Syllabus of First to Eight Sem For B.Tech Civil Engineering as per NEP 2020

2023 Batch Onwards

Second Sem, First Year

Course Category	CEL DC102			Applied Mechanics				Pre-Requisites	Nil
	L_T_P			Theory					
DCC	L	T	P/S	C	Quiz	Assignment	Mid Sem	Major	TOTAL
	3	1	0	4	20	20	20	40	100

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. acquire basic knowledge related to Forces and Equilibrium conditions
2. understand and apply the concepts of Centroid and Moment of Inertia on areas and rigid bodies
3. analyses various systems existing in static equilibrium, e.g., blocks, wedges, ladders, trusses, etc.
4. acquire basic knowledge related to stress and strain for ductile and brittle materials.

COURSE CONTENTS

Unit-I	Force and Force Systems	8 Contact Periods

Coplanar, Concurrent and Non-Concurrent Force Systems, Resultant and Resolutions, Forces in Space, Moment of Force, Varignon's Theorem, Couple and Its Properties, Resultant of a Spatial Force System.

Unit-II	Equilibrium	10 Contact Periods

Equilibrium- Equilibrium of a Particle, External & Internal Forces, Equilibrium of a Rigid Body, Types of Supports, Structural Members and Beams, Reactions of Beams. Areas and Solids: Centre of Gravity, Centroid of Lines (Basic and Composite Areas), Built-Up Sections, Product of Inertia, Mass Moment of Inertia.

Unit-III	Trusses and Frames	8 Contact Periods

Two Force and Three Force Members, Trusses, Method of Joints, Method of Sections, Determinateness of Truss, Rigid and Non Rigid Frames

Unit-IV	Friction and Simple Stress and Strain	8 Contact Periods

Type of Friction, Characteristics of a Dry Friction, Equilibrium on Rough Inclined Place, Wedge Friction, Ladder Friction

Introduction to stress-strain, Normal and Shear stresses, Stress- Strain Diagrams for ductile and brittle material, Elastic Constants, One Dimensional Loading of members of varying cross-sections

SUGGESTED BOOKS

1. Jurnarkar, S.B. and Shah, H.J.–Applied Mechanics, Charotar
2. Merium and Kraige–Engineering Mechanics, John Wiley & Sons.
3. Sharma, S.M.–Engineering Mechanics, Kirti Publications, Jammu.
4. Engineering Mechanics by Huges and Martin, E.L.B.S. and Macmillan.
5. Beer and E.R. Johnstons–Vector Mechanics, McGraw-Hill, New York

Course Category	CEL DC104				Building Materials and Construction			Pre-Requisites	Nil
	L_T_P				Theory				
DCC	L	T	P/S	C	Quiz	Assignment	Mid Sem	Major	TOTAL
	3	0	0	3	20	20	20	40	100

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. identify and characterize building materials
2. understand the manufacturing process of bricks and cement
3. identify the factors to be considered in planning and construction of buildings.
4. understand the construction practices and techniques

COURSE CONTENTS

Unit-I	Introduction	7 Contact Periods

Definition, types of buildings as per national building code, components of buildings and their functions, Types of structure – load bearing structure & framed structures, load bearing walls and partition walls, HDPE Wall panel. Foundation :- Types of foundation – shallow foundation & deep foundations for buildings, spread footings for walls & columns, Causes of failure of foundations.

Unit-II	Stone and Brick Masonry	8 Contact Periods

Stone Masonry : Technical terms, General principles to be observed during construction, random rubble masonry, coursed and un- coursed rubble masonry, Brick Masonry – Classification of bricks, manufacturing of clay bricks, tests on bricks, properties of burnt bricks. Brick masonry construction – Technical terms, general principles, commonly used types of bonds such as stretcher, header, English bond and Flemish bond, their suitability.

Unit-III	Floors, Roofs, Doors & Windows	7 Contact Periods

Types of Floors – Basement floor, ground floor and upper floors, Types of flooring material, Sahabad, Kotta, Granite, Ceramic tiles, plain tiles, mosaic tiles, glazed tiles, different types of floor finishes. Roofs – Flat & pitched roof, steel roof trusses – types and suitability, fixing details at supports, types of roof covering, AC & GI sheets, acrylic sheets, fixing details of roof covering. Different forms of commercial woodsplywood, particle-board, batten-board, block-board, novapan, sunmica, veneer sheets. Doors: Purpose, criteria for location, size of door, door frames & its types, methods of fixing,. Windows – Purpose, criteria for location, no. sizes & shapes of Windows, types of windows & their suitability. Ventilators

Unit-IV	Stairs and Plastering & Pointing - Special Aspects of Construction	8 Contact Periods

Function, technical terms, criteria for location, types of staircases, their suitability, principle of stair layout design. Plastering & pointing- Necessity, types, processes of different types of plastering, defects in plastered work. Painting & Colouring. Damp proofing – causes of dampness, its effects, various methods of damp proofing, Fire proof construction – Points to be observed during planning & construction. Fire protection requirements for a multistoried building.

SUGGESTED BOOKS

1) Mackay W.B.: Building Construction, Vol. I, II, III, Longmans.
2) Sushilkumar: Building Construction, Standard Publishers Distributors.
3) Deshpande R.S. and Vartak C.V. : A Treatise on Building Construction.
4) Sharma S.K. Kaul B.K. : A. T.B. of Building Construction, S. Chand & Co.
5) Gurucharan Sing : Building Construction Engg., Standard Book House, Delhi-6
6) Sane L.S. : Construction Engg., Manak Talas, Mumbai.

7) Chudley R. : Construction Technology, Vol. I, II, III & IV, Longmans Group Ltd.
8) ISE National Building Code of India, 1970.
9) Punmia B.C. : Building Construction.
10) A Manual of Earthquake Resistant, Non-Engineered Construction Indian Society of Earthquake Tech

Course Category	CEP DC104			Building Materials and Construction Lab			Pre-Requisites	Nil
	L_T_P			Practical/Lab				
DCC	L	T	P/S	C	File	Lab	Viva	TOTAL
	0	0	2	1	30	40	30	100

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. identify and characterize building materials
2. understand the manufacturing process of bricks and cement
3. identify the factors to be considered in planning and construction of buildings.
4. understand the construction practices and techniques

LIST OF PRACTICALS

1. Drawing of following building elements on A-2 size sheet. a) Panelled door, flush door, glazed window. b) Steel truss with details of joints, details & support, details of fixing of roof covering.
2. Planning & drawing of a staircase for the given data. [On A-2 size sheet, Design calculations, plan & section.]
3. Preparation of foundation plan from the given line plan of a two room building [On a A-2 size sheet.]
4. Layout of the above, in field.
5. Fields visits to building under construction and its report writing including material of construction, construction processes, Human recourses required, construction details.
6. Sketch book containing Free hand sketches of following i) Different types of foundations. ii) Bonds in brick masonry iii) Types of floors. [sections] iv) Types of stairs. [plans and side view] v) Line sketches of different types of steel roof trusses. vi) Details of expansion joints. vii) Details of damp proofing for basement. viii) Fixtures & fastenings of doors & windows.
7. Conduct tests on bricks to determine compressive strength, water absorption, and efflorescence as per IS codes.
8. Identify different types of stones and perform hardness and impact tests to evaluate their suitability for construction.
9. Construct and analyze different types of brick bonds (stretcher, header, English, Flemish) to understand their strength and stability.
10. Design and assemble a model of steel roof trusses, demonstrating different types of connections and support details.
11. Conduct wear and impact tests on flooring materials like ceramic tiles, granite, and mosaic tiles to determine their durability.
12. Perform hands-on plastering and pointing on a sample wall, demonstrating different finishes and identifying defects in plastered work.

Note: Any **six to eight** practical mention above should be perform by each students.

SUGGESTED BOOKS

1. Duggal, S. K. (2019). *Building Materials* (5th ed.). New Age International.
2. Punmia, B. C., Jain, A. K., & Jain, A. K. (2008). *Building Construction*. Laxmi Publications.
3. Kumar, S. (2016). *Building Construction* (20th ed.). Standard Publishers Distributors.
4. Mittal, A. K. (2014). *Civil Engineering Materials and Construction Practices*. Khanna Publishers.

5. Singh, G. (2016). *Building Construction and Materials*. Standard Publishers Distributors.

Third Semester, Second Year

Course Category	CEL ES201 a			Fluid Mechanics			Pre-Requisites	Nil
	L_T_P			Theory				
ESC	L	T	P/S	C	Quiz	Assignment	Mid Sem	Major	TOTAL
	3	0	0	3	20	20	20	40	100

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. understand the basic terms used in fluid mechanics
2. understand the broad principles of fluid statics, kinematics and dynamics
3. understand classifications of fluid flow
4. define the concepts related to boundary layer theory and drag and lift forces.

COURSE CONTENTS

Unit-I	Introduction	(8 Contact Periods)

Fundamental Concepts Definition of fluids, fluid properties-density, specific weight, specific volume, specific gravity, viscosity, compressibility, surface tension, capillarity, vapor pressure, types of fluids - Newtonian and non-Newtonian fluid, continuum, fluid pressure

Unit-II	Fluid Statics	(7 Contact Periods)

Forces on fluid elements, fundamental equation, manometers, hydrostatic thrust on submerged surfaces, buoyancy, stability of unconstrained bodies, fluids in rigid body motion

Unit-III	Fluid Kinematics and Impact of Jet	(10 Contact Periods)

Types of flow, continuity equation, derivation and applications of momentum equation, Euler's equation, Bernoulli's equation, Impact of Jet Impulse momentum principle, impact of jet on Vanes-flat, curved, Hydraulic Machines, Turbines: Importance of hydro-power, classification of turbines, description, typical dimensions and working principle of turbines. Pumps: Classification, component parts, working of centrifugal pump

Unit-IV	Flow Measuring Instruments, Types of flow and Flow in Open Channel	(18 Contact Periods)

Venturimeter, Orificemeter and Pitot Tube, Introduction to Flow through Orifices and Mouthpieces Fully developed laminar flow plates, laminar flow in pipe, Characteristics of Laminar flow through circular pipes, Reynold's Experiment, Stokes' law. Turbulent flow: Shear stress distribution, velocity distribution and shear stresses in turbulent flow, Introduction to Boundary Layer Theory Introduction, difference between pipe flow and open channel flow, types of open channels, types of flows in open channel, weir & spillway. Chezy's & Manning's formula, Roughosity coefficient, uniform flow computations, hydraulically efficient section considerations for rectangular, triangular, trapezoidal, circular sections Specific energy

SUGGESTED BOOKS

1. Fox. R. W. and Mc-Donald. A. T., "Introduction to Fluid Mechanics", John Wiley and Sons, Fifth Edition
2. Modi and Seth, "Fluid Mechanics and Hydraulic Machinery", Standard Book House, Tenth Edition , 1991
3. Kumar K. L., "Fluid Mechanics"
4. Bansal R. K., "Fluid Mechanics"
5. Jain A.K, "Fluid Mechanics including Hydraulic Machines" ISBN: 978-81-7409-194-7

6. Streeter V. L., Bedford K. W. and Wylie E. B., “Fluid Dynamics”, New York, McGraw-Hill, Ninth Edition, 1998
7. Biswas G., “Introduction to Fluid Mechanics & Fluid Machines”, Tata McGraw-Hill, 2nd Edi., 2003.

Course Category	CEP ES201			Fluid Mechanics Lab				Pre-Requisites	Nil
	L_T_P				Practical/Lab				
ESC	L	T	P/S	C	File	Lab	Viva	TOTAL	
	0	0	2	1	30	40	30	100	

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. Understand the basic terms used in fluid mechanics
2. Understand the broad principles of fluid statics, kinematics and dynamics
3. Understand classifications of fluid flow
4. Define the concepts related to boundary layer theory and drag and lift forces.

LIST OF PRACTICALS

1. Determination of Fluid Properties
2. Verification of Pascal's Law
3. Hydrostatic Force on Submerged Surfaces
4. Buoyancy and Stability Analysis
5. Reynolds Number Experiment
6. Flow Visualization Techniques
7. To calculate discharge through pipes
8. Study of pressure measuring device
9. Study of U-tube manometer
10. Study of inverted Manometer
11. Study of Pitot tube
12. Verification of Bernoulii's energy equation.
13. Determine the coefficient of discharge by venturimeter.
14. Determine the coefficient of discharge by orifice meter.
15. Determine the velocity distribution in pipes.
16. To study measurement of viscosity
17. Open Channel Flow Analysis

Note: Any **six to eight** practical mentioned below shall be performed by each student.

SUGGESTED BOOKS

1. Ahmari, H., & Kabir, S. M. I. (2018). *Applied Fluid Mechanics Lab Manual*. University of Texas at Arlington.
2. Padmanabhan, G. (2008). *Fluid Mechanics Laboratory Manual for Civil Engineering*
3. BMS College of Engineering. (n.d.). *Fluid Mechanics Laboratory Manual*.
4. Southern Illinois University Edwardsville. (2014). *Engineering Fluid Mechanics*
5. University of Minnesota. (2016). *CEGE 3502 Fluid Mechanics Lab Manual*.

Course Category	CEL DC201			Strength of Materials				Pre-Requisites	Nil
	L_T_P			Theory					
DCC	L	T	P/S	C	Quiz	Assignment	Mid Sem	Major	TOTAL
	3	0	0	3	20	20	20	40	100

COURSE OUTCOMES

On completion of the course, the student will be able to:

1. describe the concepts and principles, understand the theory of elasticity including strain/displacement and Hooke's law relationships; and perform calculations, relative to the strength and stability of structures and mechanical components.
2. define the characteristics and calculate the magnitude of combined stresses in individual members and complete structures; analyze solid mechanics problems using classical methods and energy methods.
3. analyse various situations involving structural members subjected to combined stresses by application of Mohr's circle of stress; locate the shear center of thin wall beams
4. calculate the deflection at any point on a beam subjected to a combination of loads; solve for stresses and deflections of beams under unsymmetrical loading; apply various failure criteria for general stress states at points; solve torsion problems in bars and thin-walled members.

COURSE CONTENTS

Unit-I	**Simple Stresses and Strains**	(8 Contact Periods)

Concept of stress and strain, stress and strain diagram, Elasticity and plasticity – Types of stresses and strains, Hooke's law– stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio and volumetric strain – Elastic moduli and the relationship between them –Bars of varying section – composite bars – Temperature stresses. principal stresses and principal planes, Mohr circle of stress, ellipse of stress and their applications..

Unit-II	**Bending moment and Shear Force Diagrams**	(8 Contact Periods)

Bending moment (BM) and shear force (SF) diagrams.BM and SF diagrams for cantilevers simply supported and fixed beams with or without overhangs. Calculation of maximum BM and SF and the point of contraflexure under concentrated loads, uniformly distributed loads over the whole span or part of span, combination of concentrated loads (two or three) and uniformly distributed loads, uniformly varying loads, application of moments.

Unit-III	**Bending and Shear Stresses**	(9 Contact Periods)

Theory of simple bending – Assumptions – Derivation of bending equation: M/I = f/y = E/R - Neutral axis – Determination of bending stresses – Section modulus of rectangular and circular sections (Solid and Hollow), I section, T section, Angle and Channel sections – Design of simple beam sections.

Shear Stresses- Derivation of formula – Shear stress distribution across various beam sections.

Torsion- Derivation of torsion equation and its assumptions. Applications of the equation of the hollow and solid circular shafts

Unit-IV	**Slope and Deflection - Columns and struts**	(7 Contact Periods)

Relationship between moment, slope and deflection, Moment area method, Macaulay's method. Use of these methods to calculate slope and deflection for determinant beams. Eulers theory, End conditions for columns, Thin Cylinders and Spheres- Derivation of formulae and calculations of hoop stress, longitudinal stress in a cylinder, and sphere subjected to internal pressures.

SUGGESTED BOOKS

1. Timoshenko, S. and Young, D. H., “Elements of Strength of Materials”, DVNC, New York, USA.
2. Kazmi, S. M. A., “Solid Mechanics” TMH, Delhi, India.
3. Hibbeler, R. C. Mechanics of Materials. 6th ed. East Rutherford, NJ: Pearson Prentice Hall, 2004
4. Crandall, S. H., N. C. Dahl, and T. J. Lardner. An Introduction to the Mechanics of Solids. 2nd ed. New York, NY: McGraw Hill, 1979
5. Laboratory Manual of Testing Materials - William Kendrick Hall
6. Mechanics of Materials - Ferdinand P. Beer, E. Russel Jhonston Jr., John T. DEwolf TMH 2002.
7. Strength of Materials by R. Subramanian, Oxford University Press, New Delhi.

Course Category	CEP DC201				Strength of Materials Lab			Pre-Requisites	Nil
	L_T_P				Practical/Lab				
DCC	L	T	P/S	C	File	Lab	Viva	TOTAL	
	0	0	2	1	30	40	30	100	

COURSE OUTCOMES

On completion of the course, the student will be able to:

1. Describe the concepts and principles, understand the theory of elasticity including strain/displacement and Hooke's law relationships; and perform calculations, relative to the strength and stability of structures and mechanical components.
2. Define the characteristics and calculate the magnitude of combined stresses in individual members and complete structures; analyze solid mechanics problems using classical methods and energy methods.
3. Analyse various situations involving structural members subjected to combined stresses by application of Mohr's circle of stress; locate the shear center of thin wall beams
4. Calculate the deflection at any point on a beam subjected to a combination of loads; solve for stresses and deflections of beams under unsymmetrical loading; apply various failure criteria for general stress states at points; solve torsion problems in bars and thin walled members.

LIST OF EXPERIMENTS

1. To perform the tension test on mild steel.
2. Bending tests on simply supported beam and Cantilever beam.
3. Compression test on concrete.
4. To perform the impact test.
5. To perform the shear test.
6. Investigation of Hook's law that is the proportional relation between force and stretching in elastic deformation.
7. Determination of torsion and deflection.
8. Measurement of forces on supports in statically determinate beam.
9. Determination of shear forces in beams.
10. Determination of bending moments in beams.
11. Measurement of deflections in statically determinate beam.
12. Measurement of strain in a bar.
13. Bend test steel bar.
14. Yield/tensile strength of steel bar

Note: Any **six to eight** practical mentioned below shall be performed by each student.

SUGGESTED BOOKS

1. Timoshenko, S. and Young, D. H., "Elements of Strength of Materials", DVNC, New York, USA.
2. Kazmi, S. M. A., "Solid Mechanics" TMH, Delhi, India.
3. Hibbeler, R. C. Mechanics of Materials. 6th ed. East Rutherford, NJ: Pearson Prentice Hall, 2004
4. Crandall, S. H., N. C. Dahl, and T. J. Lardner. An Introduction to the Mechanics of Solids. 2nd ed. New York, NY: McGraw Hill, 1979

5. Laboratory Manual of Testing Materials - William Kendrick Hall
6. Mechanics of Materials - Ferdinand P. Beer, E. Russel Jhonston Jr., John T. DEwolf TMH 2002.
7. Strength of Materials by R. Subramanian, Oxford University Press, New Delhi.

Course Category	CEL DC203				Concrete Technology			Pre-Requisites	Nil
	L_T_P				Theory				
DCC	L	T	P/S	C	Quiz	Assignment	Mid Sem	Major	TOTAL
	3	0	0	3	20	20	20	40	100

COURSE OUTCOMES

Students will be able to understand:

1. The various requirements of cement, aggregates and water for making concrete
2. The effect of admixtures on properties of concrete
3. The concept and procedure of mix design as per IS method
4. The properties of concrete at fresh and hardened state.

COURSE CONTENTS

Unit-I	Constituent Materials	(9 Contact Periods)

Cement - Different types - Chemical composition and Properties – Hydration of cement - Tests on cement - IS Specifications - Aggregates – Classification - Mechanical properties and tests as per BIS - Grading requirements – Water - Quality of water for use in concrete.

Unit-II	Chemical And Mineral Admixtures	(9 Contact Periods)

Accelerators – Retarders - Plasticizers - Super plasticizers - Water proofers - Mineral Admixtures like Fly Ash, Silica Fume, Ground Granulated Blast Furnace Slag and Metakaoline - Effects on concrete properties.

Unit-III	Proportioning of Concrete Mix	(9 Contact Periods)

Principles of Mix Proportioning - Properties of concrete related to Mix Design - Physical properties of materials required for Mix Design - Design Mix and Nominal Mix - BIS Method of Mix Design - Mix Design Examples

Unit-IV	Fresh and Hardened Properties of Concrete and Special Concretes	(9 Contact Periods)

Workability - Tests for workability of concrete - Segregation and Bleeding - Determination of strength Properties of Hardened concrete - Compressive strength – split tensile strength - Flexural strength - Stress-strain curve for concrete - Modulus of elasticity – durability of concrete – water absorption – permeability – corrosion test – acid resistance Light weight concretes - foam concrete- self compacting concrete – vacuum concrete - High strength concrete - Fibre reinforced concrete – Ferrocement - Ready mix concrete – SIFCON - Shotcrete – Polymer concrete - High performance concrete - Geopolymer Concrete

SUGGESTED BOOKS

1. Gupta.B.L., Amit Gupta, "Concrete Technology", Jain Book Agency, 2010.
2. Shetty,M.S, "Concrete Technology", S.Chand and Company Ltd, New Delhi, 2003
3. Bhavikatti.S.S, " Concrete Technology", I.K.International Publishing House Pvt. Ltd., New Delhi, 2015
4. Santhakumar. A.R., "Concrete Technology", Oxford University Press India, 2006.

Course Category	CEP DC203			Concrete Technology Lab			Pre-Requisites	Nil
	L_T_P			Practical/Lab				
DCC	L	T	P/S	C	File	Lab	Viva	TOTAL
	0	0	2	1	30	40	30	100

COURSE OUTCOMES

Students will be able to understand:

1. The various requirements of cement, aggregates and water for making concrete
2. The effect of admixtures on properties of concrete
3. The concept and procedure of mix design as per IS method
4. The properties of concrete at fresh and hardened state.

