writing, Choice of Words, Sentence Construction, Paragraph development, Forms of writing.

Business Communication: Technical Report Writing, Designing Resumes and Cover Letters for effective job application, E-mail writing and e-mail etiquette.

Organizational Communication: Directional communication: Downward, Upward and Horizontal Communication, Grapevine.

Reading: The following texts (one from each of the two categories listed below) are required to be read by the students in the semester:
Category 1: Animal Farm by George Orwell, Lord of the Flies by William Golding, Life of Pi by Yann Martel
Category 2: The Namesake by Jhumpa Lahiri, The God of Small Things by Arundhati Roy, Q&A by Vikas Swarup

Laboratory Work

1. Needs-assessment of spoken and written communication with feedback.
2. Training for Group Discussions through simulations and role plays.
3. Technical report writing on survey-based projects.
4. Project-based team presentations.

Course Learning Objectives (CLO)

The students will be able to:

1. Apply communication concepts for effective interpersonal communication.
2. Speak assertively and effectively.
3. Interpret non-verbal cues in professional communication.
4. Write objectively, purposefully and effectively.
5. Design effective resumes and reports.

Text Books

1. Mukherjee H.S..Business Communication: Connecting at Work. Oxford University Press.(2013)
2. Lesikar R.V, and Flately M.E., Basic Business Communication Skills for empowering the internet generation.(2006)
3. Raman, M.,and Singh ,P, Business Communication . Oxford . University Press (2008).

Reference Books

1. Riordan, G.R. Technical Communication. Cengage Learning India Private Ltd. (2012)
2. Butterfield, Jeff., Soft Skills for everyone, Cengage Learning New Delhi, (2013).
3. Robbins, S.P., & Hunsaker, P.L., Training in Interpersonal Skills, Prentice Hall of India, New Delhi, (2008).
4. Orwell, G., Animal Farm, Fingerprint Publishing, New Delhi, (2017).
5. Golding, W, Lord of the Flies, Faber & Faber; Export edition (1999)
6. Martel,Y., Life of Pi, RHC, New Delhi, (2012).
7. Lahiri,J., The Namesake, Harpercollins (2007)
8. Arundhati Roy,A., The God of Small Things, Penguin India, (2002).
9. Swarup,V., Q&A, Black Swan,(2009).

Evaluation Scheme

Sr. No.	**Evaluation elements**	**Weightage (%)**
1	MST	25-30
2	EST	40-45
3	Sessional: (May include the following) Assignment, Regular Lab assessmentand Quizzes, Project (Including report, presentation etc.)	30

UES102: MANUFACTURING PROCESSES

L	T	P	Cr
2	0	2	3.0

Course Objectives: This course introduces the basic concepts of manufacturing via machining, forming, casting and joining, enabling the students to develop a basic knowledge of the mechanics, operation and limitations of basic machining tools along with metrology and measurement of parts. The course also introduces the concept of smart manufacturing.

Machining Processes: Principles of metal cutting, Cutting tools, Cutting tool materials and applications, Geometry of single point cutting tool, Introduction to computerized numerical control (CNC) machines, G and M code programming for simple turning and milling operations, introduction of canned cycles.

Metal Casting: Introduction & Principles of sand casting, Requisites of a sound casting, Permanent mold casting processes, casting defects

Metal Forming: Hot & cold metal working, Forging, Rolling, Sheet Metal operations.

Joining Processes: Method of joining, type of electric arc welding processes, Methods of shielding, Power source characteristics, Resistance welding, Soldering, Brazing.

Smart Manufacturing: IoT and ML in manufacturing, Introduction to Additive Manufacturing, Robotics and Automation in manufacturing.

Laboratory Work:

Relevant shop floor exercises involving practices in Sand casting, Machining, Welding, Sheet metal fabrication techniques, CNC turning and milling exercises, Experiments on basic engineering metrology and measurements to include measurements for circularity, ovality, linear dimensions, profiles, radius, angular measurements, measurement of threads, surface roughness. Basic knowledge and derivations related to above measurements, uncertainties, statistical approaches to estimate uncertainties, Line fitting, static and dynamic characteristics of instruments will be discussed in laboratory classes.

Assignments: Assignments for this course will include the topics: Manufacturing of micro-chips used in IT and electronics industry and use of touch screens. Another assignment will be given to practice numerical exercises on topics listed in the syllabus. Case study related to smart manufacturing.

Micro Project: Fabrication of multi-operational jobs using the above processes as per requirement by teams consisting of 4 -6 members. Quality check should be using the equipment available in metrology lab.

Course Learning Outcomes (CLO):

After the completion of this module, students will be able to:

- identify & analyse various machining processes/operations for manufacturing of industrial components
- apply the basic principle of bulk and sheet metal forming operations
- apply the knowledge of metal casting for different requirements.

- identify and analyse the requirements for achieving a sound welded joint
- apply the concept of smart manufacturing in industrial domain

Text books:

1. Degarmo, E. P., Kohser, Ronald A. and Black, J. T., Materials and Processes in• Manufacturing, Prentice Hall of India (2008) 8thed.
2. Kalpakjian, S. and Schmid, S. R., Manufacturing Processes for Engineering Materials,• Dorling Kingsley (2006) 4thed.

Reference Books:

1. Martin, S.I., Chapman, W.A.J. , Workshop Technology, Vol.1 & II, Viva Books (2006) 4 th ed.
2. Zimmer, E.W. and Groover, M.P., CAD/CAM - Computer Aided Designing and Manufacturing, Dorling Kingsley (2008).
3. Pandey, P.C. and Shan, H. S., Modern Machining Processes, Tata McGraw Hill (2008).
4. Mishra, P. K., Non-Conventional Machining, Narosa Publications (2006).
5. Campbell, J.S., Principles of Manufacturing, Materials and Processes, Tata McGraw Hill Company (1999).
6. Lindberg, Roy A., Processes and Materials of Manufacture, Prentice Hall of India (2008) 4th ed.

Evaluation Scheme:

Sr. No.	Evaluation elements	Weightage (%)
1	MST	35
2	EST	35
3	Sessional: (May include the following) Assignment, Regular Lab assessmentand Quizzes, Project (Including report, presentation etc.)	30

UMA022: Calculus for Engineers

L	T	P	Cr
3	1	0	3.5

Course Objective: To provide students with skills and knowledge in sequence and series, advanced calculus, calculus of several variables and complex analysis which would enable them to devise solutions for given situations they may encounter in their engineering profession.

Syllabus

Sequences and Series: Introduction to sequences and infinite series, Tests for convergence/divergence, Limit comparison test, Ratio test, Root test, Cauchy integral test, Alternating series, Absolute convergence, and conditional convergence.

Series Expansions: Power series, Taylor series, Convergence of Taylor series, Error estimates, Term by term differentiation and integration.

Partial Differentiation: Functions of several variables, Limits and continuity, Chain rule, Change of variables, Partial differentiation of implicit functions, Directional derivatives and its properties, Maxima and minima by using second order derivatives.

Multiple Integrals: Double integral (Cartesian), Change of order of integration in double integral, Polar coordinates, Graphing of polar curves, Change of variables (Cartesian to polar), Applications of double integrals to areas and volumes, Evaluation of triple integral (Cartesian).

Complex analysis: Introduction to complex numbers, Geometrical interpretation, Functions of complex variables, Examples of elementary functions like exponential, trigonometric and hyperbolic functions, Elementary calculus on the complex plane (limits, continuity, differentiability), Cauchy – Riemann equations, Analytic functions, Harmonic functions.

Course Learning Objectives (CLO)

The students will be able to:

1. determine the convergence/divergence of infinite series, approximation of functions using power and Taylor's series expansion and error estimation.
2. examine functions of several variables, define and compute partial derivatives, directional derivatives, and their use in finding maxima and minima in some engineering problems.
3. evaluate multiple integrals in Cartesian and Polar coordinates, and their applications to engineering problems.
4. represent complex numbers in Cartesian and Polar forms and test the analyticity of complex functions by using Cauchy – Riemann equations.

Text Books

1. Thomas, G.B. and Finney, R.L., Calculus and Analytic Geometry, Pearson Education (2007), 9th ed.
2. Stewart James, Essential Calculus; Thomson Publishers (2007), 6th ed.

3. Kasana, H.S., Complex Variables: Theory and Applications, Prentice Hall India, 2005 (2nd edition).

Reference Books

1. Wider David V, Advanced Calculus: Early Transcendentals, Cengage Learning (2007).
2. Apostol Tom M, Calculus, Vol I and II, John Wiley (2003).
3. Brown J.W and Churchill R.V, Complex variables and applications, McGraw Hill, (7th edition)

Evaluation Scheme

Sr. No.	Evaluation elements	Weightage (%)
1	MST	25-30
2	EST	40-45
3	Sessional: (May include the following) Assignment, Regular Lab assessmentand Quizzes, Project (Including report, presentation etc.)	30

Text Books

1. Thomas, G.B. and Finney, R.L., Calculus and Analytic Geometry, Pearson Education (2007), 9th ed.
2. Stewart James, Essential Calculus; Thomson Publishers (2007), 6th ed.
3. Kasana, H.S., Complex Variables: Theory and Applications, Prentice Hall India, 2005 (2nd edition).

Reference Books

1. Wider David V, Advanced Calculus: Early Transcendentals, Cengage Learning (2007).
2. Apostol Tom M, Calculus, Vol I and II, John Wiley (2003).
3. Brown J.W and Churchill R.V, Complex variables and applications, McGraw Hill, (7th edition)

Evaluation Scheme

Sr. No.	**Evaluation elements**	**Weightage (%)**
1	MST	25-30
2	EST	40-45
3	Sessional: (May include the following) Assignment, Regular Lab assessmentand Quizzes, Project (Including report, presentation etc.)	30

SEMESTER-II

Approved in 109th Meeting of Senate held on March 16, 2023

UCB009: Chemistry

L	T	P	Cr
3	0	2	4.0

Course Objective: The course aims at elucidating principles of applied chemistry in industrial systems, water treatment, engineering materials, computational and analytical techniques.

Syllabus

Atomic and Molecular spectroscopy: Introduction to spectroscopy, principles of atomic absorption, flame emission spectrophotometry and ICP-AES (Inductively Coupled Plasma- Atomic Emission Spectroscopy), Quantification by calibration method, Jablonski diagram, fluorescence and phosphorescence, Beer-Lambert's Law, principle and applications of UV-Vis and IR spectroscopy.

Electrochemistry: Background of electrochemistry, Ionic mobility, Conductometric titrations, Modern Batteries: Pb-acid and Li ion battery, Corrosion and its protection.

Water Treatment and Analysis: Physiochemical parameters of water quality, External and internal methods of Softening of water: carbonate, phosphate, calgon and colloidal conditioning, Zeolite process, Ion exchange process, treatment of water for domestic use, Desalination of brackish water: Reverse osmosis & Electrodialysis.

Fuels: Classification of fuels, Calorific value, Cetane and Octane number, alternative fuels: biodiesel, Power alcohol, synthetic petrol, Fuel cells: H2 production and storage, Water splitting, Rocket propellant.

Chemistry of Polymers: Classification of polymers, tacticity of polymers, molecular weight calculations, Polymers in daily life, conducting, inorganic and biodegradable polymers.

Computers in Chemistry: Introduction to SMILES (Simplified Molecular Input Line-Entry System): Methodology and encoding rules, SMILES notation-chemical structure interconversions and its applications.

Laboratory Work

Electrochemical measurements: Experiments involving use of pH meter, conductivity meter, potentiometer, Spectroscopic technique, Volumetric titrations: Determination of mixture of bases, hardness, alkalinity, chloride and iron content, Application of polymers and SMILES Language.

Course Learning Objectives (CLO)
The students will be able to:

1. recognize principles and applications of atomic and molecular spectroscopy.
2. explain the concepts of conductometric titrations, modern batteries and corrosion.
3. apply and execute water quality parameter and treatment methods.
4. discuss the concept of alternative fuels, application of polymers and SMILES

5. execute laboratory techniques like pH metry, potentiometry, spectrophotometry,conductometry and volumetry.

Text Books

1. Engineering Chemistry, S. Vairam and S. Ramesh, Wiley India 1st ed, 2014.
2. Engineering Chemistry, K. S. Maheswaramma, and M. Chugh. Pearson, 2016.

Reference Books

1. Engineering Chemistry, B. Sivasankar, Tata McGraw-Hill Pub. Co. Ltd, New Delhi, 2008.
2. Engineering Chemistry, M.J. Shulz, Cengage Learnings, 2007.
3. J. Chem. Inf. Comput. Sci., D. Weininger, Vol. 28, 1988, 31-36.

Evaluation Scheme

Sr. No.	Evaluation elements	Weightage (%)
1	MST	25-30
2	EST	40-45
3	Sessional: (May include the following) Assignment, Regular Lab assessmentand Quizzes, Project (Including report, presentation etc.)	30

UES103: Programming for Problem Solving

L	T	P	Cr
3	0	2	4.0

Course Objectives: This course is designed to solve and explore the problems using the art of computer programming with the help of C Language. Students will be able to apply these problem solving concepts in real life applications.

Syllabus

Introduction to Computer Fundamentals- Computer Memory Hierarchy, Types of Software Binary number system, Algorithm, Flowchart, Formulate simple algorithms for logical and arithmetic problems.

Basics of C Programming: Structure and Life cycle of a C Program, Data types, Identifiers, Variables, Keywords, Constants, input/output statements, Operators, Type conversion and type casting. Translate the algorithms to code snippets.

Decision Making and Iterative Statements- Decision making- if, if-else, Nested if-else, Multiple if, else if, switch, Ternary Operator, **Loops-** (while, do-while, for), Nesting of Loops, break, continue and goto. Implement the switch () to solve the basic functions of scientific calculator.

Functions: Function prototype, Definition and Call, Type of Functions, Scope of variables in (Block, Function, Program, File), Storage classes (Auto, Register, Static and Extern), Recursion (with the introduction of Stack), Implementation of recursion to solve the problem of Tower of Hanoi.

Arrays and Strings- One-dimensional array its operations (Traversal, Linear Search, Insertion, Deletion, Bubble Sort), Two-dimensional and its operations (Addition, Transpose and Multiplication), Passing of array into a function (row and entire array), Input and output of a string, string inbuilt functions, 2-D Character array.

Pointers: Introduction to Pointers, Pointer arithmetic, Passing arguments to a function using pointer (understanding of call by value and call by reference), Accessing arrays using pointers Dynamic memory allocation (malloc(), calloc(), realloc() and free()), Pointer and Functions.

Structures and Union: Structure declaration, Initialization of structures, Structure variables, Accessing structure elements using (.) operator, Array of structure variables, Passing structure variable to a function (individual and entire structure), Structure pointer, Comparison of Structure and Union.

File Handling: Introduction of Files (streams in C), using File (Declaring, Opening and Closing), Operations on File (Reading, Writing and appending), and Random Access of a

file, command line argument.

Laboratory Work
To implement programs for various kinds of real life applications in C Language.

Course Learning Outcomes (CLOs) /Course Objectives (COs):

On completion of this course, the students will be able to:

1. Comprehend and analyze the concepts of number system, memory, compilation and debugging of the programs in C language.
2. Analyze the control & iterative statements to solve the problems with C language source codes.
3. Design and create programs for problem solving involving arrays, strings and pointers.
4. Evaluate and analyze the programming concepts based on user define data types and file handling using C language.

Text Books

1. C Programming Language, Brian W. Kernighan Dennis M. Ritchie, 2nd ed, 2012.
2. Programming in ANSI C, Balagurusamy G., 8th ed., 2019

Reference Books

1. Let Us C, Kanetkar Y., 16th ed., 2017
2. Programming with C, Byron S Gottfried, McGraw Hill Education, Forth edition, 2018

UES013: Electrical and Electronics Engineering

L	T	P	Cr
3	1	2	4.5

Course Objective: To introduce the basic concepts of electrical and electronics engineering.

Syllabus

DC Circuits: Introduction to circuit elements; rms and average values for different wave shapes, independent and dependent current and voltage sources; Kirchhoff's laws; mesh and node analysis; source transformations; network theorems: Superposition theorem, Thevenin's and Norton's theorem, Maximum power transfer theorem; star-delta transformation; steady state and transient response of R-L and R-C and R-L-C circuits.
AC Circuits: Concept of phasor, phasor representation of circuit elements; analysis of series and parallel AC circuits; concept of real, reactive and apparent powers; resonance in RLC series and parallel circuits; balanced three phase circuits: voltage, current and power relations for star and delta arrangement; analysis of balanced and unbalanced circuits; three phase power measurement using two-wattmeter and one-wattmeter methods.
Magnetic circuits: analogy between electric and magnetic circuits; series and parallel magnetic circuits; operating principles of electrical appliances: single-phase transformer and rotating machines; tests and performance of single-phase transformer.

Digital Logic Design: Digital signals, Number systems, Positive and negative representation of numbers, Signed-number representation, Binary arithmetic, Postulates and theorems of Boolean Algebra, Algebraic simplification, Sum of products and product of sums formulations (SOP and POS), Gate primitives, Logic Gates and Universal Gates, Minimization of logic functions, Karnaugh Maps, Logic implementation using Gates, Decoder, MUX, Flip-Flops, Asynchronous up/down counters.

Electronic Devices: p- n junction diode: V-I characteristics of diode, Operation of Bipolar Junction Transistor, CB and CE configuration, Transistor as a switch, Operation of SCR, DIAC and TRIAC.

Operational Amplifier Circuits: The ideal operational amplifier, the inverting, non-inverting amplifiers, Op-Amp Characteristics, Applications of Op-amp: summing amplifier, differentiator and integrator.

Laboratory Work: Kirchhoff's laws, network theorems, ac series and parallel circuit, three phase power measurement, magnetic circuit, tests on transformer, resonance in AC circuit, combinational circuits, flip flops, shift register and binary counters, asynchronous and synchronous up/down counters, BJT characteristics.

