COURSES OF STUDY
FOR
UNDERGRADUATE DEGREE
in
Civil Engineering

Effective for the students admitted in the years 2021-22 and onwards.

B.Tech: Civil Engineering
2nd Year - III Semester Courses

THEORY										
S.N.	Category	Course Code	Course Title	Hours			Marks			Credit
				L	T	P	IA	ETE	Total	
1	DC	3CE4-01	Fluid Mechanics	3	0	0	30	70	**100**	**3**
2		3CE4-02	Surveying	3	1	0	30	70	**100**	**4**
3		3CE4-03	Building Materials	2	0	0	30	70	**100**	**2**
4		3CE4-04	Architecture Drawing and Building Construction	3	0	0	30	70	**100**	**3**
5		3CE4-05	Engineering Geology	2	0	0	30	70	**100**	**2**
6	UC	3CE2-01	Engineering Mechanics	3	0	0	30	70	**100**	**3**
			Sub Total	**16**	**1**	**0**	**180**	**420**	**600**	**17**
PRACTICAL & SESSIONAL										
7	DC	3CE4-20	Fluid Mechanics Lab	0	0	2	60	40	**100**	**1**
8		3CE4-21	Surveying Lab	0	0	3	60	40	**100**	**1.5**
9		3CE4-22	Computer Aided Civil Engineering Drawing	0	0	3	60	40	**100**	**1.5**
		3CE4-23	Geology Lab	0	0	2	60	40	**100**	**1**
		3CE4-24	Civil Engineering Lab-I	0	0	2	60	40	**100**	**1**
10	UI	3CE7-30	Professional Training	0	0	2*	60	40	**100**	**1**
11	CCA	3CE8-00	SODECA/NCC/NSS/ANANDAM/IPR	-	-	-	-	100	**100**	**1**
			Sub-Total	**0**	**0**	**14**	**360**	**340**	**700**	**8**
			TOTAL OF III SEMESTER	**16**	**1**	**14**	**540**	**760**	**1300**	**25**

L = Lecture, T = Tutorial, P = Practical, IA = Internal Assessment, ETE = End-Term Exam, Cr = Number of Credits

* For calculation of contact hours

3CE4-01: Fluid Mechanics

3CE4-01: Fluid Mechanics

Credit: 3Max **Marks: 100 (IA=30, ETE=70)**

3L+0T+0P **End Term Exam: 3 Hours**

Course Objectives

1. To get familiar with the fundamentals of fluid and fluid flow characteristics.
2. To introduce the students about properties of the fluids, behavior of fluids under static conditions and to impart basic knowledge of the dynamics of fluids through the control volume approach and to expose to the applications of the conservation laws to a) flow measurements b) flow through pipes (both laminar and turbulent) and c) forces on pipe bends with an exposure to the significance of boundary layer theory and its applications.

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

1. Demonstrate the difference between the behavior of solids and fluids in static conditions and their properties.
2. Apply the conservation laws applicable to fluids and their applications through fluid kinematics and dynamics.
3. Explain the concept of momentum and angular momentum equations and their applications.
4. Estimate losses in pipelines for both laminar and turbulent conditions and analysis of pressure difference and velocity distribution in pipes.
5. Apply the knowledge to solve applied problems in civil engineering domain relating to fluid flow.

S.N.	Contents	Hours
1	Fluids: Definition, Type of fluids, Ideal fluids, real fluids, Newtonian and non-Newtonian fluids. Properties of Fluids: Units of measurement, Mass density, Specific weight, Specific volume, Specific Gravity, Viscosity, Surface tension and Capillarity, Compressibility and Elasticity	4
2	Principles of Fluid Statics: Basic equations, Pascal Law, Types of pressure: Atmospheric pressure, Gauge pressure, Vacuum pressure, Absolute pressure, Pressure gauges	5
3	Buoyancy; Forces acting on immersed plane surface. Centre of pressure, forces on curved surfaces. Conditions of equilibrium for floating bodies, meta-centre and analytical determination of meta centric height	7
4	Kinematics of Flow: Visualization of flow, Types of flow: Steady and unsteady, uniform and non-uniform, rotational and irrotational flow, Laminar and turbulent flow, streamline, path line, streak line, principle of conservation of mass, equation of continuity, acceleration of fluid particles local and convective, velocity, acceleration, velocity potential and stream function, elementary treatment of flow net, vorticity, circulation, free and forced vortex. Fluid mass subject to horizontal and vertical acceleration and uniform rotation	8
5	Fluid Dynamics: Control volume approach, Euler's equation, Bernoulli's equation and its applications. Reynolds transport theorem, Venture-meter, Orifice-meter, Orifices & mouthpieces, Time of emptying of tanks by orifices, Momentum and angular momentum equations and their applications, pressure on flat plates and nozzles.	10
6	Laminar Flow through Pipes: Laminar flow through pipes, Relation between shear & pressure gradient. Flow between plates & pipes. Hagen Poiseuille equation, Equations for velocity distribution, pressure difference velocity distribution over a flat plate and in a pipe section, Darcy-Weisbach equation, friction factor, minor losses, pipe networks	8
	Total	42

SUGGESTED READINGS

1. Fox, Robert W., Alan T. McDonald, and John W. Mitchell. (2020). Fox and McDonald's introduction to fluid mechanics, John Wiley & Sons.
2. Streeter, V. L. Wylie, E. B., and Bedford K.W. (2010). Fluid Mechanics, Tata McGraw Hill, New Delhi.
3. Modi P.N. and Seth S. M. (2019). Hydraulics and Fluid Mechanics including Hydraulic Machines, Standard Book House, New Delhi.
4. Som S. K., Biswas G., and Chakraborty S. (2012). Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill, Education Pvt. Ltd.
5. Pani B. S. (2016). Fluid Mechanics: A Concise Introduction, Prentice Hall of India Private Ltd.
6. Jain A. K. (2016). Fluid Mechanics including Hydraulic Machines, Khanna Publishers, New Delhi.
7. Narayana Pillai N. (2009). Principles of Fluid Mechanics and Fluid Machines, (3rd. Ed.) University Press (India) Pvt. Ltd.

3CE4-02: Surveying

3CE4-02: Surveying

Credit: 3Max **Marks: 100 (IA=30, ETE=70)**

3L+1T+0P **End Term Exam: 3 Hours**

Course Objectives

1. To provide basic knowledge about principles of surveying, and its applications in various engineering domains.
2. To provide a practical understanding of different types of survey works.
3. To figure out the required areas and volumes of land and materials needed in construction work.
4. To ensure that the construction takes place in the correct relative and absolute positions on the ground.
5. To provide an understanding of the working principles of survey instruments including conventional and modern practice.

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

1. Survey of an area under various topography and obstructions.
2. Prepare the plan or map of the area surveyed.
3. Development of contours and elevation profiles
4. Analyze, report, and wherever appropriate, distribute the survey errors.
5. Set out curve and building lay out.
6. Perform instruments checks to ensure they meet the specifications.

S.N.	Contents	Hours
1	**Surveying Principles**: Definitions, Types of Surveys, Classification of surveys, Principle, distorted or shrunk scales, Overview of modern surveying data system- Geomatics, Errors and mistakes, Accuracy and precision in surveying, Types of measurables- distance, angles, and elevation. Overview of historical Surveying Instruments - chains, tapes, and ranging, Field compass, Theodolite; Modern - Total station, GNSS Positioning. **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	10
2	**Distance Measurements:** Overview of distance measurement techniques- Chains, Taping, errors in distance measurement and correction, Operations in planimetric mapping, measurements using offsets, Optical distance measurement (ODM), Electronic Distance Measurement (EDM), EDMI classification, Total station setup, Errors in EDMI	7
3	**Direction Measurements:** Definitions, Horizontal and vertical angles, Azimuth and bearings, Deflection angles, Computations of angles and interconversion, Overview of local attraction, Overview of instruments, Relation between angles and distances, Observing horizontal and vertical angles,	7
4	**Elevation Measurements:** Reference surfaces/Datum, Positioning- planimetric, Geodetic, height above ellipsoid, Definitions- Reduced Level, levelling, trigonometric heights, physical heights, lines and planes, level surfaces, elevation and altitude, Benchmarks, types of Benchmarks, Principle of optical levelling, Structure of levels (auto and dumpy), Reading a levelling staff, Methods of levelling, Accuracy standards for levelling. Level nets, loop closure, Contouring, Contour intervals, representation of reliefs, horizontal equivalent, contour interval, characteristics of contours, methods of contouring, contour gradient.	11

	DEM, DSM, DTM, Interpolation techniques in DEM generation, Overview of photogrammetry and laser scanning. Topographic mapping and map projections. 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.	
5	**Control Survey & Traversing:** Control networks, Control establishment- GNSS positioning modes- PPS, PPK, RTK, overview of differential positioning. Triangulation and Trilateration, criterion for selection of layout of triangles. Traverse, types of traverses, referencing traverse stations, Traverse field notes, linear and angle misclosures, latitude and departure, relative precision, specifications in traversing, Traverse balancing- Bowditch's rule, Transit method, overview of least squares adjustment, rectangular coordinates from latitude and departure, Gale's Table	7
	Total	**42**

SUGGESTED READINGS

1. Charles D. Ghilani & Paul R. Wolf. (2018). Elementary Surveying, Pearson.
2. Kavanagh, B. (2018). Surveying Principles and Applications, Pearson.
3. Schoffield W., Breach, M. (2007). Engineering Surveying, CRC Press.
4. Subramanian, R. (2007). Surveying and Leveling, Oxford.
5. Kanetkar, T.P., and Kulkarni, S.L. (2006). Surveying and Leveling Part I and II, Pune Vidhyarthi Griha Prakashan.
6. Punmia, B.C., Jain, Ashok Kumar and Jain, Arun Kumar (2005). Surveying Vol. I and II, Laxmi Publications.

3CE4-03: Building Materials

3CE4-03: Building Materials

Credit: 3Max **Marks: 100 (IA=30, ETE=70)**

2L+0T+0P **End Term Exam: 3 Hours**

Course Objectives

1. To introduce students to various construction materials, techniques and practices commonly used in civil engineering construction.
2. To gain understanding of properties and usage of bricks, stones, timber, and miscellaneous materials used in construction.
3. To expose students to the various building and general construction products and their associated quality, durability, warrantees, and availability.

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

1. Recognize the requirements and manufacturing process of cement and brick.
2. Demonstrate knowledge of properties of various building materials.
3. Develop understanding of material science and behavior of various building materials used in construction.
4. Understand the properties of concrete, concrete mix proportion.

S.N.	Contents	Hours
1	**Stones:** Classification of rocks, test for stones, characteristics of a good building stone, deterioration of stones, common building stones of India, requirements as per Indian Standards **Bricks:** Composition of good brick earth, harmful ingredients, manufacture of bricks, characteristics of good bricks, shapes, classification of bricks as per IS 1077-1985 and testing as per Indian Standards. **Mortar:** Classifications, Properties, and tests as per Indian Standards **Timber:** Classification and identification of timber, defects in timber, characteristics of good timber, seasoning of timber, requirements as per Indian Standards **Tiles:** Classification of tiles, test for tiles, characteristics of tiles as per Indian Standards **Glass and glazing systems:** Classification, properties, and tests as per Indian Standards	9
2	**Concrete Constituents:** Cement: Constituents of cement and their role, composition of cement (Bogue's equation) hydration of cement, structure of hydrated cement, heat of hydration. Tests of cement as per IS code. Aggregates: Sources, Classification, properties, and grading of aggregates. Tests on aggregates as per IS code.	7
3	**Concrete:** Introduction, properties of concrete, water/cement ratio and its role, gel/space ratio, workability, compressive strength, grades, Production of Concrete: Properties of fresh concrete including workability, air content, flow ability, methods to determine and factors affecting. Properties of hardened concrete such as strengths, permeability, creep, shrinkage, factors influencing, standard tests on fresh and hardened concrete as per IS code.	5
4	Quality control of concrete, Concrete mix design. Admixture in Concrete: Chemical and mineral admixtures (their types and use under different	4

	conditions). Use of fly ash and silica fume in concrete.	
5	**SPECIAL CONCRETE** Light weight concrete, definition and its properties, applications, high strength concrete, definitions, its properties and applications, mass concrete, waste material-based concrete, shotcrete, fiber reinforced concrete: Materials. Fibers-types and properties, ferrocement, polymer concrete composites, heavy-weight concrete for radiation shielding.	3
	Total	28

SUGGESTED READINGS

1. Mehta, Scarborough, Armpriest. (2016). Building Construction: Principles, Materials, & Systems, 2nd Edition, Pearson publication, ISBN 9789332575097.
2. Gambhir M. L. (2004). Concrete Technology, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
3. Shetty M. S. (2010). Concrete Technology: Theory and Practice, S. Chand & Company.
4. Ken, Ward-Harvey. (2009). Fundamental building materials, Universal Publisher (fourth edition).
5. Edward Allen, Joseph Iano. (2014). Fundamental building materials, John Wiley & Sons (Sixth Edition).

3CE4-04: Architecture Drawing and Building Construction

3CE4-04: Architecture Drawing and Building Construction

Credit: 3Max **Marks: 100 (IA=30, ETE=70)**

3L+0T+0P **End Term Exam: 3 Hours**

Course Objectives

1. To expose students to the concepts of architectural drawings and building construction.
2. Capable of working with an architect and contractor

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

1. Plan and draw constructional details of different building components
2. Prepare building plans and other components for a project
3. Capable of supervise building constructions

S.N.	Contents	Hours
1	**Introduction to Architecture Drawing:** Types of buildings Proportion, orientation, criteria for location and site selection site plan, working drawing Building layout, Architectural, structural working drawings, Modular co-ordination and drawing on modules, **Sun Consideration:** Different methods of drawing the sun chart, sun shading devices, design of louvers, energy conservation in buildings, passive solar cooling and heating of buildings. **Climatic and comfort Consideration:** Elements of climate, global climate, climatic zones of India, comfort conditions, biclimatic chart, climate modulating devices.	8
2	**Building Bye Laws and NBC Regulations:** Objective of by-laws, Regulation regarding; means of access, lines of building frontages, covered area, floor area ratio, open spaces around buildings, height & sizes of rooms, plinth regulation and sanitation provisions. **Principles of Planning:** Various factors affecting planning viz-aspect, prospect, furniture requirement, roominess, grouping, circulation, elegance, privacy etc.	9
3	**Functional design and Accommodation requirements** (A) **Residential Buildings:** Anthropometry, activities and their spatial requirements; Area planning, living area, sleeping area, service area; Bubble diagram showing sequence of arrangement of area, plan, elevation, sectional elevation. (B) **Non-Residential Buildings:** viz-school buildings, rest house, primary health centers, post office, bank, college library, cinema theatres etc.	8
4	**Foundations:** Types spread, arch, combined, cantilevered, Raft, Grillage, Piles & wells, Footings in block cotton soil, Basement & Retaining walls **Masonry:** Stone and Brick masonry, Bonds and junctions in brick masonry, Walling, Mud wall, Sun-dried bricks, burnt bricks, stone walling, load bearing & non load bearing brick masonry for multistoried constructions, brick panel walling, reinforced masonry. Bonds & junctions **Prefabricated Construction:** Prefabricated components, Assembly at site, Low-cost housing & hollow blocks.	8
5	**Damp Proof Course:** Points of its requirement in buildings, Damp Proof Course at Plinth level, in basement and roof tops etc. joints in prefabricated construction. Anti termite treatment	9

	Lintels & Arches: Location and construction details in wood, brick, stone and R.C.C. **Stairs and Staircases:** 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. Handrail & railings, description and sketches of lift escalators. **Doors and Windows:** Details, location in buildings, sizes & construction for wooden & metal, Battened, braced, framed, flush and paneled, sliding, folding telescopic, with louvers, collapsible. Windows in timber & Metal casement, double hung, Dormer, Corner, Fanlight, skylight, clear storey etc. Low-cost ideas, Revolving doors, Aluminum door and windows. **Roofing and Flooring:** Types of Flooring, Flat roofs: Waffle floor, channels, cored units etc., inclined roofs. Form Work, Scaffolding, underpinning.	
	Total	**42**

SUGGESTED READINGS

1. Singh, Gurcharan. (1994). Building Construction Engineering, Standard Book House.
2. Sharma, S. K. (2012). Building Construction, S. Chand and Company.
3. Kumar, Sushil, (1990). Building Construction, Standard Publisher and Distributors.
4. Punima, B. C. (2002). Building Construction, Laxmi Publishing House.
5. Sharma and Kaul. (1987). A Textbook of Building Construction, S. Chand and Company.