LIST OF EXPERIMENT

- **Test of Cement:**
  1. Consistency of standard cement paste.
  2. Initial & final setting time of ordinary Portland cement.
  3. Soundness test
- **Test of Aggregate:**
  4. Sieve analysis.
  5. Flakiness index.
  6. Elongation index.
  7. Aggregate impact test.
  8. Aggregate crushing test.
  9. Specific gravity, water absorption and natural course of fine & course aggregate.
- **Test on Design concrete- fresh concrete:**
  10. Workability of concrete
  11. Compaction factor test
- **Test on Designed Concrete – Hardened Concrete:**
  12. Compressive strength of concrete
  13. Rebound hammer test
- **Field Visit:** Visit of any construction Site or RMC or Cement Plant.

Note: Any **six to eight** practical mentioned below shall be performed by each student.

SUGGESTED BOOKS

1. Gupta.B.L., Amit Gupta, "Concrete Technology", Jain Book Agency, 2010.
2. Shetty,M.S, "Concrete Technology", S.Chand and Company Ltd, New Delhi, 2003
3. Bhavikatti.S.S, " Concrete Technology", I.K.International Publishing House Pvt. Ltd., New Delhi, 2015
4. Santhakumar. A.R., "Concrete Technology", Oxford University Press India, 2006.

Course Category	CEL DC205				Soil Mechanics			Pre-Requisites	Nil
	L_T_P				Theory				
DCC	L	T	P/S	C	Quiz	Assignment	Mid Sem	Major	TOTAL
	3	0	0	3	20	20	20	40	100

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. find the index and engineering properties of the soil.
2. determine properties & demonstrate interaction between water and soil.
3. analyze and compute principles of compaction and consolidation of soil.
4. evaluate the stresses in the soil mass

Unit-I	**Physical Properties of Soil**	(9 Contact Periods)

Soil formation, Soil types, composition, three phase relations, Specific gravity, water content, shape and size, grain size distribution curves, relative density, consistency of soils, soil structure, clay minerals, Clay water relations, Unified soil classification system, IS soil classification system, field identification tests

Unit-II	**Permeability, Capillarity and Seepage**	9 Contact Periods)

Darcy's law, determination of permeability, equivalent permeability in stratified soils, Lab test for permeability, in-situ permeability test, 1-D flow, confined and unconfined flows, seepage, uplift pressure, Capillarity in soils, effective stress, pore-water pressure, quick sand, flow nets, piping, filter criteria, earth dams, vertical sand drains.

Unit-III	**Compaction and Consolidation**	(9 Contact Periods)

General principles of compaction, compaction tests, factors affecting compaction, field compaction, compaction techniques. Fundamentals, 1-D consolidation, normally and over-consolidated clays, void ratio – pressure relationships, compressibility characteristics, time rate of consolidation, coefficient of consolidation, curve fitting techniques, settlement, secondary consolidation, IS Codal provisions for assessing consolidation.

Unit-IV	**Stress Distributions and Shear Strength of Soil**	(12 Contact Periods)

Stress distribution due to surface loads: Boussinesq and Westergaard analysis for point loads, Line loads, strip loads; Stresses beneath a circular, rectangular and irregular shaped foundations, Stress distribution by 2:1 theory, Pressure isobars, Mohr-Coulomb failure criterion, direct shear test, unconfined compression test, Triaxial shear test : consolidated drained, consolidated undrained, unconsolidated undrained, vane shear test, shear strength of clays and sands, critical void ratio, stress path, pore-pressure coefficient, IS Codal provisions for assessing various shear strength properties..

SUGGESTED BOOKS

1. Couduto, D.P., "Geotechnical Engineering – Principles and Practices", Prentice Hall of India.
2. Ranjan, G. and Rao, A.S.R., "Basic and Applied Soil Mechanics", New Age International Publishers.
3. Murthy, V.N.S., "Text Book of Soil Mechanics and Foundation Engineering", CBS Publishers.
4. Das, B.M., "Principles of Geotechnical Engineering", Thomson Asia.
5. Lambe, T.W. and Whitman, R.V., "Soil Mechanics", John Wiley and Sons
6. B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain "Soil Mechanics and Foundations Engineering",
7. K.R. Arora "Soil Mechanics and Foundation Engineering",
8. Braja M. Das "Principles of Geotechnical Engineering",
9. V.N.S. Murthy "Geotechnical Engineering"

Course Category	CEP DC205			Soil Mechanics Lab				Pre-Requisites	Nil
	L_T_P				Practical/Lab				
DCC	L	T	P/S	C	File	Lab	Viva	TOTAL	
	0	0	2	1	30	40	30	100	

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. find the index and engineering properties of the soil.
2. determine properties & demonstrate interaction between water and soil.
3. analyze and compute principles of compaction and consolidation of soil.
4. evaluate the stresses in the soil mass

LIST OF EXPERIMENTS

1. Determination of Water Content using Oven Drying Method
2. Determination of Bulk Density using Core Cutter and Sand Replacement Method
3. Specific Gravity of Soil Solids using Pycnometer Method
4. Grain Size Distribution using Sieve Analysis and Hydrometer Test
5. Liquid Limit, Plastic Limit and Shrinkage Limit Test (Atterberg Limits)
6. Standard and Modified Proctor Compaction Test
7. Permeability Test (Constant Head and Falling Head Methods)
8. Direct Shear Test to determine shear strength parameters
9. Triaxial Test to determine shear strength parameters
10. Unconfined Compression Test (UCS) for cohesive soils
11. Vane Shear Test for cohesive soils
12. Consolidation Test to determine settlement parameters
13. California Bearing Ratio (CBR) Test for subgrade soil strength evaluation

Note: Any **six to eight** practical mentioned below shall be performed by each student.

SUGGESTED BOOKS

1. Couduto, D.P., “Geotechnical Engineering – Principles and Practices”, Prentice Hall of India.
2. Ranjan, G. and Rao, A.S.R., “Basic and Applied Soil Mechanics”, New Age International Publishers.
3. Murthy, V.N.S., “Text Book of Soil Mechanics and Foundation Engineering”, CBS Publishers.
4. Das, B.M., “Principles of Geotechnical Engineering”, Thomson Asia.
5. Lambe, T.W. and Whitman, R.V., “Soil Mechanics”, John Wiley and Sons
6. B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain “Soil Mechanics and Foundations Engineering”,
7. K.R. Arora “Soil Mechanics and Foundation Engineering”,
8. Braja M. Das “Principles of Geotechnical Engineering”,
9. V.N.S. Murthy “Geotechnical Engineering”

Fourth Semester, Second Year

Course Category	CEL DC202				Water Supply Engineering			Pre-Requisites	Nil
	L_T_P				Theory				
DCC	L	T	P/S	C	Quiz	Assignment	Mid Sem	Major	TOTAL
	3	0	0	3	20	20	20	40	100

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. understand detailed theoretical knowledge about obtaining quality water for drinking and industry purposes
2. understand present technologies, processes and facilities, equipment for water treatment
3. understand new methods used in water treatment, materials and equipment
4. understand the air pollution and its preventive measures

COURSE CONTENTS

Unit-I	Quantity Estimation of water	(8 Contact Periods)

Demand of water. Consumption for various purposes. Fire demand, Per capita demand. Factors affecting consumption. Fluctuation in demand. Design period, forecasting population, and design periods for water supply components. Sources: Surface sources, ground water sources, Infiltration Galleries, Relative merits of sources, assessment & suitability, selection. Intake works: Intakes, type, location, requirement & features.

Unit-II	Water quality	(6 Contact Periods)

Impurities in water, their effects and significance water borne diseases, collection of water samples. Water analysis physical, chemical and bacteriological. Water quality standards: I.S. & WHO, Flow diagrams and layouts of different water treatment works.

Unit-III	Unit Operations of water treatment	(18 Contact Periods)

Aeration**:** Purpose, type of gravity, aerator & spray aerators. Sedimentation: Plain and with coagulation, different coagulants used, dose of coagulant, Jar test, coagulant, feeding and mixing devices. Flocculation, clarrifloculator. Design criteria and design of sedimentation tanks.

Filtration: Rapid sand and slow sand filters, filter media, Rate of filtration, under drainage system and washing process, pressure filter. Simple design problems on rapid sand filters modifications of filters.

Unit-IV	Disinfection	(8 Contact Periods)

Requirement of good disinfectant, methods of disinfection. Chlorination: Methods, prechlorination, post chlorination. Break point chlorination and super chlorination forms of chlorine. Introduction to tertiary treatments like Softening, Ion Exchange, Reverse Osmosis, Defloridation, Desalination. Types of supply - Continuous, and intermittent, Types of system - Gravity; Pumping and combined gravity and pumping, Layouts of distributions system, Dead end, Grid iron, Circular system and Radial system. Maintenance of distribution system.

SUGGESTED BOOKS

1. Steel E. W, Water Supply and Sewerage, Mc-Graw Hill.
2. Kshirsagar S. R, Water Supply Engineering, Roorkee Pub house, Roorkee.
3. Birde G. S, Water Supply and Sanitary Engineering, Dhanpat Rai and Sons, Delhi.
4. Punmia B. C, Water Supply Engineering

Course Category	CEP DC202			Water Supply Engineering Lab			Pre-Requisites	Nil
	L_T_P			Practical/Lab				
DCC	L	T	P/S	C	File	Lab	Viva	TOTAL
	0	0	2	1	30	40	30	100

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. to understand detailed theoretical knowledge about obtaining quality water for drinking and industry purposes
2. to understand present technologies, processes and facilities, equipment for water treatment
3. to understand new methods used in water treatment, materials and equipment
4. to understand the air pollution and its preventive measures

LIST OF EXPERIMENTS

1. Determination of pH of water.
2. Determination of Conductivity
3. Determination of Solid's (Suspended & dissolved)
4. Determination Chlorides
5. Determination of Solid's (Suspended & dissolved)
6. Determination of Turbidity
7. Determination of Acidity
8. Determination of Dissolved Oxygen
9. Determination of Membrane filtration technique.
10. Determination of Available Chlorine
11. Determination of Residual Chlorine
12. Determination of Heavy Metals (any thee type)

Note: Any **six to eight** practical mentioned below shall be performed by each student.

SUGGESTED BOOKS

1. Steel E. W, Water Supply and Sewerage, Mc-Graw Hill.
2. Kshirsagar S. R, Water Supply Engineering, Roorkee Pub house, Roorkee.
3. Birde G. S, Water Supply and Sanitary Engineering, Dhanpat Rai and Sons, Delhi.
4. Punmia B. C, Water Supply Engineering

Course Category	CEL DC204			Structural Analysis-I				Pre-Requisites	Nil
	L_T_P			Theory					
DCC	L	T	P/S	C	Quiz	Assignment	Mid Sem	Major	TOTAL
	3	1	0	4	20	20	20	40	100

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. acquire the understanding of free body diagram, indeterminacy and determinacy of the structure.
2. find out the deflection of the beams by different methods and analysis of the structure under combined bending and axial loads.
3. understand the concept of moving loads and influence lines to find out reactions, shear force and bending moment.
4. know the behavior of two hinged arches, three hinged arches, cables and suspension bridge under different loading conditions.

COURSE CONTENTS

Unit-I	Introduction	(10 Contact Periods)

Need of analysis, techniques of structural idealization, basic tools of analysis, reactions in structure, notations and sign conventions, free – body diagrams, static determinacy, stability of structures, principle of superposition, loads on structures.

Plane Trusses: Introduction, member arrangement in a truss, stability and determinacy, roof and bridge trusses, analysis of trusses, notations and sign conventions, equations of condition, zero load test, classification of trusses.

Unit-II	Deflection of Beams	(8 Contact Periods)

Introduction, direct integration method, moment – area method, conjugate beam method, Principle of virtual work, unit load method, Betti‟s law, Maxwell‟s law, Castigliano‟s theorem.

Combined Bending and Axial Loads: Introduction, limit of eccentricity for no tension in the section, core of the section, middle third rule, wind pressure on chimneys, forces on dams.

Unit-III	Rolling Loads	(10 Contact Periods)

Introduction to rolling loads and influence lines, Determination of shear force, bending moment at a section and absolute shear force and bending moment due to single point load, uniformly distributed load, several point loads etc.

Influence lines: Introduction, moving loads, influence lines, influence lines for reactions, shear force and bending moment, influence lines for beams, girders with floor beams, Influence lines for forces in members of frames.

Unit-IV	Arches and Cables and Suspension Bridges	(9 Contact Periods)

Introduction, Analysis of two hinged and fixed arches, spandrel braced arches, influence lines for horizontal thrust, shear force and bending moment for three hinged and two hinged arches.

Cables and Suspension Bridges: Introduction, shape of a loaded cable, cable carrying point loads and UDL, cables with ends at different level, cable subjected to temperature stresses, suspension bridge with two hinged and three hinged stiffening girders, influence lines.

SUGGESTED BOOKS

1. Utku S, Norris C H and Wilbur J B, “Elementary Structural Analysis, McGraw Hill, NewYork, 1990.
2. Jain A K, “Elementary Structural Analysis” Nem Chand & Brothers, Roorkee, 1990.
3. Reddy C S , “Basic Structural Analysis” Tata McGraw Hill, New Delhi, 2003.
4. Hibbeler C, “Structural Analysis” Pearson Publishers, New Delhi, 2002.
5. Punmia B C, Jain A K and Jain A K “Theory of Structures" Luxmi Publications, 2000

Course Category	CEL DC206			Surveying for Civil Engineering				Pre-Requisites	Nil
	L_T_P			Theory					
DCC	L	T	P/S	C	Quiz	Assignment	Mid Sem	Major	TOTAL
	3	0	0	3	20	20	20	40	100

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. calculate angles, distances and levels.
2. identify data collection methods and prepare field notes.
3. understand the working principles of survey instruments.
4. estimate errors and apply corrections.

COURSE CONTENTS

Unit-I	Introduction Surveying	(10 Contact Periods)

Necessity & purpose, Geodetic & plane surveying, classification of survey, principles of surveying. Instruments for distance measurement, linear measurements, corrections to field measurements, ranging out, direct and indirect ranging. Use of distomat. Chain surveying: basic definition, principle, selection of survey stations, offsets for locating details, limiting length of offsets, degree of accuracy of offsets, use of cross staff, optical square, prism square, obstacles in chaining, plotting of chain survey work, cross staff survey.

Unit-II	Instruments for Measurement of Angles and Elevation	(10 Contact Periods)

Prismatic compass, surveyor's compass, their use and adjustments. Traversing with chain and compass, Reference meridians, bearing and azimuths. Local attraction, magnetic declination and its variation. Open & closed traverses.

Unit-III	Leveling, Countering and Theodolite Surveying	(15 Contact Periods)

Dumpy levels tilting and automatic levels, Temporary and permanent adjustments of Dumpy and tilting levels. Definition of terms, Principle, leveling methods, leveling staves, Booking and reduction of field notes, curvature and refraction. Contouring: Definition, Characteristics and uses of contour maps, methods of contouring. Measurement of Horizontal and Vertical angles with theodolite by different methods. Other uses of theodolite. Theodolite traverse

Unit-IV	Plane table Surveying	(7 Contact Periods)

Equipment, methods, two point and three-point problems, Advantages & disadvantages of plane tabling, Lehman's rules.

SUGGESTED BOOKS

1. Anderson, J.M. and Mikhail, E.M., “Surveying: Theory and Practice”, McGraw Hill.
2. Arora, K.R., “Surveying”, Vol. I, II and III, Standard Book House.
3. Chandra, A.M., “Surveying”, New Age Publishers.
4. T.P.Kanetkar & Kulkarni : Surveying and Leveling, Part I & II, Pune Vidharthi Griha Prakashan, Pune
5. B.C.Punmia : Surveying I & II, Standard Book House Delhi.
6. R.C.Brinker and P.R.Wolf, Harper and Row : Elementary Surveying.

Course Category	CEP DC206			Surveying for Civil Engineering Lab			Pre-Requisites	Nil
	L_T_P			Practical/Lab				
DCC	L	T	P/S	C	File	Lab	Viva	TOTAL
	0	0	2	1	30	40	30	100

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. calculate angles, distances and levels.
2. identify data collection methods and prepare field notes.
3. understand the working principles of survey instruments.
4. estimate errors and apply corrections.

LIST OF EXPERIMENTS

1. Measurement of length by using Distomat.
2. Chain surveying
3. Compass surveying.
4. L Section of road.
5. Cross-section of road.
6. Plane table survey.
7. Theodolite traverse.
8. Study and use of minor instruments.
9. Measurement of area of an irregular figure by digital Planimeter.
10. To find corrected bearing using prismatic compass (local attraction).
11. To find R.L. of given point (differential levelling)

Note: Any **six to eight** practical mentioned below shall be performed by each student

SUGGESTED BOOKS

1. Anderson, J.M. and Mikhail, E.M., “Surveying: Theory and Practice”, McGraw Hill.
2. Arora, K.R., “Surveying”, Vol. I, II and III, Standard Book House.
3. Chandra, A.M., “Surveying”, New Age Publishers.
4. T.P.Kanetkar & Kulkarni : Surveying and Leveling, Part I & II, Pune Vidharthi Griha Prakashan, Pune
5. B.C.Punmia : Surveying I & II, Standard Book House Delhi.
6. R.C.Brinker and P.R.Wolf, Harper and Row : Elementary Surveying.

Course Category	CEL DC208			Transportation Engineering				Pre-Requisites	Nil
	L_T_P			Theory					
DCC	L	T	P/S	C	Quiz	Assignment	Mid Sem	Major	TOTAL
	3	0	0	3	20	20	20	40	100

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. exhibit the knowledge of planning, design and the fundamental properties of highway materials in highway engineering.
2. acquire knowledge of geometric design and draw appropriate conclusions.
3. understand and use the concept of different methods in design, construction, inspection and maintenance of the pavement.
4. explain the function of various elements of railways

COURSE CONTENTS

Unit-I	Highway Development and Planning	(4 Contact Periods)

Historical Development, road patterns, master plans, road development plans, PMGSY, engineering surveys, highway projects.

Unit-II	Highway Materials and Testing and Geometric Design	(8 Contact Periods)

Embankment, Sub grade soil, sub base and base course materials, bituminous materials, testing of soil, stone aggregates and bitumen. Cross section elements, camber, super elevation, sight distances, horizontal and vertical alignment, summit and valley curves.

Unit-III	Traffic Engineering and Design of Highway Pavements and Highway Construction & Maintenance	(15 Contact Periods)

Traffic characteristics, road user & vehicular characteristics, traffic studies, road traffic safety, traffic operations, traffic control devices, intelligent transport systems, pollution due to traffic. Flexible pavements and their design, review of old methods, CBR method, IRC:37-2001, 2012, equivalent single wheel load factor, rigid pavements, stress in rigid pavement, IRC design method (IRC:58-2002). Construction of various layers, earthwork, WBM, GSB, WMM, various types of bituminous layers, joints in rigid pavements, Hot Mix Plants, Construction of Rigid Pavements

Unit-IV	Introduction to Railway Engineering	(7 Contact Periods)

Universal scenario and Indian railways, railway track development, component parts, gauge, wheel and axle arrangement, Rails and their requirements, creep and wear in rails, rail joints, types of sleepers, ballast, track fastenings, check rails and guard rails, railway cross-section

SUGGESTED BOOKS

1. Khanna, S.K. and Justo, C.E.G., "Highway Engineering", Nem Chand & Bros.
2. Mannering Fred L., Washburn Scott S. and Kilaresk Walter P.Principles of Highway Engineering and Traffic Analysis, Wiley India Pvt. Ltd
3. Kadiyali, L.R., "Traffic Engineering and Transportation Planning", Khanna Publishers.
4. Roess Roger P., Prassas, Elena S. and McShane, William R., "Traffic Engineering", Prentice Hall.
5. Papacostas, C.S. and Prevedouros, P.D., "Transportation Engineering and Planning", Prentice Hall.
6. Jotin Khisty, C. and Kent Lall, B., "Transportation Engineering – An Introduction", Prentice Hall.
7. Kadiyali, L.R., "Principles of Highway Engineering", Khanna Publishers.

8. Khanna, S.K., Justo, C.E.G. and A Veeraragavan, “Highway Material and Pavement Testing Manual”, Nem Chand & Bros
9. Chandra, Satish and Agarwal, M. M.**,** “Railway Engineering”**,** Oxford University Press, New Delhi.
10. Arora, S. P. and Saxena, S. C, “A Textbook on Railway Engineering”, Dhanpat Rai Publications (P) Ltd., New Delhi.
11. Mundrey, J. S., “Railway Track Engineering”, Tata McGraw-Hill Publishing Company, New Delhi.

Course Category	CEP DC208			Transportation Engineering Lab			Pre-Requisites	Nil
	L_T_P			Practical/Lab				
DCC	L	T	P/S	C	File	Lab	Viva	TOTAL
	0	0	2	1	30	40	30	100

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. exhibit the knowledge of planning, design and the fundamental properties of highway materials in highway engineering.
2. acquire knowledge of geometric design and draw appropriate conclusions.
3. understand and use the concept of different methods in design, construction, inspection and maintenance of the pavement.
4. explain the function of various elements of railways

LIST OF EXPERIMENTS

1. Aggregate Crushing Test
2. Aggregate Impact Test
3. Los Angles Abrasion Test
4. Shape Tests
5. Specific Gravity and Water Absorption Test on Aggregates
6. C.B.R. Test
7. Penetration Test
8. Ductility Test
9. Softening Point Test
10. Flash & Fire Test
11. Specific Gravity Tests on Bitumen
12. Marshall Stability Test

Note: Any **six to eight** practical mentioned below shall be performed by each student.

SUGGESTED BOOKS

1. Khanna, S.K. and Justo, C.E.G., "Highway Engineering", Nem Chand & Bros.
2. Mannering Fred L., Washburn Scott S. and Kilaresk Walter P.Principles of Highway Engineering and Traffic Analysis, Wiley India Pvt. Ltd
3. Kadiyali, L.R., "Traffic Engineering and Transportation Planning", Khanna Publishers.
4. Roess Roger P., Prassas, Elena S. and McShane, William R., "Traffic Engineering", Prentice Hall.
5. Papacostas, C.S. and Prevedouros, P.D., "Transportation Engineering and Planning", Prentice Hall.
6. Jotin Khisty, C. and Kent Lall, B., "Transportation Engineering – An Introduction", Prentice Hall.
7. Kadiyali, L.R., "Principles of Highway Engineering", Khanna Publishers.
8. Khanna, S.K., Justo, C.E.G. and A Veeraragavan, "Highway Material and Pavement Testing Manual", Nem Chand & Bros
9. Chandra, Satish and Agarwal, M. M., "Railway Engineering", Oxford University Press, New Delhi.
10. Arora, S. P. and Saxena, S. C, "A Textbook on Railway Engineering", Dhanpat Rai Publications (P) Ltd., New Delhi.
11. Mundrey, J. S., "Railway Track Engineering", Tata McGraw-Hill Publishing Company, New Delhi.