Course Learning Objectives (CLO)

The students will be able to:

1. apply various networks laws and theorems to solve dc circuits
2. compute different ac quantities with phasor representation
3. comprehend the operation in magnetic circuits, single phase transformer and rotating machines
4. recognize and apply the number systems and Boolean algebra.
5. reduce and simplify Boolean expressions and implement them with logic gates.
6. discuss and explain the working of diode, transistor and operational amplifier, their configurations and applications.

Text Books

1. Hughes, E., Smith, I.M., Hiley, J. and Brown, K., Electrical and Electronic Technology, Prentice Hall (2008) 10th ed.
2. Nagrath, I.J. and Kothari, D.P., Basic Electrical Engineering, Tata McGraw Hill (2002).
3. Boylestad, R.L. and Nashelsky, L., Electronic Devices & Circuit Theory, Perason (2009).
4. Mano M. M. and Ciletti, M.D., Digital Design, Pearson, Prentice Hall, (2013).

Reference Books

1. 1. Chakraborti, A., Basic Electrical Engineering, Tata McGraw−Hill (2008).
2. Del Toro, V., Electrical Engineering Fundamentals, Prentice−Hall of India Private Limited (2004).
3. David Bell, Electronics Devices and Circuits, Oxford Publications (2009).

Evaluation Scheme

Sr. No.	Evaluation elements	Weightage (%)
1	MST	25-30
2	EST	40-45
3	Sessional: (May include the following) Assignment, Regular Lab assessmentand Quizzes, Project (Including report, presentation etc.)	30

UEN008: Energy and Environment

L	T	P	Cr
2	0	0	2.0

Course Objective: The exposure to this course would facilitate the students in understanding the terms, definitions and scope of environmental and energy issues pertaining to current global scenario; understanding the need of sustainability in addressing the current environmental & energy challenges.

Syllabus

Introduction: Concept of sustainability and sustainable use of natural resources, Climate Change & its related aspects.

Air Pollution: Origin, Sources and effects of air pollution; Primary and secondary meteorological parameters; wind roses; Atmospheric stability; Source reduction and Air Pollution Control Devices for particulates and gaseous pollutants in stationary sources.

Water Pollution: Origin, Sources of water pollution, Category of water pollutants, Physicochemical characteristics, Components of wastewater treatment systems.

Solid waste management: Introduction to solid waste management, Sources, characteristics of municipal solid waste, Solid waste management methods: Incineration, composting, landfilling.

Energy Resources: Classification of Energy Resources; Non-conventional energy resources-Biomass energy, Thermo-chemical conversion and biochemical conversion route; Solar energy-active and passive solar energy absorption systems; Type of collectors; Thermal and photo conversion applications.

Course Learning Objectives (CLO)
The students will be able to:

1. comprehend the interdisciplinary context of environmental issues with reference to sustainability
2. assess the impact of anthropogenic activities on the various elements of environment and apply suitable techniques to mitigate their impact.
3. demonstrate the application of technology in real time assessment and control of pollutants.
4. correlate environmental concerns with the conventional energy sources associated and assess the uses and limitations of non-conventional energy technologies

Text Books

1. Moaveni, S., Energy, Environment and Sustainability, Cengage (2018)
2. Rajagopalan, R., Environmental Studies, Oxford University Press (2018)
3. O'Callagan, P.W., Energy Management, McGraw Hill Book Co. Ltd. (1993).

Reference Books

1. Peavy H.S., Rowe D.S., and Tchobanoglous, G. (2013) Environmental Engineering, McGraw Hill.
2. Rao, M.N. and Rao, H.V.N. (2014) Air Pollution, McGraw Hill.
3. Metcalf and Eddy. (2003) Wastewater Engineering: Treatment and Reuse, FourthEdition, McGraw Hill.
4. Rai, G.D. (2014) Non-conventional Energy Resources, Khanna Publishers.

Evaluation Scheme

Sr. No.	**Evaluation elements**	**Weightage (%)**
1	MST	25-30
2	EST	40-45
3	Sessional: (May include the following) Assignment, Regular Lab assessmentand Quizzes, Project (Including report, presentation etc.)	30

UMA023: Differential Equations and Linear Algebra

L	T	P	Cr
3	1	0	3.5

Course Objective: To introduce students the theory and concepts of differential equations, linear algebra, Laplace transformations and Fourier series which will equip them with adequate knowledge of mathematics to formulate and solve problems analytically.

Syllabus

Ordinary Differential Equations: Review of first order differential equations, Exact differential equations, Second and higher order differential equations, Solution techniques using one known solution, Cauchy - Euler equation, Method of undetermined coefficients, Variation of parameters method, Engineering applications of differential equations.

Laplace Transform: Definition and existence of Laplace transforms and its inverse, Properties of the Laplace transforms, Unit step function, Impulse function, Applications to solve initial and boundary value problems.

Fourier Series: Introduction, Fourier series on arbitrary intervals, Half range expansions, Applications of Fourier series to solve wave equation and heat equation.

Linear Algebra: Row reduced echelon form, Solution of system of linear equations, Matrix inversion, Linear spaces, Subspaces, Basis and dimension, Linear transformation and its matrix representation, Eigen-values, Eigen-vectors and Diagonalisation, Inner product spaces and Gram-Schmidt orthogonalisation process.

Course Learning Objectives (CLO)
The students will be able to:

1. solve the differential equations of first and 2nd order and basic application problems described by these equations.
2. find the Laplace transformations and inverse Laplace transformations for various functions. Using the concept of Laplace transform students will be able to solve the initial value and boundary value problems.
3. find the Fourier series expansions of periodic functions and subsequently will be able to solve heat and wave equations.
4. solve systems of linear equations by using elementary row operations.
5. identify the vector spaces/subspaces and to compute their bases/orthonormal bases. Further, students will be able to express linear transformation in terms of matrix and find the eigenvalues and eigenvectors.

Text Books

1. Simmons, G.F., Differential Equations (With Applications and Historical Notes), Tata McGraw Hill (2009).
2. Krishnamurthy, V.K., Mainra, V.P. and Arora, J.L., An introduction to Linear Algebra, Affiliated East West Press (1976).

Reference Books

1. Kreyszig Erwin, Advanced Engineering Mathematics, John Wiley (2006), 8th edition.
2. Jain, R.K. and Iyenger, S.R.K., Advanced Engineering Mathematics, Narosa Publishing House (2011), 4th edition.

Evaluation Scheme

Sr. No.	Evaluation elements	Weightage (%)
1	MST	25-30
2	EST	40-45
3	Sessional: (May include the following) Assignment, Regular Lab assessmentand Quizzes, Project (Including report, presentation etc.)	30

SEMESTER-III

Approved in 109th Meeting of Senate held on March 16, 2023

UCE311: FLUID MECHANICS

*: Lab every alternate week	L	T	P	Cr
	3	1	2*	4.0

Course Objective: To understand basic concepts of fluid flow and their applications in solving engineering problems.

Introduction: Definition of a fluid and its properties, Types of fluids.
Fluid statics: Differential equation of pressure field, Pascal law, Measurement of fluid pressure, force on submerged surfaces, Buoyancy and Flotation.
Fluid kinematics: Methods of describing fluid motion, Velocity and acceleration of a fluid particle, Type of fluid flows, Displacement of a fluid particle, Continuity equation, Velocity potential and stream function, Flow net.
Fluid dynamics: Euler's equation; Bernoulli's equation; Momentum equation; Applications, Kinetic energy and momentum correction factors.
Flow though pipes: Energy losses, Hydraulic gradient line and total energy line, Concept of equivalent pipe, Pipes in series and parallel, Flow through a siphon, and Transmission of power.
Flow measuring devices: Venturimeter, Orifice meter, orifice, Pitot tube, Time of emptying tanks of different cross-sections.
Dimensional analysis: Methods of dimensional analysis, Model studies.
Pumps and Turbines: Introduction to various types of pumps and turbines.
Laboratory Work:
Verification of Bernoulli's Theorem, Calibration of venturimeter/orifice meter**,** Determination of hydrostatic force and its location on a vertically immersed surface, Determination of friction factor for pipes of different materials, Determination of hydraulic coefficients of an orifice, Verification of momentum equation, Visualization of laminar and turbulent flow.

Course Learning Objectives (CLO)
The students will be able to:

1. Analyse and solve problems of simple fluid based engineering systems including pressures and forces on submerged surfaces.
2. Analyse fluid flow problems with the application of the mass, momentum and energy equations.
3. Evaluate practical problems associated with pipe flow systems.
4. Analyse the significant variables in hydraulic problems and to predict the performance of hydraulic prototypes.

Text Books

1. Fluid Mechanics, *Streeter*, V.L., *Wylie* E. B. and Bedford, K.W., McGraw Hill Book Company, 9th Edition, 2017.
2. Fluid Mechanics including hydraulic machines, Jain, A. K., Khanna Publisher, 9th Edition, 1998.
3. Fluid Mechanics and Fluid Power Engineering, Kumar D.S., S. K. Kataria, 9th Edition, 2015.

Reference Books

1. Theory and Application of Fluid Mechanics, Subramanya, K., Tata McGraw Hill, 1st Edition, 2010.
2. Hydraulics and Fluid Mechanics *Modi* P.N. and *Seth* S.M., Standard Book House, 22nd Edition, 2019.
3. Mechanics of Fluid Shames I. H., McGraw Hill, 4th Edition, 2002.
4. Introduction to Fluid Mechanics, Fox, R.W. and McDonald A.T., John Wiley and Sons. 10th Edition, 2020.

Evaluation Scheme

Sr. No.	Evaluation elements	Weightage (%)
1	MST	25
2	EST	40
3	Sessional: (May include the following) Assignment, Regular Lab assessmentand Quizzes, Project (Including report, presentation etc.)	35

UCE306: ARCHITECTURE DRAWING AND BUILDING CONSTRUCTION

L	T	P	Cr
2	0	2	3.0

Course Objective: To expose students to the concepts of architectural drawings and building construction.

Introduction to Architecture Drawing: Proportion, orientation, building bye laws, site plan, building layout, Architectural and structural working drawings, Modular co-ordination and drawing on modules,

Building structures: Various building components in load bearing and framed structures.

Building information modelling (BIM): Introduction to BIM and basics of modelling.

Foundations: *Shallow foundations:* Continuous, spread, arch, combined, cantilevered, Raft, Grillage, *Deep foundations:* Piles & wells, Footings in block cotton soil, Basement & Retaining walls

Masonry: Stone, Brick & Concrete Block masonry, Bonds and junctions, Walling, Mud wall, Sun-dried bricks, burnt bricks, stones walling, load bearing & non load bearing brick masonry, panel wall and reinforced masonry for multi-storied construction.

Special treatments: Damp Proof Course, points of its requirement in buildings, D.P.C. at Plinth level, in basement and roof tops etc., waterproofing treatments, anti-termite treatment, heat and acoustic insulation of buildings

Lintels & Arches: Location and construction details in wood, brick, stone and R.C.C.

Stairs & Stair cases: Suitability of location, stairs in multistoried buildings, Residential and public buildings, Fire escape, Stairs in timber, stone, brick, RCC and Metal Drawings in Plan elevation and sections. Hand rail & railings, description and sketches of lifts escalators.

Doors & Windows: Details, Location in buildings, sizes, Door-window schedule & construction for wooden & metal, Battened braced, framed, flush and paneled, sliding, folding telescopic, with louvers, collapsible, Revolving doors, Aluminum doors, etc. Windows in timber, aluminium frame & metal casement, double hung, Dormer, Corner, Fanlight, skylight, clear storey etc., and low-cost ideas.

Roofing and Flooring: Types of flooring, Flat roofs: Waffle floor, wooden flooring, channels, cored units etc, inclined roofs.

Miscellaneous: Formwork, scaffolding, underpinning.

Precast and Prefabricated Elements: Pre-engineered buildings (PEB), Prefabricated Prefinished Volumetric Construction (PPVC), Prefabricated components, Assembly at site, joints in prefabricated construction, low-cost housing &hollow blocks.

Laboratory Work

Modelling of building layout and building components in BIM based software

- A two-storey building plan with three/four rooms: Plan, Elevations & Section (Modular), Site Plan (Application of Bye laws), Foundation for walls – Construction details, Proposed doors and windows – Construction details, Roof & floor – details, in construction Stair case details
- Drawings of all the above building components e.g. Brick masonry bonds and junctions, DPC, Lintels and Arches, Stairs, Doors & Windows, Roof &roof coverings
- Drawing and detailing of typical building components

Course Learning Objectives (CLO)

The students will be able to:

1. Plan and draw constructional details of different building components
2. Capable of working with an architect and contractor
3. Prepare building plans and other components for a project
4. Capable of supervise building constructions

Text Books

1. Building Construction and Materials, Singh, Gurcharan, Standard Book House (2019).
2. Building Construction, Sharma, S. K., S. Chand and Company (2012).

Reference Books

1. Building Construction, Kumar, Sushil, Standard Publisher and Distributors (2020).
2. Building Construction, Punima, B. C., Laxmi Publishing House (2002).
3. A Text Book of Building Construction, Sharma and Kaul, S., Chand and Company (1987).
4. National Building Code, Volume-I and Volume-II, Bureau of Indian Standards (2016)
5. IS: 962: Code of Practice for Architectural and Building Drawings, Bureau of Indian Standards (2001)

Evaluation Scheme

Sr. No.	Evaluation Elements	Weights (%)
1.	MST	25
2.	EST	35
3.	Sessionals (May include Assignments/Projects/Tutorials/Quizzes/Lab Evaluations)	40

UCE309: BUILDING MATERIALS

L	T	P	Cr
2	0	2	3.0

Course Objective: To expose students to the various building and general construction products and their associated quality, durability and availability.

Cement: Manufacturing, raw ingredients, chemical and mineralogical composition and types of cement.
Aggregates: Classification of aggregates, application and advantages of Manufactured Sand.
Cement mortar and concrete: Classification, properties and applications, water cement ratio, fresh, mechanical and durability properties of concrete.
Production of Concrete: Batching, mixing, transportation, placing, compaction and curing of concrete, quality control of concrete, concrete mix design.
Special concrete: Introduction to fibre-reinforced concrete, self healing concrete, lightweight concrete.
Chemical admixtures: Accelerating admixture, water reducing admixture, retarding admixture, air-containing admixture.
Bricks and blocks: Classification and characteristics of bricks, AAC blocks, hollow concrete blocks.
Steel: Manufacturing of steel, market forms of steel, classification of reinforcing steel bars
Miscellaneous building materials: Timber, glass, plastic, water proofing materials, paints and varnishes.
Emerging civil engineering materials: Introduction to refractories, laminate, adhesives, graphene and carbon composites.

Laboratory Work

1. Tests on cement (fineness, specific gravity, consistency and strength test).
2. Tests on fine and coarse aggregates (gradation, specific gravity, water absorption).
3. Design of concrete mix for required grade of concrete.
4. Tests on fresh concrete (workability test).
5. Tests on hardened concrete (compressive strength, flexural strength and split tensile strength).

Experiential Learning (ELC) Activity

Casting of concrete canoe using innovative lightweight concrete.

Course Learning Objectives (CLO)

The students will be able to:

1. Design the mix proportions for required grade of concrete.
2. Assess the quality of procured materials such as bitumen, asphalt, insulating materials, glass, and water proofing materials, paints and varnishes on site.
3. Evaluate the quality of building materials such as timber and steel.
4. Perform experiments in laboratory to evaluate properties of construction materials such as cement, aggregate, mortar and concrete.

Text Books

1. Gambhir M. L., Concrete Technology, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2004.
2. Rangawala S. C., Engineering Materials, Charotar Publishing House, Anand, 1992.
3. Chaudhary S. C., Patel K. A., Testing & Evaluation of Civil Engineering Materials, All India Council for Technical Education (AICTE), 2023.

Reference Books

1. Shetty M. S., Concrete Technology: Theory and Practice, S. Chand & Company, 2010.
2. Kumar Sushil, Engineering Materials, Metropolitan Press, 1994.
3. Kumar Sushil, Building Construction, Standard Publishers and Distributors, 1990.
4. Punmia B. C., Building Construction, Laxmi Publishing House, 1993.

Evaluation Scheme

Sr. No.	Evaluation elements	Weightage (%)
1	MST	25
2	EST	35
3	Sessional: (May include the following) Assignment, Regular Lab assessmentand Quizzes, Project (Including report, presentation etc.)	40

UCE312 :SOLID MECHANICS

L	T	P	Cr
3	1	2*	4.0

*** Lab every alternate week**

Course Objective: This subject introduces fundamental concepts of structural mechanics to solve general engineering mechanics problems. It aims to develop an understanding of the stresses strains and deformations that develop in solid materials when they are subjected to different types of loading and to develop an understanding of the conditions at failure of such materials.

Introduction of equilibrium of bodies: Concept of Free-body diagrams and conditions of equilibrium of bodies, static determinacy.

Plane Trusses: Forces in members of a truss by method of joints and method of sections.

Axial Stress and Strain: Concept of stress, strain, elasticity and plasticity; one-dimensional stress-strain relationships; statically determinate and indeterminate problems, compound and composite bars.

Shear Force and Bending Moment Diagrams: Types of load on beams, classification of beams; axial, shear force and bending moment diagrams: simply supported, overhanging and cantilever beams subjected to any combination of point loads, uniformly distributed and varying load and moment.

Bending & Shear Stresses in beams: Derivation of flexural formula for straight beams, concept of centroid and second moment of area, bending stress calculation for beams of simple and built up sections, flitched beams. Shear stress formula for beams, shear stress distribution in beams.

Deformations: Governing differential equation for deflection of straight beams having constant flexural rigidity, Double Integration, Macaulay's, Moment Area and Conjugate Beam method for determining slopes and deflection in beams.

Laboratory Work

1. To find out the tensile strength of ductile materials (MS/Al) and plot its stress-strain characteristics.
2. To determine impact strength of ductile and brittle materials.
3. Experimental verification of theory of bending (calculation of bending stress and deflections at various points in the beam theoretically and verifying the same experimentally) and indirect evaluation of the modulus of elasticity.
4. To determine the hardness of different types of materials

Course Learning Objectives (CLO)

Upon completion of this course, the students will be able to:

1. Identify and quantify all forces associated with a static framework/ plane force systems.
2. Evaluate axial stresses and strains in various determinate and indeterminate structural systems.
3. Draw shear force diagram and bending moment diagram in various kinds of beams subjected to different kinds of loads.
4. Evaluate the different types of stresses (Bending/Shear) in flexural members.
5. Determine deformations and deflections in various kinds of beams.