3CE4-05: Engineering Geology

3CE4-05: Engineering Geology

Credit: 3Max **Marks: 100 (IA=30, ETE=70)**

2L+0T+0P **End Term Exam: 3 Hours**

Course Objectives

1. Identify the structure of earth; distinguish between different rocks and their properties; select sites for different structures in different zones and explore subsurface using different techniques.
2. To demonstrate the importance of geology to take Civil Engineering decisions to solve the earth related problems.
3. To introduce the fundamental of the engineering properties of earth materials for the use of Civil Engineering constructions.
4. To develop quantitative skills and a framework for solving Engineering Geological problems.

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

1. Know about the various internal structures of earth and plate tectonic movements.
2. Characterize the engineering properties of rocks, minerals, and soil.
3. Assess the natural occurring various geological hazards.
4. Use seismic and electrical methods to investigate the subsurface of the earth.
5. Apply Remote Sensing and GIS knowledge to investigate the Geological structures.

S.N.	Contents	Hours
1	General Geology: Subdivision of Geology. Importance of Geology in Civil Engineering. Internal Structure of the Earth, physical properties of minerals, weathering and erosion. Geological work of wind, river and ocean. Stratigraphic aspects of rocks for civil engineers. Geological Time Scale.	6
2	Petrology: Origin & classification of rocks. Texture & Structures of Igneous, Sedimentary and Metamorphic Rocks. Engineering Properties of rocks. Rocks and dimensional stones as construction material. Suitability of rocks for different Civil Engineering purposes. Structural Geology: Causes & Classification of fold, fault, joints & unconformities. Outcrop pattern. Recognition of structure from rock outcrops.	6
3	Natural Disasters and Geological Investigations (in reference to Civil Engineering): Earthquake, causes, intensity scale and seismic zone of India. Site selection for dam, tunnels, multistorey buildings, reservoirs and bridge structures Sites improvement techniques practiced in different civil engineering projects. Introduction to drilling methods.	6
4	Geophysical Methods for Subsurface Exploration: Electrical resistivity methods, Geophysical survey: Seismic refraction techniques, Ground Penetrating Radar (GPR) survey	4
5	Remote Sensing: Introduction and applications in Civil Engineering. Image acquisition, image interpretation (visual and digital, digital terrain model, airborne lithological identification). Remote sensing techniques used in civil engineering domain.	6
	Total	**28**

SUGGESTED READINGS

1. Goodman, R. E. (1993). Engineering Geology - Rock in Engineering Construction", John Wiley and Sons.
2. Varghese, P.C. (2012). Engineering Geology for Civil Engineering PHI Learning Private Limited, New Delhi.
3. Parbin Singh. (2009). A Textbook of Engineering and General Geology, Katson Publishing House, Ludhiana.
4. David George. (2009). Engineering Geology: Principles and Practice, Springer.
5. Marshak Stephen, Mitra Gautum. (2017). Basic Methods of Structural Geology, Pearson.

3CE2-01: Engineering Mechanics

3CE2-01: Engineering Mechanics

Credit: 3Max **Marks: 100 (IA=30, ETE=70)**

3L+0T+0P **End Term Exam: 3 Hours**

Course Objectives

1. To enable students to apply fundamental laws and basic concepts of rigid body mechanics to solve problems of bodies under rest or in motion.
2. To enable the students to apply conditions of static equilibrium to analyze physical systems.
3. To compute the properties of areas and bodies.

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

1. Compute the resultant of system of forces in plane and space acting on bodies.
2. Predict the support-reactions and the internal forces of the members of various trusses and frames.
3. Analyze equilibrium problems with friction.
4. Apply transfer theorems to determine properties of various sections.
5. Analyze equilibrium of connected bodies with virtual work method.
6. Analyze the forces in the frames structure.

S.N.	Contents	Hours
1	**STATICS OF PARTICLES** Vectorial representation of forces and moments Vector Operation - Concepts of particles and rigid bodies - Composition of concurrent forces in plane - Free body diagrams - Equilibrium of rigid bodies in two and three dimensions- Moment of a force about a point and about an axis, Couple moment Reduction of a system of forces to a force and a couple	10
2	**PROPERTIES OF SURFACES, MOMENTS, AND PRODUCTS OF INERTIA** First moment of areas - Centre of area - Centre of gravity Moment of Inertia for areas (Second moment of area) - Parallel axis theorem - Perpendicular axis theorem - Moment of inertia for composite area - Product of inertia Mass moment of inertia	8
3	**FRICTION** Laws of coulomb friction - Coefficient of friction - Dry friction - Sliding (skidding) friction Ladder friction - Belt friction - Rolling resistance	4
4	**KINEMATICS OF PARTICLES** Principle of virtual work for a particle and rigid body Condition for equilibrium for a conservative system Stability - Particle dynamics in rectangular coordinates, cylindrical coordinates and in terms of path variables General motion of system of particles	8
5	**WORK ENERGY METHODS, IMPULSE AND MOMENTUM** Work Energy method	8

	Conservation of energy Impulse and momentum relationship - Impulsive force - Impact force Conservation of momentum - Moment of momentum equation	
6	**RIGID BODY MOTION** Translation and rotation of rigid bodies Kinetic energy of rigid body Work and energy relations Euler's equation of motion	4
	Total	**42**

SUGGESTED READINGS

1. Russell C Hibbeler and Ashok Gupta (2010). Engineering Mechanics: Statics and Dynamics (11th Edition), Published by Pearson Education Inc., Prentice Hall.
2. Meriam J.L and Kraige L.G. (2012). Engineering Mechanics, Volume I - Statics, Volume II -Dynamics, 7th Edition, John Wiley & Sons, New York.
3. Beer, Johnston, Cornwell, and Sanghi. (2013). Vector Mechanics for Engineers: Statics and Dynamics, 10th Edition, McGraw-Companies, Inc., New York.
4. Rajasekaran S and Sankara Subramanian G. (2013). Fundamentals of Engineering Mechanics, 3rd Edition, Vikas Publishing House Pvt. Ltd., India.

3CE4-20: Fluid Mechanics Lab

3CE4-20: Fluid Mechanics Lab

Credit: 1Max **Marks: 100(IA: 60, ETE: 40)**

0L+0T+2P

Course Objectives

1. To get familiar students about the usage and working principle of different instruments used in fluid mechanics.
2. Application of instruments to calculate various parameters such as fluid pressure, discharge, losses in pipes etc.
3. Calibration of instruments

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

1. Methods of discharge measurements on conduits and open channel flow.
2. Calibration flow measuring devices used in pipes, channels and tanks assessment.
3. To calculate losses in flow.
4. Verification and characterization of fluids flow through experiments.

S.N.	Contents
1	Introduction to various Instruments.
2	Determination of metacentric height
3	Calibration of a venturi meter.
4	Determination of frictional losses in pipes of different diameters.
5	Determination of minor losses in pipes.
6	Calibration of v- notch and rectangular notch.
7	Reynolds dye experiment for flow characterization.
8	Determination of C_c, C_v and C_d of an orifice.
9	Verification of Bernoulli's theorem.
10	Calibration of orifice meter.
11	Verify the impulse momentum equation (impact of jet).

SUGGESTED READINGS

1. Gupta V. P. (2019). Laboratory manual of Fluid Mechanics and Machines, CBS, ISBN-13,9788123900094.
2. Modi P. N. and. Seth S. M. (2019). Fluid Mechanics and Hydraulic Machines, 3rd Edition, Prentice-Hall of India.
3. Kumar D. S. (2013). Fluid Mechanics and Fluid Power Engineering, S.K. Katariya & Sons.

3CE4-21: Surveying Lab

3CE4-21: Surveying Lab

Credit: 1.5Max **Marks: 100(IA: 60, ETE: 40)**

0L+0T+3P

Course Objectives

1. To understand the importance of surveying in the field of civil engineering.
2. To study the basics of linear/angular measurement methods like chain surveying, compass surveying.
3. To study the significance of plane table surveying in plan making.
4. To know the basics of levelling and theodolite survey in elevation and angular measurements.
5. To understand tacheometric surveying in distance and height measurements

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

1. Calculate angles, distances and levels
2. Understand the working principles of survey instruments
3. Estimate measurement errors and apply corrections
4. Interpret survey data and compute areas and volumes

S.N.	Contents
1	Preparing a plan of an area using distances / offsets with chain and tape
2	To carry out profile levelling and plot longitudinal and cross sections for road
3	Elevation measurements using trigonometric heighting using Total station
4	Geospatial data collection for planimetric mapping of an area using handheld GNSS Receiver
5	Plane table survey of an area
6	Setting out curves.
7	PPK positioning with DGPS Receiver system for establishing control points
8	RTK positioning with DGPS Receiver system for an area survey
9	Total station setup using bearing and resection for locating objects
10	Layout of building in the field using Total Station and development of a wireframe model

SUGGESTED READINGS

1. Charles D. Ghilani & Paul R. Wolf. (2018). Elementary Surveying, Pearson.
2. Barry Kavanagh. (2018). Surveying Principles and Applications, Pearson.
3. Schoffield W., Mark Breach. (2007). Engineering Surveying, CRC Press.
4. Subramanian, R. (2007). Surveying and Leveling, Oxford.
5. Kanetkar, T.P., and Kulkarni, S.L. (2006). Surveying and Leveling Part I and II, Pune Vidhyarthi Griha Prakashan.
6. Punmia, B.C., Jain, Ashok Kumar and Jain, Arun Kumar, (2005). Surveying Vol. I and II, Laxmi Publications.

3CE4-22: Computer Aided Civil Engineering Drawing

3CE4-22: Computer Aided Civil Engineering Drawing

Credit: 1.5Max **Marks: 100(IA: 60, ETE: 40)**

0L+0T+3P

Course Objectives

1. To learn the fundamentals of civil engineering drawings.
2. To impart knowledge and skill relevant to Building detailed drawing using computer software.
3. To make student able to learn to sketch and take field dimensions and to take data and transform it into graphic drawings and develop CAD skills

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

1. Prepare simple layout of buildings.
2. Produce working drawings for individual components like doors and windows etc.
3. Develop line diagram, building section, elevation, key plan, and sectional elevation.
4. Illustrate hand drafting any parts of a building and implement the regulations for layout of plan.
5. Draft the plan, elevation, and sectional view of the buildings

S.N.	Contents
1	To plan and draw working drawing of a Residential building with Site plan, Foundation plan, Plan, Two sectional elevations, Front elevation, Furniture plan, Water supply and sanitary plan, Electric fitting plan using drawing sheet
2	To design and draw a building among Primary Health Center, Primary School, Rest House, Post Office, Bank, College Library and Cinema Theatre using drawing sheet
3	To study and draw the labelled sketch of different Building Components on sheets with exposure to CAD: 1) Drawing of walls a. Brick and Stone masonry b. Cross section of external wall from foundation to parapet c. Partition wall, cavity wall 2) Pointing, Arches, Lintels and Floors 3) Doors and Windows 4) Stairs, Cross section of Dog legged stairs 5) Roofs: Flat and Pitched roof (Steel truss) 6) Development of Front Elevation and Sectional Elevation from a given plan 7) Development of Plan, Front Elevation and Sectional Elevation from line diagram

SUGGESTED READINGS

1. Shah, M. G. Building Drawing. McGraw-Hill.
2. AutoCAD Reference Manual

3. Kulkarni, Dhananjay M., A. P. Rastogi, and Ashoke K. Sarkar. (2009). Engineering Graphics with AutoCAD by PHI Learning Pvt. Ltd.
4. Stefan Mordue. (2015). Building Information Modeling for Dummies.
5. Sharma & Gurucharan Singh. (2020). Civil Engineering Drawing Standard Publishers.
6. Sikka V. B. (2015). A Course in Civil Engineering Drawing, Kataria & Son's.
7. George Omura. (2021). Mastering AutoCAD.
8. Kulkarni, Dhananjay M., A. P. Rastogi, and Ashoke K. Sarkar. (2009). Engineering Graphics with AutoCAD by. PHI Learning Pvt. Ltd.

3CE4-23: Geology Lab

3CE4-23: Geology Lab

Credit: 1Max **Marks: 100(IA: 60, ETE: 40)**

0L+0T+2P

Course Objectives

1. To make the students capable of studying and identify properties of rock and minerals.
2. Student should acquire knowledge about engineering properties of rocks and their minerals

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

1. Identify rocks and minerals.
2. Interpret map and able to measure strike and dip of the bedding planes.
3. Identify the various structural geological models.

S.N.	Contents
1	Identification of Minerals in Hand Specimen
2	Identification of Rocks in Hand Specimen
3	Physical Properties of Minerals
4	Physical Properties of Rocks
5	Subsurface analysis – Resistivity sounding.
6	Subsurface analysis – Seismic survey
7	Interpretation of Geological Map (10 Nos.)
7	Dip & Strike Problems (8 Nos.)
9	Identification of Geological features through wooden Models: a) Structural Geological Diagrams b) Petrological Diagrams c) Engineering Geological Diagrams

SUGGESTED READINGS

1. Chennakesavulu, N. (2009). Textbook of Engineering Geology", MacMillan Ltd., New Delhi.
2. David George. (2009). Engineering Geology: Principles and Practice, Springer.
3. Marshak Stephen, Mitra Gautum. (2017). Basic Methods of Structural Geology, Pearson
4. Parbin Singh. (2009). A Textbook of Engineering and General Geology, Katson Publishing House, Ludhiana.

3CE4-24: Civil Engineering Lab-I

3CE4-24: Civil Engineering Lab-I

Credit: 1Max **Marks: 100(IA: 60, ETE: 40)**

0L+0T+2P

Course Objectives

1. To facilitate the understanding about the behavior of construction materials.
2. Understand the quality control tests for the various civil engineering materials by performing different lab tests on materials.