Course Category	CEL DC210				Design of Concrete Structures-I			Pre-Requisites	Structural Analysis-I
	L_T_P				Theory				
DCC	L	T	P/S	C	Quiz	Assignment	Mid Sem	Major	TOTAL
	3	1	0	4	20	20	20	40	100

COURSE OUTCOMES

Students will able to:

1. explain the basic concepts of structural design methods of RCC to the practical problem
2. use the knowledge of the structural properties of materials i.e. steel and concrete in assessing the strength
3. apply the concepts of concrete structures in real problems.
4. understand structural planning and design of various components of buildings

COURSE CONTENTS

Unit-I	**Properties of Concrete**	(8 Contact Periods)

Compressive strength, tensile strength, stress-strain behavior, modulus of elasticity, shrinkage, creep, characteristic strength, grades of concrete, design stress-strain curve of concrete, reinforcing steel, types and grades, stress-strain behavior, design stress-strain curve , basic properties of concrete constituent materials and fresh concrete , design of concrete mix. Working stress and limit state design methods

Unit-II	**Design and detailing of RC Beams**	(10 Contact Periods)

Singly and doubly reinforced rectangular/flanged sections, design for shear, bond and anchorage of reinforcement, limit states of deflection and cracking. Design of RC beams subjected to torsion and detailing

Unit-III	**Design and Analysis of slabs & staircases**	(10 Contact Periods)

Design and Analysis of One-way and two-way slabs, design of staircases and detailing.

Unit-IV	**Compression members, Footing and Retaining wall**	(15 Contact Periods)

Design and detailing of compression members for axial loads and axial load plus uniaxial moment/ biaxial moments. Foundation types, design and detailing of isolated footings, introduction to combined footings. Stability analysis of retaining walls, design of gravity, cantilever type retaining walls.

SUGGESTED BOOKS

1. Pillai, S.U. and Menon, D., “Reinforced Concrete Design”, Tata McGraw- Hill.
2. Sinha, N.C. and Roy, S.K., “Fundamentals of Reinforced Concrete”, S. Chand.
3. Jain, A.K., “Reinforced Concrete Limit State Design”, 7th Ed., Nem Chand & Bros., Roorkee.
4. Shah, V.L. and Karve, S.R., “Limit State Theory and Design of Reinforced Concrete”, Structures Publication

Fifth Semester, Third Year

Course Category	CEL DC 301			Structural Analysis-II				Pre-Requisites	Structural Analysis-I
	L_T_P			Theory					
DCC	L	T	P/S	C	Quiz	Assignment	Mid Sem	Major	TOTAL
	3	0	0	3	20	20	20	40	100

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. understand the concept of degree of indeterminacy of the structure and analysis of the fixed and continuous beam by Clapeyron's theorem.
2. analysis of statically indeterminate beams and rigid frames by slope deflection method and moment distribution method
3. understand analysis of indeterminate beams and rigid frames by Kani's method and adopt appropriate technique for analysis of frames.
4. understand the analysis of space frames and concept of plastic analysis of beams and frames.

COURSE CONTENTS

Unit-I	Analysis of Indeterminate Structures	(9 Contact Periods)

Analysis of Indeterminate Structures: Degree of static and kinematic indeterminacies, analysis of indeterminate beams, pin jointed frames, rigid frames and trusses by method of consistent deformation, effect of lack of fitness, temperature, method of least work, induced reactions on statically indeterminate beams, pin jointed frames, rigid frames and trusses due to yielding of supports.

Fixed and Continuous Beams: Analysis of fixed beams, continuous beams and propped cantilevers by moment-area theorem, fixed end moments due to different types of loadings, effects of sinking and rotation of supports, bending moment and shear force diagrams for fixed beams and propped cantilevers, slope and deflection of fixed beams, analysis of continuous beams by the three moment theorom (Clapeyron's theorem) due to different types of loadings.

Unit-II	Slope and Deflection	(9 Contact Periods)

Slope and Deflection Method: Introduction, slope-deflection equations, analysis of statically indeterminate beams and rigid frames (sway and non-sway type) due to applied loads and uneven support settlements.

Moment Distribution Method: Introduction, absolute and relative stiffness of members, stiffness and carry-over factors, distribution factors, analysis of statically indeterminate beams and rigid frames (sway and non-sway type) due to applied loads and uneven support settlements, symmetrical beams and frames with symmetrical, skew-symmetrical and general loading.

Unit-III	Framed Structure	(9 Contact Periods)

Kani's Method: Introduction, basic concept, analysis of statically indeterminate beams and rigid frames (sway and non-sway type) due to applied loadings and yielding of supports, symmetrical beams and frames, general case- storey columns unequal in height and bases fixed or hinged.

Approximate Analysis of Frame: Vertical and lateral load analysis of multistory frames, portal, cantilever and substitute-frame methods and their comparison.

Unit-IV	**Space Frames and Plastic Analysis**	(8 Contact Periods)

Space Frames: Introduction, simple space truss, types of supports, equilibrium and stability conditions, analysis of determinate and indeterminate space frames using tension coefficient method.

Plastic Analysis: Basics of plastic analysis, static and kinematic theorems for plastic analysis of beams and frames.

SUGGESTED BOOKS

1) Basic structural analysis - C.S. Reddy
2) Theory of Structures, Gupta, S.P., Pandit, G. S., Gupta, R., Tata McGraw Hill
3) Structural Analysis- Thandvamoorthy TS Oxford University Press
4) Structural Analysis - Devdas Menon Narosa Publishing House
5) Indeterminate Structural Analysis C K Wang Tata McGraw Hill

Course Category	CEP DC 301				Structural Analysis-II Lab			Pre-Requisites	Nil
	L_T_P				Practical/Lab				
DCC	L	T	P/S	C	File	Lab	Viva	TOTAL	
	0	0	2	1	30	40	30	100	

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. understand the concept of degree of indeterminacy of the structure and analysis of the fixed and continuous beam by Clapeyron's theorem.
2. analysis of statically indeterminate beams and rigid frames by slope deflection method and moment distribution method
3. to understand analysis of indeterminate beams and rigid frames by Kani's method and adopt appropriate technique for analysis of frames.
4. understand the analysis of space frames and concept of plastic analysis of beams and frames.

LIST OF EXPERIMENTS

1. To verify Betti's Law
2. To verify Maxwell's reciprocal theorem
3. To find the deflection of a pine connected truss.
4. To determine the flexural rigidity (EI) of a given beam.
5. To verify Moment-Area Theorems for slope and deflection of a beam.
6. To study the behavior of different types of struts.
7. To obtain experimentally the influence line for the horizontal thrust in a two hinged arch.
8. To determine the elastic displacement of curved members.
9. To determine the horizontal displacement of the roller end in a curved beam.
10. To analyze continuous beams to determine support reactions and draw bending moment diagrams.
11. To measure the deflection of a truss and compare experimental results with theoretical predictions.
12. To determine the horizontal thrust and draw the influence line for horizontal thrust in a two-hinged arch.
13. To determine the slope and deflection of beams using various methods and compare with theoretical values.
14. Analyze propped cantilever beams under various loading conditions to determine reactions and moments.
15. Apply the moment distribution method to analyze indeterminate beams and frames.
16. Analyze simple space trusses using the tension coefficient method.

SUGGESTED BOOKS

1. Syed, S. (2018). *Structural Analysis-I Lab Manual*. Anjuman College of Engineering & Technology.
2. NRI Institute of Information Science and Technology. (2010). *Lab Manual Structural Analysis-I*.
3. Ahsanullah University of Science and Technology. (2023). *CE 312 Structural Analysis and Design Sessional-I (Lab Manual)*.
4. Padmanabhan, G. (2008). *Fluid Mechanics Laboratory Manual for Civil Engineering Students*. Kendall Hunt Publishing.
5. Rowland, S. M., Duebendorfer, E. M., & Schiefelbein, I. M. (2021). *Structural Analysis and Synthesis: A Laboratory Course in Structural Geology* (4th ed.). Wiley

Course Category	CEL DC 303			Domestic Wastewater Treatment				Pre-Requisites	Nil
	L_T_P			Theory					
DCC	L	T	P/S	C	Quiz	Assignment	Mid Sem	Major	TOTAL
	3	0	0	3	20	20	20	40	100

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. understand the concepts of wastewater engineering & treatment
2. classify and compare the different components of sewer in construction, testing & maintenance of sewers.
3. determine the requirements of safe disposal of sewage and its impact on environment
4. determine various advance and low-cost treatment of sewage and sludge

COURSE CONTENTS

Unit-I	Introduction to Domestic Wastewater and its Characteristics	(10 Contact Periods)

Quantity of storm water, DWF, variation of sewage, flow systems of sewerage - separate combined and partially combined layouts of sewerage system, Waste water characteristic, sampling of sewage, physical chemical and biological examinations, B.O.D. and C.O.D., B.O.D. equation, problems on B.O.D Pollution due to domestic and industrial waste. Waste water characteristics, sampling of sewage, physical chemical and biological examinations, B.O.D. and C.O.D., B.O.D. equation, problems on B.O.D Pollution due to domestic and industrial waste.

Unit-II	Waste water Treatment (Primary)	(10 Contact Periods)

Treatment of sewage - purpose of treatment, preliminary treatment, primary treatment and Flow diagram for conventional sewage treatment plant. Preliminary Treatment: Screening, Grit chamber, detritus tank. Primary Treatment: Sedimentation of sewage.

Unit-III	Waste water Treatment - Secondary and Biological treatment	(15 Contact Periods)

Trickling filters, low rate & high rate tricking filters, construction details, Re- circulation Modification of trickling filters Activated sludge process - Process description, Methods of aeration, loading rates. Anaerobic Reactors, Sludge Treatment, Sludge Thickeners, Disposal of Sewage and its regulations

Unit-IV	Low cost and advance waste water treatments	(6 Contact Periods)

Oxidation ponds, Aerated Lagoon, Treatment and Disposal of sludge - Digestion of sludge, sludge disposal Septic tank, working and design, Disposal of septic tank effluent Disposal of sewage on land and in stream. Effluent standards for disposal on land, into stream and into sewers

Tertiary Treatments of Sewage – Advanced Treatment, Introduction to Membrane technology and Member Bioreactors

SUGGESTED BOOKS

1. Kshirsagar S.R.: Sewerage and Sewage Treatment, Roorkee Pub House, Roorkee.
2. Steel E.W. Steel: Water Supply & Sewerage, McGraw Hill Book Co.
3. Birdie G.S.: Water Supply and Sanitary Engineering, Dhanpat Rai & Son’s.
4. Garg S.K.: Waste Water Engineering.

Course Category	CEP DC 303			Domestic Wastewater Treatment Lab			Pre-Requisites	Nil
	L_T_P			Practical/Lab				
DCC	L	T	P/S	C	File	Lab	Viva	TOTAL
	0	0	2	1	30	40	30	100

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. The concepts of wastewater engineering & treatment classify and Compare the different components of sewer in construction, testing & maintenance of sewers.
2. determine the requirements of safe disposal of sewage and its impact on environment
3. determine various techniques for treatment of sewage and sludge
4. determine various advance and low-cost treatment of sewage and sludge

LIST OF EXPERIMENTS

1. Determination of pH
2. Determination of Acidity
3. Determination of Dissolved Oxygen
4. Determination of Alkalinity
5. Demonstration of BOD
6. Demonstration of COD
7. Bacteriological Plate count and MPN tests
8. Estimation of Sulphate
9. Estimation of Phosphate
10. Bacteriological Plate count and MPN tests

Note: Any **six to eight** practical mentioned below shall be performed by each student.

SUGGESTED BOOKS

1. Kshirsagar S.R.: Sewerage and Sewage Treatment, Roorkee Pub House, Roorkee.
2. Steel E.W. Steel: Water Supply & Sewerage, McGraw Hill Book Co.
3. Birdie G.S.: Water Supply and Sanitary Engineering, Dhanpat Rai & Son's.
4. Garg S.K.: Waste Water Engineering.

Course Category	CEL DC 305			Design of Concrete Structures II				Pre-Requisites	Design of Concrete Structures I
	L_T_P			Theory					
DCC	L	T	P/S	C	Quiz	Assignment	Mid Sem	Major	TOTAL
	3	1	0	4	20	20	20	40	100

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. understand the general design considerations for continuous beams and slabs.
2. acquire knowledge on different foundation types and their general design considerations.
3. understand the general design considerations for curved beams and domes.
4. acquire general design considerations for different retaining walls and water tanks.

COURSE CONTENTS

Unit-I	Continuous Beams and slabs & Flat slabs	(9 Contact Periods)

Basic assumptions, Moment of inertia, settlements, Modification of moments, maximum moments and shear, redistribution of moments for single and multi-span beams. Flat slabs: Advantages of flat slabs, general design considerations, approximate direct design method, design of flat slabs.

Unit-II	Foundations	(7 Contact Periods)

Isolated footings, combined footings, rectangular, trapezoidal, strip, strap, raft footings.

Unit-III	Design of curved beams & Domes	(8 Contact Periods)

Analysis and Design of curved beams fixed at both ends, ring beams. Design of Domes: Meridional and hoop stress in spherical and conical domes

Unit-IV	Retaining walls & Water Tanks	(9 Contact Periods)

Design of cantilever and counterfort-type retaining walls. Water Tanks: Estimation of Wind and earthquake forces, design requirements, rectangular and cylindrical underground tanks, Intze tanks.

SUGGESTED BOOKS

1. Reinforced Concrete Structures, P. C. Varghese, Tata McGraw Hill
2. Advanced Reinforced Concrete Structures, P. C. Varghese, Tata McGraw Hill
3. Reinforced Concrete Design, M.L. Gambhir, Macmillan India Ltd., New Delhi
4. Limit State Design of Reinforced Concrete, A.K. Jain, Nem Chand and Bros., Roorkee
5. IS:456 2000
6. IS 3370 2009
7. Plain and Reinforced Concrete, Vol. 2, O P Jain and J. Krishna, Nem Chand and Bros., Roorkee
8. Reinforced Concrete Design, S U Pillai and D Menon, Tata McGraw Hill

Course Category	CEL DE 301				AI & ML in Civil Engineering			Pre-Requisites	Linear Algebra, Probability, Statistics. Comfortable with basic programming.
	L_T_P				Theory				
DEC	L	T	P/S	C	Quiz	Assignment	Mid Sem	Major	TOTAL
	3	0	0	3	20	20	20	40	100

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. understand the basics of probability, statistics, linear algebra, and numerical optimization for AI/ML.
2. develop the ability to understand and apply classical machine learning algorithms like regression, classification, and principal component analysis (PCA) to solve basic civil engineering problems.
3. explain the concepts of reinforcement learning and neural networks, including CNNs and ANNs, and their role in AI-driven solutions.
4. utilize AI and ML techniques for real-world civil engineering applications.

COURSE CONTENTS

Unit-I	Introduction to Basic Mathematics and Coding	(10 Contact Periods)

Introduction to Artificial Intelligence (AI) and Machine Learning (ML), Basics of Probability and Statistics for AI/ML, Basics of Linear Algebra (Matrices, Vectors, Eigenvalues), Numerical Optimsation, Role of AI and ML in Civil Engineering.

Unit-II	Classical Learning Algorithms	(10 Contact Periods)

Basic Concepts of AI and ML: Supervised vs. Unsupervised Learning, Regression, Classification, Principal Component Analysis (PCA), Genetic Algorithms

Unit-III	Reinforcement Learning and Neural Networks	(10 Contact Periods)

Introduction to Reinforcement Learning, Introduction to Neural Networks, Convolutional neural Networks (CNN), Artificial Neural Networks (ANNs).

Unit-IV	Applications in Civil Engineering	(10 Contact Periods)

ML for Monitoring building and bridge safety, Predicting maintenance needs, ML for better construction planning, Using ML to improve traffic flow, Checking material quality with ML, AI for predicting floods and disasters.

SUGGESTED BOOKS

1. "Machine Learning for Civil and Environmental Engineers" by S. C. K. L. and L. A. Jones.
2. "Artificial Intelligence in Civil Engineering" by S. S. Shinde and R. P. Khandelwal.
3. "Pattern Recognition and Machine Learning" by Christopher M. Bishop.
4. Coursera – "Machine Learning" by Andrew Ng (Stanford University).

Course Category	CEP DE 301			AI & ML in Civil Engineering Lab			Pre-Requisites	Nil
	L_T_P			Practical/Lab				
DEC	L	T	P/S	C	File	Lab	Viva	TOTAL
	0	0	2	1	30	40	30	100

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. Understand the basics of probability, statistics, linear algebra, and numerical optimization for AI/ML.
2. Develop the ability to understand and apply classical machine learning algorithms like regression, classification, and principal component analysis (PCA) to solve basic civil engineering problems.
3. Explain the concepts of reinforcement learning and neural networks, including CNNs and ANNs, and their role in AI-driven solutions.
4. Utilize AI and ML techniques for real-world civil engineering applications.

LIST OF EXPERIMENTS

1. **Basic Python Programming for AI & ML:** Implement basic Python operations, loops, and functions for AI/ML applications.
2. **Matrix Operations in Linear Algebra:**Perform matrix manipulations (addition, multiplication, inverse) and compute eigenvalues/eigenvectors.
3. **Probability and Statistics in AI:** Implement basic probability distributions and statistical measures in Python.
4. **Data Preprocessing and Normalization:** Load a dataset, handle missing values, normalize, and standardize data.
5. **Linear Regression Model:**Implement simple and multiple linear regression models using Python.
6. **Logistic Regression for Classification:** Develop a logistic regression model for binary classification problems.
7. **Principal Component Analysis (PCA) for Dimensionality Reduction:** Apply PCA to reduce the dimensionality of a dataset and visualize results.
8. **Genetic Algorithm for Optimization:** Implement a simple Genetic Algorithm (GA) to solve an optimization problem.
9. **Neural Network for Handwritten Digit Recognition (Using MNIST Dataset):** Train an Artificial Neural Network (ANN) to classify handwritten digits.
10. **Building a Convolutional Neural Network (CNN):** Develop a CNN model for image classification.
11. **Reinforcement Learning with OpenAI Gym:** Implement a reinforcement learning agent using Q-learning in OpenAI Gym.
12. **Bridge and Building Safety Monitoring with ML:** Use supervised learning to predict structural health conditions.
13. **AI-based Traffic Flow Prediction:** Apply ML algorithms to predict and optimize urban traffic flow.
14. **AI for Disaster Prediction (Floods, Earthquakes, etc.):** Develop a model to predict disaster occurrences using real-world datasets.
15. **AI-based Construction Planning Optimization:** Implement an ML-based optimization model to improve construction scheduling.

Note: Any **six to eight** practical mentioned above shall be performed by each student.

SUGGESTED BOOKS

1. **Bishop, C. M. (2023).** *Pattern Recognition and Machine Learning* (2nd ed.). Springer.

2. **Raschka, S., & Mirjalili, V. (2022).** *Python Machine Learning* (4th ed.). Packt Publishing.
3. **Goodfellow, I., Bengio, Y., & Courville, A. (2016).** *Deep Learning*. MIT Press.
4. **Alpaydin, E. (2021).** *Introduction to Machine Learning* (4th ed.). MIT Press.
5. **Chollet, F. (2021).** *Deep Learning with Python* (2nd ed.). Manning Publications.

Sixth Semester, Third Year

Course Category	CEL DC 302				Foundation Engineering			Pre-Requisites	Soil Mechanics
	L_T_P				Theory				
DCC	L	T	P/S	C	Quiz	Assignment	Mid Sem	Major	TOTAL
	3	0	0	3	20	20	20	40	100

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. understand the principles of soil exploration, site investigation, and foundation selection.
2. analyze the bearing capacity and settlement of shallow and deep foundations.
3. evaluate slope stability and earth pressure theories for retaining structures.
4. design machine foundations considering soil-structure interaction and dynamic loads.

COURSE CONTENTS

Unit-I	Introduction to Foundation Engineering and Soil Exploration	(8 Contact Periods)

Role of civil engineer in the selection, design and construction of foundation of civil engineering structures, Subsurface Investigation: Purpose of site investigation, Planning and execution of soil exploration and subsurface investigation; Borings methods and their types, Auger Boring, Wash boring, Percussion boring, Area ratio, Soil report, Soil profiling; Various types of subsurface explorations such as SPT, CPT (SCPT/DCPT), Pressuremeter/Dilatometer tests, Vane shear test, Plate load tests. Introduction to Geophysical explorations and their usage in subsurface exploration, Introduction to relevant IS Codes.

Unit-II	Shallow Foundation	(10 Contact Periods)

Shallow Foundations: Factors effecting locations of foundation and design considerations of shallow Foundations, Choice of type of foundations, Foundations on expansive soils. Bearing Capacity of Shallow Foundations: Safe bearing capacity, allowable bearing pressure, Terzaghi's bearing capacity equation and its modifications for square, rectangular and circular foundation, General and local shear failure conditions, Factors affecting bearing capacity of Soil. Allowable bearing pressure based on values, bearing capacity from plate load tests, SPT and CPT; Introduction to relevant IS Codes. Settlement analysis of Shallow Foundations: Types and causes of settlement, Computation of settlement, allowable settlement, Introduction to relevant IS Codes, Measures to reduce settlement.

Unit-III	Deep Foundations	(11 Contact Periods)

Pile Foundations (Bearing capacity and Settlement): Types, Construction, load carrying capacity of single pile Dynamic Formula, Static formula, Pile load tests, Load carrying capacity of pile groups in sands and clays, settlement of pile groups, Negative skin Friction, Uplift capacity of piles, Introduction to relevant IS Codes. Caissons and Well Foundations: Types of caissons, pneumatic caissons, Different shapes of well foundations. Relative Advantages and disadvantages. Different Components of wells and their function. Grip length, problems in well sinking and remedial measures.

