Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)

DEPARTMENT OF CIVIL ENGINEERING

CURRICULUM & SYLLABUS

(Programme Core and Programme Elective)

(Regulations –VTR UGE-2021)

VISION AND MISSION OF THE INSTITUTE

Vision:

To create, translate and share frontiers of knowledge embedded with wisdom and innovation for a positive transformation of emerging society.

Mission:

To nurture excellence in teaching, learning, creativity and research; translate knowledge into practice; foster multidisciplinary research across science, medicine, engineering, technology and humanities; incubate entrepreneurship; instill integrity and honour; inculcate scholarly leadership towards global competence and growth beyond self in a serene, inclusive and free academic environment.

VISION AND MISSION OF THE DEPARTMENT

Vision:

To impart knowledge and excellence in Civil Engineering with global perspectives to the student community and to make them ethically strong engineers to build the nation.

Mission:

M1: To produce Civil Engineers of high calibre with advanced technical skills and ethical values to serve the society and the nation.

M2: To make the department as a centre of excellence in the field of Civil Engineering and allied research activities.

M3: To provide knowledge base and consultancy services to the community in all areas of Civil Engineering

M4: To promote innovative ideas which original thinking in the minds of budding Engineers to face the future challenges.

DEPARTMENT OF CIVIL ENGINEERING
B. TECH - CIVIL ENGINEERING
Programme Educational Objectives

- Provide Engineering design solutions for the real world problems in Structural, Environmental, Geotechnical, Water Resources, Remote Sensing and Transportation Engineering.
- Succeed and excel in their chosen professional practice/research and pursue higher education in the field of Civil Engineering in reputed Institutions in India/Abroad.
- Make ethical decisions and demonstrate a commitment to the profession and society.
- Acquire a position that values adaptability and innovation in their profession.
- Demonstrate leadership, both in their chosen profession and in other social responsibilities.

DEPARTMENT OF CIVIL ENGINEERING
POs & PSOs of B. TECH – CIVIL ENGINEERING

PO 1 Engineering Knowledge
Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems

PO 2 Problem Analysis
Identify, formulate, research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences

PO 3 Design/ Development of Solutions
Design solutions for complex engineering problems and design system components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations

PO 4 Conduct investigations of complex problems
using research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions

PO 5 Modern Tool Usage
Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

PO 6 The Engineer and Society
Apply reasoning informed by contextual knowledge to assess social, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.

PO 7 Environment and Sustainability
Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development

PO 8 Ethics
Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.

PO 9 Individual and Team Work
Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings

PO 10 Communication
Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions

PO 11 Project Management and Finance
Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

PO 12 Life-long Learning
Recognize the need for and have the preparation and ability to engage in independent and life- long learning in the broadest context of technological change

PROGRAMME CORE

List of Courses in Programme Core (58 Credits)

Theory Courses					
S.No	**Course code**	**Course Name**	**Credits**	**Prerequisite**	**Remarks**
1	10211CE101	Engineering Mechanics	3	NIL	Applicable only for 2021 Batch
2	10211CE102	Fluid Mechanics	3	NIL	All Batches (From 2021 Batch Onwards)
3	10211CE103	Mechanics of Solids	3	Engineering Mechanics	Applicable only for 2021 Batch
4	10211CE104	Structural Analysis – I	3	Strength of Materials	All Batches (From 2021 Batch Onwards)
5	10211CE105	Design of Reinforced Concrete Elements	3	Mechanics of Solids	
6	10211CE106	Transportation Engineering	3	NIL	
7	10211CE107	Design of Steel Structures	3	Strength of Materials	
8	10211CE108	Construction Materials and Techniques	3	NIL	
9	10211CE109	Surveying	3	NIL	
10	10211CE110	Structural Analysis – II	3	Structural Analysis – I	
11	10211CE111	Foundation Engineering	3	Soil Mechanics	
12	10211CE112	Cost Estimation and Valuation	3	• Computer Aided and Building Drawing • Water Supply Engineering • Wastewater Treatment and Recycling	
13	10211CE113	Water Supply Engineering	3	NIL	
14	10211CE114	Strength of Materials - I	3	NIL	From 2022 Batch Onwards
15	10211CE115	Techniques of Repair and Rehabilitation of Structures	3	NIL	
Integrated Course					
14	10211CE201	Strength of Materials	3	Mechanics of Solids	Applicable only for 2021 Batch
15	10211CE202	Soil Mechanics	3	NIL	All Batches (From 2021 Batch Onwards)
16	10211CE203	Concrete Technology	3	Construction Materials and Techniques	
17	10211CE204	Wastewater Treatment and Recycling	3	Water Supply Engineering	
18	10211CE205	Applied Hydraulics Engineering	3	Fluid Mechanics	
19	10211CE206	Strength of Materials - II	3	Strength of Materials - I	From 2022 Batch Onwards
19	10211CE301	Surveying Practical	1	Surveying	All Batches (From 2021 Batch Onwards)
20	10211CE302	Computer Aided Building Drawing	1	Engineering Graphics	
21	10211CE303	Survey Camp	1	Surveying Surveying Practical	