Course Outcomes

1. Evaluate various properties of the basic construction materials as per standards.
2. Ensure quality control while testing/ sampling and acceptance criteria.
3. Analyze the concrete mix design parameters.

S.N.	Contents
1	To determine the fineness of cement - IS 4031 (Part 1):1996
2	To determine, for the cement paste, the: (a) 'Standard Consistency' - IS 4031 (Part 4):1988 (b) 'Initial Setting time' - IS 4031 (Part 5):1988
3	To determine the 'Specific Gravity' of the cement particles - IS 4031 (Part 11):1988
4	Determination of 'soundness of cement' - IS 4031 (Part 3):1988; and the 'compressive strength of cement' - IS 4031 (Part 6):1988
5	To determine the 'Specific Gravity', 'Water Absorption' and necessary adjustment for 'Bulking' of Fine Aggregates (size<10mm) - IS 2386 (Part III):1963
6	To determine the 'Fineness Modulus' and 'Grain Size Distribution' of Fine Aggregates - IS 2386 (Part I):1963
7	Determination of water absorption, compressive strength, and efflorescence of bricks
8	To determine the consistency of concrete mixes of given proportion by using: (a) Slump Test (b) Compaction Factor Test
9	Determination of cube and cylinder compressive strength of concrete
10	To design a concrete mix of M-20 grade in accordance with IS 10262.
11	To design concrete mix of M-40 grade with super plasticizer in accordance with IS 10262.

SUGGESTED READINGS

1. Indian standard codes IS 4031 (Part 1) – 1996, IS 4031 (Part 3 and Part 5) – 1988, IS 2386 (Part 1 to Part 6) – 1963, IS 383– 2016.
2. M.L. Gambhir, Neha Jamwal. (2017). Building and Construction Materials: Testing and Quality Control (Lab Manual Series).

B.Tech: Civil Engineering
2nd Year - IV Semester Courses

THEORY										
S.N.	Category	Course Code	Course Title	Hours			Marks			Credit
				L	T	P	IA	ETE	Total	
1	DC	4CE4-01	Geotechnical Engineering-I	3	0	0	30	70	**100**	**3**
2		4CE4-02	Mechanics of Solids	3	1	0	30	70	**100**	**4**
3		4CE4-03	Environmental Engineering	3	1	0	30	70	**100**	**4**
4		4CE4-04	Hydraulics Engineering	3	0	0	30	70	**100**	**3**
5		4CE4-05	Construction Management	3	0	0	30	70	**100**	**3**
6	UC	4CE2-01	Advanced Engineering Mathematics	3	0	0	30	70	**100**	**3**
Sub Total				**18**	**2**	**0**	**180**	**420**	**600**	**20**
PRACTICAL & SESSIONAL										
7	DC	4CE4-20	Environmental Engineering Lab	0	0	2	60	40	**100**	**1**
8		4CE4-21	Hydraulics Engineering Lab	0	0	2	60	40	**100**	**1**
9		4CE4-22	Civil Engineering Lab-II	0	0	2	60	40	**100**	**1**
10		4CE4-23	Geotechnical Engineering Lab-I	0	0	2	60	40	**100**	**1**
11	CCA	4CE8-00	SODECA/NCC/NSS/ANANDAM/IPR	-	-	-	-	100	**100**	**1**
			Sub- Total	**0**	**0**	**8**	**240**	**260**	**500**	**5**
		TOTAL OF IV SEMESTER		**18**	**2**	**8**	**420**	**680**	**1100**	**25**

L = Lecture, T = Tutorial, P = Practical, IA = Internal Assessment, ETE = End-Term Exam, Cr = Number of Credits

4CE4-01: Geotechnical Engineering-I

4CE4-01: Geotechnical Engineering-I

Credit: 3Max **Marks: 100 (IA=30, ETE=70)**

3L+0T+0P **End Term Exam: 3 Hours**

Course Objectives

1. To familiarize the students with the concepts of geotechnical engineering and its related applications in Civil Engineering.
2. Understand Mechanism of compaction, factors affecting, and effects of compaction on soil properties.
3. To explain role of water in soil behavior and how soil stresses, permeability and quantity of seepage including flow net are estimated.

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

1. Fundamental knowledge of soil and soil mass.
2. Basic introduction and determination of index properties of soil.
3. Conduct experimental studies to determine soil properties.
4. Carried out the process of soil compaction and soil stabilization.

S.N.	Contents	Hours
1	**Fundamental Definitions & Relationships:** Soil and soil mass constituents, Water content, specific gravity, void ratio, porosity, degree of saturation, air void and air content, unit weights, density index. Interrelationship of these terms. **Index Properties:** Determination of index properties of soil, water content, specific gravity, particle size distribution, sieve and sedimentation analysis, consistency limits, void ratio, and density index.	5
2	**Soil Classification:** Classification of soil for general engineering purposes, particle size, textural H.R.B. Unified and I.S. Classification systems. **Flow through Soils:** Soil water absorbed capillary and free water, Darcy's law of permeability of soil and its determination in laboratory, Field tests, factors affecting permeability, permeability of stratified soil masses. **Seepage:** Seepage pressure, Laplace's equation for seepage, Flownet construction, Uplift pressure, piping, principle of drainage by Electro Osmosis, Phreatic line.	11
3	**Stresses in Soil Mass:** Total effective and neutral pressure, calculation of stresses. Influence of water table on effective stress, quicksand phenomenon. Shear Strength of Soils: Mohr's circle of stress, shear strength of soil, parameters of shear strength, Coulomb's failure envelope, determination of shear parameters by Direct Shear Box. Triaxial and unconfined compression test apparatus.	12
4	**Soil Compaction:** Principles of soil compaction, laboratory compaction tests, Proctor's test, Modified Proctor tests, Measurement of field compaction, field methods of compaction and its control, dry and wet of optimum. Factors affecting compaction.	8
5	**Soil Stabilization:** Soil stabilization, Mechanical Stabilization, Stabilization with cement, Lime, and bitumen.	6
	Total	**42**

SUGGESTED READINGS

1. Ranjan G., Rao, A.S.R. (2016). Basic and Applied Soil Mechanics. New Age International, New Delhi.
2. Budhu, M. (2011). Soil Mechanics and Foundation, John Wiley & Sons, Inc.
3. Holtz R and Kovacs, WD, Thomas C. Sheahan (2010): Introduction to geotechnical engineering, Pearson.
4. Arora, K.R. (2020). Soil Mechanics & Foundation Engineering, Standard Publisher Dist. ISBN-13:978-8180141126.
5. Gulhati, Shashi K & Datta Manoj (2017). Geotechnical Engineering Principles and Practices, McGraw Hill Education.
6. Coduto, Donald P., Yeung, Man-chu R., Kitch, William A. (2017). Geotechnical Engineering Principles and Practices, Pearson Education Ltd.
7. Lambe. T. William and Whitman, Robert V. (2012). Soil Mechanics: Wiley India Pvt Ltd, ISBN-13: 978-8126539918.

4CE4-02: Mechanics of Solids

4CE4-02: Mechanics of Solids

Credit: 4Max **Marks: 100 (IA=30, ETE=70)**

3L+1T+0P **End Term Exam: 3 Hours**

Course Objectives

1. To understand the basic concepts of the stresses and strains for deformable bodies
2. To appreciate the development of internal forces and resistance mechanism for one dimensional and two-dimensional structural elements
3. Relationship between internal forces developed and deformations occurred in the physical object
4. To analyze and understand different internal forces and stresses induced due to representative loads on structural elements
5. To analyze and understand principal stresses due to the combination of two-dimensional stresses on an element, and failure mechanisms in different materials
6. To evaluate the behavior of members under torsion (shafts), compression (columns and struts), bending (beams), and internal pressure (pressure vessels)

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

1. To evaluate the strength of various structural elements under internal forces such as compression, tension, shear, bending and torsion.
2. To suggest suitable material from among the available in the field of manufacturing
3. To evaluate the behavior and strength of structural elements under the action of compound stresses and thus understand failure concepts.
4. To understand the basic concept of analysis and design of members subjected to torsion.
5. To understand the basic concept of analysis and design of structural elements such as columns and struts.

S.N.	Contents	Hours
1	**Introduction** A revisit to method of sections, Existence of internal forces in bodies, Concept of stress and stress resultants, Stress components on plane surface (normal and shear stresses), Elements of stress tensor and their representation on infinitesimal element in rectangular coordinates, Stress tensor as matrix, Stress tensor's symmetry property, Introduce that Elements of stress tensor change by choosing different reference axes in the material, Representation of different states of stress on infinitesimal volume element: Plane stress, triaxial stress, biaxial stress, uniaxial stress, Uniaxial tension test on steel bar: Apparatus, gauge length, Engineering stress and true stress, notion of uniaxial strain, Engineering and true stress-strain diagram of mild steel in tension and compression, Young's modulus of elasticity, Typical engineering stress-strain diagrams in tension for structural steel, aluminum, rubber, wood etc., and in compression for copper, cast iron, Idealized constitute relations (behavior) diagrams of real materials: Perfectly rigid, perfectly plastic, Elasto-plastic, Proof-stress for relevant materials, Material properties, Homogeneity and isotropy properties, Poisson's ratio and its determination from uniaxial tension test, Definition of strain energy from stress-strain curve: Resilience and toughness of linear elastic materials, Generalized Hooke's law: Hooke's law for normal stresses,	9

	Shear strain, Hooke's law in shear, stress circle	
2	**Uniaxial loaded members** Axially loaded bars: Uniaxial state of stress on transverse sections, State of stress on inclined sections, maximum normal and shear stresses, Changes in lengths of axially loaded members- prismatic bars, cables; Changes in lengths under non-uniform conditions-bars with intermediate axial loads, bars consisting of prismatic segments, bars with continuously varying loads or dimensions; Thermal expansion of bars, thermal stresses in bars confined between a) rigid supports and b) partially yielding supports Stresses in Statically Indeterminate Structures, Strain energy - elastic and inelastic strain energy, strain-energy density, volumetric strain	5
3	**Torsion** Torsional deformations of a circular bar - shear stress and strains outside and within the bar and in circular tubes; angle of twist; limitations of the torsion formula; Hollow circular bar (tube) - shear stresses, torsion formula for thin-walled tubes; Torsion of stepped and composting shafts; Stresses and strains in pure shear- stresses on inclined planes, strains in pure shear; Strain energy in torsion (pure shear);	5
4	**Shear Forces and Bending Moments** Introduction to types of beams, different types of support reactions, types of loads, shear forces and bending moments, relationships between loads, shear forces, and bending moments – for distributed, concentrated and couple loading; Shear-force and bending moment diagrams for concentrated load, uniform load, several concentrated loads, combination of loads, couple loading **Stresses in Beams** Pure bending and non-uniform bending, Theory of flexure for initially straight beams, distribution of bending stresses across the beam cross-section, curvature of a beam, longitudinal strains in beams, normal stresses in beams, moment-curvature relationship, flexure formula and limitations; Strain Energy due to bending Shear stresses in beams of rectangular cross section, circular cross section, beams with flanges - shear formula; distribution of shear stresses on transverse section, maximum and minimum shear stresses and limitations; applications on built-up beams, Shear flow and shear center	10
5	**Analysis of Stress and Strain** Plane stress- stresses on inclined sections, transformation equations for plane stress; Principal stresses and maximum shear stresses; Mohr's circle for plane stress; Hooke's law for plane stress; Relation between various elastic constants, Tri-axial stress - maximum shear stresses,	5

	Stresses and strains in the thin walls of spherical pressure vessels and cylindrical pressure vessels; Members subjected to combined loadings, Concept of theory of failure.	
6	**Deflections of Beams** Differential equations of the deflection curve; Deflections by integration of the second-order bending-moment (moment-curvature) equation; deflections by integration of the shear-force and load equations (fourth-order equation); Using method of superposition for obtaining deflections in complex loading and support conditions	4
7	**Columns** Buckling and Stability- Critical Load, Equilibrium, Euler buckling theory - Columns with pinned ends, column fixed at the base and pinned at the top, column with both ends fixed, effective length of columns, critical stress Columns with eccentric axial loads, the Secant formula for columns	4
	Total	**42**

SUGGESTED READINGS

1. Hibbeler, R.C. (2018). Mechanics of Materials, Pearson, ISBN-13: 978-9332584037.
2. Popov, E.P. (1999). Engineering Mechanics of Solids, Prentice-Hall (India).
3. Beer, F.P., Johnston, Jr., E.R., DeWolf, J.T. and Mazureu, D.E. (2009). Mechanics of Materials, 5th Edition, McGraw Hill
4. Crandall, S.H., Dahl, N.C. and Lardner, T.J., Sivakumar, M.S. (2017). An Introduction to the Mechanics of Solids, 3rd Edition, McGraw Hill

4CE4-03: Environmental Engineering

4CE4-03: Environmental Engineering

Credit: 3Max **Marks: 100 (IA=30, ETE=70)**

3L+1T+0P **End Term Exam: 3 Hours**

Course Objectives

1. To understand various sources of water supply and assessment of water quantity and quality.
2. To be familiar with water distribution Network and water treatment procedures
3. Students will be acquainted with wastewater characteristics, pollution and wastewater treatment.
4. To identify the sewage problems in locality and provide solutions.

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

1. Understand treatment of water and justify type of pipes, joints in pipe & various valves useful in water supply.
2. Apply different analysis techniques for the measurement of physical and chemical parameters of water and wastewater.
3. Understand the design of water treatment units.
4. Draw layout of distribution system.
5. Understand the design of sewerage system and wastewater treatment units.

S.N.	Contents	Hours
1	Sources of Water Supply: Surface water, ground water, springs, wells & galleries. Quantity and Quality of Water: Quantity of water per capita, variation in seasonal and hourly consumption. Forecasting of population. Standards of purity for public water supply (I.S. and WHO standards). Raw Water: Lakes and river intakes, raw water pumping. Treatment of Water: Aeration, screening, simple sedimentation, Quiescent and continuous flow types of tanks. Coagulation of water, principle of coagulation, coagulation followed by sedimentation, mixing basins.	9
2	Filtration: Slow sand filters, rapid sand filters, comparison of two filters. Disinfection: Treatment with excess lime, ozone, ultraviolet rays, boiling, chlorine and compound of chlorine for disinfection. Water Softening: Zeolite process, its limitation & advantages.	8
3	Pipes for Water Supply: Different types of pipes used in water supplies. Joints in Pipes: Bell& spigot joint, cement joint, mechanical joint, flanged joint. Valves: Air valve, reflux valve, safety valve, sluice valve. System of Supply: Constant & intermittent supply of water & its disadvantage. Layout of distribution system.	8
4	Sewage Disposal: Introduction, systems of sewage disposal, conservancy system & water carriage system. Separate, Combined and partially separate system, their advantages & disadvantages. Suitability of separate sewerage system for India. Manhole, drop manhole. Shape of sewers. Laying the sewers.	7
5	Design of Sewers: Quantity of sewage, provision for future population, Quantity of storm water, design of sewers, Estimating storm water by time of concentration method. Testing of sewer line. Cleaning of sewers. Preliminary Treatment: screening, disposal of screening, skimming tank, grit chamber, disposal of grit. Sewage Treatment: Principle of sewage, sedimentation, filtration, intermittent sand filter, introduction of trickling filter. Advantage & disadvantage of trickling filter.	10
	Total	**42**

SUGGESTED READINGS

1. Hussain, S.K. (2017). Textbook of water supply & Sanitary Engineering. Oxford & IBH Publishing co. Pvt. Ltd., New Delhi.
2. Davis M. L. and Cornwell D. A. (2012). Introduction to Environmental Engineering. Rangewala, S.C. (2016). Fundamentals of water supply & sanitary engineering. Charotar Publisher House, Anand.
3. Syed R. Qasim. (2010). Wastewater Treatment Plants, CRC Press, Washington D.C.
4. Garg, S.K. (2015). Water supply & sanitary engineering. Khanna Publishers. New Delhi.
5. Gray N.F. (2006). Water Technology. Elsevier India Pvt. Ltd., New Delhi.
6. Manual on Sewerage and Sewage Treatment Systems Part A, B and C (2013) CPHEEO, Ministry of Urban Development, Government of India, New Delhi.
7. Birdie, G. S., and Birdie. (2010). Water Supply and Sanitary Engineering.
8. Metcalf and Eddy. (2010). Wastewater Engineering–Treatment and Reuse, Tata McGraw-Hill Company, New Delhi.
9. Garg, S.K. (2015). Environmental Engineering, Khanna Publishers, New Delhi, Vol. II
10. Punmia, B.C., Jain, A.K., and Jain, A.K. (2010). Environmental Engineering, Vol. II, Laxmi Publications.
11. Manual on Water Supply and Treatment: Ministry of Urban Dev., New Delhi.