Unit-IV	Earth Pressure, Slope Stability and Machine Foundations	(11 Contact Periods)

Earth Pressure: Types of Earth pressure. Rankine's Active and passive earth pressure, Smooth Vertical wall with horizontal backfill. Bulkheads Classifications, Cantilever sheet Piles in Sandy soils and clay soils. Introduction to slope stability analysis: Finite and infinite slope

stability analyses techniques in sands and clays, Different types of slip surfaces, Various methods of slices, factor of safety determination, Taylor's factor of safety charts, stability analysis of infinite slopes, methods of slices, Bishop's simplified method. Types of machine foundations, models, response of foundation – soil system to machine excitation, cyclic plate load test, block resonance test, criteria for design.

SUGGESTED BOOKS

1. Ranjan G., Rao A S R., Basic and applied soil Mechanics, New age international Punlishers, 2016
2. Punmia B.C., Jain K A., Soil Mechanics and foundations, Laxmi Publishers, 2017
3. Murthy V N S P., Geotechnical Engineering, UBS punlishers, 2019
4. Fratta, Aguettant, Smith – Introduction to Soil Mechanics Laboratory Testing, CRC Press, 2007
5. Som, N.N. and Das, S.C., "Theory and Practice of Foundation Design",Prentice-Hall.
6. Peck, R.B., Hanson, W.E. and Thornburn, T.H., "Foundation Engineering",John Wiley
7. Couduto, Donald P., "Geotechnical Engineering – Principles and Practices", Prentice Hall.
8. Arora K.R., Soil Mechanics and Foundation Engineering, PHI publishers, 2016.
9. Das M. B., Fundamentals of Geotechnical Engineering, Cengage learning, 2010.

Course Category	CEP DC 302				Foundation Engineering Lab			Pre-Requisites	Nil
	L_T_P				Practical/Lab				
DCC	L	T	P/S	C	File	Lab	Viva	TOTAL	
	0	0	2	1	30	40	30	100	

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. understand the principles of soil exploration, site investigation, and foundation selection.
2. analyze the bearing capacity and settlement of shallow and deep foundations.
3. evaluate slope stability and earth pressure theories for retaining structures.
4. design machine foundations considering soil-structure interaction and dynamic loads.

LIST OF EXPERIMENTS

1. Determination of the shear strength of soil sample by vane shear test
2. Determination of relative density of soil by vibration table method
3. Determination of field density of soil by sand replacement method/ core cutter method
4. Determination of soil electrical resistivity.
5. Determination of liquid limit of soil by cone penetration method
6. Determination of SPT value
7. Determination of ultimate bearing capacity by Plate Load Test
8. Determination of ultimate pile load capacity Pile Load Test
9. Determination of shear strength parameters of soil by direct shear test (Digitised
10. Determination of shear strength parameters by Triaxial test a. UU test b.CU test c. CD test
11. Determination of sub-surface profile by MASW test.

Note: Any **six to eight** practical mentioned above shall be performed by each student.

SUGGESTED BOOKS

1. Ranjan G., Rao A S R., Basic and applied soil Mechanics, New age international Punlishers, 2016
2. Punmia B.C., Jain K A., Soil Mechanics and foundations, Laxmi Publishers, 2017
3. Murthy V N S P., Geotechnical Engineering, UBS punlishers, 2019
4. Fratta, Aguettant, Smith – Introduction to Soil Mechanics Laboratory Testing, CRC Press, 2007
5. Som, N.N. and Das, S.C., “Theory and Practice of Foundation Design”,Prentice-Hall.
6. Peck, R.B., Hanson, W.E. and Thornburn, T.H., “Foundation Engineering”,John Wiley
7. Couduto, Donald P., “Geotechnical Engineering – Principles and Practices”, Prentice Hall.
8. Arora K.R., Soil Mechanics and Foundation Engineering, PHI publishers, 2016.
9. Das M. B., Fundamentals of Geotechnical Engineering, Cengage learning, 2010.

Course Category	CEL DC 304				Water Resource Engineering			Pre-Requisites	Fluid Mechanics
	L_T_P				Theory				
DCC	L	T	P/S	C	Quiz	Assignment	Mid Sem	Major	TOTAL
	3	0	0	3	20	20	20	40	100

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. understanding water resources and hydrological principles.
2. familiarity with irrigation systems and water requirements for crops.
3. competence in reservoir planning and dam design.
4. design and analyze diversion head work and spillways.

COURSE CONTENTS

Unit-I	Engineering Hydrology	10 Contact Periods

Importance of water & water resource engineering, surface & ground water resources, water Resources of World and India. Necessity for Conservation and Development of Country's Water Resources. Different uses of Water Resources. Engineering Hydrology: Definition and its importance, Hydrological Cycle, Hydrologic equation, Precipitation: Forms, Types, Factors affecting, Measurement, Rain gauge Network, Estimation of Missing data, Consistency of data, Mean Areal Precipitation, Brief introduction of Intensity-duration Frequency relationship and Artificial rain.

Unit-II	Irrigation Engineering	10 Contact Periods

Irrigation Engineering: Necessity and advantages of irrigation, suitability of soils for different crops, standards for irrigation water. Minor Irrigation Works: Necessity and general layout of Bandhara and percolation Tank, Crop Water Requirements: Principal Indian crop seasons and water requirements for different crops, Duty and Delta, Consumptive use of water and its estimation, Irrigation efficiency.

Unit-III	Reservoir Planning and Dams	10 Contact Periods

Reservoir Planning: Investigation, selection of site, control levels, Reservoir Sedimmentation, Reservoir Capacity, Calculation of life Reservoir. Dams: Different types and their suitability-factors governing the selection of types of dam for project Earth Dams: Types of dams, causes of failure seepage and drainage arrangement, phreatic line, stability analysis, seepage control measures, Gravity Dams: Types of dams forces acting, modes of failure; principles of design of straight gravity dams, Elementary and practical profile, Galleries, Earthquake and its effect on dams.

Unit-IV	Diversion Head Works and spillways	8 Contact Periods

Diversion Head Works: - Selection of site and layout, components of diversion head works, design of weirs on permeable foundation, construction details of Kolhapur type weirs. Spillways: Types of spillways, spillway capacity, Flood routing through spillways, types of crest gates.

SUGGESTED BOOKS

1) Water Resource Engineering by Linsley.
2) Economics of Water Resource Planning by James & Lee.
3) A Textbook of Hydrology & Water Resources by Sharma, R.K.
4) Water Resource Project Planning by Kuiper.
5) Punmia: Irrigation & Water Power Engg.
6) Garg S.K.: Irrigation & Waterpower Engg.

Course Category	CEP DC 304			Water Resource Engineering Lab			Pre-Requisites	Nil
	L_T_P			Practical/Lab				
DCC	L	T	P/S	C	File	Lab	Viva	TOTAL
	0	0	2	1	30	40	30	100

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. understanding Water Resources and Hydrological Principles.
2. familiarity with Irrigation Systems and Water Requirements for Crops.
3. competence in Reservoir Planning and Dam Design.
4. design and Analysis of Diversion Head Works and Spillways.

LIST OF EXPERIMENTS

1. Flow measurement through open channel by Ogee Weir.
2. Flow measurement through open channel by Rectangular Weir.
3. Cross section, plan, L-section of Earth dam showing all components; details of drainage of downstream casing.
4. Design and Drawing of elementary and practical profile of gravity dam.
5. Design and drawing of diversion weir on permeable foundation.
6. Computer Aided design of unlined and lined canal.
7. Drawing of any four canal structure (No design).
8. Field visit to any water reservoir system.

Note: Any **six to eight** practical mentioned above shall be performed by each student.

SUGGESTED BOOKS

1. Water Resource Engineering by Linsley.
2. Economics of Water Resource Planning by James & Lee.
3. A Textbook of Hydrology & Water Resources by Sharma, R.K.
4. Water Resource Project Planning by Kuiper.
5. Punmia: Irrigation & Water Power Engg.
6. Garg S.K.: Irrigation & Waterpower Engg.

Seventh Semester, Fourth Year

Course Category	CEL DC 401			Design of Steel Structures				Pre-Requisites	NIL
	L_T_P			Theory					
DCC	L	T	P/S	C	Quiz	Assignment	Mid Sem	Major	TOTAL
	3	0	0	3	20	20	20	40	100

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. analyze and design the bolted and welded connections.
2. design the rolled and built-up tension & compression members.
3. design the laterally supported & unsupported flexural members including plate girders.
4. analyze the structures by plastic analysis.

COURSE CONTENTS

Unit-I	**Introduction and Simple Connections**	(10 Contact Periods)

Introduction to structural steel and its design philosophies. Properties of steel and rolled sections.

Simple Connections: Design of riveted, bolted connections, welded connections: concentric and eccentric connections, load transfer mechanisms, failure of joints, prying action, selection of fasteners.

Unit-II	**Tension & Compression members**	(10 Contact Periods)

Tension Members - Types & design of tension members; rolled and built-up sections, types of failures, lug angles, and gusset plates. Compression Members - Effective length, slenderness ratio & types of buckling, design of compression members; Rolled and Built-up sections. Design of column bases.

Unit-III	**Design of Flexural Members**	(15 Contact Periods)

Beams - Behaviour of beams in flexure, classification of sections, lateral torsional buckling, and shear strength of beams. Design of flexural member, laterally supported, laterally unsupported and built-up beams. Design of gantry girder.

Plate Girders: Design of plate girders, stiffeners, splices, curtailment of flange and web plates.

Unit-IV	**Plastic Analysis**	(7 Contact Periods)

Elementary Plastic Analysis and Design: Introduction, Scope of plastic analysis, ultimate load carrying capacity of tension members and compression members, flexural members, shape factor, mechanisms, plastic collapse, plastic analysis and design of simple portal frames.

SUGGESTED BOOKS

1. Subramanian, N. “Design of Steel Structures – Limit States Method”, Oxford University Press.
2. Duggal, S. K. “Design of Steel Structures”, Tata McGraw Hill.

Course Category	CEP DC 401			Design of Steel Structures Lab			Pre-Requisites	Nil
	L_T_P			Practical/Lab				
DCC	L	T	P/S	C	File	Lab	Viva	TOTAL
	0	0	2	1	30	40	30	100

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. Analyze and design the bolted and welded connections.
2. Design the rolled and built-up tension & compression members.
3. Design the laterally supported & unsupported flexural members including plate girders.
4. Analyze the structures by plastic analysis.

LIST OF EXPERIMENTS

1. Study of Structural Steel Sections and Properties (Measure and compare dimensions of various steel sections with IS 808 standards.)
2. Testing of Riveted and Bolted Joints.
3. Perform tensile and shear tests on welded joints to study fracture patterns.
4. Design a simple tension member and test its strength.
5. Study the buckling behavior of steel columns with different slenderness ratios.
6. Perform a three-point or four-point bending test on steel beams and compare experimental bending stresses with theoretical values.
7. Study the behavior of plate girders under loading conditions and compare the results with any computational tool.
8. Perform plastic analysis of a steel beam or portal frame.
9. Use structural design software to analyze and design a simple steel structure.

Note: Any **six to eight** practical mentioned above shall be performed by each student.

SUGGESTED BOOKS

1. Subramanian, N. “Design of Steel Structures – Limit States Method”, Oxford University Press.
2. Duggal, S. K. “Design of Steel Structures”, Tata McGraw Hill.

Honors in Environmental Engineering

Course Category	CEL DE303			Air and Noise Pollution Control			Pre-Requisites	NIL
	L_T_P			Theory				
DEC	L	T	P/S	C	Quiz	Assignment	Mid Sem	Major	TOTAL
	3	1	0	4	20	20	20	40	100

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. understand of the nature and characteristics of air pollutants
2. understand of the concepts of air quality management
3. identify noise pollution and its impact on human health
4. understand noise elementary sound theory

COURSE CONTENTS

Unit-I	Air Pollution and its Impact	(15 Contact Periods)

Air pollutants, Sources, classification, Combustion Processes and pollutant emission, Effects on Health, vegetation, materials and atmosphere, Reactions of pollutants in the atmosphere and their effects-Smoke, smog and ozone layer disturbance, Greenhouse effect. Air sampling and pollution measurement methods, principles and instruments, Ambient air quality and emission standards, Air Act, legislation and regulations, control principles, Removal of gaseous pollutants by adsorption, absorption, reaction and other methods. Particulate emission control, settling chambers, cyclone separation, Wet collectors, fabric filters, electrostatic precipitators and other removal methods like absorption, adsorption, precipitation etc. Biological air pollution control technologies, Indoor air quality

Unit-II	Air Pollution Act and its Control Technology	(15 Contact Periods)

Air Act, legislation and regulations, control principles, Removal of gaseous pollutants by adsorption, absorption, reaction and other methods. Particulate emission control, settling chambers, cyclone separation, Wet collectors, fabric filters, electrostatic precipitators and other removal methods like absorption, adsorption, precipitation etc. Biological air pollution control technologies, Indoor air quality

Unit-III	Noise Pollution and Its effect	(15 Contact Periods)

Noise pollution: Basics of acoustics and specification of sound; sound power, sound intensity and sound pressure levels; plane, point and line sources, multiple sources; outdoor and indoor noise propagation; psychoacoustics and noise criteria.

Unit-IV	Noise Pollution and its Control	(15 Contact Periods)

Effects of noise on health, annoyance rating schemes; special noise environments: Infrasound, ultrasound, impulsive sound and sonic boom; noise standards and limit values; noise instrumentation and monitoring procedure. Noise indices. Noise control methods.

SUGGESTED BOOKS

1. Anjaneyulu, D., “Air Pollution and Control Technologies”, Allied Publishers, Mumbai, 2002.

2. Rao, C.S. Environmental Pollution Control Engineering, Wiley Eastern Ltd., New Delhi, 1996.
3. Rao M.N., and Rao H. V. N., Air Pollution Control, Tata McGraw Hill, New Delhi, 1996.
4. Heumann. W.L., “Industrial Air Pollution Control Systems”, McGraw Hill, New Yark, 1997.
5. Acoustics by Beranek
6. Industrial Noise Control & Acoustics, Barron
7. Environmental Noise Pollution – PE Cunniff, McGraw Hill, New York, 1987

Course Category	CEM DE306				Industrial Waste Water Treatment and Management			Pre-Requisites	NIL
	L_T_P				Theory				
DEC	L	T	P/S	C	Quiz	Assignment	Mid Sem	Major	TOTAL
	3	0	0	3	20	20	20	40	100

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. identify environmental standards that apply to both direct and indirect industrial discharges.
2. identify industrial waste stream characteristics from several major industrial categories
3. design, conduct experiments and the ability to analyze the waste water quality
4. design a component, system or process to meet desired needs and reduce water pollution

COURSE CONTENTS

Unit-I	Introduction	(10 Contact Periods)

Sources of wastes – Industrial and domestic – Nature and characteristics of wastewater – Industrial wastewater and environmental impacts – Regulatory requirements for treatment of industrial wastewater – Toxicity of industrial effluents and Bioassay tests – Quality and quantity of industrial wastes.

Unit-II	Industrial Pollution Prevention	(10 Contact Periods)

Prevention Vs Control of Industrial Pollution – Benefits and Barriers – Waste minimization – Source reduction – Techniques – Waste Audit – Mass balance – Evaluation of pollution prevention options – waste volume reduction – Waste strength reduction – Neutralization – Removal of suspended and colloidal solids – Removal of inorganic and dissolved solids – Disposal of sludge solids.

Unit-III	Wastewater Reuse and Residual Management	(10 Contact Periods)

Individual and common effluent treatment plants – Zero effluent discharge systems – Wastewater quality requirements for its reuse – Residuals of industrial wastewater treatment – Quantification and characteristics of Sludge – Thickening, digestion, conditioning, dewatering and sludge disposal.

Unit-IV	Case Studies	(15 Contact Periods)

Industrial manufacturing process description– Wastewater characteristics– Source reduction options and waste treatment flow sheet for Textiles, Tanneries, Pulp and paper, metal finishing, Petroleum Refining, Pharmaceuticals, Sugar and Distilleries, Food Processing, fertilizers, Thermal Power Plants and Industrial Estates

SUGGESTED BOOKS

1. Frank Woodard, Industrial Waste Treatment Handbook, Butterworth–Heinemann, 2001.
2. Rao M.N. and Datta A.K., Wastewater Treatment, Oxford and IBH Publishing Co. Pvt. Ltd.
3. Nemerow N.L., Industrial Waste Treatment, Elsevier Science & Technology Books, 2006.
4. Eckenfelder- “Industrial Water pollution Control”- McGraw hill Company, New Delhi, 2001.
5. Frank Woodard, ‘Industrial waste treatment Handbook’, Butterworth Heinemann, New Delhi, 2001.

Course Category	*CEM DE306			Industrial Waste Water Treatment and Management Lab			Pre-Requisites	Nil
	L_T_P			Practical/Lab				
DEC	L	T	P/S	C	File	Lab	Viva	TOTAL
	0	0	2	1	30	40	30	100

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. identify environmental standards that apply to both direct and indirect industrial discharges.
2. identify industrial waste stream characteristics from several major industrial categories
3. design, conduct experiments and the ability to analyze the waste water quality
4. design a component, system or process to meet desired needs and reduce water pollution

LIST OF EXPERIMENTS

1. Determination of pH
2. Determination of Acidity
3. Determination of Dissolved Oxygen
4. Determination of Alkalinity
5. Demonstration of BOD
6. Demonstration of COD
7. Bacteriological Plate count and MPN tests
8. Estimation of Sulphate
9. Estimation of Phosphate
10. Bacteriological Plate count and MPN tests

Note: Any **six to eight** practical mentioned below shall be performed by each student.

SUGGESTED BOOKS

1. Frank Woodard, Industrial Waste Treatment Handbook, Butterworth–Heinemann, 2001.
2. Rao M.N. and Datta A.K., Wastewater Treatment, Oxford and IBH Publishing Co. Pvt. Ltd.
3. Nemerow N.L., Industrial Waste Treatment, Elsevier Science & Technology Books, 2006.
4. Eckenfelder- “Industrial Water pollution Control”- McGraw hill Company, New Delhi, 2001.
5. Frank Woodard, ‘Industrial waste treatment Handbook’, Butterworth Heinemann, New Delhi, 2001.

Course Category	CEL DE313				Environmental Health and Risk Management			Pre-Requisites	NIL
	L_T_P				Theory				
DEC	L	T	P/S	C	Quiz	Assignment	Mid Sem	Major	TOTAL
	3	1	0	4	20	20	20	40	100

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. Understand different hazardous substances
2. find out if people are being exposed to hazardous substances.
3. assess and control risks that could impact air, land, water and groundwater, as well as harm caused by noise.
4. understand the importance of health benefits in research while designing environment system

COURSE CONTENTS

Unit-I	Introduction	(10 Contact Periods)

Dimensions of environmental health, Causative agents of diseases, Social factors, Urban problems – Housing and health, Economy and health, Climate and other atmospheric elements, Violence, Chronic and communicable diseases, Occupational health, Epidemiological data, Occupational health hazards, Environmental exposure and diseases, industrial toxicants, Ergonomics, Controlling stress of life

Unit-II	Assessment Environment Health	(10 Contact Periods)

Epidemiology – Out break Epidemiology – Disease control – disease prevention – morbidity and mortality – Foodborne and waterborne diseases outbreaks – Integrated Approach to Health and Sanitation.

Unit-III	Elements Of Environmental Risk Assessment	(12 Contact Periods)

Hazard identification and accounting – Fate and Behaviour of toxics and persistent substances in the environment – Receptor exposure to Environmental Contaminants – Dose Response Evaluation – Exposure Assessment – Exposure Factors, Slope Factors – Dose Response calculations and Dose Conversion Factors – Risk Characterization and consequence determination – Vulnerability assessment – Uncertainty analysis – Event tree and fault tree modelling and analysis.

Unit-IV	Tools for Risk Management	(12 Contact Periods)

Risk communication and Risk Perception – comparative risks – Risk based decision making – Risk based environmental standard setting – Design of risk management programs – Case studies on risk assessment and management programme.

SUGGESTED BOOKS

1. Cutter, S.L., Environmental Risk and Hazards, Prentice-Hall of India Pvt. Ltd., New Delhi, 1999.
2. Kofi Asante Duah, “Risk Assessment in Environmental management”, John Wiley and sons, Singapore, 1998.
3. Kasperson, J.X. and Kasperson, R.E. and Kasperson,R.E., Global Environmental Risks, V.N.University Press, New York, 2003.
4. Mark Burman, Risks and Decisions for Conservation and environmental management, Cambridge University Press. London
5. Susan L Cutter, “Environmental Risks and Hazards” Prentice Hall of India, New Delhi, 1999.

6. Joseph F Louvar and B Diane Louver, Health and Environmental Risk Analysis Fundamentals with applications, Prentice Hall, New Jersey, 1997

Course Category	CEL DE314			Environmental Impact Assessment				Pre-Requisites	NIL
	L_T_P			Theory					
DEC	L	T	P/S	C	Quiz	Assignment	Mid Sem	Major	TOTAL
	3	1	0	4	20	20	20	40	100

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. obtain knowledge of EIA
2. understand EIA's methodologies and strategies
3. assess Environmental project monitoring and review
4. understand environmental management of various projects

COURSE CONTENTS

Unit-I	Introduction	(12 Contact Periods)

EIA: Introduction and planning - Evolution of EIA, EIA at project, Regional and policy levels, EIA legislative and Environmental clearance procedures in India.

Unit-II	EIA Methodologies	(10 Contact Periods)

EIA methodologies, Screening and scoping criteria, Rapid and Comprehensive EIA , Environmental health impact assessment, Significance of public participation / hearing in EIA, Resettlement and rehabilitation issues.

Unit-III	Methodologies and Strategies	(12 Contact Periods)

EIA: Methodologies and strategies - Baseline collection of data – Significant impacts – Assessment of impacts of physical, biological and socio, economic environment, Impact prediction tools / techniques such as Adhoc method, Development of environment management plan, Post project monitoring, EIA report and EIS, Review process, EIA case studies / histories for industrial projects, water resources and irrigation projects, ports and harbours, mining, transportation and other projects sectors.