22	10211CE304	Computer Aided Design and Drafting Laboratory	1	Design of Reinforced Concrete Elements	

10211CE101	ENGINEERING MECHANICS	L	T	P	C
		2	2	0	3

Course Category : Programme Core / Theory

A. Preamble:

Students undergoing this course are expected.

- To apply static equilibrium of particles both in two dimensions and also in three dimensions.
- To utilize equilibrium of rigid bodies in 2D and 3D.
- To analyze the effect of geometry on inertial behaviour.
- To understand the dynamics of particles and its applications.
- To understand the equilibrium with the presence of friction and its types.

B. Prerequisite:

- NIL

C. Link to other Courses:

- 10211CE103 – Solid Mechanics

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Solve problems involving equilibrium of particles in 2D and 3D.	K3
CO2	Apply the equilibrium of rigid bodies in plane and space.	K3
CO3	Use the properties of given cross section.	K3
CO4	Apply principles of dynamics in real world problems.	K3
CO5	Discover the effect of friction in equilibrium of particles and rigid bodies.	K3

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	H	L										L	L
CO2	H	H	L										L	L
CO3	H	H	L										L	L
CO4	H	H	L										L	L
CO5	H	H	L										L	L

F. Course Content:

UNIT I BASICS AND STATICS OF PARTICLES 6+6

Introduction – Units and Dimensions – Force – characteristics – Force system - Laws of Mechanics: Lame‟s Theorem, Parallelogram and Triangular Law of forces – Vectors – Vectorial representation of forces – Vector operations: Additions, Subtraction, Dot product, Cross product - Coplanar Forces – Resolution and Composition of forces – Equilibrium of a particle in 2D and 3D – Forces in space – Equivalent systems of forces – Principle of transmissibility – Single equivalent force.

UNIT II EQUILIBRIUM OF RIGID BODIES 6+6

Free body diagram – Types of beams and supports - Reactions of statically determinate beams – Requirements of stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of a moment and couple - Scalar components of a moment – Varignon‟s theorem – Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions.

UNIT III PROPERTIES OF SURFACES AND SOLIDS 6+6

Significance of geometric properties of Sections -Determination of Areas and Volumes – First moment of area and the Centroid of sections –Second and product moments of plane area – Theorem of PappusGuldinus - Parallel axis theorem and perpendicular axis theorem – Polar moment of inertia – Principal moments of inertia of plane areas – Principal axes of inertia – Significance of mass moment of inertia (concept only).

UNIT IV DYNAMICS OF PARTICLES 6+6

Displacement, Velocity and Acceleration, their relationship – Relative motion – Rectilinear motion and Curvilinear motion of particles – Newton‟s laws of motion – Work-Energy Equation of particles – Impulse and Momentum – Impact of elastic bodies. Impact of elastic bodies - Introduction to dynamics of rigid bodies - General Plane motion (Concept only).