4CE4-04: Hydraulics Engineering

4CE4-04: Hydraulics Engineering

Credit: 3Max **Marks: 100 (IA=30, ETE=70)**

3L+0T+0P **End Term Exam: 3 Hours**

Course Objectives

1. To impart basic knowledge about the open channel flows with analysis of uniform flow, gradually varied flows and rapidly varied flows.
2. Expose to basic principles of working of hydraulic machineries.
3. To understand the engineering hydrology and canal hydraulics

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

1. Describe the basics of open channel flows, associated classifications.
2. Analysis of uniform flow in steady state conditions with specific energy concept and its application.
3. Analyze steady gradually varied flow, water surface profiles and its length calculation using direct and standard step methods.
4. Acquired knowledge about hydraulic machines like pumps and turbines.
5. Analyze surface hydrological data and draw hydrograph and other useful parameters and design economical channel section.

S.N.	Contents	Hours
1	Dimensional Analysis & Models: Dynamical Similarity and Dimensional Homogeneity Model experiment, geometric, Kinematic and Dynamic similarity. Reynold's, Froude's, Weber's, Euler and Mach numbers. Distorted river models and undistorted models, proper choice of scale ratios. Scale effect. Principle of dimensional analysis Rayleigh method, Buckingham theorem.	7
2	Turbulent flow, Reynolds equations, Prandtl's mixing length theory, Equations of velocity distribution and friction coefficient Boundary Layer Theory: Concept of boundary layer, laminar and turbulent boundary layers, boundary layer thickness, von Karman integral equation, laminar sub-layer, hydro-dynamically smooth and rough boundaries, separation of flow and its control, cavitation.	6
3	Open Channel Flow: Uniform, Non-Uniform, and variable flow. Resistance equations of Chezy and Manning. Section factor for uniform flow. Most efficient rectangular, triangular, and trapezoidal sections. Velocity distribution in open channels. Gradually Varied Flow: Prismatic channels, Specific energy of flow. Critical depth in prismatic channels. Alternate depths. Rapid, critical and sub critical flow, Mild, steep, and critical slopes. Classification of surface curves in prismatic channels and elementary computation.	8
4	Rapidly Varied Flow: Hydraulic jump or standing wave in rectangular channels. Conjugate or sequent depths Losses in jump, location of jump. velocity distribution in open channels. Impact of Free Jets: Impact of a jet on a flat or a curved vane, moving and stationary vane. Introduction of Hydraulic machine – Type of pumps and turbines and its brief description. Draft tube and its principle.	7
5	Hydrology: Definition, Hydrologic cycle, Application to Engineering problems, measurement of rainfall, rain gauge, peak flow, flood frequency method, catchment area formulae, Flood hydrograph, Rainfall analysis, Infiltration, Runoff, Unit hydrograph and its determination,	8

	Estimation of runoff.	
6	Canal Hydraulics: Types of canals, parts of canal irrigation system, channel alignment, assessment of water requirements, estimation of channel losses, design of channels, regime and semi theoretical approaches (Kennedy's Theory, Lacey's Theory), cross section of channels.	6
	Total	**42**

SUGGESTED READINGS

1. Modi P.N. and Seth. (2013). Hydraulics and Fluid Mechanics including Hydraulic Machines. Standard Book House New Delhi. 19th edition.
2. S K Som (2012). Gautam Biswas and S Chakraborty, Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill Education Pvt. Ltd.
3. Ven Te Chow. (2009). Open Channel Hydraulics, McGraw Hill, New York.
4. Mays L. W. (2005). Water Resources Engineering, John Wiley & Sons (WSE), New York.
5. Garg S.K. and Rajeshwari Garg. (2021). Elementary Irrigation and Water Resources Engineering.
6. Mays L. W. (2005). Water Resources Engineering, John Wiley & Sons (WSE), New York.

4CE4-05: Construction Management

4CE4-05: Construction Management

Credit: 3Max **Marks: 100 (IA=30, ETE=70)**

3L+0T+0P **End Term Exam: 3 Hours**

Course Objectives

The objective of this course is to study:

1. Economics and flow of a civil construction project, from planning to execution to dismantling,
2. Involvement of different stakeholders in diverse ways
3. Optimization of project resources at different phases of construction

   so as to help a student to be able to conveniently plug-in at any stage of future construction project.

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

1. Understand and appreciate construction project handling and economics
2. Appreciate and estimate time-value of money and assets
3. Perform cost estimation of construction components
4. Plan a basic construction project and perform network analysis
5. Exercise levelling resources on basic small-scale projects
6. Have knowledge of construction industry quality, safety aspects, claims and dispute mechanisms.

S.N.	Contents	Hours
1	**Introduction to Construction Projects** Introduction to Construction Projects, Types and features, Phases of Construction Project, Project Stakeholders. (Agencies involved and their methods of execution) **Economics and Cost Estimation** Project Cost Estimation from Client's perspective: Rate Analysis and Specifications, Time Value of Money, Economic Decision Making. **Tendering and Contracts** Tendering Process and Construction Contract, Cost Estimate from Contractor's Perspective (Stages of project planning: pre-tender planning, pre-construction planning, detailed construction planning, role of client and contractor, level of detail etc)	8
2	**Project Planning and Network - I** Project Resources, Project Plan, Work Breakdown Structure (WBS), Steps in Project Planning: a) Prepare WBS, b) Obtain durations, cost expenditure and resource requirement for each activity, c) Obtain relationship between activities Planning Terminology: Event, Activity, Network, Precedence, Logic, Duration, Forward/Backward Pass, Float/Slack Time, Critical Path, Network Diagrams: Types like Arrow Networks (traditional AOA), Node Networks (modern AON), and superiority of Node networks, Preparation of Network Diagrams; Precedence Tables, Contiguous and Interruptible Activities,	6
3	**Project Planning and Network - II** Network Analysis	8

	CPM: Critical path method with AOA and AON networks PERT: Where to use and where not, Distributions, data binning and histogram examples, Most likely and expected durations, Probability density (PDF) and cumulative probability (CPF) functions, Standard normal distribution and z-tables, PERT calculations by drawing CPM network such as a) Determine the duration (or finish date) of the project, given the probability/likelihood b) Determine the probability of finishing the project, given the deadline	
4	**Project Scheduling and Control** Resource Scheduling, Resource Levelling, Resource constraints and conflicts, line of balance technique, Resource categories such as a) Labor (planning, organizing, staffing, motivation), b) material (concepts of planning, procurement, and inventory control) and c) equipment; Funds: cash flow, sources of funds Network crashing (compression the schedule) Broad classification of resource scheduling: a) Resource levelling and b) resource allocation, Solve examples on resource levelling Classification of costs, Time-Cost trade-off, Duration Shortening, Time-Cost Monitoring and Control using S-curve, Earned-value Analysis	10
5	**Construction Claims and Disputes** Construction Claims and Disputes, Claim Identification, Compensations, Disputes Causes, Dispute Resolution Mechanisms, Legal Proceedings. **Construction Quality and Safety** Quality control: Concept of quality, PDSA Cycle, Quality of constructed structure, Quality control and management, Use of manuals and checklists for quality control, Role of inspection, Basics of statistical quality control Quality control in RC structures: Quality of grouting and welds; Introduction to construction audit Safety and health on project sites: accidents; their causes and effects, costs of accidents, occupational health problems in construction, organizing for safety and health	10
	Total	42

SUGGESTED READINGS

1. Barrie, D.S., Paulson B.C. (2013). Professional Construction Management, McGraw Hill.
2. Mubarak S.A. (2019). Construction project scheduling and control. 4th Edition John Wiley & Sons.
3. Jha K.N., (2015). Construction Project Management: Theory and Practices, Pearson Press, 2nd Edition.
4. Chitkara, K.K. (2019). Construction Project Management, Tata McGraw Hill.
5. Joy, P.K. (2000). Handbook of Construction Management, Macmillan Publishers India.
6. King, R.W., Hudson, R. (1985). Construction Hazard and Safety Handbook, Butterworths.
7. Antill J.M., Woodhead R.W. (1982). Critical Path Methods in Construction Practice, Wiley.

4CE2-01: Advanced Engineering Mathematics

4CE2-01: Advanced Engineering Mathematics

Credit: 3Max **Marks: 100 (IA=30, ETE=70)**

3L+0T+0P **End Term Exam: 3 Hours**

Course Objectives

1. To familiarize the students with linear algebra and transform calculus
2. To make the students appreciate the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated

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

1. Construct analytic functions and use their conformal mapping property in application problems.
2. Apply transform methods for solving linear differential equations in engineering applications

S.N.	Contents	Hours
1.	**Introduction to Linear Algebra**: Algebraic Structures, Sets, Groups, Vector Spaces, Subspaces, Linear independences Linear Transformations, Addition, scalar multiplication and product of linear transformations, Polynomials of linear transformations, Constant coefficient linear differential operator, Null Space of linear transformations, Inverse of a linear transformation,	8
2.	**Laplace Transform**: Definition and existence of Laplace transform, Properties of Laplace Transform and formulae, Unit Step function, Dirac Delta function, Heaviside function, Laplace transforms of periodic functions. Finding inverse Laplace transforms by different methods, convolution theorem. Evaluation of integrals by Laplace transform, Solving ODEs by Laplace transforms method	8
3.	**Solution of IVP using Laplace Transforms**: Introduction to Initial Value Problems (IVP), Functions of exponential order, Convergence behavior of piecewise continuous function of exponential order, Salient features of Laplace Transforms: Linear, one-to-one, existence valid for only functions of exponential order Laplace Transforms of differentiation and integration, Shifting Theorems, Laplace Transform tables Coupled Linear Differential Equations: Forced-damped vibration (derive equations for two-particle-mass system), Free-undamped vibrations, and then Uncoupling those LDEs using Laplace transform and further solving using inverse Laplace transform	10
4.	**Fourier Series and Fourier Transforms**: Fourier series: Introduction, derivation and physical interpretation; Fourier series expansion of periodic functions: Square wave, triangular wave, sawtooth wave, Fourier Complex Sine and Cosine transforms, properties of Fourier Transforms, inverse Fourier transforms, Convolution theorem, Parseval's theorem	10

	Application of Fourier transforms to differential equations (heat equation and wave equations)	
5.	**Z-Transforms**: Definition, properties and formulae, Convolution theorem, inverse Z-transform, Application of Z-transform to solve difference equation	6
	Total	**42**

SUGGESTED READINGS

1. Robert G. Kuller, Donald R. Ostberg, Fred W. Perkins, Donald L. Kreider. (1966). An Introduction to Linear Analysis. Addison-Wesley Pub. Co.
2. Erwin Kreyszig. (2017). Advanced Engineering Mathematics. John Wiley and Sons, 10th Edition, New Delhi.
3. Grewal B.S. (2017). Higher Engineering Mathematics. Khanna Publishers, 44th Edition, New Delhi.
4. Bali N., Goyal M., and Watkins C. (2009). Advanced Engineering Mathematics. Firewall Media, 7th Edition, New Delhi.
5. Glyn James. (2011). Advanced Modern Engineering Mathematics. Pearson Education, 4th Edition, New Delhi.
6. Peter V. O'Neil (2012). Advanced Engineering Mathematics, Cengage Learning India Pvt., Ltd, 7th Edition, New Delhi.
7. Ramana B.V. (2010). Higher Engineering Mathematics, Tata McGraw Hill Co. Ltd., 11th Reprint, New Delhi.

4CE4-20: Environmental Engineering Lab

4CE4-20: Environmental Engineering Lab

Credit: 1Max **Marks: 100(IA: 60, ETE: 40)**

0L+0T+2P

Course Objectives

1. To understand the basic characteristics of water and wastewater
2. To analyze the physical, chemical, and bacteriological characterization of water and wastewater.

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

1. Apply analysis techniques to assess the physical and chemical parameters of water and wastewater.
2. Recommend the degree of treatment required for the water.
3. Quantify the pollutant concentration in water and wastewater.
4. Microscopic studies of water and wastewater.

S.N.	Contents
Part A	Physical, chemical, and bacteriological characterization of water and chemical dose determination for water treatment by performing following laboratory experiments: 1. To determine the pH value and the turbidity of a given sample of water 2. To determine the conductivity of a given water sample 3. To determine the free residual chlorine and chloride concentration in a sample of water 4. To determine the optimum coagulant dose 5. To determine the temporary and permanent hardness in a given water sample 6. To determine the dissolved oxygen (DO) in a given sample of water. 7. Microscopic studies of water
Part B	Physical, chemical, and bacteriological characterization of wastewater and strength assessment of wastewater by performing following laboratory experiments: 1. To determine the acidity and alkalinity of a wastewater sample 2. To determine total, suspended, dissolved and settable solids in a wastewater sample 3. To determine volatile and fixed solids in a wastewater sample 4. To determine the chloride concentration in a wastewater sample 5. To determine the sulphate concentration in a wastewater sample 6. To determine the BOD of a given wastewater sample 7. To determine the COD of a given wastewater sample 8. Microscopic studies of a wastewater

SUGGESTED READINGS

1. Manual on Water Supply and Water treatment. Ministry of Urban Development, Govt. of India, New Delhi.
2. Standard methods for the examination of water and wastewater. (2012). 21st Edition, Washington: APHA.
3. Dr D. R. Khanna and Dr R. Bhutiani. (2008). Laboratory Manual of Water and Wastewater Analysis.
4. Sawyer, C. N., McCarty, P. L., and Perkin, G.F. (2002). Chemistry for Environmental Engineering and Science, 5th edition McGraw-Hill Inc.
5. B. Kotaiah and Dr. N. Kumara Swamy. (2007). Environmental Engineering Laboratory Manual, Charotar Publishing House Pvt. Ltd., 1st Edition.