Unit-IV	Prediction and Assessment	(10 Contact Periods)

Prediction and Assessment of Impacts on the Noise Environment: Terminology, Noise Propagation from Point and Line Sources, Mitigation Measures - Case Study, Biological Impact Prediction and Assessment: Identifications, Related laws, Biological indices & Mitigation measures, Environmental management - Environmental Management plan, Disaster Management, Post project monitoring, Environmental Audit, Life cycle assessment

SUGGESTED BOOKS

1. Larry W. Canter, "Environmental Impact Assessment", Tata Mcgraw Hill Co, Singapore, 1996.
2. Munn R.E., "Environmental Impact Assessment", John Wiley & Sons, Toronto, 1979
3. Suresh K. Dhameja, "Environmental Engineering and Management", S. K. Kataria & Sons, Delhi. 2004.
4. Relevant MoEF Notifications and CPCB / GPCB Acts & Rules. New Delhi, 2006.
5. Hillary, R., Environmental Management Systems and Cleaner Production, Wiley Publishers, New York, 1997

Course Category	CEL DE401				Solid and Hazardous Waste Management			Pre-Requisites	NIL
	L_T_P				Theory				
DEC	L	T	P/S	C	Quiz	Assignment	Mid Sem	Major	TOTAL
	3	1	0	4	20	20	20	40	100

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. understanding of problems of municipal waste, biomedical waste, hazardous waste, e-waste, industrial waste etc.
2. knowledge of legal, institutional and financial aspects of management of solid wastes.
3. become aware of Environment and health impacts solid waste mismanagement
4. understand engineering, financial and technical options for waste management

COURSE CONTENTS

Unit-I	Introduction	(5 Contact Periods)

Solid waste sources – Nature and characteristics – Quantities and Qualities – Generation rates – Potential of disease – Nuisance and other problems

Unit-II	Processing Of Municipal Solid Waste	(10 Contact Periods)

Solid waste management – Functional elements of solid waste–on–site storage –Collection and separation – Containers and its location – Collection systems and its example – physical , chemical and microbiological characteristics of waste – Vehicle routing – Route balance – Transfer station – Processing – Recovery and reuse. Conveying and compacting waste – Shredding – Types of shredders – Shredders Design– Material separation – Types – Devices for material separation.

Unit-III	Hazardous Waste Management	(10 Contact Periods)

Introduction to hazardous waste – Definition – Characterization and composition – TCLP test – Storage and transportation of hazardous waste Physical, Chemical and Biological treatment of hazardous waste – Bioremediation of hazardous waste

Unit- IV	Electronic and Plastic Waste Management	(4 Contact Periods)

Introduction to Electronic Waste - Exposure pathway of pollutants emitted from Recycling of E-Waste - E-Waste Management Rules of India (2011 and 2016 Rules). Plastics – What it is? Types, Uses and Global Statistics - Plastic Waste – Sources, Production, Global and Indian Context - Plastic Waste Management Rules 2016 (India) - Impact of Plastics on Marine Life, Effect on Wildlife, Human Health and Environment - Plastic Waste Management Practices

SUGGESTED BOOKS

1. David Rimbers, Municipal Solid Waste Management: Pollution Technologies Review, Noyes Data Corporation, London. 1990.
2. Charles A. Wentz, Hazardous Waste Management, McGraw Hill, New York. 1995.
3. Tchobanoglous G., Solid Wastes: Engineering principles and Management issues, McGraw Hill Book Company, Delhi. 1977.
4. Michael D. Lagrega, Phillip L. Buckingham, Jeffrey C. Evans, Hazardous Waste Management McGraw Hill, New York. 1994
5. Gaynor W. Dawson, Basil W. Mercer, “Hazardous Waste Management” Wiley Interscience, New York. 1986
6. Solid Waste Management –CPHEEO Manual, New Delhi.

Course Category	CEL DE413				Integrated Solid Waste Management			Pre-Requisites	NIL
	L_T_P				Theory				
DEC	L	T	P/S	C	Quiz	Assignment	Mid Sem	Major	TOTAL
	3	1	0	4	20	20	20	40	100

COURSE OUTCOMES

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

1. demonstrate a comprehensive understanding of waste generation rates, waste composition, and the integrated waste management strategies for Municipal Solid Waste (MSW).
2. evaluate the technical aspects and environmental impacts of various waste management processes.
3. evaluate the technical aspects of energy generation from waste.
4. apply knowledge through the examination of case studies from smart cities.

COURSE CONTENTS

Unit-I	Introduction	(10 Contact Periods)

Solid waste sources – Nature and characteristics – Quantities and Qualities – Generation rates – Potential of disease – Nuisance and other problems , MSW Rules 2016, Swachh Bharat Mission and Smart Cities Program- Disposal of Municipal Solid Waste: Landfill, Snitary land filling – Planning – Site selection – Design

Unit-II	Integrated Solid Waste Management	(10 Contact Periods)

Processes and Composting - Energy Recovery from Municipal Solid Waste - Current Issues in Solid Waste Management and Review of MSW Management in India - Construction and Demolition (C&D) Waste Management – Overview

Unit-III	Waste to Energy	(10 Contact Periods)

Biochemical Processes and Composting and Energy Recovery from Municipal Solid Waste, C&D Waste – Regulation, Beneficial Reuse of C&D Waste Materials

Unit-VI	Case Study	(10 Contact Periods)

Current Issues in Solid Waste Management and Review of MSW Management Status in First List of 20 Smart Cities in the Country, MSW Rules 2016, Swachh Bharat Mission and Smart Cities Program

SUGGESTED BOOKS

1. William A Worrell and P. Aarne Veslind, Solid Waste Engineering, 2nd Edition (SI Edition) Cengage Learning, 2012 (ISBN-13: 978-1-4390-6217-3).
2. George Tchobanoglous, Hilary Theisen and Samuel A Vigil, Integrated Solid Waste management, Tata McGraw Hill.
3. Manual on Solid Waste Management, prepared by The Central Public Health and Environmental Engineering Organization (CPHEEO), India.
4. MSW Management Rules 2016, Govt. of India, available online at CPCB website

Course Category	CEM DE415				Advanced Water and Wastewater Treatment			Pre-Requisites	NIL
	L_T_P				Theory				
DEC	L	T	P/S	C	Quiz	Assignment	Mid Sem	Major	TOTAL
	3	0	0	3	20	20	20	40	100

COURSE OUTCOMES

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

1. understand basic concepts of water and wastewater treatment
2. understand concept of various unit operations of water treatment systems
3. understand the concept of Membrane Technology
4. understand membrane Bio Reactor in water and wastewater treatment systems.

COURSE CONTENTS

Unit-I	Introduction	(10 Contact Periods)

Overview of Advanced Waste Water Treatment Introduction, Need of Advanced Waste Water Treatment, Purpose of Advanced Waste Water Treatment. Nutrient Removal – Nitrogen & Phosphorus Nitrogen Removal: .Nitrification , Denitrification Simultaneous nitrification and denitrification Phosphorus Removal.

Unit-II	Advance Process of Treatment	(10 Contact Periods)

Adsorption Introduction, Fundamentals of adsorption, Type of adsorbents, Ion Exchange Fundamentals of Ion Exchange.

Unit-III	Introduction to Membrane Technology	(10 Contact Periods)

Membrane Filtration Membrane Process Terminology Membrane Process Classification and operation: Microfiltration, Ultrafiltration, Nano filtration, Reverse Osmosis , Electrodialysis Membrane Configurations: Plate-and-frame module , Spiral-wound module , Tubular module , Hollow-fiber module Membrane Fouling: Modes of membrane fouling , Control of membrane fouling Application of membrane processes: Microfiltration , Ultrafiltration.

Unit-IV	Membrane Bio Reactor for Wastewater Treatment	(10 Contact Periods)

Membrane Bio Reactor Introduction MBR Process Description : Membrane Bioreactor with Membrane Module Submerged in the Bioreactor, Membrane Bioreactor with Membrane Module Situated Outside the Bioreactor MBR System Features.

SUGGESTED BOOKS

1. Waste water Engineering: Treatment and Disposal by Metcalf & Eddy
2. Environmental Engineering- Peary, Rowe & Tclobaloglous
3. Membrane Systems for Wastewater Treatment –Water Environment Federation
4. Membrane Separation Processes by Kaushik

Course Category	*CEM DE415			Advanced Water and Wastewater Treatment Lab			Pre-Requisites	Nil
	L_T_P				Practical/Lab			
DEC	L	T	P/S	C	File	Lab	Viva	TOTAL
	0	0	2	1	30	40	30	100

COURSE OUTCOMES

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

1. understand basic concepts of water and wastewater treatment
2. understand concept of various unit operations of water treatment systems
3. understand the concept of Membrane Technology
4. understand membrane Bio Reactor in water and wastewater treatment systems.

LIST OF EXPERIMENTS

1. Determination of pH
2. Determination of Acidity
3. Determination of Dissolved Oxygen
4. Determination of Alkalinity
5. Demonstration of BOD
6. Demonstration of COD
7. Bacteriological Plate count and MPN tests
8. Estimation of Sulphate
9. Estimation of Phosphate
10. Bacteriological Plate count and MPN tests

Note: Any **six to eight** practical mentioned below shall be performed by each student.

SUGGESTED BOOKS

1. Waste water Engineering: Treatment and Disposal by Metcalf & Eddy
2. Environmental Engineering- Peary, Rowe & Tclobaloglous
3. Membrane Systems for Wastewater Treatment –Water Environment Federation Membrane Separation Processes by Kaushik

Honors in Structural Engineering

Course Category	CEL DE305				Advance Construction Practice			Pre-Requisites	NIL
	L_T_P				Theory				
DEC	L	T	P/S	C	Quiz	Assignment	Mid Sem	Major	TOTAL
	3	1	0	4	20	20	20	40	100

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. know the different types of formworks and scaffolding.
2. understand the various types of concrete and different method of concreting
3. knowledge about fabrication and erections of various structures.
4. know about different construction methods and practices.

COURSE CONTENTS

Unit-I	Scaffolding and Slip Forms	(8 Contact Periods)

Concrete Construction Methods, Formwork Design and Scaffolding; Slip Forms and other moving forms; Pumping of Concrete; Grouting and Mass Concreting Operations (roller compacted concrete)

Unit-II	Types of Concrete and Curing	(8 Contact Periods)

Ready-Mix Concrete; Various Methods of Handling and Placing Concrete, Accelerated curing, Hot and cold weather concreting, Under water concreting, Prestressing.

Unit-III	Composite Construction	(5 Contact Periods)

Steel and Composite Construction Methods, Fabrication and erection of structures including heavy structures, Prefab construction, Industrialized construction and Modular coordination.

Unit-IV	Special Construction Method & Bridge Construction	(8 Contact Periods)

Special Construction Methods, Construction in Marine Environments, High Rise Construction, Bridge Construction including Segmental Construction, Incremental Construction and Push Launching Techniques; Safety, Quality Measures and Reliability

SUGGESTED BOOKS

1. Neville A M and Brooks J J “Concrete Technology”, Pearson Education Asia, Singapore, 1994.
2. Neville A M “Properties of Concrete”, Pearson Education, New Delhi, 2004.
3. Peurifoy R L “Construction Planning, Equipment and Methods” McGraw Hill Ltd., New York, 2002.

Course Category	CEL DE407			Advanced Reinforced Concrete Design				Pre-Requisites	Design of Concrete Structures-I
	L_T_P			Theory					
DEC	L	T	P/S	C	Quiz	Assignment	Mid Sem	Major	TOTAL
	3	1	0	4	20	20	20	40	100

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. understand the deflection and crack criteria of RCC structures.
2. estimate the wind and seismic load on a structure
3. understand the general design considerations for fire load.
4. design the bunker and chimney.

COURSE CONTENTS

Unit-I	Deflection and Crack Width Estimation	(7 Contact Periods)

Introduction, Short-term deflection of beams and slabs, Deflection due to imposed loads, Short-term deflection of beams due to applied loads, Deflection of slabs by IS 456 and comparison with foreign codes. Factors affecting crack width in beams, Mechanisms of flexural cracking, Calculation of crack width, Simple empirical method, Estimation of crack width in beams by IS 456.

Unit-II	Seismic and Wind Design of Structures	(10 Contact Periods)

Introduction to seismic load, General principles, Factors that increase ductility, Specifications of materials for ductility, ductile detailing of beams – Requirements, Ductile detailing of columns and frame members with axial load (P) and moment (M) – Requirements.
Introduction to wind load, General principles, overview of IS 875 part III for wind load calculations.

Unit-III	Fire Resistant Design of Buildings	(10 Contact Periods)

Introduction, ISO 834 standard heating conditions, Grading or classifications, Effect of high temperature on steel and concrete, Effect of high temperatures on different types of structural members, Analytical determination of the ultimate bending moment, Capacity of reinforced concrete beams under fire.

Unit-IV	Design of Bunkers and Chimney	(10 Contact Periods)

Introduction of Bunkers and Silos, Design of rectangular bunkers, circular bunkers and silos. Introduction of chimney, Design factors, Stresses due to self weight, wind and temperature, Combinations of stresses.

SUGGESTED BOOKS

1. Reinforced Concrete Structures, P. C. Varghese, Tata McGraw Hill
2. Advanced Reinforced Concrete Structures, P. C. Varghese, Tata McGraw Hill
3. Reinforced Concrete Design, M.L. Gambhir, Macmillan India Ltd., New Delhi
4. Limit State Design of Reinforced Concrete, A.K. Jain, Nem Chand and Bros., Roorkee
5. Design of Reinforced Concrete Structures, S. Ramamrutham, Dhanpat Rai Publicating Company
6. IS 456: 2000 — Plain and reinforced concrete – Code of practice (fourth revision)
7. SP 16: 1980 — Design Aids (for Reinforced Concrete) to IS 456: 1978.
8. IS 875 (Parts 1-5): 1987 — Code of practice for design loads (other than earthquake) for buildings and structures (second revision

School Elective Course - 2

Course Category	CEL DE 307				Advanced Structural Analysis			Pre-Requisites	Structural Analysis-II
	L_T_P				Theory				
DEC	L	T	P/S	C	Quiz	Assignment	Mid Sem	Major	TOTAL
	3	1	0	4	20	20	20	40	100

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. understand the concept of energy methods for solving indeterminate structures.
2. apply the concept of matrix methods to derive stiffness matrix of different members.
3. analyze the structural members using stiffness method.
4. analyze the structural members using flexibility method.

COURSE CONTENTS

Unit-I	Indeterminate Structures - Energy Methods	10 Contact Periods

Kinematic indeterminacy, energy theorem-Castigliano theorem, virtual work done, unit load method, Application to solve different indeterminate beams and frames.

Unit-II	Stiffness Matrix Method	10 Contact Periods

Matrix; vector; basic matrix operations; rank; solution of linear simultaneous equations; eigenvalues and eigenvectors. Introduction to stiffness matrix method, Development of stiffness matrices by physical approach, stiffness matrices for truss and frame elements, displacement transformation matrix, development of total stiffness matrix, analysis of simple structures, plane truss and plane frame, nodal loads and element loads, lack of fit and temperature effects.

Unit-III	Direct Stiffness Method	10 Contact Periods

Introduction, element stiffness matrix, rotation transformation matrix, transformation of displacement and load vectors and stiffness matrix, equivalent nodal forces and load vectors, assembly of stiffness matrix and load vector, determination of nodal displacement and element forces, analysis of plane truss, plane frame [with numerical examples].

Unit-IV	Flexibility Method	8 Contact Periods

Development of flexibility matrices by physical approach, Flexibility matrices for truss and frame elements, load transformation matrix, development of total flexibility matrix of the structure, analysis of simple structures, plane truss and plane frame, nodal loads and element loads, lack of fit and temperature effects.

SUGGESTED BOOKS

1. Ramumrutham, S., and Narayan, R., Theory of Structures, Dhanpat Rai Publishing Company.
2. Wang, C.K., Statically Indeterminate Structures, Mc Graw Hill
3. Pandit, G.S., Structural Analysis, CBS Publication.
4. Pandit and Gupta, Structural Analysis a Matrix Approach Tata Mc Graw Hill
5. Wang, C.K., Matrix methods of structural analysis, International Textbook Company.
6. Weaver and Gere, Matrix Analysis of Framed structures, CBS Publishers.

Course Category	CEL DE 309			Engineering Geology				Pre-Requisites	NIL
	L_T_P			Theory					
DEC	L	T	P/S	C	Quiz	Assignment	Mid Sem	Major	TOTAL
	3	0	0	3	20	20	20	40	100

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. introduce the fundamental concepts of geology.
2. provide knowledge of rocks, minerals, and their engineering properties
3. develop an understanding of engineering geology in construction and underground structures,
4. explore the role of engineering geology in infrastructure and energy development.

COURSE CONTENTS

Unit-I	**Introduction to Geology and Earth's Geological Framework**	(12 Contact Periods)

Introduction to Geology, Earth as a part of solar system, Origin of earth, Age of the earth, internal structure of earth, Advances in engineering geology, significance and kinds of geo-ground, geomorphology of river valley and mountainous regions and landforms.

Unit-II	**Rocks, Minerals, and Geomechanical Properties**	(12 Contact Periods)

Mode of origin of rocks, Engineering geological properties of rocks, concept of geological strata and geomechanical classification of rock, Rock-water interaction, weathering, weathering indices, erosion, and deposition, Geological work of wind, water, glaciers, river and sea. Common rock forming minerals and their importance in Civil Engineering.

Unit-III	**Engineering Geology of Construction and Underground Structures**	(12 Contact Periods)

Geological construction materials, deleterious rocks, and cement-aggregates reactions, Engineering Geology of dams and forces acting on dams, Tunnels and methods of tunneling, treatment and anchoring of geological strata. Effect of geological structures such as folds, faults, beddings, foliations and lineation on stability of dams foundation and Tunnels, Rock-load/ground pressure, factors affecting ground pressure, method for determination of ground pressure.

Unit-IV	**Engineering Geology for Infrastructure and Energy Development**	(12 Contact Periods)

Engineering geological investigations for roads and highways, bridges and buildings foundations, Engineering Geological Natural hazards and mitigations: landslide, earthquakes and induced seismicity, Geomorphology of sea and sea shore, shoreline engineering geology, hazards and mitigation, Engineering geological aspects of geothermal energy, Coal bed methane (CBM), Gas hydrate, shale gas, Carbon Capture, Usage and Storage (CCUS).

SUGGESTED BOOKS

1. B.S. Sathya Narayaan Swami, “Engineering Geology”, Dhanpat Rai Publication
2. Parbin Singh, “Engineering and General Geology”,
3. K.M. Bangar, “Principles of Engineering Geology “,
4. Bickel, J.O., & Kuesel, T.R., “Tunnel Engineering Handbook”,
5. Fred G. Bell, “Geological Hazards: Their Assessment Avoidance and Mitigation”
6. L.M. Bangar, “A Text Book of Geology and Engineering”, Standard Publishers
7. V.D. Muthayya, “Text Book of Geology”, Oxford & IBH Publishing
8. P.K. Mukherjee, “Text Book of Geology “, The World Press Private
9. C. Kesavulur, Macmillan “Engineering Geology”.

Course Category	CEP DE 309			Engineering Geology Lab			Pre-Requisites	Nil
	L_T_P			Practical/Lab				
DEC	L	T	P/S	C	File	Lab	Viva	TOTAL
	0	0	2	1	30	40	30	100

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. introduce the fundamental concepts of geology.
2. provide knowledge of rocks, minerals, and their engineering properties by
3. develop an understanding of engineering geology in construction and underground structures,
4. explore the role of engineering geology in infrastructure and energy development.

LIST OF EXPERIMENTS

1. Identification of Rocks and Minerals
2. Determination of Specific Gravity of Rocks
3. Study of Geological Maps
4. Measurement of Dip and Strike Using Clinometer Compass
5. Study of Structural Geology Models
6. Permeability Test on Rocks
7. Slake Durability Test on Rocks
8. Engineering Properties of Rocks Using Point Load Test
9. Uniaxial Compressive Strength (UCS) Test on Rocks
10. Study of Groundwater Movement Using Darcy's Law

Note: Any **six to eight** practical mentioned below shall be performed by each student.

SUGGESTED BOOKS

1. B.S. Sathya Narayaan Swami, "Engineering Geology", Dhanpat Rai Publication
2. Parbin Singh, "Engineering and General Geology",
3. K.M. Bangar, "Principles of Engineering Geology ",
4. Bickel, J.O., & Kuesel, T.R., "Tunnel Engineering Handbook",
5. Fred G. Bell, "Geological Hazards: Their Assessment Avoidance and Mitigation"
6. L.M. Bangar, "A Text Book of Geology and Engineering", Standard Publishers
7. V.D. Muthayya, "Text Book of Geology", Oxford & IBH Publishing
8. P.K. Mukherjee, "Text Book of Geology ", The World Press Private
9. C. Kesavulur, Macmillan "Engineering Geology".

Course Category	CEL DE 311			Construction Management and Costing				Pre-Requisites	NIL
	L_T_P			Theory					
DEC	L	T	P/S	C	Quiz	Assignment	Mid Sem	Major	TOTAL
	3	1	0	4	20	20	20	40	100

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. understand modern construction practices.
2. optimize construction projects based on costs.
3. determination of quantities of items and labour requirement of civil engineering works.
4. preparation of estimate of the civil engineering works.

COURSE CONTENTS

Unit-I	Basics of Construction and Construction Project Planning	(10 Contact Periods)

Unique features of construction, construction projects- types and features, phases of a project, agencies involved and their methods of execution. Stages of project planning; Techniques of planning- Bar charts, Gantt Charts. Networks, types of precedence relationships, preparation of CPM networks: activity on link and activity on node representation, computation of float values, critical and semi critical paths, calendaring networks. PERT, determining three time estimates, analysis, slack computations, calculation of probability of completion.

Unit-II	Construction Equipment & Project Monitoring	(10 Contact Periods)

Conventional construction methods Vs Mechanized methods; Equipment for Earthmoving, Dewatering; Concrete mixing, transporting & placing; Cranes, Hoists and other equipment for lifting; Equipment for transportation of materials. Equipment Productivities.
Basics of Modern Project management systems such as Lean Construction; Use of Building Information Modelling (BIM) in project management.