UNIT V FRICTION 6+6

Frictional force – Laws of Coloumb friction – Simple contact friction – Sliding Friction - Inclined planes - Angle of Repose - Belt friction – Ladder friction - Roller friction

TOTAL : 30+30=60 PERIODS

G. Learning Resources:

a) Text Books:

1. Beer, F.P and Johnson Jr. E.R., “Vector Mechanics for Engineers”, Statics and Dynamics, McGraw–Hill International Edition, 2019.
2. Natarajan K.V., Engineering Mechanics, Dhanalakshmi Publishers, 2011.

b) References:

1. Hibbeller R.C., Engineering Mechanics, Vol. 1 Statics, Vol. 2 Dynamics, Pearson Education Asia Pvt. Ltd., 2015.
2. Rajasekaran S. and Sankarasubramanian G., Engineering Mechanics, Vikas Publishing House Pvt Ltd, 2011.
3. Kottiswaran N., Engineering Mechanics, Sri Balaji Publications Pvt. Ltd., 2015.

4. Palanichamy M. S., and Nagan S., Engineering Mechanics (Statics and Dynamics), Tata McGraw Hill, New Delhi, 2012.
5. Shames I. H., and Krishna MohanaRao G., Engineering Mechanics (Statics and Dynamics), Dorling Kindersley India Pvt. Ltd. (Pearson Education), 2011.
6. Timoshenko S,Young D.H, J.V.Rao, SukumarPati, Engineering Mechanics, McGraw Hill Education (India) Private Limited., 2013.
7. Kumar K. L., Engineering Mechanics, Tata McGraw- Hill, New Delhi, 2011.

c) Online Resources

a) https://nptel.ac.in/courses/112/106/112106286/
b) https://nptel.ac.in/courses/122/104/122104015/

10211CE102	FLUID MECHANICS	L	T	P	C
		2	2	0	3

Course Category / Type: Programme Core / Theory

A. Preamble:

- This course deals helps the learners to understand the fundamental properties of fluids, static and dynamic behavior and its applications to engineering problems.
- To introduce the students about properties of the fluids, behavior of fluids under static conditions
- To impart basic knowledge of the dynamics of fluids through the control volume approach and its applications of the conservation laws and its applications.
- To expose the students to the principle of dimensional homogeneity, dimensional analysis and model studies

B. Prerequisite:

- NIL

C. Link to other Courses:

- 10211CE205 – Applied Hydraulic Engineering

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Select the fluid properties and its behavior in static conditions.	K3
CO2	Choose the conservation laws and its applications to fluid kinematics and dynamics.	K3
CO3	Establishing the relationship among the parameters involved in the given phenomenon and predicting the performances of the prototype by model studies.	K3
CO4	Experiment with the concept of boundary layer theory and its application to estimate drag force.	K3
CO5	Identify the role of friction and surface roughness for laminar and turbulent flows and analysis of pipe connected in series and parallel.	K3

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L	H		M									L	
CO2	H	H		M									M	
CO3	H	H	M	M	L								L	
CO4	L	H		M		L							L	
CO5	M	H		M		M	M						M	

F. Course Content:

UNIT I FLUID PROPERTIES AND FLUID STATICS 6+6

Scope of fluid mechanics-Definitions of fluid – SI units – Fluid properties – Method of analysis-Continuum concept- system and control volume- Pascal Law-Hydrostatic law-Manometry-Forces on plane and curved surfaces – Buoyancy

UNIT II FLUID KINEMATICS AND DYNAMICS 6+6

Classification and types of fluid flows-Stream, streak and path lines – Velocity and acceleration- Continuity equation – Velocity potential and stream functions -Flow nets – Energy and momentum conservation laws- Euler and Bernoulli's equations- Application to velocity and discharge measurements-Linear momentum equation-Application to pipe bend-Moment of momentum equations.

UNIT III DIMENSIONAL ANALYSIS AND MODEL STUDIES 6+6

Fundamental dimensions - Dimensional homogeneity - Rayleigh‟s method and Buckingham Pi theorem - Dimensionless parameters - Similitude and model studies - Distorted and undistorted models.

UNIT IV BOUNDARY LAYER 6+6

Definition of boundary layers - Laminar and turbulent boundary layers - Displacement, momentum and energy thickness - Momentum integral equation - Applications.