Text Books

1. Engineering Mechanics of Solids, E.P. Popov and T.A. Balan, Pearson India Education Services, 2018.
2. Strength of Materials, D.K. Singh, Springer International Publishing, Fourth edition, 2020.

Reference Books

1. Mechanics of materials, R. C. Hibbeler, Pearson, Tenth edition, 2016.
2. Mechanics of materials, F.P. Beer, E.R. Johnston, D. Mazurek, McGraw-Hill Higher Education, 2011.

Evaluation Scheme

Sr. No.	Evaluation elements	Weightage (%)
1	MST	25
2	EST	35
3	Sessional: (May include the following) Assignment, Regular Lab assessmentand Quizzes, Project (Including report, presentation etc.)	40

UMA035: OPTIMIZATION TECHNIQUES

L	T	P	Cr
3	0	2	4.0

Course Objective: The main objective of the course is to formulate mathematical models and to understand solution methods for real life optimal decision problems. The emphasis will be on basic study of linear and non-linear programming problems, Integer programming problem, Transportation problem, Two person zero sum games with economic applications and project management techniques using CPM.

Scope of Operations Research: Introduction to linear and non-linear programming formulation of different models.

Linear Programming: Geometry of linear programming, Graphical method, Linear programming (LP) in standard form, Solution of LP by simplex method, Exceptional cases in LP, Duality theory,Dual simplex method, Sensitivity analysis.

Integer Programming: Branch and bound technique, Gomory's Cutting plane method.

Network Models: Construction of networks, Network computations, Free Floats, Critical path method (CPM), optimal scheduling (crashing). Initial basic feasible solutions of balanced and unbalanced transportation problems, optimal solutions, assignment problem.

Multi-objective Programming: Introduction to multi-objective linear programming, efficient solution, efficient frontier.

Nonlinear Programming:

Unconstrained Optimization: unimodal functions, Fibonacci search method, Steepest Descent method.

Constrained Optimization: Concept of convexity and concavity, Maxima and minima of functions of n-variables, Lagrange multipliers, Karush-Kuhn-Tucker conditions for constrained optimization

Laboratory Work: Lab experiments will be set in consonance with materials covered in the theory Using **Matlab**.

Course learning outcome: Upon Completion of this course, the students would be able to:

1. formulate the linear and nonlinear programming problems.
2. solve linear programming problems using Simplex method and its variants.
3. construct and optimize various network models.
4. construct and classify multi-objective linear programming problems.
5. solve nonlinear programming problems.

Text Books:

1. Chandra, S., Jayadeva, Mehra, A., Numerical Optimization and Applications, Narosa Publishing House, (2013).
2. Taha H.A., Operations Research-An Introduction, PHI (2007).

Recommended Books:

1. Pant J. C., Introduction to optimization: Operations Research, Jain Brothers (2004)
2. Bazaarra Mokhtar S., Jarvis John J. and ShiraliHanif D., Linear Programming and Network flows, John Wiley and Sons (1990)
3. Swarup, K., Gupta, P. K., Mammohan, Operations Research, Sultan Chand & Sons, (2010).
4. H.S. Kasana and K.D. Kumar, Introductory Operations research, Springer publication,

(2004)
5. Ravindran, D. T. Phillips and James J. Solberg: Operations Research- Principles and Practice, John Wiley & Sons, Second edn. (2005).

Evaluation Scheme

Sr. No.	Evaluation elements	Weightage (%)
1	MST	30
2	EST	45
3	Sessional: (May include the following) Assignment, Regular Lab assessmentand Quizzes, Project (Including report, presentation etc.)	25

UES012: ENGINEERING MATERIALS

L	T	P	Cr
3	1	2	4.5

Course Objective: To provide basic understanding of engineering materials, their structure and the influence of structure on mechanical, chemical, electrical and magnetic properties

Structure of solids: Classification of engineering materials, Structure-property relationship in engineering materials, Crystalline and non-crystalline materials, Miller Indices, Crystal planes and directions, Determination of crystal structure using X-rays, Inorganic solids, Silicate structures and their applications. Defects;Point, line and surface defects.

Mechanical properties of materials: Elastic, Anelastic and Viscoelastic behaviour, Engineering stress and engineering strain relationship, True stress - true strain relationship, review of mechanical properties, Plastic deformation by twinning and slip, Movement of dislocations, Critical shear stress, Strengthening mechanism, and Creep.

Equilibrium diagram: Solids solutions and alloys, Gibbs phase rule, Unary and binary eutectic phase diagram, Examples and applications of phase diagrams like Iron - Iron carbide phase diagram.

Electrical and magnetic materials: Conducting and resister materials, and their engineering application; Semiconducting materials, their properties and applications; Magnetic materials, Soft and hard magnetic materials and applications; Superconductors; Dielectric materials, their properties and applications. Smart materials: Sensors and actuators, piezoelectric, magnetostrictive and electrostrictive materials.

Corrosion process: Corrosion, Cause of corrosion, Types of corrosion, Protection against corrosion.

Materials selection: Overview of properties of engineering materials, Selection of materials for different engineering applications.

Laboratory Work and Micro-Project:

Note: The micro-project will be assigned to the group(s) of students at the beginning of the semester. Based
on the topic of the project the student will perform any of the six experiments from the following list:

1. To determine Curie temperature of a ferrite sample and to study temperature dependence of permeability in the vicinity of Curie temperature.
2. To study cooling curve of a binary alloy.
3. Determination of the elastic modulus and ultimate strength of a given fiber strand.
4. To determine the dielectric constant of a PCB laminate.
5. Detection of flaws using ultrasonic flaw detector (UFD).
6. To determine fiber and void fraction of a glass fiber reinforced composite specimen.
7. To investigate creep of a given wire at room temperature.
8. To estimate the Hall coefficient, carrier concentration and mobility in a semiconductor crystal.
9. To estimate the band-gap energy of a semiconductor using four probe technique.
10. To measure grain size and study the effect of grain size on hardness of the given metallic specimens.

Course Outcomes: Student will be able to:
1. classify engineering materials based on its structure.
2. draw crystallographic planes and directions.
3. distinguish between elastic and plastic behavior of materials.
4. distinguish between isomorphous and eutectic phase diagram.
5. classify materials based on their electrical and magnetic properties.
6. propose a solution to prevent corrosion.

Text Books:
1. W.D. Callister , Materials Science and Engineering; John Wiley & Sons, Singapore, 2002.
2. W.F. Smith, Principles of Materials Science and Engineering: An Introduction; Tata Mc-Graw Hill, 2008.
3. V. Raghavan, Introduction to Materials Science and Engineering; PHI, Delhi, 2005.

Reference Books:
1. S. O. Kasap, Principles of Electronic Engineering Materials; Tata Mc-Graw Hill, 2007.
2. L. H. Van Vlack, Elements of Material Science and Engineering; Thomas Press, India, 1998.
3. K. G. Budinski, Engineering Materials – Properties and selection, Prentince Hall India, 1996

Evaluation Scheme

Sr. No.	Evaluation elements	Weightage (%)
1	MST	25
2	EST	35
3	Sessional: (May include the following) Assignment, Regular Lab assessmentand Quizzes, Project (Including report, presentation etc.)	40

SEMESTER-IV

Approved in 109th Meeting of Senate held on March 16, 2023

UCE303 :STRUCTURAL ANALYSIS

L	T	P	Cr
3	1	2	4.5

Course Objective: This course aims to develop an understanding of techniques of structural analysis to calculate displacements of statically determinate and indeterminate structures. This subject also introduces the concept of drawing influence line diagrams for determinate structures.

Displacements: Energy Methods: Strain energy in members, Betti's and Maxwell's Laws of reciprocal deflections, Castigliano's theorems, Unit load method for 2D-frames.
Indeterminate structures: Introduction, Static and kinematic indeterminacies, Stability of structures, internal forces in two and three-dimensional structures.
Analysis of Indeterminate Beams and Frames: Classical Methods: Theorem of three moments Methods of consistent deformation, Introduction to development of flexibility matrix; Conventional methods: Slope deflection method, Moment Distribution method, Introduction to development of stiffness matrix.
Moving Loads and Influence Line Diagrams for Statically Determinate Structures: Bending moment and shear force diagrams due to single and multiple concentrated rolling loads and uniformly distributed moving loads, equivalent UDL, shear force and bending moment envelopes.

Laboratory Work:
List of experiments:
1. To study the variation of BM at different locations in a simply supported beam.
2. To calculate deflections in a simply supported and cantilever beam.
3. To plot the deflected shape of a simply supported beam under constant load at centre as length varies.
4. To find the deflection of a pin connected truss.
5. Experimental project/assignment/micro-project: Students in a group of 4-5 students will do a mini-project based on modeling and analysis of indeterminate frames.

Course Learning Objectives (CLO)
Upon completion of this course, the students will be able to:
1. Calculate deformation of statically determinate structures.
2. Analyze statically indeterminate beams using classical and conventional methods.
3. Develop qualitative diagrams showing the displaced shape, bending moments and support reactions for an indeterminate structure.
4. Draw influence line diagrams for statically determinate beams.

Text Books
1. Structural Analysis, R. C. Hibbeler, Pearson Prentice Hall, Eighth edition, 2012.
2. Basic Structural Analysis, CS Reddy, Tata Mc Graw Hill, Third edition, 2011.

Reference Books
1. Advanced Structural Analysis, P. Dayaratnam, Tata McGraw Hill Publishers, 1983.
2. Theory of Structures, B.C. Punmia and A.K. Jain, Luxmi Publications 2003

Evaluation Scheme

Sr. No.	Evaluation elements	Weightage (%)
1	MST	25
2	EST	35
3	Sessional: (May include the following) Assignment, Regular Lab assessmentand Quizzes, Project (Including report, presentation etc.)	40

UCE405: SURVEYING

L	T	P	Cr
3	0	3	4.5

Course Objective: Surveying as a subject in civil engineering aims to provide basic knowledge about principles of surveying for a location, and its application in design and construction of engineering projects. The students develop skills using surveying instruments including measuring tapes, theodolites, and advanced measurement equipment such as total stations.

Surveying: Definition, classification of surveys, Principle, distorted or shrunk scales, precision in surveying.

Chain Surveying: Types of chains, tapes, ranging–direct & indirect, chaining on sloping ground, mistakes in chaining, corrections for linear measurements. Reconnaissance, station selection, limiting length of offsets, field notes.

Compass Traversing: Types of compasses, bearings, meridians, declination, dip of magnetic needle, bearing of lines from included angles, local attraction, closing error and its removal.

Theodolite: Types of theodolites, measurement of angles, temporary and permanent adjustments, closed & open traverse, omitted measurements, consecutive and independent co-ordinates, advantages and disadvantages of traversing closing error, Bowditch & Transit Rules

Leveling: Definitions of terms used in leveling, different types of levels, parallax, staff, temporary adjustments, bench marks, booking and reducing the levels, rise and fall method, line of collimation method, errors in leveling, permanent adjustments, corrections to curvature and refraction, setting out grades.

Contours: Definition, representation of reliefs, horizontal equivalent, contour interval, characteristics of contours, methods of contouring, contour gradient, uses of contour maps. Plane Table Surveying: Introduction to plane table surveying, principle, instruments, working operations, setting up the plane table, centering, leveling, Orientation, methods of plane table survey, two- and three-point problems, danger circle, Lehmann's Rules, errors.

Tacheometry: Definitions and terms used in tacheometry, determination of constants, angular tacheometry with staff vertical and staff inclined, Merits and Demerits; Analytic lens, tangential method of tachometry, subtense method of tacheometry.

Trigonometric Leveling: Definitions & terms, curvature & refraction Methods: direct & reciprocal, eye and object correction, coefficient of refraction.

Curves setting: Definition, elements of a simple curve, different methods of setting out a simple circular curve, elements of a compound curve, reverse curves, transition curves, their characteristics and setting out, vertical curves, setting out vertical curves, sight distances.

Total Station: Working principle and survey with total station.

Global Positioning Systems (GPS): Working principle, Types of GPS, Corrections, Application of GPS. DGPS-working principle.

Digital Elevation model: Introduction and application

Field astronomy: Introduction, basic principle, and application

Remote sensing: Basic concepts, Principle, and applications Photogrammetry: Concepts and application for map preparation

Laboratory Work

1. Measurement of distances/offsets, and bearings with chain and tape, and compass
2. Levelling Exercises.
3. Measurement of vertical and horizontal angles with theodolite.
4. Tacheometric Survey and determination of tacheometric constants.
5. Plane table survey of an area.
6. Setting out curves.
7. Surveying with Total Station.
8. Survey with DGPS

Course Learning Objectives (CLO)

The students will be able to:

1. Measurement of linear distances with various instruments.
2. Measurement of angles with various instruments.
3. Prepare map of an area surveyed
4. Measure topographical features of an area and prepare topographic map.
5. Setting out of curves.

Text Books

1. Anderson and Mikhail. Surveying Theory and Practice, 7th Edition, McGraw Hill Education (2012)
2. Duggal, S.K. Surveying, Vol.I and II, 5th Edition, (2019)
3. Subramanian,R. Surveying and Levelling,Oxford 2nd edition (2012)
4. Venkatramaiah,C.,A Text Book of Surveying, Universities Press(2011)

Reference Books

1. Punmia, B.C., Jain, Ashok Kumar and Jain, Arun Kumar, Surveying Vol.I and II, Laxmi Publications(2005)
2. Agor,R., Surveying, Khanna Publishers (1991)
3. Singh,Narinder, Surveying,Tata McGraw Hill (1992)

Evaluation Scheme

Sr. No.	Evaluation elements	Weightage (%)
1	MST	25
2	EST	35
3	Sessional: (May include the following) Assignment, Regular Lab assessmentand Quizzes, Project (Including report, presentation etc.)	40

UCE406 :DESIGN OF CONCRETE STRUCTURES

L	T	P	Cr
3	1	2*	4.0

Course Objective: To expose the students to design philosophies & methodologies of various methods of design for reinforced concrete elements

Introduction*:* Reinforced concrete, definition, properties of materials, grades of concrete and reinforcing steel, stress-strain curves, permissible stresses, design philosophies: working stress design, ultimate strength and limit state design method.

Limit State Design Method: Introduction, Limit States, Characteristic values, characteristic strength, characteristic loads, design values for materials and loads, factored loads.

Limit State of Collapse (Flexure): Types of failures, assumptions for analysis and design of singly reinforced, doubly reinforced, and flanged sections, Design of Lintels, Design of one-way slabs and two-way rectangular slabs.

Limit State of Collapse (Shear, bond and torsion): Introduction - Design for shear, structural components subjected to torsion, design of rectangular beam section for torsion, development length, the continuation of reinforcement (beyond cut-off points).

Limit State of Serviceability*:* Deflection, effective span to effective depth ratio, modification factors for singly reinforced, doubly reinforced and flanged beams, crack formation and its control

Limit State of Collapse (Compression): Columns and their classification, reinforcement in columns, assumptions, short and long (both tied and helical) columns subjected to axial load, short columns subject to axial, uniaxial and biaxial bending, Interaction Diagrams

Limit State Design of miscellaneous structures: Design of isolated footings, Design of staircases.

Introduction to Working Stress Design Method

Application of SP 16 and Detailing of Reinforcement: Use of SP: 34, Codal Provision for RC Elements: (I) General (II) for ductility.

Laboratory Work (if applicable)

Project would be based on "Design of Concrete Mixes of Different Grades, Study of Strength Properties and Flexural Behaviour of RCC Beams"

1. Design and development of Concrete Mix of a particular Grade of concrete
2. At the age of 28 days, measurement of properties such as Compressive Strength, Splitting Tensile Strength, Flexural strength, and Modulus of Elasticity. Plot the stress-strain curve of concrete at 28 days of age and Reinforcing Steel
3. Study of behaviour of any one type of RCC beams made of the same grade of concrete, subjected to flexural loading.

a. Balanced Section
b. Under-reinforced Section
c. Over-reinforced Section

Course Learning Objectives (CLO)

Upon completing this course, the students can:

1. Analyse the flexural members.
2. Design and Detail the flexural member with consideration for deflection, shear, bond and torsion
3. Design and detail compression members
4. Design other elements such as footings, stair-case

Text Books

1. Reinforced Concrete Design, Gambhir, M. L., Prentice Hall of India(2013).
2. Limit State Design of Reinforced Concrete, Jain, A. K., Arun K. Jain, Dr. Punmia, Laxmi Publications (2007).
3. Limit State Design, Ram Chandra, Standard Book House (2011).
4. Limit State Design of Reinforced Concrete Structures, P. Dayaratnam, P Sarah, Meditech, 2nd Edition, 2017
5. Design of Reinforced Concrete Structures, N. Subramanian, Oxford University Press, (2013)

Reference Books

1. Reinforced Concrete Design, Pillai &Menon, Tata McGraw Hill Publishers(2022).
2. Limit State Design of Reinforced Concrete, Varghese, P. C., Prentice Hall of India(2008).
3. Fundamentals of Reinforced Concrete, Sinha, S. N. and Roy, S Chand Publishers(2014)

Evaluation Scheme

Sr. No.	Evaluation elements	Weightage (%)
1	MST	25
2	EST	35
3	Sessional: (May include the following) Assignment, Regular Lab assessmentand Quizzes, Project (Including report, presentation etc.)	40

UMA012: NUMERICAL AND STATISTICAL COMPUTATIONS

L	T	P	Cr
3	0	2	4.0

Course Objective: The main objective of this course is to understand and implement various numerical and statistical methods to solve civil engineering problems.