4CE4-21: Hydraulics Engineering Lab

4CE4-21: Hydraulics Engineering Lab

Credit: 1Max **Marks: 100(IA: 60, ETE: 40)**

0L+0T+2P

Course Objectives

1. To understand the basic concepts of hydraulics
2. To develop an understanding of the model studies of hydraulic structures and design of open channel sections under different situations

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

1. Derive the relationship among the sequent depths of steady rapidly varied flow and estimating energy loss in hydraulic jump with exposure to positive and negative surges.
2. Analyze the water surface profiles under different flow situations

S.N.	Contents
1	To prepare the slope calibration chart for an experimental flume.
2	To study the velocity distribution in open channel flow.
3	To determine the Manning's roughness coefficient of an experimental flume over different roughness beds.
4	To conduct the laboratory flume experiment for construction of specific energy curves for various discharges.
5	To conduct the laboratory flume experiment for plotting of gradually varying flow (GVF) profiles.
6	To compare the experimental GVF profiles with computed GVF profiles.
7	To conduct the laboratory flume experiment for determination of energy loss in various types of hydraulic jumps.
8	To determine the coefficient of discharge of sharp crested weir and broad crested weir.
9	To determine the coefficient of discharge of Venturi flume.
10	To determine the coefficient of discharge of Parshall flume.

SUGGESTED READINGS

1. Modi P.N. and Seth, S.M. (2003). Hydraulics and Fluid Mechanics including Hydraulic Machines, Standard Book House, New Delhi.
2. S K Som; Gautam Biswas and S Chakraborty. (2012). Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill Education Pvt. Ltd.
3. Ven Te Chow. (2009). Open Channel Hydraulics, McGraw Hill, New York.
4. Dr. G L Asawa (2019). Laboratory Work in Hydraulic Engineering, New Age International (P) Ltd., Publishers, ISBN 9788122418101
5. Raikar R.K. (2012). Laboratory Manual Hydraulics and Hydraulic Machines, Prentice Hall India Learning Private Limited.

4CE4-22: Civil Engineering Lab-II

4CE4-22: Civil Engineering Lab-II

Credit: 1Max **Marks: 100(IA: 60, ETE: 40)**

0L+0T+2P

Course Objectives

1. To impart knowledge and skill relevant to the mechanical properties of materials subjected to different types of loading.

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

1. Apply the knowledge of testing steel rod subjected to tension and torsion.
2. Explain the hardness of different metals.
3. Exert knowledge about the testing of helical spring and carriage spring.
4. Acquire the knowledge about double shear test on metal and impact test on metal.

S.N.	Contents
1	Tests on Mild steel to obtain stress-strain relationship, and to determine material constants: a) Young's Modulus, b) Poisson's ratio, and to characterize, yield stress and strain, ultimate stress, stress at fracture, fracture strain
2	Tension test on Tor steel (HYSD bars) and proof stress
3	Torsion Test on Mild Steel Circular Bar
4	Bend and Rebend Test on structural reinforcement steel bars
5	Impact test on metal specimen (Izod and Charpy)
6	Hardness Tests on Ferrous and Non-Ferrous Metals: Brinell and Rockwell Tests
7	Modulus of Rupture of Wooden Beam
8	Characterization of concrete using NDT methods: a) Ultrasonic Pulse Velocity (UPV) test (for Elasticity modulus) (IS 516 - Part 5, Sec 1 :2018), b) Rebound Hammer test (for strength) (IS 516 - Part 5, Sec 4 :2020), and finally using c) compressive strength test in CTM (IS 516)

SUGGESTED READINGS

1. Strength of Materials Laboratory Manual, Anna University, Chennai-600025.
2. IS 432 (Part I) -1992 – Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement.
3. Rajput, R.K. (2014). Strength of Materials, S. Chand & Company Ltd., New Delhi.
4. S.D. Hasan. (2020). Civil Engineering Materials and their testing. ISBN 9788173197390
5. Sood, Hemant. (1996). Laboratory manual on testing of Engineering materials. New Age International (P) Ltd., ISBN 9788122407570
6. M.L. Gambhir, Neha Jamwal. (2017). "Building and Construction Materials: Testing and Quality Control (Lab Manual Series)".

4CE4-23: Geotechnical Engineering Lab -I

4CE4-23: Geotechnical Engineering Lab -I

Credit: 1Max **Marks: 100(IA: 60, ETE: 40)**

0L+0T+2P

Course Objectives

1. Introduce the students to the basic concepts and principles of soil mechanics.
2. Determine the index and engineering properties of soil.

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

1. Conduct experimental studies to determine soil properties.
2. Evaluate the compaction and consolidation characteristics of soils in engineering practices.
3. Determine the shear strength of soils.

S.N.	Contents
	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 the Standards and Specifications.
1.	Determination of field density by Core cutter & Sand replacement method
2.	Grain size Analysis by Mechanical & Hydrometer Method.
3.	Determination of Specific Gravity by Pycnometer.
4.	Determination of Liquid Limit, Plastic limit & Shrinkage limit.
5.	Determination of Permeability by constant head & variable head permeameter.
6.	Consolidation Test
7.	Unconfined Compression Test.
8.	Direct Shear Test.

SUGGESTED READINGS

1. Ranjan G. & Rao. (2007). Basic and Applied Soil Mechanics. New Age International, New Delhi.
2. Holtz, R.D., Kovacs, W.D., Sheahan, T.C. (2013). Introduction to geotechnical engineering by John Wiley New York.
3. Braja M. Das. (2014). Principles of Geotechnical Engineering, Cengage learning Pvt. Ltd, 8th Edition.
4. William A Kitch. (2011). Geotechnical Engineering Lab manual, Kendall/Hunt Publishing Co, U.S.

B.Tech.: Civil Engineering

3rd Year - V Semester Courses

THEORY										
S.N.	Category	Course code	Course Title	Hours			Marks			Credit
				L	T	P	IA	ETE	Total	
1	DC	5CE4-01	Structural Analysis-I	3	0	0	30	70	**100**	**3**
2		5CE4-02	Concrete Structures -I	3	0	0	30	70	**100**	**3**
3		5CE4-03	Steel Structures-I	3	0	0	30	70	**100**	**3**
4		5CE4-04	Geotechnical Engineering -II	3	0	0	30	70	**100**	**3**
5		5CE4-05	Transportation Engineering-I	3	0	0	30	70	**100**	**3**
6	DE†	**Departmental Elective I**		2	0	0	30	70	**100**	**2**
		5CE5-11	Air and Noise Pollution							
		5CE5-12	Field Exploration and Geotechnical Processes							
		5CE5-13	Advanced Concrete Technology							
		5CE5-14	Pavement Materials							
		5CE5-15	Fundamentals of Remote Sensing							
7	DE†	**Departmental Elective II**		2	0	0	30	70	**100**	**2**
		5CE5-16	Solid Waste Management							
		5CE5-17	Design of Foundation and Retaining Structures							
		5CE5-18	Introduction to Finite Element Methods							
		5CE5-19	Traffic Engineering							
		5CE5-20	Geographic Information Systems							
Sub Total				**19**	**0**	**0**	**180**	**420**	**600**	**19**
PRACTICAL & SESSIONAL										
8	DC	5CE4-20	Geotechnical Engineering Lab -II	0	0	2	60	40	**100**	**1**
9		5CE4-21	Transportation Engineering Lab	0	0	2	60	40	**100**	**1**
10		5CE4-22	Estimation and Valuation	0	0	2	60	40	**100**	**1**
11	UI	5CE7-30	Industrial Training	0	0	2‡	60	40	**100**	**3**
12	CCA	5CE8-00	SODECA/NCC/NSS/ANANDAM/IPR	-	-	-	-	100	**100**	**1**
			Sub- Total	**0**	**0**	**8**	**240**	**260**	**500**	**7**
		TOTAL OF V SEMESTER		**19**	**0**	**8**	**420**	**680**	**1100**	**26**

L = Lecture, T = Tutorial, P = Practical, IA = Internal Assessment, ETE = End-Term Exam, Cr = Number of Credits

† **It will be mandatory for the department to offer all the electives to the students. However, in case of scarcity of faculty members to offer the DEs, at least 3 electives from each DE-I and at least 3 electives from DE-II categories must be offered.**

‡ For calculation of contact hours

5CE4-01: Structural Analysis - I

5CE4-01: Structural Analysis - I

Credit: 3Max **Marks: 100 (IA=30, ETE=70)**

3L+0T+0P **End Term Exam: 3 Hours**

Course Objectives

1. To obtain fundamental understanding of different types of structures and their characteristics based on which their analysis procedures are determined.
2. To understand different analysis procedures of plane determinate truss.
3. To obtain an understanding on shear force, bending moment, and displacement of structure using various methods.
4. To obtain an understanding on rolling load and influence line diagram for determinate and indeterminate structures.
5. To understand different methods for analysis of indeterminate structure.

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

1. Classify different type of structures
2. Determine the stress resultants, degrees of freedom, static and kinematic indeterminacy of a structure.
3. Analyze a plane determinate truss.
4. Derive the expression of strain energy of a structural component due to different stress resultants and also the deflection of beams from the strain energy function.
5. Draw the influence line diagrams for determinate and indeterminate structures.
6. Analyze indeterminate beams and simple plane frames by applying different methods of analysis.

S.N.	Contents	Hours
1	**Basic concepts** Structural Systems - Degrees of Freedoms, Static indeterminacy, Kinematic indeterminacy. Determinate and indeterminate structures. Stability- Unsymmetrical bending, Shear centers.	06
2	**Analysis of plane trusses** Basic Principles, Types of supports, Analysis by Method of joints and by Method of sections	04
3	**Analysis of plane beam and displacement of statically determine structures** Support reactions, Shear force and bending moment in statically determinate beams; Determination of slope and deflections of beams using successive integration method – Macaulay's Method, 'Moment of the Area' Method, Conjugate beam method	06
4	**Strain energy and its usage for determination of displacement of statically determine structures** Strain energy due to axial load, bending, and shear; theorem of minimum potential energy, principle of virtual work, law of conservation of energy; Deflection of Beams using Strain Energy Method. Castigliano's 1st and 2nd Theorems, Deflection of Beams using Virtual work method, Castigliano's theorem and the Unit load method.	10
5	**Rolling loads & influence lines** Rolling loads and Concept of Influence lines – Influence lines for reactions, shear force and bending moment in beams – load position for maximum shear force and bending moment at a section in beam – Absolute maximum bending moment in beams- Influence lines for member forces in Trusses –Muller Breslau's Principle.	8

6	**Analysis of indeterminate structures** Indeterminate Structures: Analysis of Fixed beam, Continuous beam and simple frames with and without translation of joints by method of Consistent Deformation. Three moments Theorem for continuous beams, Analysis of Propped Cantilever.	8
	Total	**42**

SUGGESTED READINGS

1. Hibbler, R. C. (2006). Structural Analysis, 6th edition, Pearson Prentice Hall, New Delhi.
2. Wang, C.K. (2017). Intermediate Structural Analysis, McGraw Hill Education, ISBN-13: 978-0070702493
3. Reddy, C. S. (2017). Basic Structural Analysis, TATA McGraw Hill Publishers.
4. Gali, A., Newville, A. M., Brown, T. G. (2009). Structural Analysis – A Unified Classical and Matrix Approach, Sixth Edition, Spon Press, UK.
5. Patil, H. S., Patil, Y. D., Patel, J B. (2016). Structural Analysis-I, Synergy Knowledge ware Publisher, Mumbai.
6. Gahlot, P. S., Gehlot, D. (2012). Fundamentals of Structural Mechanics, CBS Publisher, New Delhi.
7. Thandavamoorthy, T. S. (2011). Structural Analysis, Oxford University Press, New Delhi.

5CE4-02: Concrete Structures -I

5CE4-02: Concrete Structures -I

Credit: 3Max **Marks: 100 (IA=30, ETE=70)**

3L+0T+0P **End Term Exam: 3 Hours**

Course Objectives

1. To impart knowledge on basic of concepts of design of reinforced concrete structures and
2. Make the students able to design and detail the basic elements like beam, slab, column, and footing using reinforced concrete.

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

1. Understand various design philosophies.
2. Analyze and design of beams for flexure, shear, torsion and bond stress using limit state design method.
3. Analyze and design structural members for serviceability condition.
4. Analyze and design of beam, slab, column, and footing using reinforced concrete.

S.N.	Contents	Hours
1	**Introduction** Introduction to RC Elements, Loads on Structures, Design Philosophies - Working stress and limit state methods, Codes of Practice, Materials for reinforced cement concrete (RCC) – Design loads – Concrete structural systems – Basis of structural design – Principles of limit state design – Characteristics strength and design strength, idealized stress-Strain curve for materials – Design codes (IS 456:2000, IS:875, IS:13920 (2016), IS:1893(2016))	07
2	**Limit state design of beams under flexure and shear** Limit state of Collapse in Flexure – Design parameters of stress block – Analysis of singly reinforced rectangular sections – Moment of resistance – Design of singly and doubly reinforced rectangular section – Analysis and design of flanged beam sections. Behavior of RC Beams under shear –Design for torsion and shear	11
3	**Limit state design of slabs** Types of slabs – Behavior of one way and two-way slabs – Design of one way simply supported and continuous slabs – Design of two-way slabs.	08
4	**Limit state design of columns** Types of columns – Behavior of axially loaded RC Columns-Uniaxial and Biaxial loaded column – Practical provision on Reinforcement Detailing.	08
5	**Limit state design of footing** Types of footings – General design consideration for RC Footings – Structural design of axially loaded isolated rectangular and circular footings – Analysis of footing subjected to vertical load and moments.	08
	Total	**42**

SUGGESTED READINGS

1. Pillai, S. U. and Menon, D. (2009). Reinforced Concrete Design, 3rd edition, Tata Mc Graw Hill Publication Ltd, New Delhi.
2. Subramanian, N. (2013). Design of Reinforced Concrete Structures, Oxford University Press, New Delhi.
3. Sinha, S. N. (2006). Reinforced Concrete Design, 2nd edition, Tata Mc Graw Hill Publishing Co., Ltd, New Delhi.
4. Gambhir, M. L. (2006). Fundamentals of Reinforced Concrete Design, Prentice Hall of India, New Delhi.

5CE4-03: Steel Structures-I

5CE4-03: Steel Structures-I

Credit: 3Max **Marks: 100 (IA=30, ETE=70)**

3L+0T+0P **End Term Exam: 3 Hours**

Course Objectives

1. To analyze behavior of simple steel members in tension, compression, and flexure
2. To design steel tension members, columns, beams, beam-columns and column bases
3. To analyze and design connections in steel construction.
4. To design slightly complex members such as built-up columns and plate girders

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

1. Understanding the general practice in steel construction based on Limit State Design
2. Design simple components in structural steel construction.
3. Design moderately complex components in steel construction.