UNIT V LAMINAR AND TURBULENT FLOW OF INCOMPRESSIBLE FLUID 6+6

Reynold‟s experiment - Laminar flow in pipes and between parallel plates - Development of laminar and turbulent flows in pipes - Darcy-Weisbach equation - Moody diagram - Major and minor losses of flow in pipes - Pipes in series and parallel.

TOTAL: 30+30=60 PERIODS

G. Learning Resources:

a) Text Books:

1. Streeter, V.L. Wylie, E. B. and Bedford K.W, Fluid Mechanics. (9 th Ed.) Tata McGraw Hill NewDelhi, 1998
2. Modi P.N and Seth Hydraulics and Fluid Mechanics including Hydraulic Machines, Standard Book House New Delhi. 2003
3. Jain A. K. Fluid Mechanics including Hydraulic Machines, Khanna Publishers, New Delhi, 2014.

b) References:

1. Yunus A Cengel and John M. Cimbala, Fluid Mechanics: Fundamentals and Applications, (4th Ed.) Tata McGraw Hill, 2019
2. S K Som; GautamBiswas and S Chakraborty, Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill Education Pvt. Ltd., 2012
3. Kumar K.L., “Engineering Fluid Mechanics”, Eurasia Publishing House (P) Ltd., New Delhi, 1995.

c) Online Resources:

1. http://nptel.ac.in/courses/112105171/1
2. https://nptel.ac.in/courses/105103095/1
3. http://nptel.ac.in/courses/112105183/1

10211CE103	MECHANICS OF SOLIDS	L	T	P	C
		2	2	0	3

Course Category / Type: Programme Core / Theory

A. Preamble:

- This course deals about the fundamental concepts of stress, strain and deformation of solids with applications to bars, beams and thin cylinders. Also it deals with the analysis of determinate beams, trusses, shafts and springs.

B. Prerequisite:

- 10211CE101 – Engineering Mechanics

C. Link to other Courses:

- 10211CE201- Strength of Materials

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Determine the stress, strain and deformation characteristics of different materials.	K3
CO2	Analyze truss members and determine the deformation in cylinders.	K3
CO3	Determine the shear force and bending moment and load carrying capacity of beams.	K3
CO4	Determine the slope and deflection of beams by various methods and the shear stress distribution.	K3
CO5	Determine the stresses and deformation of shafts, stress and deflection in springs.	K3

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	H		L		M	M							
CO2	H	H		L	M	M	M					M		
CO3	H	H		L	M	M	M					M		
CO4	H	H		L		M	M							
CO5	H	H		L		M	M							

F. Course Content:

UNIT I SIMPLE AND COMPOUND STRESSES 9

Tension, compression and shear stresses – Strain, elasticity, Hooke‟s law, Limit of proportionality, Modulus of elasticity, Stress-Strain curve, Lateral strain – Temperature stresses – Deformation of simple and compound bars – Shear modulus, Bulk modulus, Relationship between elastic constants – Biaxial state of stress – Stress on inclined plane – Principal stresses and principal planes.

UNIT II ANALYSIS OF PLANE TRUSS, THIN CYLINDERS AND SHELLS 6+6

Stability and equilibrium of plane frames – Types of trusses – Analysis of forces in truss members –Method of joints, Method of sections – Thin cylinders and shells under internal pressure – Deformation of thin cylinders and shells.

UNIT II ANALYSIS OF PLANE TRUSS, THIN CYLINDERS AND SHELLS 6+6

Stability and equilibrium of plane frames – Types of trusses – Analysis of forces in truss members –Method of joints, Method of sections – Thin cylinders and shells under internal pressure – Deformation of thin cylinders and shells.

UNIT III TRANSVERSE LOADING ON BEAMS 6+6

Bending moment, shear force diagrams for simply supported, Cantilever and over hanging beams – Under Concentrated, uniformly distributed, varying distributed load, combination of above loading – Relationship between bending moment and shear force — Theory of simple bending – Analysis of stresses – Load carrying capacity of beams – Proportioning of sections.