Basic of Errors: Floating-point representation, rounding and chopping errors.
Non-Linear Equations: Bisection, Newton - method for simple and multiple roots and order of convergence.
Linear Systems and Eigen-Values: Gauss elimination method using partial pivoting, Gauss--Seidel method, Rayleigh's power method for eigen-values and eigen-vectors of matrix.
Interpolation and Approximations: Lagrange (with error analysis), Newton's divided difference and forward difference interpolation formulas**.**
Numerical Integration: Newton-Cotes quadrature formulae (Trapezoidal and Simpson's rules) and their error analysis**.**
Differential Equations: Solution of initial value problems using Euler's, Modified Euler's and Runge - Kutta methods (fourth-order), Solution of boundary value problems using finite difference method.
Curve Fitting and Regression: Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas, Bivariate distribution, correlation coefficients, regression lines, formula for regression coefficients and rank correlation (only two variables).
Probability Distribution: Mathematical expectations, Definition of probability distribution (Probability Mass Function and Probability Density Function), Poisson, Binomial, Exponential, Uniform and Normal distributions.

Laboratory Work: Lab experiments will be set in consonance with materials covered in the theory. Implementation of numerical and statistical techniques using MATLAB to solve following civil engineering problems:
1. Non Linear Equation: A simply supported beam problem to find the point (s) of zero shear and zero moments.
2. Linear System and Eigen Values: Column problem subjected to axial load and bi-axial moments and to find the principal normal stresses and the direction cosine of the normal principal stresses. Calculate the forces in each members of a truss subjected to given loading.
3. Interpolation and Approximation: Find the Water levels of reservoir at intermediate points.
4. Numerical Integration: Find the capacity of a reservoir.
5. Differential Equation: Finding the solution of a single degree of freedom (SDOF) subjected to free and forced vibration.
6. Population growth problem.

Course Outcomes: Upon successful completion of the course, the students will be able to
1. obtain numerical solution of nonlinear equations using bisection and Newton-Raphson methods.
2. solve system of linear equations numerically using direct and iterative methods.
3. construct interpolating polynomials with practical exposure and analyze the correlated data using the
4. linear regression models.
5. solve integration and initial value problems numerically. .
6. solve civil engineering problems using various probability distributions.

Text Books:

1. E. Ward Cheney and David R. Kincaid, Numerical Mathematics and Computing, Cengage, 2013.
2. Walpole, Ronald E., Myers, Raymond H. Myers, and Sharon L. Myers, Probability and Statistics for
Engineers and Scientists, 9th edition Pearson Education, 2012

Reference Books:

1. Burden L. R., Faires D. J. and Burden A.M., Numerical Analysis, Brooks Cole, 10th edition, 2015.
2. Steven C. Chapra and Raymond P. Canale, Numerical Methods for Engineers, McGraw-Hill Higher Education; 7th edition, 2016.
3. M.K. Jain, S.R.K. Iyengar, and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, New Age International, 2003.
4**.** Richards A. Johnson, Probability and Statistics for Engineers, 9th Edition, PHI Learning, 2018.

Evaluation Scheme

Sr. No.	**Evaluation elements**	**Weightage (%)**
1	MST	25
2	EST	35
3	Sessional: (May include the following) Assignment, Regular Lab assessment and Quizzes, Project (Including report, presentation etc.)	40

UTA027: **Artificial Intelligence**

L	T	P	Cr
3	0	2	4.0

Course Objective: This course introduces students to the fundamental concepts, techniques, and applications of Artificial Intelligence (AI). Students will gain theoretical knowledge and practical skills in areas such as problem-solving using search techniques, machine learning and designing intelligent agents for solving particular engineering problems

Introduction to Artificial Intelligence: Foundations, scope, types of AI, problems, and approaches of AI
Intelligent agents: Structure of agents, Types of agent programs: reflux, model-based, goal-driven, utility-driven, and learning agents
Problem spaces: State Space Representation, Representation of problems as state space, problem characteristics, sample applications
Uninformed Search Algorithms: Brute Force search, Depth-First Search, Breadth-First search, Depth-Limited Search, Uniform Cost Search, Bidirectional Search
Informed search algorithms: Heuristic Functions, Best-First search, Beam Search, Hill Climbing, A* algorithm, AO graph, stochastic search algorithms: Simulated Annealing and Genetic Algorithm
Game playing: Minimax algorithm, alpha-beta pruning, iterative deepening
Introduction to Machine Learning: Well-Posed learning problems, Basic concepts, Designing a learning system, Types of machine learning: Supervised learning, Unsupervised learning, Semi-supervised Learning and Reinforcement learning, Types of data: structured and unstructured data. **Supervised Learning:** Introduction to supervised learning tasks, Tree induction algorithms: split algorithm based on Information Gain (ID3), split algorithm based on Gain Ratio (C4.5), split algorithm based on Gini Index (CART), Instance based algorithms: K Nearest Neighbours (K-NN), Probabilistic algorithms: Naïve Bayes algorithm, Evaluation metrics
Unsupervised Learning: Introduction to supervised learning tasks, Partitioning-based methods

Laboratory Work (if applicable): Basics of Python programming language: Data Types, Data Structures, Flow Control, Functions, Basic Data Science packages: NumPy, Pandas, SciPy
Implementing Search algorithms in C/C++/Java/Python: Depth first, Breadth first, Hill climbing, best first, A* algorithm, Implementation of games: 8-puzzle, Tic-Tac-Toe, tower of Hanoi and water jug problem using heuristic search
Implementing Machine Learning algorithms: Tree-based methods, K-NN, Naïve-Bayes algorithms, K-Means (from scratch and using sklearn library)

Course Learning Objectives (CLO)
The students will be able to:
1. Analyze methods and theories in the field of Artificial Intelligence and categorize various problem domains.
2. Design intelligent agents for concrete computational problems.
3. Analyze and apply different problem-solving strategies and search algorithms.
4. Implement and evaluate machine learning algorithms for various real-world tasks

Text Books
1. Russel S., Norvig P., Artificial Intelligence: A Modern Approach, Prentice Hall (2014)

3rd ed
2. Murphy, Kevin P. Machine learning: a probabilistic perspective. MIT press, (2012) 3rd ed.

Reference Books

1. Rich E., Knight K. and Nair B. S., Artificial Intelligence, Tata McGraw Hills (2009) 3rd ed.
2. Luger F. G., Artificial Intelligence: Structures and Strategies for Complex Problem Solving, Pearson Education Asia (2009) 6th ed.

SEMESTER-V

Approved in 114th Meeting of Senate held on March 7, 2025

UCE501: SOIL MECHANICS				
	L	**T**	**P**	**Cr**
	3	**1**	**2**	**4.5**

Course Objective: This subject aims to develop an understanding of soil as a civil engineering material and to introduce the students about the basic concepts and principles of soil mechanics. Further they will be introduced to the concepts of compaction, consolidation and determination of shear strength of soil

Introduction: Soil formation, various soil types

Phase relationships: Index properties, sieve & hydrometer analysis, Atterberg's limits, sensitivity, thixotropy, and plasticity charts. Determination of engineering properties of soil. Indian standard and Unified classification systems of soils

Clay Mineralogy: Introduction to Clay minerals their characteristics. Soil structure

Seepage and Permeability: Darcy's law, validity of Darcy's Law, seepage velocity, factors affecting permeability, Laboratory and field determination of permeability. Flow net and its properties, Laplace equation, methods of drawing flownet, seepage through earth dams, exit gradient and seepage pressures, phenomenon of piping and heaving, filters. Anisotropy, Permeability of layered soils

Stresses in Soils: Stresses beneath various loaded areas, Boussinesq and Westergard's formulae, pressure bulbs, Newmark's chart, Approximate methods

Consolidation: Terzaghi's theory, time rate of consolidation, consolidation test, Compressibility & Coefficient of Consolidation, NC, OC soils, determination of pre-consolidation pressure, settlement analysis, secondary consolidation

Shear Strength: Definition, Mohr's stress circle, Mohr-Columb strength theory, direct, triaxial, unconfined and vane shear

Effective Stress Principle Capillarity, types of head, seepage forces, quick sand condition, and critical hydraulic gradient

Compaction: Compaction tests as per IS code, OMC, factors affecting compaction, control of compaction, field compaction equipment and their suitability tests. Drainage conditions, Concept of pore pressure coefficients, shear characteristics of normally consolidated, over consolidated clays and dense and loose sands, Dilatancy, residual strength

Laboratory Work:
The students will be introduced to Index and Engineering properties of soils to complement the theory component of the course by performing experiments. They will perform related experiments as per BIS specifications
1. Determination of field density by Core cutter & Sand replacement method
2. Grain size Analysis by Mechanical method

3. Grain Size Analysis by Hydrometer method
4. Determination of Specific Gravity by Pycnometer
5. Determination of Liquid Limit, Plastic limit
6. Determination of Shrinkage limit
7. Determination of Permeability by constant head & variable head permeameter
8. Determination of Coefficient of Consolidation by Consolidation Test
9. Determination of OMC and MDD by IS standard Compaction test
10. Direct Shear Test

Experimental Project/assignment/Micro Project: Students in groups of 4 to 6 will do the projects
1. Bringing soil samples from the field classify them by performing lab tests and then determining the optimum moisture content and maximum dry density.
2. Based on OMC and MDD they will prepare samples for determination of CBR

Course Learning Objectives (CLO)

Upon the completion of this course, the students will be able to:

1. Determine the index and engineering properties of soil
2. Evaluate the influence of water on engineering properties of soil
3. Evaluate the compressibility characteristics of soils in engineering practices
4. Determine the shear strength of soils by various methods

Text Books:
1. Gopal Ranjan & A.S.R. Rao, Basic and Applied Soil mechanics, New Age Publisher, New Delhi (2016)
2. V.N.S. Murthy, A text book on Soil Mechanics and Foundation Engineering, U.B.S. Publisher, New Delhi.(2005)
3. Parshotham Raj, Geotechnical Engg., Pearson , New Delhi.(2013)

Reference Books:
1. Das B.M., Principles of Soil Mechanics, Thomson Publisher, USA (2015)
2. Venkatramaiah Geotechnical Engg., New Age Publisher, New Delhi (2012)
3. Singh Alam Modern Geotechnical Engineering, CBS Publishers, New Delhi (2014)

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weights (%)
1.	MST	25
2.	EST	35
3.	Sessionals (May include Assignments/Projects/Quizzes/Tutorials/Lab Evaluations)	40

UCE401: HYDROLOGY AND GROUND WATER

	L	T	P	Cr
	3	1	0	3.5

Course Objective: The overall objective of this course is to acquaint students to the engineering aspects of water science. The students will learn different pathways of water movement, estimation and analysis of various components of pathways and its applications in designing various water related projects

Introduction: Hydrologic cycle, Scope and Applications

Precipitation*:* Measurement by rain gauge and other methods, estimation of missing data, consistency of records, optimum number of rain gauge station, mean precipitation, presentation and analysis of rainfall data

Abstractions from Precipitation: Evaporation, factors affecting evaporation, measurement, infiltration, factors affecting infiltration, measurement, infiltration indices

Run off: Run-off estimation, rainfall-runoff correlation, flow duration curve, hydrographs, base flow separation, unit hydrographs and its application, distribution graph, synthetic unit hydrograph

Stream flow measurement: Velocity measurement: floats, velocity rods, current meters, discharge computation: velocity area method, moving boat method, slope area method, stage discharge curve, notches, weirs, venturiflume, standing wave flume, free overfall

Floods Frequency analysis: Peak flood estimation, methods of frequency analysis, flood routing

Ground Water Hydraulics: Type of aquifers, aquifer constants, Darcy's law, Steady flow towards fully penetrating well, Equation of motion and its applications to ground water flow problems, introduction to the use of distributed groundwater

Course Learning Objectives (CLO)

Upon the completion of this course, the students will be able to:

1. Perform analysis on precipitation, evaporation and infiltration data for various applications
2. Estimate runoff and discharge generated from watershed and/or stream by using various techniques
3. Apply the principles of flood frequency analysis and flood routing to forecast floods
4. Apply hydraulic principles of groundwater flow in different geological formations

Text Books:

1. Subramanya, K., Engineering Hydrology, Tata McGraw-Hill Publication (2015)
2. Reddy, Jaya Rami., A textbook of Hydrology, University Science Press, New Delhi (2014)
3. Raghunath, H. M., Hydrology: Principles, analysis and Design, New Age International

Publishers (2015)

Reference Books:

1. Chow, V.T., Maidment, D.R., and Mays, L.W., Applied Hydrology, Mc-Graw-Hill International Editions, New York (2006)
2. Misstear, B., Banks, D., and Clark, L., Water Wells and Boreholes, John Wiley& Sons Ltd, UK(2013)
3. Shaw, E.M., Beven, K.J., Chappell, N.A., and Lamb, R. , Hydrology in Practice, Spon Press, New York(2014)
4. Viessman, W. and Lewis, G.L., Introduction to Hydrology, Prentice Hall of India Pvt Limited, New Delhi (2012)

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weights (%)
1.	MST	30
2.	EST	45
3.	Sessionals (May include Assignments/Projects/Quizzes/Tutorials/Lab Evaluations)	25

UCE511: TRANSPORTATION ENGINEERING-I				
	L	**T**	**P**	**Cr**
	3	**0**	**2***	**3.5**

Course Objective: The objective of the course is to enable students study different types of pavements, to analyze road pavement structures, to differentiate between the different types of materials used and to design and construct road pavements. Another objective is to expose the students to geometric design, both vertical and horizontal and to enable the civil engineering students to study the road user characteristics and formulate fundamental principles of traffic flow, traffic characteristic measurements

General: Different modes of transport, Development of Transport System, Phased development of Roads in India, Planning & Management of Highways, Various road plans developed in India, Road patterns, Highway Surveys & Alignment, Design, Drawings, Estimates & Project Report

Traffic Studies: Road user characteristics, Importance of traffic studies, spot speed, speed and delay and origin and destination studies. Traffic accident studies, Causes of accidents and Remedial Measures, Parking studies

Geometric Design of Highways: Introduction, Highways Classification, Right of way, Width of formation, Sight Distances, Stopping site distance, overtaking sight distance, overtaking zones, camber, Road Curves, Transition Curves, Super elevation, Widening at curves, IRC codal recommendations for various geometric design parameters, Road Safety Audits, Highway capacity & Intersection design

Construction of Roads: Various types of bituminous layers constructions and their selection, specifications for embankments, subgrade, granular subbase, water bound macadam, wet mix macadam, surface dressing, premix carpet, bituminous macadam, dense bituminous macadam, bituminous concrete, mastic asphalt, stone matrix asphalt, dry lean concrete, cement concrete pavements, Importance & Principles of Highway Drainage, Surface Drainage & Sub-Surface drainage

Types of bituminous binders and Mix design: Manufacturing of bitumen, Paving bitumen specifications as per IS 73: 2013, comparison between bitumen, tar, cut back & emulsion, Modified binders and its rheology, Design of bituminous mixes: Requirement of bitumen mixes, design of bituminous mixes as per Marshall Stability & flow method, parametric evaluation of bituminous mixes, IRC & MORTH recommendations for the design mix of various layers of pavements

Pavement Design: Factors affecting design of pavements, design principles & design procedures as per IRC 37 guidelines, Design of PQC pavements as per IRC 58 & SP62, Use of software's IITPAVE, KENPAVE

Failures of flexible and rigid pavements & Highway Maintenance: Causes of Failures and Remedial Measures, Maintenance of flexible and rigid pavements, pavement evaluation and

its strengthening method, overlay design using IRC 81 & IRC115 guidelines, concept of thin & ultrathin white toppings, design & scheduling of maintenances activities, development of Pavement maintenance management systems for different categories of roads, Economic Evaluation of Highway Projects and Life Cycle Costing Concept

Laboratory Work:
The students will perform various quality control tests as per Indian Road Congress (IRC) & Ministry of Road Transport & Highways (MORTH) specifications for the various layers of the pavement section. Paving bitumen & bituminous mix testing like penetration value, softening point, viscosity & binder rheology, ductility value, centrifugal extraction, aggregate strength tests, pavement layer gradation & stability - flow analysis, Deflection studies for the granular layers of the flexible & rigid pavements

Experimental Project/assignment/Micro Project: Students in groups of 4 to 6 will do the projects
1. Calculate the un-soaked and soaked CBR value of different soil samples
2. Design the flexible pavement as per IRC 37 guidelines for the given traffic data
3. Design the rigid pavements as per the IRC 58 guidelines for the given traffic data

Course Learning Objectives (CLO)

Upon the completion of this course, the students will be able to:

1. Quantify the specifications of various road construction materials required
2. Perform geometric design of highways and expressways
3. Perform analysis and design of flexible and rigid pavements
4. Address highway maintenance, drainage and economic issues
5. Perform the traffic studies necessary before making changes to or designing new road Infrastructure

Text Books:
1. Khanna S.K. and C.E.G. Justo, Highway Engineering, Nem chand Bros (2017)
2. Kadyali L. R.; Highway Engineering, Nem Chand & Brothers, Roorkee (2018)

Reference Books:
1. Sharma & Sharma; Principle and Practice of Highway Engineering, Asia Publishing House, New Delhi (2010).
2. G.V.Rao, Tata McGraw Hill, New Delhi Principles of Transportation and Highway Engineering (2002)
3. Yoder E. J.; Principles of Pavement Design, John Wiley & Sons (2011)

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weights (%)
1.	MST	25
2.	EST	35
3.	Sessionals (May include Assignments/Projects/Quizzes/Tutorials/Lab Evaluations)	40

UCE512: DESIGN OF STEEL STRUCTURES				
	L	**T**	**P**	**Cr**
	3	**1**	**0**	**3.5**

Course Objective: To learn (i) basic concepts and applications of various types of soil reinforcement, and (ii) design of reinforced earth structures

Introduction: Loads, structural steels and their specifications, structural elements, design specifications as per IS: 800, structural layout, strength and stiffness considerations, efficiency of cross-section, safety and serviceability considerations as per IS2062-2011

Bolted and Welded Connection: Types of Bolts, advantages and disadvantages of bolted connections, failure of bolted joints, design of the concentric bolted joint, the efficiency of joint. Design of Eccentric bolted connections. **Welded Connection**: Types of welded joints, design of welded joint subjected to axial loads

Tension Members: Types of tension members, net area, net effective area for angles, tees, design of tension members, tension splice, and lug angles.