S.N.	Contents	Hours
1	**Introduction to Steel Structures:** Types of Steel Structures, Rolled Steel Sections, Built-up Steel Sections, Characteristics of Steel, Stress-Strain Curve, Types of Loads on Structures, Codes of Practice, Steel-Section Tables, Uniaxial Stress-Strain Behavior of Steel Design Philosophies: Working Stress Method, Factor of Safety, Allowable Stresses. Limit State Method, Partial Safety Factors, Design Loads, Design Strengths. Tension Members: Gross-Area, Net Area, Service Loads, Design of Flats, L-section, I-section and Channel-section as tension members	2+ 2+ 4= 8
2	**Compression Members:** Slenderness Ratios, Global and Local Buckling, Design Stresses; Design using Rolled Steel (I and L) Sections - Design of short column (Struts) and Long Columns; Design of Compound Columns; Introduction to Steel Columns of Built-up Sections with Lateral Connection Systems, Design of built-up Columns and their Lateral Connections	8
3	**Beams:** Plastic analysis of bending of beam, Plastic behavior and development of Elastic and Plastic Moments in beams, Classification of beam sections as per bending behavior – Plastic, Compact, Semi-compact, Slender; Rolled Steel Sections used for beams, Beams with single span, multiple spans, cantilever support; Built-up Beams, Support conditions of ends and top flange, Lateral torsional buckling, Design of above beams without and with lateral torsional buckling for Flexure and Shear.	8
4	**Riveted and Bolted Connections:** Types of Joints, Failure Mechanisms, Strength of Rivets and Bolts, Pitch, Gauge, Edge Distance, Design of bolted connections – Lap joints, Double cover butt joints (with and without filler plate), single cover. **Welded Connections:** Types of Joints, Failure Mechanisms, Strength of Weld, Minimum and Maximum Size, Minimum Length, Design of welded joints (both eccentric and centric) Eccentric Connections: Design of Beam-Column Joints and Column Base.	10
5	Introduction to Plate Girders, Steel Bridges, Steel Towers **Plate Girder:** Shear in Plate Girder, High Shear Condition, Analysis and Design of Plate Girder	2+6

	Total	**42**

SUGGESTED READINGS

1. Subramanian, N (2016). "Design of Steel Structures – LIMIT STATE METHOD", Oxford Higher Education. ISBN10 – 9780199460915
2. IS 800: 2007 "General Construction in Steel – Code of Practice", Bureau of Indian Standards
3. Duggal, S. K. (2014). "Limit State Design of Steel Structures", McGraw Hill Education.

5CE4-04: Geotechnical Engineering -II

5CE4-04: Geotechnical Engineering -II

Credit: 3Max **Marks: 100 (IA=30, ETE=70)**

3L+0T+0P **End Term Exam: 3 Hours**

Course Objectives

1. To learn how three phase system is used in soil and how are soil properties estimated using three phase system.
2. The course will explain the role of water in soil behavior and how soil stresses, permeability and quantity of seepage including flow net are estimated.
3. The course will impart the knowledge of compaction, estimating the magnitude and time-rate of settlement due to consolidation.
4. Impart knowledge of determining shear parameters and stress changes in soil due to foundation loads, earth pressure theory and slope stability.

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

1. Calculate stresses in soil under various types of loading.
2. Find compressibility & consolidation characteristics.
3. Check slope stability of embankment & calculate amount of Earth pressure.
4. Calculate safe bearing capacity.
5. Calculate the earth pressure and use it for stability analysis.
6. Carry out Soil investigation, geophysical investigation for foundation.

S.N.	Contents	Hours
1	Stress in Soil under Surface Loading: Bossinesq's and Westergaard's analysis of vertical pressure and its distribution in a soil mass. Vertical stresses, horizontal and shear stresses (due to concentrated loads). Isobar diagram, Vertical stress distribution on a horizontal plane. Influence diagram. Vertical stresses at point under line load and strip load. Vertical stresses at a point under circular and rectangular loaded area, New Marks' chart. Pressure bulb and its significance in Foundation exploration. Stresses in soil below foundations.	9
2	Compressibility and Consolidation: One-dimensional consolidation of soil, Degree of consolidation, consolidation test. Terzaghi's one-dimensional consolidation theory, Compressibility parameters, co-efficient of consolidation. Preconsolidation pressure and its determination. Normally, over and under consolidated soils. Methods of predicting settlement & its rate. Total and differential Settlement. Stability of Slopes: Classification of slopes, Stability analysis of infinite slopes. Stability of finite slopes by Swedish and Friction circle method. Taylor's stability number curves.	8
3	Earth Pressure: Active, passive and earth pressure at rest Rankine's and Coulomb's theories Rebhann's and Culman's graphical method for active earth pressure (vertical and inclined back retaining walls), horizontal and inclined cohesionless back fill. Stability analysis of retaining walls.	8
4	Bearing Capacity of Soils: Terminology related to bearing capacity. Common types of foundations. Terzaghi and Meyehoff's theory for bearing capacity. Rankine's method for minimum depth to foundation Skempton's method. Effect of water table on bearing capacity. IS code method to determine bearing capacity. Plate load and penetration tests.	9

5	Site Investigations: Planning of Investigations. Methods of explorations, depth of exploration. Undisturbed and disturbed samples. Types of Samples. Brief description of procedures of sampling, Transportation and storage of samples, Depth, number & extent of boreholes Geophysical methods of investigations. Foundations: Introduction to pile, well and machine foundations.	8
	Total	**42**

SUGGESTED READINGS

1. Budhu, M. (2011). Soil Mechanics and Foundation, John Wiley & Sons, Inc.
2. Braja M. Das. (2014). Principles of Geotechnical Engineering. Cengage learning Pvt. Ltd, 8th Edition.
3. Ranjan G. & Rao, A.S.R. (2016). Basic and Applied Soil Mechanics. New Age International, New Delhi.
4. Holtz R and Kovacs, WD, Thomas C. Sheahan (2010): Introduction to geotechnical engineering, Pearson.
5. Arora, K.R. (2020). Soil Mechanics & Foundation Engineering, Standard Publisher Dist. ISBN-13:978-8180141126.
6. Gulhati, Shashi K & Datta Manoj (2017). Geotechnical Engineering Principles and Practices, McGraw Hill Education.
7. Coduto, Donald P., Yeung, Man-chu R., Kitch, William A. (2017). Geotechnical Engineering Principles and Practices, Pearson Education Ltd.
8. Punmia, B. C., Jain, A. K. and Jain, A. K. (2017). Soil Mechanics and Foundations, Laxmi Publication, New Delhi, (2017).
9. Lambe. T. William and Whitman, Robert V. (2012). Soil Mechanics: Wiley India Pvt Ltd, ISBN-13: 978-8126539918.

5CE4-05: Transportation Engineering-I

5CE4-05: Transportation Engineering-I

Credit: 3Max **Marks: 100 (IA=30, ETE=70)**

3L+0T+0P **End Term Exam: 3 Hours**

Course Objectives

1. To introduce the fundamentals of highway engineering, including development plans, geometric design, and construction processes.
2. To provide the students with in-depth knowledge and understanding of the principles governing the geometric design of highways.
3. To understand the construction procedure and material specifications of rigid and flexible pavements.
4. To apply the design procedures to a "real life" highway design & maintenance project.

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

1. Diverse knowledge of highway engineering practices applied to real-life problems.
2. Design highway geometrics, the vertical profile of the road, factors controlling the alignment, and explain sight distances and horizontal and vertical curves.
3. Describe the properties of highway materials, design flexible and rigid pavements and explain factors to consider for various types of pavements.
4. Understand the principles of the construction and maintenance of highways.

S.N.	Contents	Hours
1	Highway Development Plans: Historical Development; Functional classification of rural and urban roads; Planning Visions – 2021 (Rural Highways), 2025 (Rural roads), National Urban Transport Policy (NUTP), PMGSY; Components of Detailed Project Report (DPR) of roads; Public Private Partnership Models.	6
2	Highway alignment: basic requirements for an ideal alignment, factors governing highway alignment, highway location surveys and studies, highway alignment in hilly areas, drawings and reports, highway project preparation. Geometric Design: Design factors; Cross-section elements, Sight distances; Road Alignment - Horizontal and Vertical profiles; Combination of profiles; Placement of utilities and services; Design considerations in hill areas; Design software. Elementary Traffic Engineering: Significance of different Traffic Engineering Studies viz. Speed, Volume, O & D, Parking and Accident's Study. Importance and types of Traffic Signs, Signals, road markings, and Road Intersections.	8
3	Highway Materials and Mix Design: Soil – Desirable properties, Tests – Atterburg limits, Proctor values, CBR, Modulus (k); Stone Aggregates – Desired properties, Tests; Asphalt – Classification, properties, routine tests, and modifiers; Cement and Cement Concrete – Desirable properties for pavements; Bituminous Mix design and Concrete Mix design.	7
4	Pavement Design: Factors affecting design; Traffic volume and Axle load survey; Flexible pavements – Layers, design requirements and IRC-37 based design; Rigid pavements: Layers, design requirements, stresses in layers, Design based on IRC-58.	7
5	Highway Construction: Design specification and construction steps of subgrade, embankments, granular layers (GSB, WBM, WMM), bituminous sub-bases, bases, binder and surface courses, concrete pavement (DLC and PQC), Joints in bituminous and rigid pavements; Guidelines for Externally funded Road Projects.	8

6	Highway Maintenance: Types of surface and sub-surface failures, Evaluation and remedial measures; Drainage – surface and sub-surface, Filter design criteria: Design of overlays based on Benkelman Beam and Falling Weight Deflectometer (FWD)	6
	Total	**42**

SUGGESTED READINGS

1. Kadiyali, L. R. (2019). Transportation Engineering Khanna Publishing.
2. Khanna, S.K. and Justo, C.E.G., (2000). Highway Engineering, Nem Chand & Bros.
3. Wright, Paul H. and Dixon, Karen K., (2004). Highway Engineering, John Wiley & Sons Inc.
4. Papacostas, C.S. and Prevedouros, P.D., Transportation Engineering and Planning, Prentice Hall.
5. Jotin Khisty, C. and Kent Lall, B. (2016). Transportation Engineering – An Introduction, Third edition, Pearson India.
6. Chakroborty, P. and A. Das (2005). Principles of Transportation Engineering, Prentice Hall of India Pvt. Ltd, New Delhi, India.
7. Ministry of Road Transport and Highways. (2013). Specifications for Road and Bridge Works, Fifth Edition, Indian Roads Congress, New Delhi, India.
8. Relevant Indian Roads Congress Codes – Geometric Aspects: IRC:38, 69, 73, 86, SP-23.

   Pavements: IRC:37, 58, 15, 44

   Others: IRC: SP-42, SP-88, MORT&H Specifications and latest publication as available.

5CE4-20: Geotechnical Engineering Lab -II

5CE4-20: Geotechnical Engineering Lab -II

Credit: 1Max **Marks: 100(IA: 60, ETE: 40)**

0L+0T+2P

Course Objectives

1. To provide students with firsthand experience of performing various geotechnical tests to determine fundamental properties of soils.
2. Through practical exercises, students will learn the procedures for conducting tests related to soil consolidation, shear strength, hydraulic conductivity, mineralogical analysis, and microstructural examination.

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

1. Solid understanding of geotechnical testing methods and their applications in characterizing soil behavior.
2. Imparting knowledge of and ability to perform laboratory tests needed to determine foundation design parameters

S.N.	Contents
1	Oedometer test for consolidation of soils.
2	Determination of swelling index by swelling pressure test
3	Determination of shear strength parameters of soil by Unconfined Compressive strength Test
4	Determination of shear strength of cohesive soils by Vane Shear Test
5	Determination of shear strength parameters of cohesionless soils by Direct Shear Test
6	Determination of shear strength parameters by Triaxial Test
7	Determination of in–situ shear strength by Standard Penetration test
8	To determine of hydraulic conductivity of soil theoretically and verify by experimental method.
9	To perform XRD and SEM test on the soil

5CE4-21: Transportation Engineering Lab

5CE4-21: Transportation Engineering Lab

Credit: 1Max **Marks: 100(IA: 60, ETE: 40)**

0L+0T+2P

Course Objectives

1. To provide a platform to undergraduate students for practical implementation of highway materials
2. To study the physical consensus and source properties of aggregate materials.
3. To measure and study the physical properties of bitumen.

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

1. The principles and procedures of testing Aggregates used in highways
2. The principles and procedures of testing bitumen used in highways
3. The techniques to characterize various pavement materials through relevant tests

S.N.	Contents
1	California Bearing Ratio test
2	Aggregate Los Angeles Abrasion value test
3	Aggregate Impact value test
4	Aggregate crushing value test
5	Aggregate Flakiness and Elongation Index test
6	Aggregate water absorption and specific density test
7	Aggregate Soundness test
8	Bitumen Penetration Test
9	Bitumen Softening Point test
10	Bitumen ductility test
11	Bitumen Flash and Fire Point test
12	Bitumen Viscosity test
13	Bitumen specific gravity test
14	Bituminous Mix design
15	Concrete Mix design

SUGGESTED READINGS

1. Khanna, S.K. and Justo, C.E.G., "Highway Material Testing Manual", Nem Chand & Bros. 2004
2. Relevant Indian Roads Congress Codes – Geometric Aspects: IRC:38, 69, 73, 86, SP-23. Pavements: IRC:37, 58, 15, 44
3. Others: IRC: SP-42, SP-88, MORT&H Specifications and latest publication as available.

5CE4-22: Estimation and Valuation

5CE4-22: Estimation and Valuation

Credit: 1Max **Marks: 100(IA: 60, ETE: 40)**

0L+0T+2P

Course Objectives

1. Understand terminology related to estimates.
2. Acquire knowledge of the methodology of estimating & costing.
3. Calculate the quantity of material used in building construction, road, and canal.
4. Detail estimate of small buildings
5. Calculate the valuation of the building and rent fixation.

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

1. Know the essential components related to estimation practice.
2. Understand the methods of estimate and costing.
3. Analyze the materials consumption in buildings, rods, canals, etc.
4. Prepare detailed estimates of buildings, roads, and canals.
5. Prepare valuation and rent fixation of building.

S.N.	Contents
1	**Rules and Methods** Rules & methods of measurement/specifications. Long-wall & Short-wall methods Centre line method. Types of estimates. Use of Basic Scheduled Rate Books (BSR) of PWD/CPWD.
2	**Exercises/Problems on Estimation of Quantities** Earthwork in excavation & masonry work in foundation & up-to plinth. Detailed estimates for superstructure items, woodwork, plasters, etc. Estimate of R.C.C and steel work for - Slab - beam – column & trusses. Detailed estimate of small residential building (two-roomed) . Earthwork for Roadwork – earthwork in cutting/filling. . Estimate of Slab Culvert- including all the components. . Earthwork Calculation for canal works in embankment & cutting.
3	**Exercises/Problems in Analysis of Rates** . Rate analysis & preparation of bills – Data analysis of rates for various items of work – abstract estimates. . Building rent calculations

SUGGESTED READINGS

1. B. N., Datta (2020). Estimating and Costing in Civil Engineering Theory and Practice, CBS Publishers & Distributors Private Limited, New Delhi.
2. Birdi, G.S. (2014). "Estimating and costing in Civil Engineering", Dhanpat Rai & Sons, New Delhi.
3. Bellis, H.F. & Schmidt, W.A. Architectural Drafting, McGraw-Hill Book Co. Inc., London, ISBN-13 : 978-0070044180
4. Chakraborty, M. (2006). Estimating, Costing Specifications & Valuation in Civil Engineering, Chakraborty Publisher, New Delhi.