Unit-III	Estimating and Valuation	(14 Contact Periods)

Introduction: Purpose of estimating and valuation, Types of estimates. Building Estimate: Main items and their unit of measurement, methods of Measurement-Methods of estimating quantities, Estimating quantities of building. Estimation of quantity of load bearing structure with single room & two rooms, Estimation of quantity single storied residential building, Estimation of quantity Different R.C.C. structures, Estimation of quantity of water supply and sanitary works, Estimation of quantity of culverts and bridges, Road estimating, Estimation of quantity of Trusses. Introduction to estimates of other Civil engineering structures.

Unit-IV	Specification	(8 Contact Periods)

Objectives and importance of specification, Specification of materials, specification of works, specification as per building classification, Language of specific writing. Tenders And Contracts: Tender notice, tender document, Contract-contractor and terms and conditions of contract, Agreement, Form of Contract, Responsibility of owner, Architect, Contractor and Engineer

SUGGESTED BOOKS

1. Varghese, P.C., "*Building Construction"*, Prentice Hall India.
2. *National Building Code,* Bureau of Indian Standards, New Delhi.
3. Chudley, R., *Construction Technology*, ELBS Publishers.
4. Peurifoy, R.L. Construction Planning, Methods and Equipment, McGraw Hill
5. Nunnally, S.W. Construction Methods and Management, Prentice Hall
6. Jha, Kumar Neeraj., Construction Project management, Theory & Practice, Pearson Education India.
7. Punmia, B.C., Khandelwal, K.K., Project Planning with PERT and CPM, Laxmi Publications, 2016.

School Elective Course - 3

Course Category	CEL DE 302				Advance Fluid Mechanics and Hydraulic Machine			Pre-Requisites	Fluid Mechanics
	L_T_P				Theory				
DEC	L	T	P/S	C	Quiz	Assignment	Mid Sem	Major	TOTAL
	3	0	0	3	20	20	20	40	100

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. understand the principles of fluid flow through pipes and open channels.
2. analyze energy losses in pipe flow and design efficient hydraulic systems.
3. study gradually and rapidly varied flow in open channels, including hydraulic jumps.
4. explore the working principles and applications of hydraulic machines, including pumps and turbines.

COURSE CONTENTS

Unit-I	Flow Through Pipes	(10 Contact Periods)

Introduction, Loss of Energy in pipes, Loss of Energy due to friction, Minor energy losses in pipes, Major energy losses in pipes, Flow through pipes in series, Flow through parallel pipes, Flow through branched pipes

Unit-II	Flow in Open Channel and Steady & Uniform Flow	(18 Contact Periods)

Introduction, difference between pipe flow and open channel flow, types of open channels, types of flows in open channel, geometric elements, velocity distribution, measurement of velocity-(pitot lube, current meter) weir & spillway

Chezy's & Manning's formula, Roughosity coefficient, uniform flow computations, hydraulically efficient section considerations for rectangular, triangular, trapezoidal, circular sections Specific energy: definition & diagram, concept of critical, sub-critical, super-critical flow.

Unit-III	Gradually and Rapidly Varied Flow	(11 Contact Periods)

Gradually Varied Flow in Open channels: Assumptions and Differential equations of GVF, Classification of Bed slopes. Rapidly Varied Flow in Open Channels: Phenomenon of Hydraulic Jump and energy Dissipation, Classification of Hydraulic Jump, Practical Uses of Hydraulic Jump.

Unit-IV	Jets & Pumps	(12 Contact Periods)

Impact of Jet Impulse momentum principle, impact of jet on Vanes-flat, curved, Hydraulic Machines, Turbines: Importance of hydro-power, classification of turbines, description, typical dimensions and working principle of turbines. Pumps: Classification, component parts, working of centrifugal pump, performance characteristics, selection of pump, common pump troubles & remedies, introduction to different types of pumps such as reciprocating, multi-stage, jet, air lift, submersible pump.

SUGGESTED BOOKS

1. Fox. R. W. and Mc-Donald. A. T., “Introduction to Fluid Mechanics”, John Wiley and Sons, Fifth Edition
2. Modi and Seth, “Fluid Mechanics and Hydraulic Machinery”, Standard Book House, Tenth Edition , 1991
3. Kumar K. L., “Fluid Mechanics”

4. Bansal R. K., “Fluid Mechanics”
5. Jain A.K, “Fluid Mechanics including Hydraulic Machines” ISBN: 978-81-7409-194-7
6. Streeter V. L., Bedford K. W. and Wylie E. B., “Fluid Dynamics”, New York, McGraw-Hill, Ninth Edition, 1998
7. Biswas G., “Introduction to Fluid Mechanics & Fluid Machines”, Tata McGraw-Hill, 2nd Edi., 2003

Course Category	CEP DE 302			Advance Fluid Mechanics and Hydraulic Machine Lab			Pre-Requisites	Nil
	L_T_P			Practical/Lab				
DEC	L	T	P/S	C	File	Lab	Viva	TOTAL
	0	0	2	1	30	40	30	100

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. understand the principles of fluid flow through pipes and open channels.
2. analyze energy losses in pipe flow and design efficient hydraulic systems.
3. study gradually and rapidly varied flow in open channels, including hydraulic jumps.
4. explore the working principles and applications of hydraulic machines, including pumps and turbines.

LISTS OF EXPERIMENTS

1. Verification of Bernoulli's theorem
2. Determination of friction factor in pipes
3. Study of minor losses in pipe flow
4. Flow measurement using a Venturimeter and Orifice meter
5. Determination of Manning's coefficient for open channel flow
6. Experimental study of specific energy and critical flow conditions
7. Observation of hydraulic jump and determination of its energy dissipation
8. Impact of jet on vanes (flat and curved surfaces)
9. Performance characteristics of a centrifugal pump
10. Efficiency and performance analysis of a hydraulic turbine

Note: Any **six to eight** practical mentioned below shall be performed by each student.

SUGGESTED BOOKS

1. Fox. R. W. and Mc-Donald. A. T., "Introduction to Fluid Mechanics", John Wiley and Sons, Fifth Edition
2. Modi and Seth, "Fluid Mechanics and Hydraulic Machinery", Standard Book House, Tenth Edition , 1991
3. Kumar K. L., "Fluid Mechanics"
4. Bansal R. K., "Fluid Mechanics"
5. Jain A.K, "Fluid Mechanics including Hydraulic Machines" ISBN: 978-81-7409-194-7
6. Streeter V. L., Bedford K. W. and Wylie E. B., "Fluid Dynamics", New York, McGraw-Hill, Ninth Edition, 1998
7. Biswas G., "Introduction to Fluid Mechanics & Fluid Machines", Tata McGraw-Hill, 2nd Edi., 2003

Course Category	CEL DE 306			Pre stressed Concrete				Pre-Requisites	Design of Concrete Structures I
	L_T_P			Theory					
DEC	L	T	P/S	C	Quiz	Assignment	Mid Sem	Major	TOTAL
	3	1	0	4	20	20	20	40	100

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. understanding of the behavior of prestressed concrete structures.
2. calculate the losses in prestress.
3. analyze and design the section for flexure and shear.
4. assess the defection and crack width in prestressed members.

COURSE CONTENTS

Unit-I	Introduction to Prestressed Concrete	8 Contact Periods

Brief history of prestressing, general principles of prestressing–pre-tensioning and post-tensioning, advantages and limitations of prestressed concrete, materials – High strength concrete and high tensile steel and their characteristics, prestressing systems and devices.

Unit-II	Losses in Prestress	8 Contact Periods

Loss of pre-stress in pre tensioned and post tensioned members due to various causes like elastic shortage of concrete, shrinkage of concrete, creep of concrete, Relaxation of steel, slip in anchorage bending of member and frictional losses.

Unit-III	Analysis Design of Members	10 Contact Periods

Analysis of sections for flexure; Elastic analysis of concrete beams pre-stressed with straight, Concentric, eccentric, bent and parabolic tendons, kern lines. Design of sections for flexure and shear.

Unit-IV	Deflection and Crack Width	8 Contact Periods

Importance of control of deflections – factors influencing deflections – short term deflections of uncracked members, prediction of long term deflections, limits of deflection, stage wise prestressing. Calculation of Crack Width- Method of calculation, Limits of crack width.

SUGGESTED BOOKS

1. Krishna Raju N., Prestressed concrete, 5th Edition, Tata McGraw Hill Company, New Delhi, 2012
2. Pandit.G. S. and Gupta. S. P., Prestressed Concrete, CBS Publishers and Distributers Pvt. Ltd, 2012
3. Rajagopalan. N, Prestressed Concrete, Narosa Publishing House, 2002.
4. Dayaratnam.P., Prestressed Concrete Structures, Oxford and IBH, 2013
5. IS1343:1980, Code of Practice for Prestressed Concrete, Bureau of Indian Standards, New Delhi, 2012.

Course Category	CEL DE 308				Airport Engineering			Pre-Requisites	Nil
	L_T_P				Theory				
DEC	L	T	P/S	C	Quiz	Assignment	Mid Sem	Major	TOTAL
	3	1	0	4	20	20	20	40	100

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. understand the classification, planning, and design principles of airport infrastructure, including runways, taxiways, and aprons.
2. develop the ability to design and analyze the geometric features of runways and taxiways, considering factors like gradients, elevations, and the wind rose diagram.
3. apply knowledge of airport terminal design, aircraft parking systems, air traffic control, and safety protocols to ensure efficient operations.
4. gain expertise in airport pavement design and maintenance, including the evaluation of load-bearing capacity, material selection, and environmental considerations.

COURSE CONTENTS

Unit-I	**Introduction to Airport Planning and Design**	(14 Contact Periods)

Classification of airports, planning, surveys, site selection for airports, runway length, patterns, orientation, wind rose diagram, width and grades of runway, taxiways and aprons, differences between highway and airport pavements, introduction to various design methods, airport drainage systems.

Unit-II	**Runway and Taxiway Design**	(10 Contact Periods)

Runway and taxiway design, factors such as elevation, temperature, gradient, runway length, geometric design aspects like width, slopes, shoulders, sight distances, wind rose diagram for runway orientation, taxiways, holding aprons, holding bays, exit taxiways, airport capacity, delay factors.

Unit-III	**Airport Facilities and Terminal Planning**	(10 Contact Periods)

Design of airport terminals, passenger facilities, support services, aircraft parking systems, aprons, hangars, air traffic control systems, navigational aids, visual aids, runway markings, lighting, signage, airport security measures, safety protocols, emergency services.

Unit-IV	**Airport Pavement Design and Maintenance**	(8 Contact Periods)

Airport pavement design, flexible and rigid pavements, load-bearing capacity, material properties, classification using Load Classification Number (LCN) and Pavement Classification Number (PCN), pavement performance evaluation, maintenance techniques, environmental considerations, noise pollution.

SUGGESTED BOOKS

1. Airport Planning & Management by Seth Young and Alexander Wells, McGraw-Hill Education, 2011.
2. Introduction to Airport Engineering and Management by Norman J. Ashford, H. P. Wright, and Saleh Mumayiz, Pearson Education, 2011.
3. Airport Design and Operation by Antonin Kazda and Robert C. Caves, Elsevier, 2015.

School Elective Course – 4

Course Category	CEL DE312			Advanced Concrete Technology				Pre-Requisites	Concrete Technology
	L_T_P			Theory					
DEC	L	T	P/S	C	Quiz	Assignment	Mid Sem	Major	TOTAL
	3	0	0	3	20	20	20	40	100

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. understand the properties of fresh and hardened concrete.
2. apply the basic concepts to develop special concrete.
3. analyze and durability aspect of the concrete.
4. assess the strength of concrete using different non-destructive tests.

COURSE CONTENTS

Unit-I	Introduction to Concrete Technology	8 Contact Periods

Properties of Fresh and hardened concrete and quality control in concrete construction. physical and chemical aspects of cement hydration, type and morphology of hydrates. Rheological behavior of fresh Concrete – Fresh and hardened concrete properties. Modern trends in concrete manufacture and placement techniques, Methods of transportation, placing and curing. Sustainability- Recycling of concrete.

Unit-II	Special Concrete	10 Contact Periods

Light weight aggregate concrete – Cellular concrete – No fines concrete– High Strength concrete – Fibre reinforced concrete – Different types of fibres – Factors affecting properties of F.R.C, Polymer concrete – Types of Polymer concrete – Properties of polymer concrete, High performance concrete, Self-Compacting concrete, Hot weather concrete, Cold weather concrete, under water concreting, Geopolymer concrete, self healing concrete.

Unit-III	Durability of Concrete	10 Contact Periods

Modulus of elasticity – Dynamic modulus of elasticity – Poisson's ratio – Creep of concrete – Factors influencing creep – Relation between creep & time – Nature of creep – Effects of creep – Shrinkage –types of shrinkage. Deterioration processes – Physical, Chemical, Environmental & Biological; Measures for ensuring durability, Corrosion of reinforcing steel, protective measures. Durability issues in concretes –carbonation sulphate attack – chloride attack – permeability, Acid attack – Seawater attack, freezing and thawing, etc.

Unit-IV	Non-destructive Testing	10 Contact Periods

Non-destructive testing - Analysis of concrete members using rebound hammer, ultrasonic pulse velocity meter. Identification of reinforcement using rebar locator. Introduction to visual optical method, Magnetic particle testing, Eddy current testing, Acoustic emission testing, and Radiography.

SUGGESTED BOOKS

1. A. M. Neville, Properties of Concrete, ELBS publications.
2. M. S. Shetty, Concrete Technology, S. Chand & Co.
3. A. R. Santhakumar, Concrete Technology, 2nd Edition, Oxford University Press.
4. M. L. Gambhir, Concrete Technology, Tata Mc. Graw Hill Publishers, New Delhi
5. Siddique, R., "Special Structural Concretes", Galgotia Publications Pvt. Ltd., New Delhi, India, 2000.

Course Category	CEP DE312			Advanced Concrete Technology lab			Pre-Requisites	Nil
	L_T_P			Practical/Lab				
DEC	L	T	P/S	C	File	Lab	Viva	TOTAL
	0	0	2	1	30	40	30	100

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. Understand the properties of fresh and hardened concrete.
2. Apply the basic concepts to develop special concrete.
3. Analyze and durability aspect of the concrete.
4. Assess the strength of concrete using different non-destructive tests.

LIST OF EXPERIMENTS

1. Rebound hammer test
2. Ultrasonic pulse velocity meter
3. Use Rebar locator for identifying the size and location of rebar in concrete structure.
4. To check the permeability of concrete.
5. To check the strength of the concrete sample subjected to acid attack.
6. Compressive strength of light weight concrete.
7. Compressive strength of geopolymer concrete.
8. Compressive and flexural strength of fibre reinforced concrete.
9. Workability of self compacting concrete using different methods.
10. Mix design of concrete using recycled aggregates.

Note: Any **six to eight** practical mentioned below shall be performed by each student.

SUGGESTED BOOKS

1. A. M. Neville, Properties of Concrete, ELBS publications.
2. M. S. Shetty, Concrete Technology, S. Chand & Co.
3. A. R. Santhakumar, Concrete Technology, 2nd Edition, Oxford University Press.
4. M. L. Gambhir, Concrete Technology, Tata Mc. Graw Hill Publishers, New Delhi
5. Siddique, R., “Special Structural Concretes”, Galgotia Publications Pvt. Ltd., New Delhi, India, 2000.

Course Category	CEL DE314				Railway Engineering			Pre-Requisites	Nil
	L_T_P				Theory				
DEC	L	T	P/S	C	Quiz	Assignment	Mid Sem	Major	TOTAL
	3	1	0	4	20	20	20	40	100

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. explain the historical development, advantages, and limitations of different railway systems, along with track alignment requirements, components, and permanent way concepts.
2. apply principles of geometrical design to railway tracks, including gradient, superelevation, transition curves, and track design for high-speed trains.
3. analyse track maintenance and rehabilitation techniques, including turnout design, automated maintenance, signalling, and interlocking systems.
4. evaluate various resistances, hauling capacity, tractive effort, locomotive classification, and stresses in track components for efficient railway operations.

COURSE CONTENTS

Unit-I	Introduction	(14 Contact Periods)

Historical development of Indian Railway, Advantages and limitation of different types rail systems, Railway track alignment- Basic requirements, Factors, Engineering surveys for track alignment, Permanent way- Typical cross-section, requirements, Concept of gauges, coning of wheels, Rails–Functions, Requirements, Types of rail sections, Creeps and kinks, Sleepers – Functions, Requirements, types, sleeper density, Ballast – Functions, Materials, Ballast less Tracks. Track fitting and fastenings.

Unit-II	Geometrical Design of Railway Tracks	(10 Contact Periods)

Gradients, Grade compensation, speed of train, Superelevation, Cant deficiency Horizontal/Vertical curves- Necessity, Transition curves, Design of transition curve. Widening of gauges in curves, Design of tracks for high speeds: Geometrical requirements, Challenges

Unit-III	Track Maintenance and Rehabilitation	(10 Contact Periods)

Points and Crossings - Design of turnouts, working principles, Automated maintenance and upgrading. Signaling and Interlocking: Signaling, Interlocking and track circuiting- Construction and maintenance.

Unit-IV	Resistance and Stresses	(8 Contact Periods)

Various resistances and their evaluation, hauling capacity, tractive effort, locomotives and their classification, stresses in the track and its components.

SUGGESTED BOOKS

1. Chandra, Satish and Agarwal, M. M.**,** "Railway Engineering"**,** Oxford University Press, New Delhi.
2. Arora, S. P. and Saxena, S. C, "A Textbook on Railway Engineering", Dhanpat Rai Publications (P) Ltd., New Delhi.
3. Mundrey, J. S., "Railway Track Engineering", Tata McGraw-Hill Publishing Company, New Delhi.

Course Category	CEL DE316				Rock Mechanics & Tunneling Technology			Pre-Requisites	Nil
	L_T_P				Theory				
DEC	L	T	P/S	C	Quiz	Assignment	Mid Sem	Major	TOTAL
	3	0	0	3	20	20	20	40	100

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. develop an understanding of the fundamental principles of rock mechanics and its applications in engineering.
2. impart knowledge of tunneling methods, underground excavation techniques, and their practical implications.
3. analyze various excavation techniques, including drilling, blasting, and mechanized tunneling.
4. introduce tunnel support systems, ground treatment methods, and safety considerations in tunneling projects.

COURSE CONTENTS

Unit-I	Introduction to Rock Mechanics	(12 Contact Periods)

Determination of physical properties of rocks, failure criterion, rock mass classification, stress around mine openings, strain and displacement of the rock mass, rock reinforcement and support, subsidence. Sub surface investigations in rocks and engineering characteristics or rocks masses. Classification of rocks, Field & laboratory tests on rocks, Stress deformation of rocks, Failure theories and sheer strength of rocks, bearing capacity of rocks.

Unit-II	Fundamentals of Tunneling and Underground Excavations	(10 Contact Periods)

Scope and Application of Tunneling, Historical Developments in Tunneling, Art of Tunneling and Tunnel Engineering, Future Considerations in Tunneling, Types of Underground Excavations Tunnel, adit, decline, shaft, Parameters influencing location, shape, and size. Geological aspects in tunnel planning, Site investigations for tunneling.

Unit-III	Tunneling Methods and Excavation Techniques	(12 Contact Periods)

Tunneling Methods: Types and purpose of tunnels, Factors affecting the choice of excavation technique, Soft ground tunneling, hard rock tunneling, Shallow and deep tunneling methods, Cut and cover, cover and cut techniques, Pipe jacking, jacked box excavation, Muck disposal, support systems, and remedial measures; Tunneling by Drilling and Blasting: Unit operations in conventional tunneling, Drilling principles, equipment, tools, drill selection, Rock drillability factors, Blasting mechanics, explosives, initiators, blast hole nomenclature, Blast design, tunnel blast performance, influencing parameters; Tunneling by Mechanized Methods: Road headers and impact hammers – cutting principles, selection, performance, and limitations Tunnel Boring Machines (TBM) – boring principles, excavation methods, applications, and constraints.

Unit-IV	Tunnel Support, Ground Treatment, and Safety Considerations	(10 Contact Periods)

Tunnel Support Systems: Principal types of supports and their applicability; Ground Treatment in Tunneling: Adverse ground conditions and effects on tunneling, Introduction to ground control measures; Tunnel Services: Ventilation, drainage, and pumping systems; Shaft Sinking Methods: Vertical and inclined shafts, Decline methods, shaft/raise boring machines; Tunneling Hazards and Safety Measures: Explosions, flooding, chimney formation, squeezing ground

SUGGESTED BOOKS

1. Engineering Rock Mechanics: An Introduction to the Principles by J. A. Hudson and J. P. Harrison
2. Rock Mechanics: For Underground Mining by Barry H.G. Brady
3. fundamentals of rock mechanics, 4th edition, John Conrad Jaeger, Neville G. W. Cook, Robert Zimmerman
4. Rock mass classification, by Bhawani Singh and R.K. Goel
5. Introduction to rock mechanics by Richard E. Goodman
6. Tunnel Engineering by Subhash C Saxena

Course Category	CEP DE316			Rock Mechanics & Tunneling Technology Lab			Pre-Requisites	Nil
	L_T_P			Practical/Lab				
DEC	L	T	P/S	C	File	Lab	Viva	TOTAL
	0	0	2	1	30	40	30	100

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. develop an understanding of the fundamental principles of rock mechanics and its applications in engineering.
2. impart knowledge of tunneling methods, underground excavation techniques, and their practical implications.
3. analyze various excavation techniques, including drilling, blasting, and mechanized tunneling.
4. introduce tunnel support systems, ground treatment methods, and safety considerations in tunneling projects.

LISTS OF EXPERIMENTS

1. Determination of Physical Properties of Rocks – Density, porosity, and water absorption.
2. Uniaxial Compressive Strength (UCS) Test – Determination of rock strength under compression.
3. Brazilian Tensile Strength Test – Indirect determination of tensile strength of rocks.
4. Point Load Strength Test – Assessing the strength of rock samples in the field.
5. Shear Strength Test on Rock Samples – Direct shear test to determine cohesion and friction angle.
6. Slake Durability Test – Assessing the weathering resistance of rock.
7. Determination of Rock Mass Classification – Using RMR (Rock Mass Rating) and Q-System.
8. Model Experiment on Drilling and Blasting Techniques – Understanding drilling patterns and blast design.
9. Tunnel Stability Analysis using Numerical or Physical Models – Simulation-based or scaled model studies.
10. Assessment of Tunnel Support Systems – Demonstrating different types of rock reinforcement and support mechanisms.