Compression Members: Axially loaded columns, effective length, slenderness ratio, allowable stresses, general specifications, design of axially loaded members, laced and battened columns and their design, built-up compression members

Plastic Design: Introduction, advantages and disadvantages, , theory of plastic bending, plastic hinge mechanism, collapse load analysis, static and mechanism method, distributed loading, design consideration.

Flexural Members (Beams): Design criteria, permissible stresses, laterally supported beams and their design laterally unsupported beams and their design, web buckling, web crippling

Course Learning Objectives (CLO)

Upon completion of this course, the students will be able to:

1. Design tension members
2. Design the bolted and welded connections between various structural components
3. Design compression members
4. Find out ultimate load of the structural systems using plastic analysis
5. Design flexural members

Text Books

1. Subramanya, N, Design of Steel Structures, N. Subramanian, Oxford University Press (2016).
2. Duggal, S.K. Limit State Design of Steel Structures, McGraw Hill (2010.)
3. Bhavikatti S.S, Design of Steel Structures, Ik International Publishing House, New Delhi,

2017
4. Sai Ram, K.S, Design of Steel Structures, Pearson Education in South Asia, 2010.
5. Chandra R. and Gehlot V, Limit State Design of Steel Structures, Scientific Publishers, 2009

Reference Books

1. Ajmani, A. L. and Arya, A. S., Design of Steel Structures, Nem Chand and Brothers (2000).
2. Dunham, C.W., Planning of Industrial Structures, John Wiley and Sons (2001).
3. Gary, W., Steel Designer's Manual, Prentice Hall (2008).
4. Gambhir M L, Fundamentals of Structural Steel Design, McGraw Hill Education India Pvt Limited, 2013.
5. Sarwar Alam Raz, Structural Design in Steel, New Age International Publishers, 2014

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weights (%)
1.	MST	30
2.	EST	45
3.	Sessionals (May include Assignments/Projects/Quizzes/Tutorials/Lab Evaluations)	25

UCE513: CONSTRUCTION MANAGEMENT				
	L	**T**	**P**	**Cr**
	3	**0**	**2**	**4.0**

Course Objective: This subject aims to develop an understanding of principles and techniques of estimating construction costs, with emphasis on quantity take-off and pricing elements of work. It also covers the basic principles, techniques, and practices used as management tools by contractors to plan, schedule, and control time and costs on building various infrastructure projects.

Quantity Surveying and Cost Estimation : Quantity survey measurements, Bill of quantities, analysis of rates for different items of work, Specifications and Units of different items of work, Detailed Estimate of various items of Building and Pavements using MS Excel, Common schedule of rates for different items of works, Bar Bending Schedule

Contracts: Typesofcontractsandtheircharacteristics,procedurefortendering/e-tendering and contracts, BOT, DBFOT, PPP & HAM financial models, evaluation and examination of tenders, award of work, Joint Ventures, Concession Agreements,

Network Techniques: Methods of Scheduling-Gantt Chart, Bar chart, Development of Bar charts and Gantt chart, Merits & limitations of Bar chart & Gantt chart. Concept of CPM & PERT: Introduction to Critical path method (CPM), Program evaluation & review techniques (PERT), Network Diagramming of Projects Activity-on arrow (AOA) Diagrams- Concept of Activity and Event, Time-Analysis of Networks- Forward Pass, Backward Pass, Probabilistic Durations- Optimistic Time, Pessimistic Time, Most Likely Time, Project Scheduling- ES and LS Schedules as Limits, Resource Scheduling, Time/Cost Trade-off Definitions, functions & characteristics of project planning and principles of project Planning and Management, Bar milestone charts, Planning and scheduling with PERT / CPM, Time cost optimization, Probability concepts Allocation of resources and resource levelling, Updating, Application of software for Project planning, scheduling

Experimental Project/assignment/Micro Project

1. Complete cost estimation of the building or highway project using MS Excel
2. Development of a contract document for the infrastructure project.
3. Planning & Scheduling of infrastructure project using software.

Course Learning Objectives (CLO)

Upon completion of this course, the students will be able to:

1. Perform the rate analysis for the various construction activities
2. Estimate the cost for the building and the road projects
3. Perform the project planning, scheduling, and time-cost optimization of the project.

4. Perform resource allocation and project controlling of the project

Text Books:

1. Kohli D. S.; A Text book on Estimating and Costing and Accounts, S. Chand & Company New Delhi (2013)
2. R.L. Peurifoy, W.B.Ledbetter and C.J.Schexnayder,“ Construction planning and methods”, Fifth edition, McGraw Hill International edition(2010)

Reference Books:

1. Seetharaman S., Construction Engineering and Management,Umesh Publication Delhi(2017)
2. Punima B. C. and Khandelwal; Project Planning and Control with PERT and CPM, Laxmi Publication New Delhi(2016)
3. K.K. Chitkara, Construction project management: planning, scheduling and controlling, Tata McGraw-Hill.(2014)
4. L.S. Srinath, PERT and CPM Principles and Application, Third edition, Affiliated east-west press Pvt Ltd (2001)

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weights (%)
1.	MST	25
2.	EST	35
3.	Sessionals (May include Assignments/Projects/Quizzes/Tutorials/Lab Evaluations)	40

UCE592: SURVEY PROJECT				
	L	**T**	**P**	**Cr**
	-	**-**	**-**	**3.0**

Course Objective: To expose student to the various surveying tools and techniques in the field. The students, after completing their second year, are supposed to go on a survey camp, which shall be held over a period of three to four weeks, either at the university or at some site outside. As a part of this they have to prepare a topographical sheet of the area highlighting the main features including contouring etc

Course Learning Objectives (CLO)

Upon the completion of this course, the students will be able to:

1. Perform basic surveying on a considerably difficult hilly terrain
2. Set up traverse stations, base-line measurements, fly leveling, detailing, and contouring

SEMESTER-VI

Approved in 114th Meeting of Senate held on March 7, 2025

UCE614: HYDRAULIC ENGINEERING				
***: Lab every alternate week**	**L**	**T**	**P**	**Cr**
	3	**1**	**2***	**4.0**

Course Objective: This course aims to design open channel sections under different situations. Further, this course aims to expose the students to various aspects of applications of laminar flow, turbulent flow, boundary layer formation and drag and lift to real flow situations.

Flow in open channels: Introduction, analysis of uniform flow, most economical channel sections, specific energy and its applications to channel transitions, momentum equation for flow in open channels, specific force concept, analysis of non-uniform flow, water surface profiles, hydraulic jump, surges

Flow in pipes: Navier-Stokes equations for laminar flow, laminar flow through a pipe and parallel plates, laminar flow past a sphere, shear stress in turbulent flow, velocity distribution equations for turbulent flow in pipes, Resistance of smooth, rough and commercial pipes, pipe network analysis, pressure transients

Boundary layer flow: Boundary layer characteristics, Von-Karman momentum integral equation and its applications to velocity profiles, separation of boundary layer, Introduction to drag and Lift

Laboratory Work:
Students will perform following basic experiments in Hydraulic Engineering:
1. To determine the viscosity of liquid and to verify stokes Law
2. To determine Manning's coefficient of roughness for the bed of a given flume
3. To measure the velocity distribution in a rectangular flume and to determine the energy and momentum correction factors
4. To study the flow characteristics through a rectangular open channel transition
5. To study the formation of hydraulic jump in a horizontal rectangular open channel
6. To measure velocity distribution over a flat surface in a wind stream and to determine the displacement and momentum thickness
7. To measure the pressure distribution around a cylinder/airfoil placed in a wind stream and to calculate the coefficient of drag

Experimental Project/assignment/Micro Project: Students in groups of 4 to 6 will do projects on channels roughness, weirs, velocity distribution in channels of different cross-sections, free overfall, drag and lift on various body shapes

Course Learning Objectives (CLO)

Upon the completion of this course, the students will be able to:

1. Design the most economical channel sections and to use the specific energy concept in channel transitions
2. Analyze the water surface profiles under different flow situations including hydraulic jump and surges

3. Employ the concepts of laminar, turbulent flow and boundary layer formation in real flow situations
4. Analyze water distribution networks and pressure transients

Text Books:

1. Modi and Seth, Fluid Mechanics and Fluid Machines, Standard Book House, New Delhi (2010)
2. Subramanya K., Flow in open Channels, Tata McGraw Hill, New Delhi (2008)
3. French R. H, Open Channel Hydraulics, McGraw Hill Publishing Company, New York (2007)

Reference Books:

1. Som and Biswas, Introduction to Fluid Mechanics and Machines, Tata McGraw Hill, New Delhi (2012)
2. Rangaraju K. G., Flow through Open Channels, Tata McGraw Hill, New Delhi (2008)
3. Schlichting H., Boundary Layer Theory, Tata McGraw Hill, New Delhi (2008)
4. Henderson F. M: Open Channel Flow, McMillan, New York (2007)

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weights (%)
1.	MST	25
2.	EST	45
3.	Sessionals (May include Assignments/Projects/Quizzes/Tutorials/Lab Evaluations)	30

UCE605: TRANSPORTATION ENGINEERING-II				
	L	**T**	**P**	**Cr**
	3	**1**	**0**	**3.5**

Course Objective: This subject aims to develop an understanding of the structural & geometrical design of various components of railway track as per the Indian railways guidelines. Further to this, subject also aims at introducing the detail concepts of the airport engineering and to give the students the confidence of delivering a complete geometric and structural design of runway, taxiway and apron pavements

Railway Engineering:

Permanent way specifications: Gauges in railway tracks, typical railway track cross-section, coning of wheels

Rails: Function of rails, requirement of rails, types of rail sections – comparison of rail types, length of rail, rail wear, rail failures, creep of rails, rail fixtures and fastenings – Fish plates, spikes, bolts, chairs, keys, bearing plates

Sleepers: Functions and requirements of sleepers, classification of sleepers, timber, metal and concrete sleeper, comparison of different types of sleepers, spacing of sleepers and sleeper density

Ballast: Function and requirements of ballast, types, comparison of ballast materials

Geometric design: Alignment design, horizontal curves, super elevation, equilibrium, cant and cant deficiency, length & setting out of transition curve, gradients and grade compensation, negative super elevation design

Points and crossings: Introduction, necessity of points and crossings, design of a turnout as per Indian railways specifications

Signaling and interlocking: Objects of signaling, engineering principle of signaling, classification of signaling, control of train movements, interlocking definition, necessity and function of interlocking, methods of interlocking, mechanical devices for inter locking, Traction and tractive resistances, stresses in track, Hauling capacity of locomotive, modernization of railway track

Airport Engineering:

Airport Planning: Airport site selection, various surveys for site selection. Classifications of obstructions, Imaginary surfaces, Approach zone and turning zone, Runway orientation using wind rose diagrams, basic runway length, corrections for elevation, temperature & gradient, airport classification

Runway & Taxiway Design: Geometric design of runway as per ICAO & FAA guidelines, taxiway layout, geometric design standards for taxiway & aprons, Rapid Exit Taxiways, Structural design of runway pavements, Design of flexible and rigid runways as per FAA

procedure using FAARFIELD and PCA method, Design of joints for airport pavements, Specifications for the different layers of runway and taxiway pavements, Pavement Evaluation for runway & taxiway, LCN-PCN method, design of overlay using COMFAA & ELMOD, Pavement management systems for runway pavements

Airport Layouts: Terminal area, parking area, apron & hanger typical airport layouts, Lightings and markings design for airside area of an airport

**Experimental Project/assignment/Micro Project: **

1**.** To analyze & design the flexible & rigid airport pavements using FAARFIELD.
2. To design the turnout as per the Indian Railway specifications.
3. To perform the data analysis for developing management systems for airport pavements.

Course Learning Objectives (CLO)

Upon the completion of this course, the students will be able to:

1. Determine the runway orientation and the runway length as per FAA &ICAO guidelines.
2. Design the airport pavements including air-side marking & lighting as per ICAO & FAA guidelines
3. Evaluate pavement and learn the concept of pavement maintenance management system.
4. Employ Railway Track specifications and perform geometric design of the railway track.
5. Design turnout and crossings as per the Indian Railways

Text Books:

1. Arora and Saxena, Railway Engineering, Dhanpat Rai & Sons, New Delhi (2006)
2. Khanna, Arora & Jain, Airport Planning and Design, Nem Chand & Brothers, Roorkee (1999)
3. ICAO and FAA, various advisory circulars guidelines (2018)

Reference Books:

1. Rangawala, Railway Engineering, Charotar Publishing House, Anan (2017)
2. Aggarwal M.M., and Satish Chandra Railway Engineering, Oxford University Press (2013)
3. Horenjeff Robert, Airport Engineering, McGraw Hill International Publisher (2010)

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weights (%)
1.	MST	30
2.	EST	40
3.	Sessionals (May include Assignments/Projects/Quizzes/Tutorials/Lab Evaluations)	30

UCE615: WATER AND WASTE WATER ENGINEERING				
***: Lab every alternate week**	**L**	**T**	**P**	**Cr**
	3	**1**	**2***	**4.0**

Course Objective: To introduce the water supply and sanitation systems, designing the components associated with the water supply and sanitation systems, and suitable treatment processes for both water supply and wastewater.

Water and water supply system: Water quality, source of surface water pollution, water quality standards; Water demand, components of water supply system; water intake works; Water transmission systems

Water treatment*:* Water treatment plants and components; Technologies for the removal of suspended, colloidal and dissolved solids and for disinfection; Design of coagulation-flocculation-settling, slow sand and rapid gravity filtration, membrane filtration, ion exchange, adsorption and chlorination units.

Wastewater system: Quantification of sewage; Characterization of sewage; Types of sewerage systems; Design of sewers and storm sewers, sewer outfalls and sewer appurtenances

Wastewater treatment: Components; Design of screens, degritters, clarifiers and roughing filters; Activated Sludge, UASB and modified UASB reactors, and Waste stabilization pond systems, vegetated ponds and constructed wetland systems; Sewage treatment plant sludge handling facilities

Laboratory Work:
pH, acidity, alkalinity and hardness testing; DO, BOD and COD; Solids (TSS, VSS and TDS); Nutrients (TKN, TN and TP); SVI and Settling tests; Chlorination, residual chlorine and MPN test; Oil and grease and pesticides; Iron, fluorides, sulfates, chlorides, sulfides and phenols

Experimental Project/assignment/Micro Project: Students in groups of 4 to 6 will do the projects on:
1. Design of Sewerage systems
2. Design of Water treatment plants/Sewage treatment plants

Course Learning Objectives (CLO)

Upon the completion of this course, the students will be able to:

1. Characterize water and wastewater
2. Design a water supply system/sewerage system
3. Conceive and design a water treatment plant
4. Conceive and design a sewage treatment plant

Text Books:
1. Garg, S.K , Environmental Engineering, Vol. I,. Khanna Publishers, New Delhi (2023)

2. Manual on Water Supply and Treatment by Ministry of Urban Development, New Delhi (2024)
3. Manual on sewerage and sewage treatment, Ministry of Urban Development, New Delhi (2013)
4. P.N. Modi; Sewage Treatment and disposal & Waste Water Engineering, Standard Book House New Delhi (2020)

Reference Books:
1. Met Calf & Eddy Wastewater Engineering, McGraw Hill (2017).
2. Peavy, Rowe and Tchobanglous, Environmental Engineering, McGraw Hill (2017).
3. Sawyer, McCarty &Parkins, Environmental Chemistry, McGraw Hill (2003).
4. Standard Methods for the Examination of Water and Waste Water, American Public Health Association (2022)

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weights (%)
1.	MST	25
2.	EST	35
3.	Sessionals (May include Assignments/Projects/Quizzes/Tutorials/Lab Evaluations)	40

UCE613: FOUNDATION ENGINEERING				
***: Lab every alternate week**	**L**	**T**	**P**	**Cr**
	3	**1**	**2***	**4.0**

Course Objective: This subject aims to expose the students to geotechnical design of different types of shallow and deep foundations. Further they will be exposed to understanding of earth pressure for stability of retaining structures along with various techniques for stability of slopes.