5CE5-11: Air and Noise Pollution

5CE5-11: Air and Noise Pollution

Credit: 2Max **Marks: 100 (IA=30, ETE=70)**

2L+0T+0P **End Term Exam: 3 Hours**

Course Objectives

1. Introduction to Air Pollution and its effects, sampling, and measurement.
2. Study the property of atmosphere, meteorological variables, and plume behavior.
3. To develop an understanding of the pollution control methods of particulate matter.
4. Gaseous pollution control methods and Automobile pollutions.
5. To give the concept Air population legislation in India and current topics.

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

1. Learn about Air Pollution, its effects and measurement with understanding of the Metrological concept and Plume behavior.
2. Understanding of control of particulate Matter by Different Methods and control of Gaseous Pollutants and automobile Pollution.
3. Awareness of Air Pollution Legislation in India and current topic.
4. Understanding the basics about sound and noise including worldwide scenario of noise pollution and different monitoring techniques.
5. They will be able to suggest the control measures to different noise generated from different sources.

S.N.	Contents	Hours
1	Sources and classification of Air Pollution Effects of Air Pollution onHuman health, plants, Animals and Property. Meteorology- Concept of Atmosphere, wind movements. Atmospheric lapse rates, Adiabatic lapse rate and their consequences, Plume behavior. Plume rise-equation, estimation of stack height.	6
2	Pollution control Method of a Particulate matter: Types of Particulate control methods- Settling chambers, cyclone separators, scrubbers, filters and Electrostatic precipitators- Mechanism, Their design and application.	5
3	Gaseous Pollution control method and Automobile Pollution: Types of gaseous Pollution Control method- absorption, adsorption, and combustion process. Automobile pollution- Sources of pollution, composition of auto exhaust & control method	5
4	Air Pollution Legislation and Global Problem: Air Quality Standard, Ambient Air Quality Standard and Emission standard. Air Pollution, legislation and regulation in India.Air Pollution Indices. Global problem of air pollution and its remedial measure. Air Pollution from major Industrial Operations- Case study	6
5	Basics of Sound, Sound propagation in air, Fundamentals of Noise, Difference between sound and noise. Measurement of noise,Sources of noise, Outdoor and Indoor Noise pollution in India, Factors Affecting Noise Pollution, Road Traffic Noise Monitoring, Ambient Noise Monitoring, health effects of noise. Noise Control Measures, Industrial noise control, Principles of Noise Pollution Control, Sound Absorption, Basics about Noise Barrier.	6

	Total	**28**

SUGGESTED READINGS

1. Rao, M.N. and Rao, H.V. N. (2017). Air pollution, M C Graw Hill Education, ISBN-13: 978-0074518717.
2. Agarwal, S.K. (2005). Noise Pollution. APH Publishing Corporation, ISBN-13: 978-8176488334.

5CE5-12: Field Exploration and Geotechnical Processes

5CE5-12: Field Exploration and Geotechnical Processes

Credit: 2Max **Marks: 100 (IA=30, ETE=70)**

2L+0T+0P **End Term Exam: 3 Hours**

Course Objectives

1. To learn about objectives and stages of site investigation: types of samples and samplers.
2. To know about the different Geotechnical investigation methods.
3. To assess the location of the ground water table.
4. To assess the general suitability of the site.
5. To learn preparation of soil investigation report.

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

1. The site-specific field investigations methods.
2. The different methods of boring, types of samples and sampling
3. Detailed methods of in-situ soil testing.
4. Detailed methods of soil testing in the laboratory.
5. Prepare the Geotechnical investigation report.

S.N.	Contents	Hours
1	Purpose; Overview of method of soil exploration- Boring, sampling, Standard penetration test, Static and dynamic cone tests, Plate load test; Correlation between penetration resistance and strength parameters.	5
2	Planning of Sub-soil Investigation; Number of bore holes and depth of exploration; Types of tests to suit soil conditions; In-situ method of determination of different soil properties like shear strength, permeability etc.; Determination of water table, underwater subsoil exploration.	7
3	Methods of Geophysical Exploration- Seismic reflection, refraction, and electrical resistivity methods.	6
4	Exploration methods in Rocks-investigation, sequence, drilling, sampling and bore hole inspection; Laboratory method of determining the various properties and behavior of soils.	5
5	Dynamic testing of soils; Method of Geotechnical study for various Civil engineering design and construction; Preparation of necessary report; Instrumentation.	5
	Total	**28**

SUGGESTED READINGS

1. Clayton, C.R.I., Matthews, M.C. and Simons, N.E. (1995) Site investigation: A handbook for engineers, Oxford, GB. Blackwell Science.
2. Richard L. Handy Merlin G. (2007). Geotechnical Engineering Soil & Foundation Principles & Practice, Spangler Publ.
3. Simons, N. E., Menzie, B. K., Matthews, M.C. (2002). A Short course in Geotechnical, Thomas Telford.

5CE5-13: Advanced Concrete Technology

5CE5-13: Advanced Concrete Technology

Credit: 2Max **Marks: 100 (IA=30, ETE=70)**

2L+0T+0P **End Term Exam: 3 Hours**

Course Objectives

1. Understand cement hydration and microstructure.
2. Comprehend advanced mixture design principles and particle packing theories.
3. Learn durability aspects, corrosion, and advanced concrete characterization techniques.

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

1. Identify and explain the phases involved in cement hydration and their role in concrete properties.
2. Utilize particle packing theories to design concrete mixtures for optimal performance.
3. Identify various durability mechanisms and their effects on concrete performance.
4. Consider rheological properties and their influence on concrete behavior during different stages.
5. Interpret data obtained from advanced characterization techniques to understand concrete properties.

S.N.	Contents	Hours
1	**Hydration and micro-structure of cement** Hydration of Cements and Micro-structural development, Mineral additives, Chemical admixtures, Cracking and Volume stability, Deterioration processes, Special concretes, Advanced Characterization Techniques, Sustainability issues in concreting, Modeling properties of concrete	6
2	**Particle packing and rheology** Advanced Mixture Design, Design Philosophy - Particle Packing & Rheology - Discrete and Continuous approach, Packing density of powders and aggregates - Experimental tests and Models, Ternary Packing Diagram, Mixture Design of Self - Compacting Concrete (SCC); Fresh Concrete Properties, Empirical test for SCC – Rheology, Basics, Parameters, Models, Rheometers, Rheology of Paste and concrete – Pumping, Setting, Curing, Plastic shrinkage, Strength Development, Maturity Method; Hardened Concrete Properties, Factors influencing strength, Interfacial Transition Zone, Stress strain relationship –Localization, End effects, Loading Conditions; Dimensional Stability, Creep and Shrinkage.	11
3	**Durability aspects of concrete** Durability, Permeability and Porosity, Chemical attack (Sulphate attack, Delayed Ettringite Formation, Chloride attack, Acid Attack, Sea Water attack, Carbonation, Freezing and Thawing, Alkali aggregate reaction, Alkali carbonate reaction Corrosion, Mode of action, failure, Tests& Protection methods.	7
4	**Rebar corrosion** Rebar Corrosion, Factors inducing rebar corrosion, electrochemical process, role of chloride in corrosion, role of carbon-di-oxide in corrosion, onset of corrosion, corrosion propagation, and service life prediction of concrete structures	4
5	**Advanced characterization techniques:** SEM, XRD, XRF *etc*. Sustainability issues in	1

	concreting	
	Total	**28**

SUGGESTED READINGS

1. Shetty, M.S. (2006). Concrete Technology, S. Chand & Comp. Ltd
2. Mehta, P.K., and Monterio, P.J. (2014). Concrete: Microstructure, Properties, and Materials, 4th Edition, McGraw-Hill Education, ISBN: 9780071797870
3. Gambhir, M.L. (2017). Concrete technology, Tata McGraw Hill, New Delhi
4. Neville, A.M. (2012). Properties of concrete, Pearson Education India
5. Bungey, J.H. (1989). Testing of Concrete in Structures, Surrey University Press, London.
6. Hewlett, P. (1998). Lea's Chemistry of Cement and Concrete, Fourth Edition, Arnold Publishers, NY.
7. Bentur, A., Diamond, S., and Berke, N.S., (1997). Steel Corrosion in Concrete, E&FN Spon, UK.
8. Taylor, H. W. F. (1990). Cement Chemistry, Academic Press, Inc., San Diego, CA.
9. Lea, F. M. (1971). The Chemistry of Cement and Concrete, Chemical Publishing Company, Inc., New York.
10. Mindess, S., and Young, J. F. (1981). Concrete, Prentice Hall, Inc., NJ.
11. Newman, J. and Choo, B. S. (2003). Advanced Concrete Technology, Four Volume Set, Elsevier.

5CE5-14: Pavement Materials

5CE5-14: Pavement Materials

Credit: 2Max **Marks: 100 (IA=30, ETE=70)**

2L+0T+0P **End Term Exam: 3 Hours**

Course Objectives

1. The basic and fundamental understanding about the behavior of various materials used in the construction of pavements.
2. Characterization, tests, and engineering properties of these materials in context with its field application.
3. Current practices and future trends in pavement materials.

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

1. To understand the effect of various materials on the mechanical properties of properties
2. To differentiate between the different types of materials used and to design and construct road pavements
3. Using the knowledge of requirements of various materials used in pavement construction, the student will be able to think critically for the selection of alternate construction materials available locally and this formulate economical and sustainable construction practice.

S.N.	Contents	Hours
1	Soil: Introduction to soil as a highway material; Classification of soils; Consistency Limits; Soil compaction and role of moisture; Mechanical properties of soil; Introduction to expansive soils, relevant tests, and soil stabilization techniques.	5
2	Aggregates: Aggregate origin, types, production, and quarrying operation; Classification of aggregates; Aggregate gradation and gradation parameters; Theories of aggregate blending; Minerology of aggregates and its importance; Aggregate shape and texture: quantification and importance; Aggregate strength properties, and relevant tests.	5
3	Bitumen, Modified bitumen, Bitumen emulsion and Cutback bitumen: Bitumen as a binding agent; Production of bitumen; Physical and rheological properties of bitumen; Introduction to viscoelasticity; Chemistry of bitumen; Ageing of bitumen; Grading of bitumen, and relevant tests: Penetration grade, Viscosity grade, Performance grade; Bitumen modification: Need, Types and Importance; Introduction of bitumen emulsion: Theory of emulsification, Uses, Grading of emulsions, and Relevant tests; Introduction to cutback bitumen: Types, Uses, and relevant tests.	7
4	Bituminous Mixtures: Production of bituminous mixtures: Laboratory and Plant; Role of bituminous mixture and desirable properties; Volumetrics of bituminous mixture; Mix design of bituminous mixture: Marshall and Superpave methods; Mechanical tests and characterization of bituminous mixtures; Introduction to performance-based mix design concepts; Mix design of cold bituminous mixtures; Mix design of hot recycled mixtures	5
5	Cement: Cement and Cement Concrete– Desirable properties for pavements; Concrete Mix Design: Concrete proportioning and importance of various constituents; Introduction and mix design of pavement quality concrete, Dry lean concrete, and Pervious concrete Alternative Pavement Materials: State of the art on various alternative materials for construction of flexible and rigid pavements.	6
	Total	**28**

SUGGESTED READINGS

1. All relevant codes/standards from Indian Roads Congress (IRC), Bureau of Indian Standards (BIS), American Society of Testing Materials (ASTM), and American Association of State Highway and Transportation Officials (AASHTO).
2. Nikolaides, A. (2015). Highway Engineering: Pavements, Materials and Control of Quality, CRC Press, T&F.
3. Ray, E., Kandhal, P.S., Roberts, F.L., Lee, D., Brown, T.W.K. (2009). Hot Mix Asphalt Materials, Mixture Design, and Construction, NAPA Research and Education Foundation.
4. Kandhal, P.S., Veeraragavan, A., Chaudhary, R. (2023). Bituminous Road Construction in India, PHI publications.

5CE5-15: Fundamentals of Remote Sensing

5CE5-15: Fundamentals of Remote Sensing

Credit: 2Max **Marks: 100 (IA=30, ETE=70)**

2L+0T+0P **End Term Exam: 3 Hours**

Course Objectives

1. To get a knowledge of Physics of Remote Sensing.
2. Discuss the Data Acquisition Platforms
3. To understand the Techniques of image interpretation
4. Demonstrate and understanding the Data analysis
5. Understanding the Microwave Remote Sensing & Radar

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

1. Select the type of remote sensing technique/data for required purpose
2. Identify the earth surface features from satellite images
3. Data Analysis methodologies
4. Gain the in-depth knowledge for data acquisition - characteristics of different types of platforms
5. Explain Microwave Remote Sensing & Radar.

S.N.	Contents	Hours
1	**Introduction and Basic Concepts**: Introduction, Basic concepts of remote sensing, Airborne and space born sensors, Passive and active remote sensing, EMR Spectrum, Energy sources and radiation principles, Energy interactions in the atmosphere, Energy interactions with earth surface features, Spectral reflectance curves	5
2	**Remote Sensing Systems**: Satellites and orbits, Polar orbiting satellites, Spectral, radiometric and spatial resolutions, Temporal resolution of satellites, Multispectral, thermal and hyperspectral sensing, Some remote sensing satellites and their features **Digital Image Processing** -Image Restoration: Geometric corrections, Co-registration of Data, Ground Control Points (GCP), Atmospheric corrections, Solar illumination corrections,	8
3	**Digital Image Processing - Image Enhancement**: Concept of color, Color Composites, Contrast stretching – linear and non-linear stretching, Filtering techniques, Edge enhancement, Density slicing, Thresholding, Intensity-Hue Saturation (IHS) images, Time composite images, Synergetic images. **Digital Image Processing – Information Extraction:** Multispectral classification, Ground truth collection, Supervised and unsupervised classification, Change detection analysis, Principal component Analysis, Ratio images, Vegetation indices	9
4	**Digital Image Processing Software**: Image processing software, Multispectral classification Algorithms, Image processing using MATLAB. **Digital Elevation Modeling**: Introduction, Sources of digital elevation data, Types of DEMs, Radar interferometry, Shuttle Radar Topographic Mission (SRTM) data	5
5	**Remote Sensing Applications:** Watershed management, Rainfall-runoff modeling, Irrigation	3

	management, Flood mapping, Drought assessment, Environmental monitoring, other applications **Advanced Topics:** Microwave remote sensing, sources of microwave data, Global positioning System (GPS), GPS for ground truth collection	
	Total	**30**

SUGGESTED READINGS

1. Campbell, J.B., and Wynne, R.H. (2011). Introduction to Remote Sensing, The Guilford Press.
2. Lillesand, T.M., and Kiefer, R.W. (2002). Remote Sensing and Image Interpretation, John Wiley & Sons, Singapore.
3. Cambell, J.B. (2002). Introduction to Remote Sensing, Taylor & Francis, UK.
4. Schowengerdt, R.A. (2006). Remote Sensing - Models and Methods for Image Processing, Elsevier India Pvt. Ltd., New Delhi.
5. Gibson, P.J. (2000). Introduction to Remote Sensing - Principles and Concepts, Routledge - Taylor & Francis.
6. Gibson, P.J. and Power, C.H. (2000). Introduction to Remote Sensing - Digital Image Processing and Applications, Routledge Taylor & Francis.
7. Elachi, C., and Zyl, J.V. (2006). Introduction to the physics and techniques of Remote Sensing, John Wiley & Sons publications.
8. Lillesand T.M & Kiefer R.W. (2008). Remote Sensing and Image Interpretation, John Wiley & Sons.
9. Matzler, C. (2006). Thermal microwave radiation: Applications for remote sensing, The institution of Engineering and Technology, London.
10. Rees, W. G. (2001). Physical Principles of Remote Sensing, Cambridge University Press.