Note: Any **six to eight** practical mentioned below shall be performed by each student.

SUGGESTED BOOKS

1. Engineering Rock Mechanics: An Introduction to the Principles by J. A. Hudson and J. P. Harrison
2. Rock Mechanics: For Underground Mining by Barry H.G. Brady
3. fundamentals of rock mechanics, 4th edition, John Conrad Jaeger, Neville G. W. Cook, Robert Zimmerman
4. Rock mass classification, by Bhawani Singh and R.K. Goel
5. Introduction to rock mechanics by Richard E. Goodman
6. Tunnel Engineering by Subhash C Saxena.

School Elective Course -5

Course Category	CEL DE403				Earthquake Resistant Design			Pre-Requisites	Nil
	L_T_P				Theory				
DEC	L	T	P/S	C	Quiz	Assignment	Mid Sem	Major	TOTAL
	3	1	0	4	20	20	20	40	100

COURSE OUTCOMES

On completion of the course students will be able to:

1. understand the engineering seismology including causes and effects of earthquakes.
2. solve the equation of motion for undamped/damped vibrations for free/forced vibrations.
3. analyze the different code provisions for building irregularities.
4. evaluate the seismic forces on buildings using static and dynamic methods of analysis.

COURSE CONTENTS

Unit-I	**Seismology**	(7 Contact Periods)

Engineering Seismology – Earthquake phenomenon – Causes and effects of earthquakes – Faults – Structure of earth, Plate tectonics, Elastic Rebound theory, Earthquake terminology – Source, Focus, Epicenter, etc. Earthquake size – Magnitude and intensity of earthquakes, Classification of earthquakes, Seismic waves, Seismic zones, Seismic zoning map of India, Seismograms and Accelerograms.

Unit-II	**Structural Dynamics**	(11 Contact Periods)

Theory of vibrations – Lumped mass and continuous mass systems, Single Degree of Freedom Systems, Formulation of equations of motion – Undamped and damped free vibration, Damping, Response to harmonic excitation, Response to damped forced vibrations. Determination of natural frequencies of vibration and mode shapes. Orthogonal properties of normal modes, Mode superposition method of obtaining response

Unit-III	**Code Provisions**	(10 Contact Periods)

Review of the latest Indian seismic code IS:1893 – 2016 (Part-I) provisions for buildings. Earthquake design philosophy – Assumptions. Code detailing provisions-IS:13920 provisions for ductile detailing in R.C buildings – Beam, column and joints.

Aseismic Planning - Plan irregularity, Torsion irregularities, Re-entrant corners, Nonparallel systems, Diaphragm discontinuity, Vertical discontinuities in load path, Irregularity in strength and stiffness, Mass irregularities, Vertical geometric irregularity, Proximity of adjacent buildings.

Unit-IV	**Earthquake Engineering**	(10 Contact Periods)

General principles and design criteria – Assumptions, Design Acceleration spectrum, Horizontal seismic coefficient, Design acceleration, Importance factor, Response reduction factor, Design lateral force, Design imposed loads for earthquake, calculation of seismic weight, Analysis by Equivalent Static Method and Dynamic Method (Response Spectrum Method), Storey drift limitation.

SUGGESTED BOOKS

1. A.K. Chopra, 'Dynamics of Structures', Pearson Education, Indian Branch, Delhi.
2. Clough & Penzien, Dynamics of Structures', International Edition, McGraw Hill.
3. Pankaj Agarwal & Manish Shrikhande, 'Earthquake Resistant Design of Structures', Prentice Hall of India, New Delhi.

4. S. K. Duggal, “Earthquake Resistant Design of Structures”, Oxford University Press, 1st Edition, 2012.
5. IS 1893 (Part 1): 2016, Indian Standard “Criteria for Earthquake Resistant Design of Structures, Part 1, General provisions and Buildings, Bureau of Indian Standard, New Delhi.
6. IS 13920: 2016 Indian Standard “Ductile Design and Detailing of Reinforced Concrete Structures, subjected to Seismic forces - Code of Practice, Bureau of Indian Standard, New Delhi.
7. IITK-BMTPC, Earthquake Tips “Learning Earthquake Design and Construction” by C. V. R. Murthy, Building Material and Technology Promotion Council, India.

Course Category	CEL DE405				Bridge Engineering			Pre-Requisites	Nil
	L_T_P				Theory				
DEC	L	T	P/S	C	Quiz	Assignment	Mid Sem	Major	TOTAL
	3	1	0	4	20	20	20	40	100

COURSE OUTCOMES

On completion of the course students will be able to:

1. demonstrate fundamental knowledge of the types of bridges, design of bridges, and evaluation of design forces.
2. design of various types of bridge decks.
3. design of steel truss bridges.
4. design of plate girder bridge and composite decks.

COURSE CONTENTS

Unit-I	Introduction	(10 Contact Periods)

Historical evolution of bridges; Types of bridges; Modern trends in bridge engineering. *Bridge loading standards*: Evolution of bridge loading standards; Indian Roads Congress (IRC) bridge loading standards; Impact factors.
Influence line diagrams: Use of influence line diagrams to calculate the effect of IRC standard moving loads on the truss bridge elements and plate girder bridges; Evaluation of design forces, moment, etc. in bridges.

Unit-II	Concrete Slab Bridges (Culverts)	(8 Contact Periods)

Effective width method; Grillage analogy for standard IRC loads; Analysis of RC slabs using Pigaurd's Curves subjected to standard IRC loads; Design of slab decks based on Ultimate limit state and Serviceability limit state.

Unit-III	Steel Truss Bridges	(10 Contact Periods)

General features of steel trussed bridges; Various types of truss bridges; Analysis of truss bridges subjected standard IRC loads; Design specifications; Design of steel truss bridges elements.

Unit-IV	Plate Girder Bridges and Composite Decks	(15 Contact Periods)

Introduction to plate girder bridges; General features of plate girder bridges; Non-composite plate girder bridges and design specifications. Composite plate girder bridges and design principles.

SUGGESTED BOOKS

1. Johnson, D.V., 2017. Essentials of bridge engineering. Oxford and IBH Publishing.
2. Krishna R.N., 2019. Design of Bridges. Oxford & IBH Publishing Co. Pvt. Ltd.
3. Rajgopal, N., 2006. Bridge Superstructure. Narosa Publishing House.
4. Frýba, L., 1996. Dynamics of railway bridges. Thomas Telford Publishing.

Course Category	CEL DE407			Advance Foundation Engineering				Pre-Requisites	Foundation Engineering
	L_T_P			Theory					
DEC	L	T	P/S	C	Quiz	Assignment	Mid Sem	Major	TOTAL
	3	1	0	4	20	20	20	40	100

COURSE OUTCOMES

On completion of the course students will be able to:

1. understand the advanced concepts of shallow and deep foundations, including bearing capacity and settlement analysis.
2. analyze various types of deep foundations, including piles and well foundations, with their design methodologies.
3. evaluate pile behavior under different loading conditions and interpret results from in-situ tests.
4. assess construction procedures, stability, and challenges associated with well foundations.

COURSE CONTENTS

Unit-I	Shallow Foundations: Bearing Capacity and Settlement	(8 Contact Periods)

Theoretical and empirical approaches to bearing capacity estimation for complex soil conditions; Nonlinear and probabilistic approaches to settlement analysis; Advanced methods for allowable bearing pressure determination using penetration test data (SPT, CPT); Raft foundations and combined footings; Problems of excavations. Soil-structure interaction effects in shallow foundations; Consolidation settlement analysis using finite element modeling (FEM)

Unit-II	Deep Foundations: Piles and Raft Foundations	(10 Contact Periods)

Advanced pile foundation concepts: Pile behavior in multilayered soils, Under-reamed piles and their applications, Pile-soil interaction and lateral load considerations; Dynamic and cyclic loading effects on pile performance; Excavation challenges: Retaining structures, dewatering, and soil stabilization, Uplift resistance of piles: Design of straight-shaft and under-reamed piles for tension loads, Load tests and interpretation: Static and dynamic pile load testing, Osterberg cell test, Pile group behavior: Group efficiency factors,Negative skin friction and its mitigation, Settlement analysis using Skempton's and Meyerhof's methods; Innovative pile foundation techniques, Drilled shafts with enlarged bases; Micropiles and helical piles in urban construction.

Unit-III	Well Foundations: Construction, Stability, and Challenges	(8 Contact Periods)

Advanced well foundation design principles: Thickness optimization of well steining for sinking, Grip length estimation based on geotechnical conditions; Construction methodologies: Sinking techniques and self-weight considerations, Special methods for handling obstructions and soil variations; Stability analysis of well foundations: Terzaghi's lateral stability approach, Analysis of tilts and shifts: Causes, permissible limits, and rectification techniques, Impact of scour and seismic forces on well foundations, Case studies on deep foundation failures and mitigation strategies

Unit-III	Soil Dynamics	(10 Contact Periods)

Fundamentals of Soil Behavior under Dynamic Loads; Types of Dynamic Loads: Machine loads, traffic loads, seismic loads; Dynamic Properties of Soils: Elastic modulus, damping ratio, shear modulus; Wave Propagation in Soils: Types of waves, stress-strain behavior; Measurement of shear modulus and damping ratio; Resonant column test, cyclic triaxial test,

and block vibration test; Factors affecting dynamic soil properties; Field testing methods: Standard Penetration Test (SPT), Seismic Cone Penetration Test (SCPT)

SUGGESTED BOOKS

1. Murthy, V.N. S. Advanced Foundation Engineering, CBS Publishers, New Delhi, 2007
2. Ranjan G. and A. S. R. Rao, Basic and Applied Soil Mechanics, New Age International, 2002
3. Gulhati, S. K. and Datta, M. Geotechnical Engineering, Tata McGraw Hill Education, 2005
4. Tomlinson, M. J. and Booman, R. Foundation Design and Construction, Prentice Hall Publishing, 2001.
5. Tomlinson, M. J. and Woodwrd, J. Pile Design and Construction Practice. CRS Press, 2015.
6. Kurien, N. P. Design of foundation systems: principles and practices. Alpha Science International, 2005
7. Das, B. M., & Ramana, G. V. (2019). *Principles of Soil Dynamics* (3rd ed.). Cengage Learning.

School Elective Course -6

Course Category	CEL DE411				Structural Dynamics			Pre-Requisites	Nil
	L_T_P				Theory				
DEC	L	T	P/S	C	Quiz	Assignment	Mid Sem	Major	TOTAL
	3	1	0	4	20	20	20	40	100

COURSE OUTCOMES

On completion of the course students will be able to:

1. understand the concept of structural dynamics.
2. solve the SDOF system with forced vibrations.
3. solve the MDOF system.
4. evaluate the performance of system with vibration control devices.

COURSE CONTENTS

Unit-I	Introduction to Structural Dynamics	(08 Contact Periods)

Sources of vibration, types of excitations, spring action and damping; Degrees of freedom; Application of Newton's laws, D'Alembert's principle, Single degree of freedom systems; Mathematical model of physical systems; Free vibrations of undamped and viscously damped systems; Coulomb damping material and radiation damping.

Unit-II	Response of Single Degree of Freedom	(10 Contact Periods)

Response of viscously undamped/damped SDOF systems to harmonic excitation; short duration impulse; unit impulse response. Response of undamped/damped system of rectangular, triangular and ramp loading; response to general dynamic excitation; Duhamel integral method. Numerical evolution of dynamic response of linear systems, Frequency domain analysis, Fast Fourier Transform

Unit-III	Response of Multi Degree of Freedom	(10 Contact Periods)

Multiple degree of Freedom system: Vibration of undamped 2 DOF systems; Response of 2 DOF to harmonic excitation, mode superposition, vibration absorber, Lagrange equation and their application to lumped parameter models of MDOF. Free vibration of MDOF systems, methods of solving eigen value problems; iteration methods. Dynamic response of MDOF systems-modal superposition method. Vibration of Continuous Systems: Free vibrations of Continuous systems-axial and transverse vibration of bars/beams. Response of continuous systems to dynamic loads. Energy Principle, Rayleigh-Ritz method.

Unit-IV	Vibration Control	(15 Contact Periods)

Classical and non-classical damping, Force transmissibility and base motion; Principle of vibration measuring instruments; base isolation technique, tunned mass damper, modeling and design specifications, Isolators with stiffness and damping control, active and passive control system.

SUGGESTED BOOKS

1. R.W. Clough and J. Penzien, Dynamics of Structures, Second edition, McGraw Hill international edition, 1993.
2. Mario Paz, Structural dynamics, CBS Publishers 1987.
3. Anil K. Chopra, Dynamics of structures: Theory and applications to earthquake engineering, PHI Ltd., 1997.
4. K. Rao, Vibration analysis and foundation dynamics, Wheeler, 1998.Johnson, D.V., 2017. Essentials of bridge engineering. Oxford and IBH Publishing.
5. Humar, J.L., Dynamics of Structures, Prentice Hall, 1990.

Course Category	CEL DE413				Dam Engineering			Pre-Requisites	Nil
	L_T_P				Theory				
DEC	L	T	P/S	C	Quiz	Assignment	Mid Sem	Major	TOTAL
	3	1	0	4	20	20	20	40	100

COURSE OUTCOMES

On completion of the course students will be able to:

1. identify and explain types of dams, their components, and basic design principles.
2. apply basic structural design and stability analysis for dam types.
3. understand hydrological and hydraulic concepts, including flood estimation and seepage.
4. assess dam safety, monitor performance, and apply basic maintenance practices.

COURSE CONTENTS

Unit-I	Introduction to Dams and Their Types	(10 Contact Periods)

Overview of Dam Engineering, What are dams and their role in civil engineering, Types of dams and their functions, Basic construction and materials used in dams, Introduction to major dam failures and their lessons, Gravity Dams: Basic concepts and applications, Embankment Dams: Design principles and materials used, Arch Dams: Design considerations and use cases, Core components of dams (reservoir, spillway, dam body), Basic function and importance of each component.

Unit-II	Basic Design and Structural Considerations	(10 Contact Periods)

Design of Dams, Basic design principles for gravity and embankment dams, Load considerations in dam design (dead load, water load, live load), Basic stability analysis: Ensuring safety and structural integrity, Common materials for dam construction (concrete, earth, and rock), Construction techniques and challenges in dam engineering, Basic Stability Concepts: Introduction to stability (sliding and overturning), Introduction to factors of safety in dam design.

Unit-III	Hydrology and Hydraulics of Dams	(10 Contact Periods)

Hydrology in Dams, Basic hydrology: Rainfall, runoff, and flood estimation, Watershed concepts and their importance in dam design, Hydraulics in Dams, Flow through the dam: Introduction to seepage and its effects, Spillways and energy dissipation structures, Basic reservoir operation concepts.

Unit-IV	Dam Safety, Monitoring, and Maintenance	(10 Contact Periods)

Dam Safety and Regulations, Introduction to safety standards for dams (IS 3370, IS 7894), Common risks and safety concerns for dam structures, Monitoring and Instrumentation, Basic methods of monitoring dams (deformation, seepage, etc.), Role of instrumentation in ensuring dam safety, Maintenance and Rehabilitation, Simple methods of dam maintenance, Common issues in dams and their solutions (seepage, cracks, etc.).

SUGGESTED BOOKS

1. S. K. Garg, "Design of Dams", Khanna Publishers, 2009. (Covers types of dams, their components, and basic construction.)
2. M. L. Ghosh, "Design of Dams: Principles and Applications", Dhanpat Rai & Sons, 2009.
   (Provides an introduction to different dam types and their functions.)
3. B. C. Punmia, "Surveying and Leveling", Laxmi Publications, 2005. (For basic design and stability analysis concepts.)

4. S. R. S. P. Rao, "Dams and Appurtenant Structures", Tata McGraw-Hill, 2004. (Details on load analysis and basic stability in dam construction.)
5. M. J. S. A. S. P. Rao, "Structural Design of Concrete Dams", CRC Press, 2015. (Focuses on the structural design principles for different dam types.)
6. Subramanya, K., "Engineering Hydrology", Tata McGraw-Hill, 2013. (Introductory text on hydrology and its role in dam design.)
7. Linsley, R. K., and Franzini, J. B., "Water Resources Engineering", McGraw-Hill, 1994.
   (Covers flood estimation and hydraulic design considerations.)
8. Kumar, A., "Dam Safety: Guidelines, Criteria, and Technology", Cambridge University Press, 2016.
   (Provides insights into safety standards and regulations in dam engineering.)
9. IS 3370 and IS 7894 – Indian Standard codes for dam safety and design. (Relevant IS standards for dam safety, monitoring, and design principles.)

Course Category	CEL DE415				High Speed Railway Engineering			Pre-Requisites	Nil
	L_T_P				Theory				
DEC	L	T	P/S	C	Quiz	Assignment	Mid Sem	Major	TOTAL
	3	1	0	4	20	20	20	40	100

COURSE OUTCOMES

On completion of the course students will be able to:

1. understand the fundamentals of high-speed rail (HSR) systems and their role in modern transportation.
2. analyze the design, construction, and operational aspects of HSR infrastructure.
3. evaluate track alignment, materials, and technologies for efficient and safe HSR operations.
4. study the environmental, economic, and safety considerations in HSR development.

COURSE CONTENTS

Unit-I	Introduction to High-Speed Rail Systems	(10 Contact Periods)

Historical development and global HSR networks; Development, engineering, design and construction of high-speed rail (HSR) passenger transport systems with particular emphasis on the unique engineering elements of HSR technology; Definition and characteristics of high-speed rail; Comparison of HSR with conventional rail and other transport modes; HSR technology and innovations.

Unit-II	High-Speed Rail Infrastructure Design	(10 Contact Periods)

Track alignment and geometric design standards; Key elements of HSR systems and subsystems including: core systems (trains, power, signal, communication and control), track system and civil infrastructure (earthwork, bridges, viaducts and tunnels). Also covered are basic design and construction of HSR stations and rolling stock maintenance facilities; Materials and construction techniques for HSR infrastructure.

Unit-III	High-Speed Train Operations and Safety	(10 Contact Periods)

Train control and signaling systems (ETCS, CBTC); Traction, braking, and aerodynamics in high-speed trains; Safety measures, risk assessment, and accident prevention; Maintenance strategies for HSR infrastructure and rolling stock.

Unit-IV	Economic, Environmental, and Future Trends in HSR	(10 Contact Periods)

Cost-benefit analysis and financial models for HSR projects; Environmental impact and sustainability of HSR; Future trends and advancements in HSR technology; Case studies of successful high-speed rail projects worldwide.

SUGGESTED BOOKS

1. Chandra, S. and Agarwal, M. M., “Railway Engineering”, Oxford. 2007
2. Arora, S. P. and Saxena, S. C., “A Text Book of Railway Engineering”, Dhanpat Rai Publications. 2004
3. Mundrey, J. S., “Railway Track Engineering”, Tata Mcgraw Hill. 2000
4. Khanna, S. K., Arora, M. G. and Jain, S. S., “Airport Planning & Design”, Nem Chand and Bros. 2000
5. Horonjeff, Robert and McKelvey, Francis X., “Planning & Design of airports’, 4th Ed., McGraw Hill. 1993
6. Saxena, S.C., “Airport Engineering – Planning and Design”, CBS Publishers. 2008.

Minor Specialization in Civil Engineering

Course Category	CEL GE302				Basic Building Construction			Pre-Requisites	Nil
	L_T_P				Theory				
GEC	L	T	P/S	C	Quiz	Assignment	Mid Sem	Major	TOTAL
	3	1	0	4	20	20	20	40	100

COURSE OUTCOMES

On completion of the course students will be able to:

1. understand the components and types of building foundation.
2. differentiate between different types of roofs, staircases and openings.
3. analyze the different components of masonry building construction
4. assess the different components of RCC building construction

COURSE CONTENTS

Unit-I	Building Foundation	10 Contact Periods

Definition of foundation, Purpose of foundation, Bearing Capacity of soil and its relevance to foundation Classification of Foundation - Shallow Foundation, Deep Foundation, Various types of foundation and its suitability, with sketches: spread footing, stepped footing, isolated and combined footing, raft foundation, grillage foundation, pile foundation (Types of piles based on Function only). Causes of failure of foundation.

Unit-II	Roof, Staircase and Openings	10 Contact Periods

Identify the various components of Flat and sloping roof, classify roofs of different types, describe the features of steel sloping roof truss, Advantages of steel truss over timber sloping roof. Identify the different components of stairs, Enlist the various materials used in the construction of stairs, Classify the different types of stairs. Explain the function of different types of openings like lintels, arches, doors, windows and ventilators, describe the types of different kinds of openings with their sketches and limitations.

Unit-III	Masonry Construction	10 Contact Periods

Brick Masonry, definition of the terms related to brick masonry- header, stretcher, bond, closer, quoins, course, face, back, hearting, joint, bat, etc. General principles to be followed in construction of brick masonry. Different types of Bonds: English Bond, Flemish Bond, Stretcher Bond, Header Bond, Racking Bond, Zigzag Bond, Garden Wall Bond. Plan and Elevation of these bonds. Comparison of English Bond with Flemish Bond. Various types of junctions in Brick Masonry. Stone Masonry - terms related to stone masonry, joints in stone masonry: Butt Joint, rebated joint, rusticated joint, dowel joint. types of stone masonry - rubble masonry: Coursed Rubble, Uncoursed Rubble, Random Rubble, Dry Rubble, Ashlar Masonry. Comparison between Brick Masonry and Stone Masonry.

Unit-IV	RCC Construction	8 Contact Periods

Main principles and advantages of RCC construction – definition, properties and advantages of RCC. Formwork: Definition of Formwork, Requirements of Formwork, Materials used in Formwork, Types of Formworks, Removal of Formwork. Building components – beams, columns, beam-column joint, slab, unreinforced masonry wall, load bearing wall, shear wall.