Soil Exploration: Introduction to soil exploration, scope, soil exploration for different structures, spacing, significant depth, boring and sampling techniques, bore hole plan, types of samples, penetration test (SCP and SPT), sample disturbances and Geophysical methods

Earth Pressure: At rest condition, states of plastic equilibrium, Rankine and Coulomb's theories for active and passive conditions, Lateral Earth pressure in layered soils. Stability of cantilever Retaining wall. Introduction to Reinforced Earth Wall

Stability of Slopes: Infinite slope, types of failure, total and effective stress analysis, Taylor's stability numbers, concept of factors of safety, method of slices, modified method of slices, Swedish's circle method, friction circle method

Bearing Capacity: Definitions, introduction to shallow and deep foundation, depth of foundation, Concept of net and gross bearing capacity. Terzaghi's general bearing capacity equation, IS code equation, factors affecting bearing capacity. Settlements for clays and sands, permissible settlements, bearing capacity by penetration tests, Influence of eccentric and inclined loads, plate load test

Pile Foundations: Types, function, selection of piles, pile driving formulae, equipment, point, bearing and friction piles. Load carrying capacity of single pile, group action, spacing of piles, Negative skin friction, settlement of pile groups, under-reamed piles

Caissons and Wells: Introduction, components, shapes, Construction and sinking of well, tilts and shifts

Machine Foundation: Definition, types, problem of machine foundation, soil spring constants, General Design Criteria for machine foundation

Laboratory Work:
The students will be introduced to various laboratory & field experiments as per BIS specifications

1. Determination of Relative density of coarse grained soils in dry and saturated conditions
2. Determination of Unconfined compressive strength
3. Determination of compressibility characteristics of fine grained soils by Consolidation test
4. Determination of bearing capacity by Standard Penetration test
5. Determination of shear strength of sands by Tri-axial shear test

6. Determination of bearing capacity by Plate load test
7. Determination of bearing capacity by static and dynamic cone Penetration test
8. Determination of bearing capacity by lab and field vane shear test

Experimental Project/assignment/Micro Project: Students in groups of 4 to 6 will do the projects by conducting test like SPT , PLT and lab tests, the students will determine the safe bearing capacity for various structures like Multistoried buildings, OHSR etc

Course Learning Objectives (CLO)

Upon the completion of this course, the students will be able to:

1. Design and analyze problems related to shallow and machine foundations
2. Analyze lateral earth pressure for design of earth retaining structures
3. Assess stability of natural/man-made slopes under varying in-situ material properties
4. Design and analyze problems related to pile and well foundations

Text Books:

1. Gopal Ranjan& A.S.R. Rao, Basic and Applied Soil mechanics, New Age Publisher, New Delhi (2016)
2. Murthy V.N.S., Advanced Foundation Engineering, C.B.S. Publisher, New Delhi (2017)
3. Parshotham Raj, Geotechnical Engg., Pearson , New Delhi (2013)

Reference Books:

1. Bowles J.E., Foundation Analysis and Design, McGraw Hill Book Company, New York (2009)
2. Das B.M., Principles of Soil Mechanics, Thomson Publisher, USA (2015)
3. Saran Swami, Soil Dynamics and Machine Foundations, Galgotia Publishers, New Delhi (2016)

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weights (%)
1.	MST	25
2.	EST	35
3.	Sessionals (May include Assignments/Projects/Quizzes/Tutorials/Lab Evaluations)	40

UCE693: GROUP DESIGN PROJECT

	L	T	P	Cr
	1	0	2	3.0

Course Objective: The main objective of the project is to gain hands-on experience in tackling the planning, analysis and design issues in open-ended structural design projects while performing the analysis and design of representative structural system and components. This project work covers various aspects including planning, architectural design, geotechnical constraints, structural analysis and design and construction planning & scheduling

During the project, various experts from industry/academics/public body are invited to deliver talks on relevant issues like:

- Planning & preparation of architectural drawings of the building
- Design of building frames: Load pattern, design of continuous beams/slabs and detailing of various structural components as per the relevant Indian codal guidelines
- Preparation of detailed structural drawings
- Design of various allied services for the building project
- Preparation of general & special conditions of the contract for the project including specifications of the building based upon utility & functional aspects.
- Preparation of the detailed cost estimation for the project

The final project report should include the following

- Description of the General Design Problem, Constraints, Functions, Design Life, and Other Relevant Considerations.
- Design Assumptions, Analysis Methodologies Employed, and a Flowchart of the Design Process
- Specific Design Considerations and Architectural Considerations
- Design Details Including:
  - Load Types, Loads, and Load Cases
  - Analysis and Design Computations
  - Deformed Shapes
  - Member Dimensions and Reinforcement Details.
- Written and Illustrated Descriptions of the Architectural, Structural Designs including the services and bill of quantities.
- Conclusions

Course Learning Objectives (CLO)

Upon the completion of this course, the students will be able to:

1. Function as a member of the design team
2. Develop the general arrangement drawings
3. Produce detailed structural design & drawings and viable construction sequence
4. Produce a bill of quantities and calculate approximate construction cost

Reference Books:

1. Varghese, P. C., Limit State Design of Reinforced Concrete, PHI Publishers (2000)
2. Jain, A.K., Reinforced Concrete-Limit State Design, Nem Chand & Bros (2014)
3. Pillai & Menon, Reinforced Concrete Design, Tata McGraw Hill Publishers(2014)

Evaluation Scheme:

Activity	**Submission time line**	**Weightage (%)**
Problem Formulation & Design Flow Chart	End of Week 4 of fifth semester	5
Midway report-1	Before the start of EST of 5th Semester	20
Midway report-2	Before the start of MST of 6th Semester	30
Final Assessment & Final Report & Presentation	End of 6th Semester	45 (Report = 20 + Presentation and Viva Voce = 25)

SEMESTER-VII

Approved in 114th Meeting of Senate held on March 7, 2025

UCE702: ADVANCED CONSTRUCTION TECHNOLOGY

	L	T	P	Cr
	3	1	0	3.5

Course Objective: The basic objective of the course is to expose the students to the latest and advanced construction techniques, which is fast and reliable. Students will be introduced to building information modeling software, which helps in management of construction site including automation process at site.

Pre-Cast and Prefabricated Structures

Introduction: Need for prefabrication and pre-cast, Materials, Modular coordination, Standardization, Systems, Production, Transportation, Erection.

Behaviour of Structural Components: Large panel constructions, Construction of roof and floor slabs, Wall panels, Columns and Shear walls.

Design Principles: Disuniting of structures; Design of cross section based on efficiency of material used; Problems in design because of joint flexibility and allowance for joint deformation. Joint in structural members, Joints for different structural connections, Dimensions and detailing of expansion joints.

Bridge Construction Methods

Construction procedure: segmental construction; Precast vs cast-in-place; Cantilever construction; Incremental launching method; Accelerated bridge construction. Factors affecting the selection of bridge construction methods.

Automation in Construction

3D Printing: Introduction, Principle, methods, materials, Advantages and disadvantages. Applications in construction industry: Pre-fabrications, Development of building elements, erection of contours, topologies and urban planning details, printing a building.

Robotics in Construction: Objective; Types of robots used in construction. Application: Demolition; Surveying; Paving; concrete finishing; Welding; Brick laying; Risk and Cost Benefit Analysis

Course Learning Objectives (CLO)

Upon the completion of this course, the students will be able to:

1. Design the prefabricated elements and also have the knowledge of the construction methods with prefabricated elements
2. Relate the challenges associated with different construction methods of bridges
3. Understand the 3D Printing process in construction
4. Understand the different automation process in construction

Text Books:

1. CBRI, Building materials and components, India, 1990
2. Gerostiza C.Z., Hendrikson C. and Rehat D.R., "Knowledge based process planning for construction and manufacturing", Academic Press Inc., 1994

Reference Books:

1. Met Koncz T., "Manual of precast concrete construction", Vol. I, II and III, Bauverlag, GMBH, 1976.
2. "Structural design manual", Precast concrete connection details, Society for the studies in the use of precast concrete, Netherland BetorVerlag, 2009

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weights (%)
1.	MST	30
2.	EST	45
3.	Sessionals (May include Assignments/Projects/Quizzes/Tutorials/Lab Evaluations)	25

UCE725: ADVANCED CONSTRUCTION MATERIALS AND TECHNIQUES

	L	T	P	Cr
	3	1	0	3.5

Course Objective: The basic objective of the course is to expose the students to the latest and advanced construction materials used for thermal and sound insulation and special concretes used for specific field applications. The students will also be introduced to newer and latest construction techniques followed in construction industry

Advanced Construction Materials: Plastics, Timber products and Preservation, materials for thermal insulation, materials for sound insulation

Special Concretes: Light Weight Concrete, Vaccuum Concrete, Waste Material Based Concrete, Fiber reinforced concrete, Polymer Concrete Composites, Ferrocement, Concreting at High and Low Temperatures, Self- Compacting Concrete (SCC), Ready Mixed Concrete (RMC) and its characteristics and advantages, Shotcrete and concreting in tunnels

Techniques for Tunneling and Formwork*:* Earthwork including cut and cover method, TBM, EBM and trenchless technology, Slip Form Shuttering, Latest type of Formwork, e.g. DOKA

High Rise Structures: Construction techniques for high rise buildings, chimneys. Special problems of high-rise construction

Fire Resistance in Structures*:* Fire hazards in buildings and preventive measures

Low Cost Housing: Types, Design and advantages

Course Learning Objectives (CLO)

Upon the completion of this course, the students will be able to:

1. Characterize and specify advanced construction materials for thermal and sound insulation, smart materials and plastic and timber products.
2. Identify Special Concretes used in construction industry for specific applications.
3. Identify and Specify construction techniques for earthwork, tunneling and formwork.
4. Identify the various construction techniques for High Rise Buildings.

Text Books:

1. M.L. Gambhir , Neha Jamwal, Building Materials, Products, properties and systems, Mc Graw Hill (2011)
2. M.L. Gambhir, Concrete Technology, McGrawHill (2013)
3. Subir Sarkar, SubhajitSarawati, Construction Technology, Oxford University Press (2008)

Reference Books/Journals:

1. Low Cost Houses, Publications by HUDCO, India Habitat Centre, Lodhi Road, New Delhi

(1982)
2. F. Glower, Structural Pre-cast Concrete, Oxford Publishers (1974)
3. Neil Jackson and R. K. Dhir, Civil Engineering materials, Macmillan Fourth edition (1996)

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weights (%)
1.	MST	30
2.	EST	50
3.	Sessionals (May include Assignments/Projects/Quizzes/Tutorials/Lab Evaluations)	20

UCE800: PROJECT				
	L	**T**	**P**	**Cr**
	-	**-**	**2**	**4.0**

Course Objective: To expose students to a design problem related to various disciplines of civil engineering.
The project work shall consist of various components related to design of structures, geotechnical investigations, water supply distribution system, irrigation engineering and highway design. The student is supposed to take up any three of these projects. They shall be evaluated on the basis of project report and viva-voce examination.

Course Learning Objectives (CLO)

Upon the completion of this course, the students will be able to:

1. Apply principles of geotechnical investigations in designing super structures
2. Use design codes
3. Solve design problems related to structure, highway, water supply, and irrigation
4. Function as a member of the design team
5. Write effective reports and improve presentation skills

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weights (%)
1.	Mid Semester Evaluation	30
2.	End Semester Evaluation(includes Final Presentation, Viva-Voce and Project Report)	70

UCE796: PRACTICAL TRAINING (SIX WEEKS)				
	L	**T**	**P**	**Cr**
	-	**-**	**-**	**4.0**

Course Objective: To have extensive on-site exposure to various civil engineering aspects. The students of the alternate scheme shall have to undergo a six weeks industrial training in the summer vacations. They can take up the training at a design office, construction or related sites etc. After completion of their training they have to submit a project report and also make a presentation in front of a panel of internal faculty members only.

Course Learning Objectives (CLO)

Upon the completion of this course, the students will be able to:

1. Employ technical knowledge and state-of-the art practice related to the chosen topic.
2. Enumerate modern construction materials and techniques.
3. Improve presentation skills.

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weights (%)
1.	End Semester Evaluation (includes Final Presentation, Viva-Voce and Project Report)	100

UCE799: PROJECT SEMESTER				
	L	**T**	**P**	**Cr**
	-	**-**	**-**	**15.0**

Course Objective: The objective of the six month industrial training is to expose the final year civil engineering students to the competency, knowledge and skills needed to succeed at the workplace. By undergoing industrial training, they will be able to relate the theory that they learnt and applied them practically. Industrial Training is essential for students to develop the practical skills that they will need to be effective professional engineers

Course Introduction: The project semester is aimed at developing the undergraduate education programme in engineering to include a practical training in a professional engineering setting (a company, top educational institution, research institute etc.) hereafter referred to as host "organization" as deemed appropriate. The participating organizations are selected that are either already visiting Thapar University for placement or are forming new relationships of mutual benefit. The project semester gives the student the opportunity to translate engineering theory into practice in a professional engineering environment. A central requirement of the project semester is that it must be based around significant engineering work and is principally assessed on that basis. The technical activity should be related to both the student's engineering studies and to the host organization's activities, and it should constitute a significant body of engineering work at the appropriate level. It should involve tasks and methods that are more appropriately completed in a professional engineering environment and should, where possible, make use of human and technology resources provided by the organization. It consolidates the student's prior learning and provides a context for later research studies. The student remains a full time registered student at ThaparInstitute during the project semester and this activity is therefore wholly distinct from any industrial interactions which may occur over vacation periods

Course Learning Objectives (CLO)

The project work undertaken as part of the project semester is diverse. As a result, the Learning Outcomes will vary, but on completion of the module, students will have achieved several learning outcomes from the following list:

1. Able to identify and use appropriate mathematical methods, numerical techniques and software tools for application to new and ill-defined engineering problems;
2. Be able to integrate knowledge, handle complexity and formulate judgements with incomplete or limited information;
3. Have the ability to redesign products, processes or systems in order to improve productivity, quality, safety and other desired needs;
4. Have the ability to apply design methods, processes and techniques to unfamiliar, ill-defined problems, involving other disciplines;
5. Be able to design according to codes of practice and industry standards; to identify limitations of codes of practice and the need for their application
6. Have the ability to investigate and define a need and identify constraints including health, safety and legal issues and the impact of engineering solutions in a societal and environmental

context;
7. Be able to make engineering judgements that take cognizance of the social, environmental, ethical, economic, financial, institutional and commercial considerations affecting the exercise of their engineering discipline;
8. Have the ability to consult and work with experts in various fields in the realization of a product or system;
9. Have knowledge and understanding of concepts from a range of areas outside engineering;
10. Be able, via knowledge and understanding of group dynamics, to exercise leadership;
11. Be able to select and apply appropriate communication tools and write technical papers and reports;
12. Be able to describe the relevant advantages and disadvantages of various technologies to an audience, and to communicate effectively in public.

Evaluation Scheme:

Each student is assigned a faculty supervisor who is responsible for managing and assessment of the project semester. This includes a Reflective Diary which is updated throughout the project semester, an Interim Project Report, a Final Report with Learning Agreement/Outcomes and a Final Presentation & Viva which involves the faculty Supervisor and some other members from the department. A hard copy and electronic copy of all reports are required. The mentor from the host organization will be asked to provide his assessment on the designated form. A suggested weighting for the assessments is as follows:

Activity	**Submission time line**	**Marks awarded by**	**Weightage (%)**
Reflective Diary	End of Project Semester	Faculty Supervisor	10
Goals Report	End of week 4 of project semester	Faculty Supervisor	5
Midway Report	End of week 10 of project semester	Faculty Supervisor	15
Final Assessment	End of Project Semester	Host Mentor	20
Final Report	End of Project Semester	Committee assessment	20
Oral and Poster presentation and viva	End of Project Semester		30

SEMESTER-VIII

Approved in 114th Meeting of Senate held on March 7, 2025

UCE809: SEISMIC RESISTANT DESIGN OF STRUCTURES				
	L	**T**	**P**	**Cr**
	3	**1**	**0**	**3.5**

Course Objective: This course will be providing insight into design of structures to withstand earthquake forces and related seismic safety issues.

Earthquake Genesis: Causes of earthquake and propagation, Earthquake occurrence and return period, Characterization of strong ground motions, Seismic hazard assessment, Review of damage in past earthquakes.

Introductory Structural Dynamics: Basic concepts of structural vibrations in Single-Degree and Multi-Degree of Freedom systems

Seismic Analysis of Buildings- Introduction to Indian Standard IS 1893 (Part-1)-2016, Seismic design philosophy, Design response spectrum, Seismic analysis of buildings–Static and Dynamic analysis procedures using codal provisions. Seismic load combinations; Introduction to analysis of masonry-infilled RC buildings.

Seismic Design of Building Components: Concept of ductility for seismic resistance; Capacity based design; Introduction to Indian Standard, IS 13920-2016, Detailing provisions in structural elements using codal provisions.

Course Learning Objectives (CLO)

Upon the completion of this course, the students will be able to:

1. Understand concepts and fundamentals related to seismology & seismic hazard assessment.
2. Perform basic dynamic analysis of single and multi-degree of freedom systems
3. Evaluate lateral forces in buildings for seismic loads.
4. Understand ductile detailing provisions in building components

Text Books:

1. Pankaj Agarwal, andManish Shrikhande, Earthquake Resistant Design of Structures, PHI(2022)
2. Mario Paz and William Leigh, Structural Dynamics(Theory and Computation),Kluwer Academic Publishers, London (2004)
3. Srinivas Vasam and K. Jagannadha Rao, Structural Dynamics and Earthquake Engineering, Publisher: S.K. Kataria & Sons, (2018) ISBN 10: 9350146541 / ISBN 13: 9789350146545

Reference Books:

1. Chopra A.K., Dynamics of structures – Theory and Applications to Earthquake Engineering, Pearson Education (2016).
2. Roberto Villaverde, Fundamental Concepts of Earthquake Engineering, CRC Press, (2009), ISBN 9781420064957

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weights (%)
1.	MST	30
2.	EST	40
3.	Sessionals (May include Assignments/Projects/Quizzes/Tutorials/Lab Evaluations)	30

ELECTIVE-I

Approved in 114th Meeting of Senate held on March 7, 2025

UCE831 :BRIDGE ENGINEERING

L	T	P	Cr
3	1	0	3.5

Course Objective: The course introduces various components of bridges and their various types. Standard loading standards developed by IRC which form a consistent basis for design are introduced. The course provides a lucid exposition of the theory and design of~~,~~ RC box culverts and T- Beam Bridges,. The course covers the theory and design of superstructure and substructure (piers and abutments), bearing and foundations.