UNIT IV DEFLECTION OF BEAMS AND SHEAR STRESSES 6+6

Deflection of beams – Double integration method – Macaulay‟s method – Conjugate Beam method – Variation of shear stress – Shear stress distribution in Rectangular, I sections, Solid circular sections, Hollow circular sections, Angle and channel sections

UNIT V TORSION AND SPRINGS 6+6

Stresses and deformation in circular (solid and hollow shafts) – Shafts fixed at both ends – Leaf springs – Stresses in helical springs – Deflection of springs.

TOTAL: 30+30=60 PERIODS

G. Learning Resources:

a) Text Books:

1. Bansal R.K., “Strength of Materials”, Laxmi Publications, 6th Edition, New Delhi, 2017.
2. Rajput.R.K. “Strength of Materials (Mechanics of Solids)”, S.Chand and Co, New Delhi, 2015
3. Subramanian R., “Strength of Materials”, Oxford University Press, 3rd Edition New Delhi, 2016

b) References:

1. Egor. P.Popov, Engineering Mechanics of Solids, Prentice Hall of India, Second Edition,New Delhi 2015..
2. Timoshenko, S.P. and Gere, J.M. Mechanics of Materials, Tata McGraw Hill, 1992
3. William A.Nash, “Theory and Problems of Strength of Materials”, Tata McGraw-Hill publishing Co., New Delhi, 2007.
4. Srinath L.S, “Advanced Mechanics of Solids”, Tata McGraw-Hi publishing Co., New Delhi, 2007.

c) Online Resources:

1. https://nptel.ac.in/courses/105106116/
2. http://nptel.ac.in/courses/112107147/
3. http://nptel.ac.in/courses/105106116/38

10211CE104	STRUCTURAL ANALYSIS-I	L	T	P	C
		2	2	0	3

Course Category / Type: Programme Core / Theory

A. Preamble:

- This course covers analysis of statically determinate and statically indeterminate structures. It further develops skills in determining reactions and bending moments on structures and familiarizes the students with the basic concepts of structural analysis.

B. Prerequisite:

- 10211CE201 – Strength of Materials

C. Link to other Courses:

- 10211CE110–Structural Analysis -II

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Compute the deflection of pin jointed & rigid jointed frames by using principle of virtual work.	K3
CO2	Sketch the influence line for shear force, bending moment and member forces in statically determinate structure.	K3
CO3	Analyze the different types of Arches	K3
CO4	Analyze the continuous beams and frames by slope deflection method.	K3
CO5	Analyze the continuous beams and frames by moment distribution method	K3

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	M		L								L	M	
CO2	H	M		L								L	M	
CO3	H	M		L								L	M	
CO4	H	M		L								L	M	
CO5	H	M		L								L	M	

F. Course Content:

UNIT I DEFLECTION OF DETERMINATE STRUCTURES 6+6

Principles of virtual work for deflections – Deflections of pin-jointed plane frames and rigid plane frames – Williot diagram - Mohr‟s correction

UNIT II MOVING LOADS AND INFLUENCE LINES (DETERMINATE & INDETERMINATE STRUCTURES) 6+6

Influence lines for reactions in statically determinate structures – influence lines for member forces in pin-jointed frames – Influence lines for shear force and bending moment in beam sections – Calculation of critical stress resultants due to concentrated and distributed moving loads. Muller Breslau‟s principle – Influence lines for continuous beams and single storey rigid frames – Indirect model analysis for influence lines of indeterminate structures – Beggs deformeter

UNIT III ARCHES 6+6

Arches - Structural forms – Examples of arch structures – Types of arches – Analysis of three hinged, two hinged and fixed arches - Parabolic and circular arches – Settlement and temperature effects- introduction to folded plates.

UNIT IV SLOPE DEFLECTION METHOD 6+6

Slope deflection equations- Analysis of continuous beams and rigid frames – Support Settlements.

UNIT V MOMENT DISTRIBUTION METHOD 6+6

Stiffness and carry over factors – Distribution and carryover of moments - Analysis of continuous Beams - Plane rigid frames without sway – Support settlement.