SUGGESTED BOOKS

1. Mackay W.B. Building Construction, Vol. I, II, III, Longmans.
2. Sushil Kumar, Building Construction, Standard Publishers Distributors.
3. Deshpande R.S. and Vartak C.V. A Treatise on Building Construction.
4. Sharma S.K. Kaul B.K., A. T.B. of Building Construction, S. Chand & Co.

5. Gurucharan Sing, Building Construction Engg., Standard Book House, Delhi-6

Course Category	CEL GE401				Basic Construction Material			Pre-Requisites	Nil
	L_T_P				Theory				
GEC	L	T	P/S	C	Quiz	Assignment	Mid Sem	Major	TOTAL
	3	1	0	4	20	20	20	40	100

COURSE OUTCOMES

On completion of the course students will be able to:

1. know the fundamental knowledge of materials.
2. understand the classification and characteristics of materials for construction.
3. understand the application of steel, aluminum, wood in construction.
4. know about cement and composite materials, polymers and plastics.

COURSE CONTENTS

Unit-I	Fundamentals of Materials	(8 Contact Periods)

Fundamentals of material structure, from atomic bonding to failure theories; structure-property relationships; general engineering properties of materials

Unit-II	Classification of Materials	(8 Contact Periods)

Classification of bricks, manufacturing of clay bricks, tests on bricks, properties of burnt bricks, Types of flooring material, Sahabad, Kotta, Granite, Ceramic tiles, plain tiles, mosaic tiles, glazed tiles, different types of floor finishes.

Unit-III	Application of steel, Aluminum, wood in construction	(5 Contact Periods)

Structure of iron and steel – phase diagrams; properties of reinforcing steel and structural steel; corrosion; properties and applications of Al and Cu, Structure of wood; processing of timber for construction; defects and deterioration of wood; properties and applications of glass

Unit-IV	Cement, Composite materials / Polymers and Plastics	(8 Contact Periods)

History of cement, manufacturing of cement, types of cement, Particulate and fibre reinforced composites; structure and behaviour of polymers and plastics.

SUGGESTED BOOKS

1. Mackay W.B., Building Construction, Vol. I, II, III, Longmans.
2. Sushilkumar, Building Construction, Standard Publishers Distributors.
3. Deshpande R.S. and Vartak C.V., A Treatise on Building Construction.
4. Sharma S.K. Kaul B.K. A. T.B., of Building Construction, S. Chand & Co.
5. Gurucharan Sing, Building Construction Engg., Standard Book House, Delhi-6
6. Punmia B.C., Building Construction.

Course Category	CEL GE402				Basic Construction Practices			Pre-Requisites	Nil
	L_T_P				Theory				
GEC	L	T	P/S	C	Quiz	Assignment	Mid Sem	Major	TOTAL
	3	1	0	4	20	20	20	40	100

COURSE OUTCOMES

On completion of the course students will be able to:

1. understanding of sub-structure and super-structure construction techniques
2. knowledge of construction equipment and technology.
3. familiarity with traditional and vernacular construction practices
4. proficiency in safety standards and management

COURSE CONTENTS

Unit-I	Sub-structure and Super-structure	10 Contact Periods

Digging and excavation of trenches–drilling and blasting techniques, pile driving techniques and sinking of wells. Concrete and reinforced concrete works, formwork – reinforcement– concreting – mechanized methods for erection of Buildings and installations. Cast-in-situ and pre-cast concrete. Concreting below ground level, underwater concreting, design of forms.

Unit-II	Erection of Construction Units	10 Contact Periods

Different types of scaffolding, Tunneling techniques, Pre-cast and prefabricated construction – need and advantages. Modular construction – I.S. recommendations for modular planning, standardization, mass production and transportation, Tunnel boring machine. Overview of earthmoving equipment, excavating equipment, compacting equipment, construction equipment, hauling equipment, conveying equipment, concrete production equipment.

Unit-III	Traditional Construction Practices	10 Contact Periods

Timber construction, adobe construction, heritage building, stone masonry, bamboo structure, random rubble masonry construction, Ashlar construction, Vernacular architecture. Traditional roof and cladding materials. Traditional construction practices in deserts and coastal areas.

Unit-IV	Safety in Construction Industry	8 Contact Periods

Introduction to Construction Industry- Safety issues in construction- Human factors in construction safety management. Roles of various groups in ensuring safety in the construction industry. Safety in various construction operations- Excavation- under- water works- under-pinning & shoring Ladders & Scaffolds- Tunneling- Blasting- Demolition- Pneumatic caissons confined Space Temporary Structures. Indian Standards on construction safety- National Building Code Provisions on construction safety. Safety in material handling and equipment- Safety in storage & stacking of construction materials.

SUGGESTED BOOKS

1. Mackay W.B. Building Construction, Vol. I, II, III, Longmans.
2. Sushil Kumar, Building Construction, Standard Publishers Distributors.
3. Gurucharan Sing, Building Construction Engg., Standard Book House, Delhi-6
4. Ilay Cooper and Barry Dawson. Traditional buildings of India, Thames and Hudson Ltd., London. 1998.
5. K. N. Vaid, Construction Safety Management.
6. National Building Code of India

Course Category	CEL GE403				Renewable Energy Technology			Pre-Requisites	Nil
	L_T_P				Theory				
GEC	L	T	P/S	C	Quiz	Assignment	Mid Sem	Major	TOTAL
	3	1	0	4	20	20	20	40	100

COURSE OUTCOMES

On completion of the course students will be able to:

1. understand the fundamentals and significance of renewable energy sources.
2. analyze the working principles and technologies of solar, wind, biomass, hydro, and geothermal energy.
3. assess the environmental and economic impacts of renewable energy systems.
4. apply engineering solutions for efficient energy harvesting, storage, and utilization.

COURSE CONTENTS

Unit-I	Introduction to Renewable Energy	(8 Contact Periods)

Overview of global and Indian energy scenarios; Need for renewable energy, classification of energy sources; Environmental impacts of conventional energy sources, Energy conservation and sustainable development.

Unit-II	Solar Energy	(10 Contact Periods)

Solar radiation principles and measurement; Photovoltaic (PV) systems: Types, components, and applications; Solar thermal energy: Collectors, solar water heating, and power generation; Solar energy storage systems and hybrid technologies.

Unit-III	Wind and Biomass Energy	(10 Contact Periods)

Wind energy: Basics, site selection, aerodynamics, wind turbine types, and power generation; Biomass energy: Biomass resources, biofuels, biogas production, and applications; Waste-to-energy conversion technologies; Case studies on wind and biomass energy utilization.

Unit-IV	Hydropower and Emerging Renewable Technologies	(10 Contact Periods)

Small and large-scale hydropower projects: Design, components, and environmental impact; Geothermal energy: Basics, applications, and advantages; Ocean energy: Tidal, wave, and OTEC (Ocean Thermal Energy Conversion); Hybrid energy systems and smart grids for renewable integration.

SUGGESTED BOOKS

1. D.P. Kothari, K.C. Singal, Rakesh Ranjan “Renewable Energy Sources and Emerging Technologies”, Publisher: PHI Learning Pvt. Ltd., Year: 2020
2. G.D. Rai “Non-Conventional Energy Sources, Publisher: Khanna Publishers”, Year: 2019
3. S.P. Sukhatme, J.K. Nayak “Solar Energy: Principles of Thermal Collection and Storag”, Publisher: McGraw Hill Education, Year: 2021
4. Godfrey Boyle “Renewable Energy: Power for a Sustainable Future”, Publisher: Oxford University Press, Year: 2017
5. John Twidell, Tony Weir “Renewable Energy Resources”, Publisher: Routledge, Year: 2021.

Course Category	CEL GE404				Watershed Management and Rainwater Harvesting			Pre-Requisites	Nil
	L_T_P				Theory				
GEC	L	T	P/S	C	Quiz	Assignment	Mid Sem	Major	TOTAL
	3	1	0	4	20	20	20	40	100

COURSE OUTCOMES

On completion of the course students will be able to:

1. understand the fundamentals of watershed hydrology and its role in water resource management.
2. analyze techniques for watershed planning, conservation, and management.
3. study rainwater harvesting methods for sustainable water supply.
4. evaluate the environmental and socio-economic impacts of watershed projects.

COURSE CONTENTS

Unit-I	Introduction to Watershed Management	(10 Contact Periods)

Watershed definition, characteristics, and classification; Hydrological cycle and watershed hydrology; Factors influencing watershed development; Watershed degradation and its impact on the environment.

Unit-II	Watershed Conservation and Management Techniques	(12 Contact Periods)

Soil and water conservation measures; Erosion control methods and land use planning; Watershed modeling and management approaches; integrated watershed management (IWM) concepts.

Unit-III	Rainwater Harvesting Techniques	(12 Contact Periods)

Principles and need for rainwater harvesting; Traditional and modern rainwater harvesting methods; Rooftop rainwater harvesting system design; Groundwater recharge techniques and structures.

Unit-IV	Socio-Economic and Environmental Aspects	(10 Contact Periods)

Community participation and policy frameworks in watershed management; Climate change impact and adaptation strategies; Economic evaluation of watershed projects; Case studies of successful watershed and rainwater harvesting projects.

SUGGESTED BOOKS

1. Garg, S.K. “Irrigation Engineering and Hydraulic Structures”; Publisher: Khanna Publishers, Year: 2020
2. Tideman, E.M. “Watershed Management: Guidelines for Indian Conditions”, Publisher: Omega Scientific Publishers, Year: 2000
3. Sharma, R.K. & Sharma, T.K. “Water Resources Engineering: Principles and Practice” Publisher: Oxford & IBH Publishing; Year: 2002
4. Agarwal, S.K. “Water Resource Engineering: Principles and Practice”, Publisher: Sudha Publications, Year: 2018
5. Rao, K.L. “India’s Water Wealth”, Publisher: Orient Blackswan,, Year: 1982.

Syllabus of VAC, AEC, and SEC as per NEP 2020

2023 Batch Onwards

Course Category	CEL VA101				Basics of Civil Engineering			Pre-Requisites	Nil
	L_T_P				Theory				
VAC	L	T	P/S	C	MI-01	MI-02	MA	ASGN	Total
	2	0	0	2	20	20	50	10	100

COURSE OUTCOMES

After completion of this course, students shall be able to:

1. understand the scope and role of Civil Engineering in development of society
2. understand the importance of surveying and defining linear and angular measurement
3. understand the basics of water and waste management
4. understand the basic concept of building components

COURSE CONTENTS

Unit-I	Introduction and Scope	(6 Contact Periods)

Introduction to Civil Engineering Introduction and scope of Civil Engineering - Role of Engineers in the infrastructure development – Various types of Civil Engineering Structures

Unit-II	Building Components	(6 Contact Periods)

Components of Buildings Selection of site - basic functions of buildings - types of buildings – Residential, Public, Commercial, and Industrial. Types of foundation and their suitability. Superstructure –Types of construction: Load Bearing - Framed, and Composite - Building Materials Introduction to basic construction materials; cement, bricks, stone, aggregates, reinforcing steel, structural glazing, structural steel; Concrete types: PCC, RCC, Prestressed, Precast and Ready-Mix Concrete. Use of various eco- friendly materials in construction

Unit-III	Survey and Transportation	(6 Contact Periods)

Surveying Various types of maps and their uses - Principles of survey. Introduction to various survey instruments – Types of different types of surveying and levelling

Transportation Engineering Role of transportation in national development; Various modes of Transportation. Classification of Highways: Expressways, NH, SH, MDR, ODR, VR; Types of Pavements, Traffic Signs, signals

Unit-IV	Water and Environment Engineering	(6 Contact Periods)

Environment and Natural Resource Management Water supply Sources, drinking water requirements, impurities in water and their effects; Purification of water, modern purification processes; Standards of purified water. Waste Management: Collection and Disposal methods of Liquid, solid and gaseous wastes. Water Resources Engineering Introduction to Hydraulic structures of storage; water conveyance systems; Watershed management: Definition, Necessity and methods; Roof top rain water harvesting and Ground water recharge

Instrumentation in Civil Engineering Structures: Various Instruments used in construction, water resources, Environmental Engineering, Foundation Engineering

Sustainable Development: Role of Engineers in Sustainable Development. Concept of green buildings

SUGGESTED BOOKS

1. Elements of Civil Engineering: By S. S. Bhavikatti

2. Basic Civil Engineering: By Dr. B. C. Punmia, Ashok Kumar Jain, Arun Kumar Jain.

3. Concrete Technology: By M.S.Shetty

4. Surveying And Levelling: By Kanetkar and Kulkarni

5. Irrigation And Hydraulic Structures: By S.K.Garg

6. Water Supply And Sanitary Engineering: Including Environmental Engineering, Water And Air Pollution Laws And Ecology:By G. S. Birdie, J. S. Birdie

7. Building Construction: By Sushil Kumar

8. Transportation Engineering: By Khanna & Justo

9. Building Drawing Design: By Shah and Kale

10. Construction Planning, Equipments And Methods:Robert Peurifoy, Clifford J. Schexnayder, Aviad Shapira and Robert Schmitt

Course Category	CEL VA102				Introduction to Numerical Methods			Pre-Requisites	Nil
	L_T_P				Theory				
VAC	L	T	P/S	C	Minor Project I	Minor Project I	Major Project	ASGN	TOTAL
	2	0	0	2	20	20	50	10	100

COURSE OUTCOMES

Students will be able to:

1. apply numerical methods to obtain approximate solutions to mathematical problems.
2. understand the difference operators and the use of interpolation.
3. understand numerical techniques to find the roots of non-linear equations and solution of system of linear equations.
4. understand numerical differentiation and integration and numerical solutions of ordinary and partial differential equations.

COURSE CONTENTS

Unit-I	Introduction to Fundamentals of Numerical Methods	(10 Contact Periods)

Introduction to fundamentals of numerical methods, Interpolation: Interpolation with equal intervals, Newton's forward difference formula, Newton's backward difference formula, interpolation with unequal intervals, Newton's divided difference formula, and Lagrange's interpolation formula, Numerical Solutions of Algebraic and Transcendental Equations: Regula-Falsi method, Newton-Raphson method, Difference equations: Linear homogeneous and non-homogeneous difference equations of order *n* with constant coefficients and their solutions.

Unit-II	Numerical Differentiation and Integration	(10 Contact Periods)

Introduction to MATLAB programming, Numerical Differentiation and Integration: Numerical differentiation of a function, differential coefficients of a function in terms of its difference, numerical integration of a function, trapezoidal rule, Sympson's rule, Weddle's rule., Numerical Solutions of Ordinary Differential Equations: Picard's method, Taylor series method, Euler's method and Runga-Kutta method, Numerical Solution of Simultaneous Equations and Eigen Value Problems: Guass elimination method, Guass-Jordan method, Guass-Jacobi and Guass-Seidel iteration methods, power methods for solving Eigen value problems.

SUGGESTED BOOKS

1. Numerical Methods by RL Burden & JD Faires.
2. An Introduction to Numerical Analysis by K. E. Atkinson.

Course Category	CEL AE102				Introduction to Disaster Management			Pre-Requisites	Nil
	L_T_P				Theory				
AEC	L	T	P/S	C	Project I	Mid Sem	Project II	Viva/ Presentation	TOTAL
	2	0	0	2	20	20	20	40	100

COURSE OUTCOMES

After completion of this course, students shall be able to:

1. understand the various types of Disasters.
2. discuss the vulnerability profile of India
3. analyse the impact of disaster on different stakeholders
4. evaluate the Relationship between Development and Disasters

COURSE CONTENTS

Unit-I	Disaster-An Overview	08 Contact periods

Introduction to natural Disasters-earthquake, flood, drought, cyclone, volcano, tsunami, landslide, coastal erosion, avalanche, thunderstorm, forest fire, tornado; types and causes; man-made disasters; introduction to hazard; vulnerability; risk; exposure; prevention; mitigation; and hazard and vulnerability profile of India.

Unit-II	Disaster Impact and Management	16 Contact periods

Types of disaster impacts-economic, social, physical, political, ecological, environmental; climate change; urban disaster; demographic aspects of disaster; mental health and psycho-social issues in disaster; trends in disasters.

Disaster management cycle-mitigation, preparedness, response, recovery; education and public awareness; role of technology in disaster management; early warning system; disaster relief; impact of media; role of different stakeholders; emergency health services; policies for disaster risk reduction.

SUGGESTED BOOKS

1. P. K. Goyal, A. K. Gupta. Disaster Management, All India Council for Technical Education, 2023.
2. Introduction to Disaster Management, Virtual University for Small States of the Commonwealth.
3. The Disaster Management Act 2005.
4. Disaster Management in India, Ministry of Home Affairs, Government of India.

Course Category	CEL SE102			Earthquake Resistant Construction Practices				Pre-Requisites	Nil
	L_T_P			Theory					
SEC	L	T	P/S	C	MI-01	MI-02	MA	ASGN	Total
	2	0	0	2	20	20	50	10	100

COURSE OUTCOMES

After completion of this course, students shall be able to:

1. differentiate regular and irregular buildings
2. apply the ductile design and detailing provisions to beam, columns and shear walls.
3. demonstrate the special confining reinforcement provisions in structural members.
4. apply the ductile design and detailing provisions to masonry structures.

COURSE CONTENTS

Unit-I	Building Configuration	08 Contact periods

Seismic zones of India – Importance factor, Introduction – Regular and Irregular Buildings. Plan Irregularities – Torsion Irregularity – Re-entrant corners - Floor slabs having excessive cut-outs or openings- Out-of-plane offsets in Vertical Elements – Non-parallel Lateral Force system. Vertical Irregularities – Vertical Geometric Irregularity – In-plane discontinuity in Vertical Elements resisting lateral force – strength Irregularity (weak storey) – Floating or stub columns.

Unit-II	Brick Masonry Construction Practices	08 Contact periods

Masonry Structures - Brick masonry structures - Stone masonry structures - Importance of lintel beams and sill beams - Importance of reinforcement bars in Masonry structures - Strengthening of the edges of the openings and provision of reinforcement at the ends of walls.

Unit-III	Framed Structures Construction Practices	08 Contact periods

Review of Latest IS: 13920 provisions General specifications – Beams – Columns – Shear walls. Special confining reinforcement. Review of Latest IS: 4326 requirements - General principles – Special Construction features relating to separations of structures (above ground only).

SUGGESTED BOOKS

1. A.K. Jain “Dynamics of Structures with Mat Lab Applications” Pearson India Education Series Pvt.Ltd., Delhi, 2016

2. Pankaj Agarwal & Manish Shrikhande, “Earthquake Resistant Design of Structures”, 5th Edition Prentice Hall of India, New Delhi, 2011.

3. S.K.Duggal, “Earthquake Resistant Design of Structures”, Oxford University Press, 1st Edition, 2012.

4. Code of practice for Brick work - IS:2212 and SP:20 Handbook on Masonry design and construction.

Course Category	CEL SE104			Geo-Environmental Engineering				Pre-Requisites	Nil
	L_T_P				Theory				
SEC	L	T	P/S	C	Class Performance	Quiz	Assignment	Major	Total
	2	0	0	2	20	20	20	40	100

COURSE OUTCOMES

After completion of this course, students shall be able to:

1. understand the fundamentals of geoenvironmental engineering and its significance in environmental protection.
2. analyze soil-water-contaminant interactions and their impact on the subsurface environment.
3. evaluate waste containment systems and their design considerations.
4. apply geotechnical principles for sustainable waste management and pollution control.

COURSE CONTENTS

Unit-I	Fundamentals of Geo-enviromental Engineering	(6 Contact Periods)

Scope of geoenvironmental engineering - multiphase behavior of soil – role of soil in geoenvironmental applications – importance of soil physics, soil chemistry, hydrogeology, biological process – sources and type of ground contamination – impact of ground contamination on geo-environment - case histories on geoenvironmental problems.

Unit-II	Soil-Water-Contaminant Interaction	(13 Contact Periods)

Soil mineralogy characterization and its significance in determining soil behavior – soil-water interaction and concepts of double layer – forces of interaction between soil particles; Concepts of unsaturated soil – importance of unsaturated soil in geoenvironmental problems - measurement of soil suction - water retention curves - water flow in saturated and unsaturated zone; Soil-water-contaminant interactions and its implications – Factors effecting retention and transport of contaminants

Unit-III	Waste Containment System	(11 Contact Periods)

Evolution of waste containment facilities and disposal practices – Site selection based on environmental impact assessment –different role of soil in waste containment – different components of waste containment system and its stability issues – property evaluation for checking soil suitability for waste containment – design of waste containment facilities.

SUGGESTED BOOKS

1. Sharma, H. D., & Lewis, S. P. "Waste Containment Systems, Waste Stabilization, and Landfills", Wiley.
2. Rowe, R. K. "Geotechnical and Geoenvironmental Engineering Handbook", Springer, Kluwer Academic Publications, London, 2000.
3. Reddi L.N. and Inyang, H. I.,"Geoenvironmental Engineering,Principles and Applications" Marcel Dekker Inc. New York, 2000.
4. Yong, R. N.,"Geoenvironmental Engineering, Contaminated Soils, Pollutant Fate, and Mitigation" CRC Press, New York, 2001.
5. Fredlund D.G. and Rahardjo, H., "Soil Mechanics for Unsaturated Soils" Wiley-Interscience, USA, 1993.
6. Mitchell, J.K.,"Fundamentals of Soil Behavior" Wiley, 2005. 7. Hillel D.,"Introduction to Environmental Soil Physics" Academic Press, New York, 2003.
7. Hillel D.,"Introduction to Soil Physics" Academic Press, New York, 1982.
8. Sparks, D.L.,"Environmental Soil Chemistry" Academic Press, New York, 2002.

9. Bagchi,A.,"Design of landfills and integrated solid waste management" John Wiley & Sons, Inc., USA, 2004.
10. Alvarez-Benedi J. and Munoz-Carpena, R.,"Soil-WaterSolute Process Characterization:An Integrated Approach" CRC Press, New York, 2005.
11. Berkowitz,B. Dror, I. and Yaron,B.,"Contaminant Geochemistry" Springer, Germany, 2008.
12. Mohamed,A. M. O.,"Principles and Applications of Time Domain Electrometry in Geoenvironmental Engineering" Taylor and Francis, New York, 2006.