Introduction: Definition, components of a bridge, classifications, the importance of bridges, Need for investigations, selection of bridge site, preliminary data to be collected, sub-surface investigations for a bridge

Standard Specifications: Road bridges, I.R.C. loadings, code provisions on width of carriageway, clearances

Design of RC Culvert: Components, Design loadings, Design of slab culvert, Design of single cell box culvert

RC T-beam Bridges: Introduction, *Design of Superstructure and Substructure*

Design of Superstructure: Design of *Two-way Deck Slab* using Pigeaud's Curves, Courbon's Theory, Design of *Longitudinal and Cross Girders*

Design of Substructure: Various types of expansion bearing and fixed bearings, Design of *Elastomeric Laminated bearings*, Design of *Abutment*

Foundations: Overview, Design of Pile Cap, Design of Well Foundation

Experimental Project/assignment/Micro Project
Design of single cell box culvert for different classes of IRC loading using software

Course Learning Objectives (CLO)

Upon completion of this course, the students will be able to:

1. Design various components of superstructure of T-beam bridges
2. Design various components of substructure and foundation of T-beam bridges
3. Design single cell box culvert on software

Text Books

1. Victor, D. Johnson, Elements of Bridge Engineering, Oxford and IBH Publishers, New Delhi(2019)
2. Vazirani & Ratwani, Design of Concrete Bridges, Khanna Publishers, New Delhi (2010)
3. Raju, N. Krishna, Design of Bridges, 5th Edition, Oxford and IBH (2019)

Reference Books

1. Raina, V.K., Analysis, Design and Construction of Bridges, Tata McGraw Hill (2010)

2. Jagadeesh T.R., Jayaram M.A., Design of Bridge Structures, 3rd Edition, PHI (2020)

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weights (%)
1.	MST	30
2.	EST	45
3.	Sessionals (May include Assignments/Projects/Quizzes/Tutorials/Lab Evaluations)	25

UCE616: ADVANCED CONCRETE DESIGN				
	L	**T**	**P**	**Cr**
	3	**1**	**0**	**3.5**

Course Objective: The subject aims to develop an understanding of design and detailing of various types of combined footings and beams curved in plan,. Subject also covers the design concepts of water retaining and earth retaining structures

Combined Footings: Different types, design of rectangular, trapezoidal, strap and raft footings, Pile Foundations

Retaining Walls: Types, behavior, stability requirements, design of cantilever type retaining walls. Introduction to counterfort type retaining wall

Water Tanks: Introduction, general design requirements on no crack basis, Design of circular and rectangular tanks resting on ground, Design philosophy for design of overhead tanks, introduction to Intze type tanks and their staging and foundation

Beams curved in plan: Reinforced Concrete Design Circular beam loaded uniformly and supported on symmetrically placed columns

Flat Slabs: Introduction and Terminology, IS Code Provisions, Analysis and Design of Flat Slab, Reinforcement Detailing

Experimental Project/assignment/Micro Project

Students will be required to design and prepare structural drawing for watertank

Course Learning Objectives (CLO)

Upon completion of this course, the students will be able to:

1. Design various types of combined footings
2. Design RCC water tanks
3. Design cantilever type retaining walls
4. Design beams curved in plan and flat slabs

Text Books

1. Jain, A.K., Reinforced Concrete-Limit State Design, Nem Chand & Bros (2012)

Reference Books

1. Varghese, P. C., Limit State Design of Reinforced Concrete, PHI Publishers (2016).

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weights (%)
1.	MST	30
2.	EST	45
3.	Sessionals (May include Assignments/Projects/Quizzes/Tutorials/Lab Evaluations)	25

UCE617: TRAFFIC ENGINEERING AND GEOMETRIC DESIGN				
	L	**T**	**P**	**Cr**
	3	**1**	**0**	**3.5**

Course Objective: The course aims to provide students with a core understanding of traffic engineering, geometric design, and Highway planning. Students will learn the core concepts of traffic flow, design control devices and road alignments, and apply statistical methods to traffic studies

Core Elements of Traffic Engineering

Traffic Flow Characteristics & Studies: Fundamental parameters, fundamental relationships, headways, traffic stream models, gap & gap acceptance, queuing theory, volume, speed and delay studies.

Capacity and Level of Service (LOS): Capacity analysis of urban and rural roads, capacity of rotaries, LOS concepts as per Indian standards

Traffic Control Devices: Traffic signals, signal design methods (Webster's and IRC), design and placement of traffic signs, Traffic intersections, conflict points

Statistical Applications: Probability functions and statistics, normal distribution and applications, binomial and Poisson distributions

Core Elements of Geometric Design

Design Factors & Space Standards: Human and vehicle factors, space standards for highways, expressways, urban arterials, elements for cycle tracks, pedestrian walkways.

Alignment Design: Horizontal alignment, super-elevation, transition curve, vertical alignment, alignment coordination, consideration for hill roads, relevant IRC standards, introduction to geometric design inconsistency evaluation.

Intersections: Types of intersections, layout design, design considerations, channelization, on and off ramps. Rotary Intersection Design.

Highway Planning Process: Road alignment, surveys for highway projects (topographic, traffic, soil, and material surveys), DPR.

Course Learning Objectives (CLO)

The students will be able to:

1. Analyze traffic flow, capacity, and level of service using standard methodologies.
2. Apply geometric design principles in highway Incorporate stakeholder engagement and community participation in decision-making processes.
3. Design intersection and interchange design and other traffic control devices
4. Prepare and understand a Detailed Project Report for a highway project

Text Books:

1. Khisty CJ and Lal, BK, Transportation Engineering-An Introduction, Prentice Hall, 3rd edition, 2016.
2. R.P. Roess, E.S. Prassas and W.R. McShane, Traffic Engineering, 3rd Ed., Prentice Hall, New Jersey, 2004.
3. C.S. Papacostas and P.D. Prevedouros, Transportation Engineering and Planning,

3rd Ed., Prentice Hall, New Jersey, 2001. J.H. Banks, Introduction to Transportation Engineering, McGraw-Hill, New York, 2002.

4. P.H. Wright and K. Dixon, Highway Engineering, Th. Ed., Wiley, New York, 2003. M. Meyer and E.J. Miller, Urban Transportation Planning, 2nd Ed., McGraw Hill, New York, 2001
5. Indian Highway Capacity Manual (Indo-HCM), CRRI, New Delhi, 2017.
6. IRC codes on geometric aspects: IRC: 38, 52, 69, 73, 86, SP-23

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weights (%)
1.	MST	30
2.	EST	45
3.	Sessionals (May include Assignments/Projects/Quizzes/Tutorials/Lab Evaluations)	25

UCE618: SUSTAINABLE CONSTRUCTION PRACTICES

L	T	P	Cr
3	1	0	3.5

Course Objective: The objective of this course is to expose the students to the concepts of sustainability in the context of building and conventional engineered building materials, such as Concrete, Bricks, and achieving the same through lower Carbon cements, Superior brick kilns and Recycled aggregate minimizing consumption of natural resources including water.

Principles of Sustainability: Basics of Carbon Cycle, Fundamentals of Sustainability, Triple Bottom Line, Embodied carbon and embodied energy

Sustainable Materials: Role of Materials: Carbon from Cement, alternative cements and cementitious material, Alternative fuel for cements for reduction in carbon emission, Sustainability issues for concrete, Types of Composite Cement, Natural Building Materials and systems; Clay bricks and Types of Kilns

Sustainable Construction: Role of quality control, minimization of natural resource utilization, geo-polymer concrete, concrete with alternative material for sustainability, Curing Methods and Use of Waste Water for Mixing and Curing; Sustainable Waste Management; Sustainable construction methods like low carbon construction, off site manufacture, etc. Introduction to design for Durability method for sustainable mix design

Green Buildings: Operational energy reduction and net zero building, Optimization for design of building for energy efficiency, Thermal Diffusivity, Green Performance rating, requirements of LEED, GRIHA etc.

Exercise/ Assignments

Case studies related to the application of traditional and advanced technology for sustainable construction.

Course Learning Objectives (CLO)

Upon completion of this course, the students will be able to:
1. Understand importance of sustainability in construction
2. Develop concrete with alternative sustainable Construction materials and methods
3. Get familiar with international mix design based on durability
4. Understand the definition and concept green buildings

Text Books

1. Concrete Technology by A. M. Neville, J.J. Brooks, 2010
2. Sustainability of Construction Materials, Jamal Khatib, 2016

Reference Books

1. Siddique R, Cachim P. Waste and Supplementary Cementitious Materials in Concrete: Characterization, Properties and Applications. Woodhead Publishing

2. Michael Thomas, Supplementary Cementing Material in Concrete, CRC Press, 2013

3. Satish Chandra, Waste materials used in concrete, Noyes Publications, 1997

4. BS 8500-1 (2015): Concrete–Complementary British Standard to BS EN 206-1–Part 1: Method of Specifying and Guidance for the Specifier

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weights (%)
1.	MST	30
2.	EST	45
3.	Sessionals (May include Assignments/Projects/Quizzes/Tutorials/Lab Evaluations)	25

UCE803 : IRRIGATION ENGINEERING				
	L	**T**	**P**	**Cr**
	3	**1**	**0**	**3.5**

Course Objective: To expose students to various methods of irrigation and design of hydraulic structures

Introduction: Introduction, types and methods of irrigation, concept of smart irrigation systems

Water Requirement of Crops: Soil-moisture-irrigation relationship, depth and frequency of irrigation, irrigation efficiencies, consumptive use and its determination, duty and delta relationship, factors affecting duty, crop seasons.

Canal Irrigation: Canal irrigation system, canal alignment, canal losses, estimation of design discharge of a canal, design of stable channels by Lacey's and Kennedy's theory, Water logging, design of tile drains.

Canal Head works: Layout and component parts of a diversion headwork scheme, design of weir/barrage as per IS specifications

Design of Impermeable floor: Causes of failure of hydraulic structures founded on previous foundations, Bligh's creep theory and Khosla seepage theory, hydraulic jump and its applications in the design of hydraulic structures, design of a canal head regulator.

Canal Regulation Works: Canal falls, necessity, location, and types of falls, design of a vertical drop fall and a glacis fall, roughening measures for energy dissipation, cross regulators and distributary's head regulators, canal escape and canal outlets

Cross Drainage (CD) Works: Need, types, selection of suitable CD work, design of CD works

Course Learning Objectives (CLO)

Upon completion of this course, the students will be able to:

1. Work out the water requirement of crops.
2. Solve problems related to different structures needed for diverting and regulating irrigation water
3. Describe and define different types of cross drainage works

Text Books

1. S.K. Garg, *Irrigation Engineering and Hydraulic Structures*, Khanna Publishers, *New Delhi (2015).*
2. P.N.Modi, *Irrigation Water Resources and Water Power Engineering,* Standard Book House, New Delhi*(2014)*
3. Bharat Singh, *Fundamentals of Irrigation Engineering,* Nem Chand, Roorkee (2005)

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weights (%)
1.	MST	30
2.	EST	45
3.	Sessionals (May include Assignments/Projects/Quizzes/Tutorials/Lab Evaluations)	25

ELECTIVE-II

Approved in 114th Meeting of Senate held on March 7, 2025

UCE838 :PRESTRESSED CONCRETE

L	T	P	Cr
3	1	0	3.5

Course Objective: To make students familiar with the analysis and design of typical pre-stressed concrete structural elements as per IS codal provisions

Introduction-Theory and Basic Concepts: Prestressing concrete terminology, advantages and applications of prestressed concrete, types of prestressing, materials for prestressed concrete and permissible stresses, prestressing systems and devices, losses in prestress.

Limit State Design: Review of limit state design concepts- safety and serviceability requirements.

Analysis and Design for Axial Tension and Flexure: Analysis of members under axial load and flexure, resultant stresses at a section, analysis at service loads-load balancing concept, cracking moment, analysis for ultimate strength, calculation of moment demand, design of type 1 and type 2 members, detailing requirements, analysis of partially prestressed sections.

Analysis and Design for Shear and Torsion: Stress in an uncracked beam**,** limit state of collapse for shear and torsion, design steps and detailing requirements.

Calculations of Deflection and Crack Width: Total deflection due to gravity load and prestressing force, limits of deflection, limits of span-to-effective depth ratio, prediction of long-term deflections, calculation of crack width, limits of crack width.

Transmission of Prestress in pre-tensioned and post-tensioned members: Introduction, transmission length and end zone reinforcement

Course Learning Objectives (CLO)

Upon completion of this course, the students will be able to:

1. Characterize the materials required and various methods of prestressing and evaluate losses in various pre-stressed members.
2. Analysis of prestressed concrete members under flexure and tension.
3. Evaluate the deflections and crack widths in prestressed concrete members.
4. Design various prestressed concrete structural elements for bending, axial tension, shear and torsion
5. Analysis and design of end zone in pre-tensioned and post-tensioned members

Text Books

1. Krishna Raju N., “Prestressed concrete”, 5th Edition, Tata McGraw Hill Company, New Delhi,2012.
2. Pandit G. S. and Gupta S. P., “Prestressed Concrete”, CBS Publishers and Distributers Pvt. Ltd,2012.
3. Singh S. B., “Analysis and Design of Prestressed Concrete Structures” Willey, 2023.

Reference Books

1. Structural design manual, Precast concrete connection details, Society for the studies in the use of precast concrete, Netherland BetorVerlag, 2009
2. Glower, F., “Structural Pre-cast Concrete”, Oxford Publishers (2008)
3. Rajagopalan.N, “Prestressed Concrete”, Narosa Publishing House, 2002

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weights (%)
1.	MST	30
2.	EST	45
3.	Sessionals (May include Assignments/Projects/Quizzes/Tutorials/Lab Evaluations)	25

UCE821 :HYDRAULIC STRUCTURES

L	T	P	Cr
3	1	0	3.5

Course Objective: To introduce the different types of dams and other dam related structures usually observed in a river

Introduction: Types, classification, factors governing the selection of a dam site

Gravity Dams: Forces acting on gravity dam, Design, Modes of failure and criteria for structural stability, principal and shear stress, methods of analysis, elementary profile of a gravity dam, high and low gravity dam, Joints in gravity dam, Galleries, foundation treatment

Earth dam: Classification, Method of construction, Causes of failure, Design criteria, seepage line and its location, Design of Filters, Seepage control, Stability of earth dams.

Spillways: Location, types, design consideration, energy dissipation below spillways, design of stilling basin, spillway crest gates.

Coffer Dams: Use of cofferdams, types of coffer dams, merits and demerits, design of coffer dams.

Surge tank: Function and types of surge tank, methods of surge analysis, design consideration of surge tank.

River training works: Necessity, Causes of meandering, methods of training for rivers.

Software Application: Settlement analysis, slope stability analysis of hydraulic structures under different conditions using Rocscience software.

Course Learning Objectives (CLO)

Upon completion of this course, the students will be able to:

1. Design and analyse the various types of dams and surge tank.
2. Design the appropriate types of spillways.
3. Categorise the type of river training works

Text Books

1. Garg, S.K. ,Irrigation Engineering and Hydraulic structures, Khanna Publishers, New Delhi (2010).
2. Varshney, R.S., Concrete Dams, Oxford and IBH Publishing Company, New Delhi.(2009)
3. Novak, Pavel, Moffat, AIB, and Nalluri, C. ,Hydraulic structures, Taylor& Francis, (2007).

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weights (%)
1.	MST	30
2.	EST	45
3.	Sessionals (May include Assignments/Projects/Quizzes/Tutorials/Lab Evaluations)	25

UCE822 :URBAN TRANSPORTATION PLANNING

L	T	P	Cr
3	1	0	3.5

Course Objective: To expose the students to various concepts of transportation planning on urban platform, Land use planning, use of transportation modelling in travel demand management and public transit studies

The Transportation Planning Process and Problems: Terminology of Transportation Planning, Functional Components, Brief Overview of Models used in Transportation Planning, Stakeholder input in the planning process, Environmental concerns, Smart growth and sustainable alternatives, Energy based planning, Intelligent Transportation Systems, Global Positioning Systems.

Transportation System Impacts: Travel Facilities, Origin and Destination, Transit Surveys Decision making Process, Transportation Demand Management (TDM).

Modeling: Transportation system characteristics and interrelationships, User costs and Human Activities, Travel Demand Forecasting, Trip Generation, Trip Distribution, Modal Choice, Trip Assignment.

Land Use Transportation System: Urban system components, Urban Spatial Structure, Location Theory, Land use planning, Land use Models, Land use transport models – (Lowry and Garin), Lowry Models, Transit Oriented Development(TOD).

Urban Public Transportation: Urban Growth and Public Transport needs, Transit mode characteristics, transit characteristics, Fleet size and capacity estimation, Smart cities based Transit Planning

Project assignment/ Micro project:

1. Study area delineation
2. Travel Survey Design
3. Home interview survey
4. Data analysis
5. Use of Transportation Simulation Software like VISUM/ TransCAD.
6. Case study: Planning for transportation systems of a specific location

Course Learning Objectives (CLO)

Upon completion of this course, the students will be able to:

1. Understand the concept of Transportation Planning in the Regional and City level Planning
2. Design Travel Demand and Transit based Surveys.
3. Estimate Travel Demand of a particular corridor, city or area
4. Perform Four Stage Modelling for Travel demand and further Design transportation alternatives for the same.
5. Suggest mass transit alternatives for a given conditions on the base of its characteristics and capacity estimate

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weights (%)
1.	MST	30
2.	EST	45
3.	Sessionals (May include Assignments/Projects/Quizzes/Tutorials/Lab Evaluations)	25

UCE823 :CLIMATE CHANGE AND ITS IMPACT ON WATER RESOURCES

L	T	P	Cr
3	1	0	3.5

Course Objective: To provide students with necessary knowledge to understand climate change and its impact on water resources with emphasis on hydrological cycle, adaption and mitigation strategies.

Introduction: Basic definitions, greenhouse gases, global warming, weather and climate, climate variability and climate change, climate change scenarios over India

Climate Change Modeling: Simple climate models, General Circulation models, concept of statistical downscaling

Hydrological cycle and climate change: Tools and techniques for analysing changes in precipitation patterns and runoff. Effect of climate variability on:river flow variations leading to floods or droughts, glacier melt, sea level rise and urban flooding. Case studies on water crisis.

Climate change adaptation: Role of indigenous traditional knowledge and resilience for future sustainability, different levels of adaption, adaption strategies, examples of climate change adaption in agriculture, urban planning, disaster preparedness including nature based solutions.

Policy Framework for Climate Change Adaptation: Climate change policies, SDGs Approach, International Climate Change Agreements.

Course Learning Objectives (CLO)

Upon completion of this course, the students will be able to:

1. Define key terms associated with climate science, climate impacts, climate change policies
2. Download hydro-meterological data for climate change modelling
3. Analyse the impact of climate change on hydrological cycle and explain the effect of climate variability on water resources
4. Learn different adaption strategies and ways to address anticipated climate risks through policies and planning.

Text Books

1. Brewster, E. N. *Climate Change Adaptation: Steps for a Vulnerable Planet*, New York, Nova Science, 2010
2. Rao Y.S.,Zhang, C.T., Ojha, C.S.P., Gurjar, B.R., Tyagi, R.D., and Kao, C.M. Climate change modelling, mitigation and adaptation, ASCE, 2013
3. Kevin E Trenberth. *Climate System Modeling*, Cambridge UniversityPress, 2010.