5CE5-16: Solid Waste Management

5CE5-16: Solid Waste Management

Credit: 2Max **Marks: 100 (IA=30, ETE=70)**

2L+0T+0P **End Term Exam: 3 Hours**

Course Objectives

1. To educate the students on the principles involved in the management of municipal solid waste from source identification up to disposal.

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

1. Understand the fundamentals of solid wastes and the types, needs and sources of solid wastes.
2. To understand the methods of waste characterization and source reduction and to study the various methods of generation of wastes.
3. To understand in detail about the storage, collection, and transport of wastes and to study about the methods used for handling and segregation of wastes.
4. To know about the basics of the waste disposal options and a detailed study on the disposal in landfills and to learn about landfill remediation.
5. To understand about the waste transformation and material/energy recovery technologies about municipal solid wastes

S.N.	Contents	Hours
1	Sources, Composition & Properties of solid waste, Municipal solid waste, Hazardous solid waste, Handling & Separation of solid waste, Municipal Waste (Management & Handling Rules, 2016), Integrated solid waste management (SWM) System, Hierarchical approach for SWM. Solid Waste Collection & Transportation: Types of collection systems (Hauled-container system & Stationary container system), Collection routes & their Layout, Solid waste transfer stations	7
2	Solid waste generation and collection rates; Waste handling and separation, storage and processing at source, solid wastes collection methods, separation, processing, and transformation of solid wastes; transfer and transport of solid wastes	7
3	Methods of Disposal of Municipal Solid Waste Landfills: Classification, Types & methods, Site selection, Site preparation, Composition, Characteristics, Generation, & Control of Landfill gases; Composition, Formation, Movement & control of leachate in landfills; landfill design. Re-vegetation of closed landfill sites, Long-term post closure plan, Groundwater monitoring during & after closure.	7
4	Transformation and recycling of waste materials; Composting: Theory of composting, Manual and mechanized composting, Design of composting plan, Recovery of bioenergy from organic waste. Thermal Conversion Technologies: Incineration, Pyrolysis & Gasification Systems. Types & design of Incinerators.	7
	Total	**28**

SUGGESTED READINGS

1. Tchobanoglous, G., Theisen, H., Vigil, S.A. (2014). Integrated Solid Waste Management: Engineering, Principles & Management issues, McGraw-Hill- International Edition.
2. Lagrega, M.D., Buckingham, P.L., Evans, J.C. (2001). Hazardous Waste Management and Environmental Resource Management, McGraw-Hill- International Edition.

3. Peavy, H.S., Rowe, D.R., Tchobanoglous, G. (2017). Environmental Engineering, McGraw-Hill-International Edition.
4. Davis, M.L., Cornwell, D.A. (2012). Introduction to environmental engineering, McGraw-Hill-International Edition.
5. CPHEEO Manual on Municipal Solid Waste Management.

5CE5-17: Foundation and Retaining Structures

5CE5-17: Foundation and Retaining Structures

Credit: 2Max **Marks: 100 (IA=30, ETE=70)**

2L+0T+0P **End Term Exam: 3 Hours**

Course Objectives

1. To know about the various types of foundations and their provision depending upon the type of soil.
2. To obtain a fundamental understanding of the concepts of foundation design.
3. To give a clear idea regarding analysis and design procedure of different types of shallow foundations.
4. To give a clear idea regarding analysis and design procedure of different types of deep foundations.
5. To give an idea regarding different types of earth retaining structures and their analysis and design procedure.

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

1. Learn about the different types of shallow foundations and their load carrying capacity.
2. Know about the deep foundations like pile foundation and well foundation.
3. Analysis and design procedures of different types of foundations.
4. Choose the suitable types of foundations for any structure.
5. Learn the analysis and design procedures of different types of earth retaining structure.

S.N.	Contents	Hours
1	**Foundations:** Overview on various types of foundations for Buildings, Bridges and Industrial buildings, Classification of foundations, Basis for design; Review of major soil parameters used in proportioning of foundations.	3
2	**Shallow foundations:** Selection of type and depth of foundations, Settlement calculations-Components of settlement; Limits of settlement; Accuracy in Foundation Settlement Prediction; Allowable Settlement; Allowable Soil Pressure; Estimation of settlement of footings and rafts on sands from Penetration and Plate load test data; Estimation of settlement of footing/ rafts on cohesive soils using consolidation test data; Proportioning of footings.	8
3	**Well foundations:** Situations where adopted; Elements of wells; Types; Methods of construction; Tilt and shift; Remedial measures. Proportioning- Depth and size of wells based on scour depth; Terzaghi's lateral stability analysis.	5
4	**Retaining Structure:** Earth pressure at rest; Active and passive earth pressure computations using Rankine's and Coulomb's earth pressure theories; Additional Earth pressure due to surcharge loading. Stability analysis for retaining walls; Choice of backfill material and importance of drainage. Bracing for open cuts- Recommended design diagrams of earth pressure for typical soils.	6
5	**Pile Foundation:** Introduction, Types of piles, Estimation of pile capacity by static and dynamic formulae, Methods of analysis of pile resistance, Load-transfer method of estimating pile capacity; Outline of steps involved in proportioning; Capacity and settlement of single and group of piles; Proportioning with field/lab data as input.	6
	Total	**28**

SUGGESTED READINGS

1. Bowles, J.E. (1997). Foundation Analysis and Design, McGraw-Hill, New York.
2. Murthy, V. N. S. (2017). Textbook of Soil Mechanics and Foundation Engineering, CBS Publishers &

Distributers, New Delhi.

3. Poulose, H.G. and Davis, E.H. (1980). Pile foundation Analysis and Design, John Wiley & Sons, NY.
4. Winterkorn, H.F. and Fang, H.Y. (1975). Foundation Engineering Handbook, Van Nostrand Reinhold.

5CE5-18: Introduction to Finite Element Methods

5CE5-18: Introduction to Finite Element Methods

Credit: 2Max **Marks: 100 (IA=30, ETE=70)**

2L+0T+0P **End Term Exam: 3 Hours**

Course Objectives

1. To understand the various numerical techniques and importance of Finite Element Method (FEM)
2. Understand the mathematical and physical principles underlying the FEM
3. To understand the importance of interpolation function in FEM
4. Be able to evaluate the 1-D structure with FEM
5. Be able to create his/her own FEM computer programs, for analysis of simple problems

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

1. To understand the importance of FEM over other numerical techniques.
2. To understand the importance of FEM over analytical methods and convergence requirements in FE analysis.
3. The use of various types of shape functions for FE analysis.
4. To determine displacements, stresses, and strains in 1-D problems.
5. To write computer program to evaluate displacements, stresses, and strains in 1-D problems.

S.N.	Contents	Hours
1	**Introduction to Finite Element Analysis:** Matrix Algebra, Fundamentals of continuum mechanics: Stress, displacement and strains, constitutive relationship; Background of Finite Element Analysis, Overview of Various Numerical Methods, Concepts of Elements and Nodes, Degrees of Freedom	5
2	**Boundary Value Problem** - Approximate Solution – Variational and Weighted Residual Methods - Ritz and Galerkin Formulations -Concepts of Piecewise Approximation and Finite Elements, Displacement and Shape Functions - Weak Formulation - Minimum Potential Energy	7
3	**Finite elements and interpolation functions**: Introduction, Interpolation functions- One, two and three independent spatial variables; Linear, quadratic, Cubic and Lagrange form of interpolation function, Higher order elements in one-dimension; Convergence requirement, Degree of continuity	6
4	**One-dimension finite element analysis:** Introduction, Generation of Stiffness Matrix and Load Vector, Linear spring, Truss element, Local and global element equation, Computation of stress in bar-element, Torsion of circular shaft, steady state heat conduction, flow through porous media.	5
5	**Beam element:** Review of beam theory, Finite element formulation of a beam element- Shape functions, Strain-displacement relationship, Beam stiffness matrix, load vector, Analysis of beam problem.	5
	Total	**28**

SUGGESTED READINGS

1. Reddy, J. N. (2005). An Introduction to the Finite Element Method, McGraw-Hill International Editions.
2. Desai, Y. M., Eldho, T. I., Shah, A. H. (2011). Finite Element method with Application in Engineering,

Pearson Education India.

3. Seshu, P. (2012). The Finite Element Analysis, PHI.
4. Fish, J. and Belytschko, T. (2007). A First Course in Finite Elements, John Willey & Sons.

5CE5-19: Traffic Engineering

5CE5-19: Traffic Engineering

Credit: 2Max **Marks: 100 (IA=30, ETE=70)**

2L+0T+0P **End Term Exam: 3 Hours**

Course Objectives

1. To provide understanding on basic traffic characteristics and various models describing the relationship among traffic stream parameters
2. To train students to collect and analyze traffic data
3. To prepare students to perform capacity and level of service analysis of a highway
4. To teach students to perform traffic signal design using IRC guidelines
5. To make students aware of traffic regulations and measures to manage traffic
6. To enable students to understand the importance of roadway safety and accident analysis

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

1. Describe traffic stream parameters and their relationship
2. Identify various traffic stream models and their application
3. Collect the traffic data and analyze it using statistical tools.
4. Evaluate capacity and level of service for a given highway
5. Design traffic signal using IRC guidelines
6. Describe various measures of traffic regulations and management
7. Collect the data related to accidents and identify accident hot spots

S.N.	Contents	Hours
1	**Basic Concept of Traffic Characteristics**: Traffic engineering definitions: functions, organization and importance, necessity of understanding the behavior of road user and vehicle characteristics, human factors governing the road user behavior- power performance and other vehicular characteristics. Traffic studies and surveys: Speed studies: presentation of data, journey time and delay studies, uses and various methods, relative merits and demerits Vehicular volume counts: types, various available methods, relative merits and demerits, planning of traffic counts, vehicle occupancy surveys. Origin: destination surveys, need and uses, various available methods, checks for accuracy, presentation of data. Parking surveys: needs and types. Study of various photographic techniques available for traffic studies. Traffic signs and markings: types, location, height etc., miscellaneous traffic control aids like roadway delineators, hazard markers, object marker, speed breakers, rumble strips etc., Street lighting: needs, definitions, laws of illumination, methods of discernment, glare problem, light lantern arrangement, types of lamps, planning and designing.	8
2	**Traffic Stream Models:** Introduction to traffic stream models – Greenshield's, Greenberg, Underwood, Northwestern models– Application of traffic stream models – Shock waves **Highway capacity and Level of service:** Basic definitions related to capacity – Level of service (LOS) concept – Factors affecting capacity and LOS – Computation of capacity and LOS for 2-lane highways – Multilane highways – Freeways – IRC guidelines	7
3	**Traffic Signals:** Traffic signals – Warrants for signalization – Design of traffic signal by	4

	Webster method – Signal coordination and area traffic control – IRC guidelines	
4	**Road safety: Purpose** of accident studies - Accident data collection – Identification of accident hot spots - Use of Global Positioning Systems (GPS) and Geographic Information Systems (GIS) – Causative factors of road accidents - Predictive models - Road Safety Auditing - Measures to increase Road safety.	6
5	**Intelligent Transportation Systems:** Components of ITS, Traffic Management - Incident Management, Strategies for working hours - Congestion Pricing, Advanced vehicle control and safety systems, Electronic toll collection, Traveller Information System, Benefits and costs of ITS.	5
	Total	**28**

SUGGESTED READINGS

1. Mannering, F. L., Washburn, S.S., Kilareski, W.P. (2012). Principles of Highway Engineering and Traffic Analysis, John Wiley & Sons.
2. Garber, N., Hoel, L.A. (2015). Traffic and Highway Engineering, 5th Edition, Cengage Learning, USA.
3. Kadiyali, L.R., Lal, N.B. (2011). Traffic Engineering and Transport Planning, Khanna Publishers, New Delhi, India.

5CE5-20: Geographic Information Systems

5CE5-20: Geographic Information Systems

Credit: 2Max **Marks: 100 (IA=30, ETE=70)**

2L+0T+0P **End Term Exam: 3 Hours**

Course Objectives

1. To get a knowledge of GIS terminologies.
2. To understand the Spatial Database Management Systems
3. Demonstrate and understanding the various types of Data structure and its models
4. Understanding the Spatial Analysis, Cartographic Principles and Design

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

1. Analyze spatial and attribute data for solving spatial problems.
2. Preparation of geospatial features in computing environment.
3. Create GIS and cartographic outputs for presentation.
4. Understand the software/hardware requirements for implementing a GIS Project.

S.N.	Contents	Hours
1	**Introduction** – GIS definition, development, application areas. Map Concept- Map-Definition, Elements of Maps, Types of maps, Advantages and disadvantages of analog/digital maps, Coordinate Systems- Geometric models of earth, Global/Local coordinate system, Projection Systems- Classification, Cylindrical projection, Conical projection, Selection of a particular projection.	7
2	**Fundamental concepts of GIS** – Modeling Real World Features- Raster data model, vector data model, Data Formats- Spatial and Non-Spatial data, Data collection and Input, Data conversion, Hardware & software Requirements. **Topology** – Editing and Error Rectification, Types of topologies, Topological Relationships.	7
3	**Spatial Analysis –** Buffer Analysis-Variations in Buffering, Applications of buffering, **Overlay Analysis –** Feature type and overlay, Vector Overlay methods, Network Analysis-Impedance, Shortest path analysis, closest facility, Concepts of Proximity analysis, Neighborhood operations.	7
4	**GIS Project Planning** – Steps in GIS project, Problem Identification and Implementation of a GIS project.	3
5	**GIS Applications** – Transportation, Water Resources, Environment, Geology, Emergency Management, Agriculture, Real Estate. **Advances in GIS** – Concepts and application of Mobile and Web GIS.	4
	Total	**28**

SUGGESTED READINGS

1. Lo, C.P., and Yeung, A.K.W. (2016). Concepts and Techniques of Geographic Information Systems, second Edition, Prentice Hall India Pvt. Ltd.
2. Burrough, P.A., and McDonnell. R.A., Lloyd, C.D. (2015). McDonnell, Principles of Geographical Information Systems, Oxford University Press.
3. Longley, P.A (2015). Geographic Information systems and Science, 4th John Wiley & Sons Edition.
4. Demers, M. N. (2002). Fundamentals of Geographic Information Systems, John Wiley & Sons, 3rd Edition.

5. Longley, P.A., Goodchild, M. F., Maguire, D. J., and Rhind, D. W. (2005). Geographic Information Systems and Science, 2nd Edition, John Wiley & Sons.
6. Chang, K. (2018). Introduction to Geographic Information Systems, 9th Edition, Tata Mc Graw Hill Publishing Company Ltd, New Delhi.
7. Burrough, P.A. (2005). Principles of GIS for Land Resource Assessment, Oxford Publications.