Reference Books

1. Joseph, J.R. *Climate Change: What Everyone needs to know*, Oxford University Press, 2014
2. Kendal M. and Ann, H.S. *The climate modelling primer*, Wiley-Blackwell, 2014

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weights (%)
1.	MST	30
2.	EST	45
3.	Sessionals (May include Assignments/Projects/Quizzes/Tutorials/Lab Evaluations)	25

UCE824 :GEOTECHNICES FOR UNDERGROUND STRUCTURES

L	T	P	Cr
3	1	0	3.5

Course Objective: To enable students in visualizing and critically analysing the behavior of underground structures with reference to various supporting systems under different loading conditions due to induced earth pressure

Excavation methods and lateral supporting system: Introduction, excavation methods and lateral supporting systems, retaining walls, strutting systems, factors influencing on the selection of the retaining strut system, case history. Types of sheet piles, principal advantages of sheet piles, analysis of cantilever wall in sands, and clays, Anchored bulk head stability, Free earth support method, fixed earth support method, Types and Design of anchor systems

Coffer Dams: Types of cofferdams, relative merits and their advantages as compared to other types, comparison between circular and diaphragm types, failure modes of cells, stability analysis of cofferdams

Open cuts: necessity of bracing and strutting in open cuts, pressure distribution diagram under various cases, deep open cut in loose and dense sands, deep open cut in normally loaded and stiff clays. Stability Analysis of open cuts

Excavation and Protection of Adjacent Structures: Introduction, protection of building using the behaviour of excavation induced deformation, building protection by auxiliary methods, construction defects and remedial measures, building rectification methods

Dewatering: Methods of Dewatering, Ditches and sumps, well point system, deep well drainage installation, vacuum method Bleeder wells, sand drain installation, electro-osmosis. Design of dewatering system for deep excavations

Trenchless Technology: Introduction, methods like Horizontal Auger Boring, Horizontal Directional Boring, Directional Drilling, Micro-tunneling, Pilot Tube Micro-tunneling, Pipe Jacking, Moling, Hydroexcavation, Guided Drilling, Jack and Bore

Tunnelling: Introduction , types of tunnels, , Various Construction Methods of tunnelling like Drill and blast, TBM, NATM, SCL. Tunnel lining system Primary and Secondary support system based on rock mass classification, RMR system and Q- system. Ground improvement techniques in Tunnel

Course Learning Objectives (CLO)

Upon completion of this course, the students will be able to:

1. Analyze the underground structures with reference to various supporting systems that needs for underground construction
2. Design the underground structures
3. Develop an ability to protect the adjacent building due to underground construction.

Reference Books:

1. Deep Excavation Theory and Practice by Chang – Yu Ou, Taylor & Francis Group, London, UK, 2006.
2. Gopal Ranjan& A.S.R. Rao, Basic and Applied Soil mechanics, New Age Publisher, New Delhi (2016)
3. Foundation Engineering by Peck, R. B., Hanson, W.E., and Thornburn, T.H., John Wiley & Sons,
4. Foundation Analysis and Design by Bowles, J. E. 4th Ed. McGraw – Hill Book Company, New York, USA, 2009

Evaluation Scheme:

Sr. No.	**Evaluation Elements**	**Weights (%)**
1.	MST	30
2.	EST	45
3.	Sessionals (May include Assignments/Projects/Quizzes/Tutorials/Lab Evaluations)	25

UCE825: LIFE CYCLE ASSESSMENT				
	L	**T**	**P**	**Cr**
	3	**1**	**0**	**3.5**

Course Objective: To introduce the concepts of circular economy and Life Cycle decision making for minimal environmental impact in manufacturing, commerce and service industries. Life Cycle analysis and Life Cycle Assessment will be applied to resource selection, process choices and waste management.

Introduction to life cycle analysis (LCA): Boundaries, functional unit, life cycle assessment (LCA assessment)

Concepts of LCA: Policy and organisational drivers, and application in practice life cycle assessment methodology including (e.g. stages of LCA, Setting the goal, scope, functional unit and boundaries of LCA, comparing products, identifying environmental indicators, interpretation of the LCA assessment (characterised vs normalised)

Assessment Methods: International standards on LCA (e.g. ISO 14044, PAS 2050),
Tools used for LCA (e.g. Open LCA), Principles and practice of design for sustainability.

LCA in Construction: Environmental purchasing based on LCA, Reuse, recycle, recover, waste management,
Symbiosis – one company's waste becoming another company's feedstock.

Case Study: Undertake an LCA analysis for an activity/product/service, identify information inputs, environmental impacts and LCA analysis outputs, develop an assessment methodology to enable you to evaluate the relative impacts of the most significant aspects of all the potential solutions, and hence reach a conclusion of the preferred solution (the Life Cycle Assessment)

Course Learning Objectives (CLO)

The students will be able to:

1. Evaluate the economic, environmental, social and technical aspects that influence a manufacturing organisation
2. Appraise the product lifecycle and the related impact on a business
3. Analyse the information required to undertake an LCA
4. Undertake an LCA and assess its limitations.

Text Books

1. Arvanitoyannis, I.S., 2008. ISO 14040: life cycle assessment (LCA)–principles and guidelines. *Waste management for the food industries*, pp.97-132.
2. Life Cycle Analysis in Construction industry, George Xanthakis, 2014
3. Life Cycle Assessment in the Built Environment, Robert Crawford, 2011

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weights (%)
1.	MST	30
2.	EST	45
3.	Sessionals (May include Assignments/Projects/Quizzes/Tutorials/Lab Evaluations)	25

ELECTIVE-III

UCE854: ADVANCED STEEL STRUCTURE DESIGN				
	L	**T**	**P**	**Cr**
	3	**1**	**0**	**3.5**

Course Objective: The objective of this course is to expose students to design of various industrial structures and steel bridges

Column Bases: Introduction, slab base, gusseted base, design of column base subjected to axial load and moment

Plate Girders: Introduction, weight and economic depth, design of flanges, design of web, curtailment of flange plates, intermediate and bearing stiffeners, design of a riveted and welded plate girders, web and flange splice.

Industrial Buildings (Steel Structures)*:* Design of roof trusses and supporting system, Industrial building frames

Introduction to Pre-Engineered Buildings (PEB): Comparison with Conventional Steel Buildings, Components of PEB

Steel Bridges: Standard specifications for railway bridges, Railway bridge code. General arrangement of single-track broad-gauge railway bridge with open floor, design of stringers, cross girders, main trusses, top and bottom lateral bracing, complete design of through type truss bridge

Experimental Project/assignment/Micro Project

Students will have to submit reports on the design of various structural elements of a steel building.

Course Learning Objectives (CLO)

The students will be able to:

1. Design Column base
2. Analyze and design plate girders
3. Analyze and design different components of truss bridges
4. Analyze and design different components of industrial buildings

Text Books:

1. Subramanian, N., Design of Steel Structures, Oxford University Press (2008).
2. Ajmani, J. L. and Arya, A. S., Design of Steel Structures, Nem Chand and Brothers (2000).

Reference Books:

1. Dunham, C.W., Planning of Industrial Structures, John Wiley and Sons (2001).
2. Gary, W., Steel Designer's Manual, Prentice Hall (2008).
3. S. M. A. Kazimi and R. S. Jindal, "Design of Steel Structures", Prentice Hall of IndiaPvt Ltd (1988).
4. M. Edwin, J. Gaylord and J. E. Stallmeyer, "Design of Steel Structures", Mc Graw Hill (2006).

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weights (%)
1.	MST	30
2.	EST	45
3.	Sessionals (May include Assignments/Projects/Quizzes/Tutorials/Lab Evaluations)	25

UCE855: DESIGN OF REINFORCED EARTH STRUCTURES				
	L	**T**	**P**	**Cr**
	3	**1**	**0**	**3.5**

Course Objective: To learn (i) basic concepts and applications of various types of soil reinforcement, and (ii) design of reinforced earth structures

Detailed Syllabus

1. Introduction to Reinforced Earth Structures

Historical Background and Evolution, Basic Principles and Concepts of Reinforced Earth, Mechanism of Reinforcement and Load Transfer, Advantages and Applications of Reinforced Earth, Comparison with Conventional Retaining Structures

2. Materials Used in Reinforced Earth Structures

Types of Reinforcements: Geosynthetics, Metallic Strips, Geogrids, Geocells, Geomembranes, Properties and Selection Criteria for Reinforcement Materials, Soil-Reinforcement Interaction, Testing and Quality Control of Reinforcement Materials, Durability and Long-Term Performance of Reinforcements

3. Design and Analysis of Mechanically Stabilized Earth (MSE) Walls

Types of Reinforced Earth Retaining Walls, Failure Mechanisms: Internal, External, and Compound Failures, Design Methods: Limit Equilibrium and Limit State Approaches, Seismic Considerations in Reinforced Earth Walls, Drainage and Facing Considerations, Case Studies of Reinforced Retaining Walls, Lessons from Failures in Reinforced Earth Structures

4. Design of Reinforced Slopes and Landslide Mitigation

Types of slopes and their stability, Reinforcement Methods for Slope Stabilization, Design of Reinforced Slopes using Geosynthetics and Soil Nailing, Retaining systems involving breast walls, gabion walls, Landslide Control Measures and Case Studies

5. Codal provisions

Review of related codes like SP102, IS14458, IS14680, Applicability for different situations.

Experimental Project/assignment/Micro Project

Numerical modelling and simulation of Reinforced Earth Walls and Slopes using RS3, Slide3

Course Learning Objectives (CLO)

The students will be able to:

1. Learn the concept of reinforced earth and factors affecting same Analyze and design plate girders
2. Design reinforced earth retaining wall
3. Application of reinforcement to stabilize slope and evaluate stability
4. Prepare and analyse computer aided numerical model of retaining wall and slope

Text Books:

1. Bowels J.E., Foundation Analysis and Design, McGraw Hill Book Company (1997),
2. Shukla, S.K., Yin, Jian-Hua, Fundamentals of Geosynthetic Engineering, Taylor & Francis (2006).
3. Koerner, R., Designing with Geosynthetics, 6th Ed. Prentice Hall (2005),
4. Saran, S., Reinforced Soil and Its Engineering Applications, I.K. international (2005).

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weights (%)
1.	MST	30
2.	EST	45
3.	Sessionals (May include Assignments/Projects/Quizzes/Tutorials/Lab Evaluations)	25

UCE856 :ADVANCED SURVEYING				
	L	**T**	**P**	**Cr**
	3	**0**	**2***	**3.5**

Course Objective: Apply the knowledge of modern surveying techniques like remote sensing and GIS, aerial surveying and Drone surveying for various projects, which is an esstential tool for any civil engineering projects

Global Positioning Systems (GPS): Working Principle, Types of GPS, Application of GPS, DGPS-working Principle, DGPS errors (RT & PP).

Fundamentals of Remote Sensing: Introduction to Remote sensing and electromagnetic spectrum, types of sensors, Orbit and path, Geometric and Radiometric errors, image interpretation-visual and digital

GIS techniques: Basic concepts, Topology, Data models- Vector and Raster, attribute, Digital Elevation models, Map, Projections

Aerial Surveying and Photogrammetry: Basic concepts, principles, and applications of photogrammetry, concepts, and applications for map preparation, Stereoscopy, LIDAR

Drone Surveying: Introduction to drones, comparison of surveying drone and its accuracy; techniques of controlling errors

Course Learning Objectives (CLO)

The students will be able to:

1. Process the raw satellite imagery and prepare landuse and land cover maps and integrated with GIS
2. Process aerial survey data and estimate vertical and horizontal distances.
3. Carry out drone survey and process the data for various uses.

Text Books:

1. Gopi, S., Sathikumar, R, and Madhu, N. Advanced Surveying, Pearson Publisher, 2023
2. Garg, P.K., Introduction to surveying and geomatics engineering, CBS Publishing, 2023
3. Arora KR, Surveying (Vol. III). Standard Book House, 2015

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weights (%)
1.	MST	30
2.	EST	40
3.	Sessionals (May include Assignments/Projects/Quizzes/Tutorials/Lab Evaluations)	30

UCE857: INTEGRATED WATERSHED MANAGEMENT				
	L	**T**	**P**	**Cr**
	3	**1**	**0**	**3.5**

Course Objective: To impart students with a comprehensive understanding of watershed systems and need for a holistic approach to managing a watershed, considering all aspects of the ecosystem

Introduction: Definition, principles, classification and geomorphology of watersheds, physical and hydrological characteristics of watershed, factors affecting watershed management

Fundamentals of watershed hydrology: Understanding the natural processes within a watershed, water flow dynamics, rainfall-runoff modelling and water yield assessments from watershed

Soil, land use and water quality assessment and management: Principles of soil erosion, estimation of soil erosion using soil erosion models, land cover mapping, point and non-point pollution parameters, streamflow measurements. Strategies to mitigate soil erosion including contour farming, terracing, check dams, and vegetation restoration, best management practices.

Integrated planning and decision making: Approaches to develop comprehensive watershed management plans considering social, economic, and environmental factors, stakeholder engagement and collaborative decision-making, introduction to multi criteria decision making and modelling tools in a watershed.

Course Learning Objectives (CLO)

The students will be able to:

1. Define a watershed as a system and identify major environmental problems within a watershed.
2. Perform soil, land use and water quality assessments within a watershed
3. Incorporate stakeholder engagement and community participation in decision-making processes.

Text Books:

1. Debarry Paul A.. *Watershed: Processes, Assessment and Management*, John Wiley & Sons, New Jersey, 2004
2. Dhruva N.V.V., Sastry G. and Patnaik U.S. 1990. *Watershed Management*, Indian Council of Agricultural Research, New Delhi, 1990
3. Murthy, J.V.S., *Watershed Management*, New Age International Publishers, 2017
4. Iyer K. G. and Roy U.N., (ed.). *Watershed Management and Sustainable Development*, Kanishka Publishers, New Delhi, 2005

Reference Books:

1. Isobel W. Heathcote., (2009) *Integrated Watershed Management: Principles and Practice*. Wiley & Sons, Incorporated, John, USA, second edition, 2009
2. Tideman E.M. *Watershed Management–Guidelines for Indian Conditions*, Omega Scientific Publishers, New Delhi, 1999
3. Paul A. DeBarry. (2004). *Watersheds: Processes, Assessment and Management*. Wiley & Sons, Incorporated, John, USA, second edition, 2004
4. Randhir O. Timothy, 2007. *Watershed Management-Issues and Approaches*, IWA Publishing, 2007

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weights (%)
1.	MST	30
2.	EST	45
3.	Sessionals (May include Assignments/Projects/Quizzes/Tutorials/Lab Evaluations)	25

UCE858 : **PAVMENT ANALYSIS AND DESIGN**

L	T	P	Cr
3	1	0	3.5

Course Objective: This course equips students with a comprehensive understanding of pavement materials and structural design. It covers the properties and testing of aggregates, bituminous binders, and concrete, along with mix design methodologies. Students will learn pavement design principles for flexible and rigid pavements using IRC guidelines, traffic load analysis, and mechanistic-empirical methods. Hands-on experience with software tools will enhance analytical skills, enabling students to design, evaluate, and optimize pavement systems effectively.

Detailed Syllabus-

1. **Pavement Materials—**Review of aggregates (properties, classification, tests, aggregate blending, alternative aggregates); review of bituminous binders (grades, types, modified binders, tests, rheology); review of soil-aggregate mixes; materials for rigid pavements; mix design for asphalt mixtures; mix design for pavement quality concrete as per IRC 44. Software for aggregate blending. Rheological studies for modified binders using DSR.

2. **Flexible Pavement Design and Analysis—**Concepts of VDF, LDF, CFD analysis; traffic calculations; provisions from relevant IRC codes; design as per latest IRC 37 guidelines, design of pavements using cement treated subbase, cement treated bases, Granular crack relief layer (AIL), Stress absorbing membrane inter layers, Full Depth Reclamation & bitumen emulsion/foamed bitumen treated reclaimed asphalt pavement RAP base & IRC approved new technologies; Low volume pavement design using IRC: SP-72guidelines, Pavement design using geosynthetics as per IRC: SP: 59 guidelines, Design procedures in case of construction using recommended recycling technologies using IRC:120 guidelines.

3. **Rigid Pavement Design and Analysis—**Types of rigid pavements; Stresses in rigid pavement; relative stiffness; combination of stresses; IRC 58 and IRC SP 62 recommendations; joints; load transfer by dowel bars, tie bars using software/spreadsheet, Design of PQC slabs using separation membrane and without separation membranes, Short panelled concrete slabs design.

Special Topics—IRC:15; IRC: SP:76; IRC:SP:63; perpetual pavements; PCI analysis, software exposure to KENPAVE, KENSLABS; PerROAD; industry case studies

Exercise/ Assignments

- Develop spreadsheet / computer program for asphalt mix design, mix design of pavement quality concrete, calculations of VDF, design traffic, etc.
- Apply soft computing techniques on pavement data available in open repositories

Course Learning Objectives (CLO)

Upon completion of this course, the students will be able to:

1. Evaluate pavement materials and mix designs using standard tests
2. Design and analyze flexible pavement systems using relevant guidelines
3. Design and analyze rigid pavement systems using relevant guidelines

Text Books

1. Pavement Analysis and Design, Huang, YH, Prentice Hall, 2008
2. Principles of Pavement Design, ET Yoder and MW Witczak, John Wiley and Sons, 1975.
3. Highway Engineering, SK Khanna, CEG Justo, A Veeraragavan, Nem Chand & Bros, 2015.

4. Design and Performance of Road Pavements, D Croney and P Croney, McGraw Hill, 1998
Reference Books 1. IRC:37-2018, Guidelines for the design of flexible pavement 2. IRC:58-2015, Guidelines for the design of plain jointed rigid pavements for highways

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weights (%)
1.	MST	30
2.	EST	45
3.	Sessionals (May include Assignments/Projects/Quizzes/Tutorials/Lab Evaluations)	25