TOTAL: 30+30 = 60 PERIODS

G. Learning Resources:

a) Text books:

1. Bhavikatti, S.S, Structural Analysis, Vol.1, Vikas Publishing House Pvt. Ltd., NewDelhi-4, 2010.
2. Bhavikatti, S.S, Structural Analysis, Vol.2, Vikas Publishing House Pvt. Ltd., NewDelhi-4, 2013.
3. Punmia.B.C, Ashok Kumar Jain & Arun Kumar Jain, Theory of structures, Laxmi Publications, New Delhi, 2004.
4. Vaidyanathan,R&Perumal P, Structural Analysis, Vol.1 & 2, Laxmi Publications, NewDelhi,2016.

b) References:

1. William Weaver, Jr and James M.Gere, Matrix analysis of framed structures, CBS Publishers & Distributors, Delhi, 1995
2. Pandit G.S. and Gupta S.P., Structural Analysis – A Matrix Approach, Tata McGraw Hill Publishing Company Ltd., 2006
3. Reddy.C. S, “Basic Structural Analysis”, Tata McGraw Hill Publishing Company, 2005.
4. Negi L.S. and Jangid R.S., Structural Analysis, Tata McGraw Hill Publishing Co. Ltd. 2004.

c) Online Resources:

1. https://nptel.ac.in/courses/105/105/105105180/
2. https://nptel.ac.in/courses/105/105/105105166/

10211CE105	DESIGN OF REINFORCED CONCRETE ELEMENTS	L	T	P	C
		2	2	0	3

Course Category: Programme Core / Theory

A. Preamble:

Students undergoing this course are expected

- To impart fundamental knowledge on design concepts for structural elements.
- To design and detail basic structural elements like beam, slab, staircase, column and footing in accordance with the IS code of practice concerned.

B. Prerequisite:

- 10211CE103 - Mechanics of Solids

C. Link to other Courses:

- 10212CE102 - Design of Advanced Concrete and Masonry Structures
- 10211CE304 - Computer Aided Design and Drafting Laboratory

D. Course Outcomes:

Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Understand the various design methods of concrete structures and design a beam using working stress method.	K3
CO2	Design different types of slab and staircase and draw the reinforcement details.	K3
CO3	Classify the types of beam and design a beam for shear and torsion and draw the reinforcement details.	K3
CO4	Classify the types of column and design a column and draw the reinforcement details.	K3
CO5	Classify the types of footing and design a footing and draw the reinforcement details.	K3

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L		H					M				M	M	
CO2	M		H					H		M		M	M	
CO3	M		H					H		M		M	M	
CO4	M		H					H		M		M	M	
CO5	M		H					H		M		M	M	

F. Course Content:

UNIT I INRODUCTION TO DESIGN OF CONCRETE STRUCTURES 6+6

Objective of structural design - Steps in RC structural design process - Type of loads on structures and load combinations - Load transfer in framed structure - Design concepts - Concept of working stress method, ultimate load method and limit state method - Advantages of limit State method over other methods - Design codes and specification - Limit states - Characteristic strength and load - Partial safety factor - Limit State philosophy as detailed in IS code - Introduction to National Building Code (NBC) - Fire resistant guidelines - Design of singly and doubly reinforced beams by working stress method

UNIT II LIMIT STATE DESIGN OF SLABS AND STAIRCASES 6+6

Types of slabs - Behaviour of one way and two way slabs - Design of one way simply supported and continuous slabs - Design of two way slabs for various edge conditions - Types of staircases - Loads on stairs - Design of ordinary and dog-legged staircase.

UNIT III LIMIT STATE DESIGN OF BEAMS 6+6

Behaviour of RC members in bond and anchorage - Design requirements as per IS code - Calculation of anchorage and development length - Behaviour of RC beams in shear and torsion - Design of singly reinforced beams, doubly reinforced beams, flanged beams (T and L beams).

UNIT IV LIMIT STATE DESIGN OF COLUMNS 6+6

Classification of columns - Axial, uniaxial and biaxial bending - Braced and unbraced columns - Orientation of columns in buildings - Behaviour of short and slender columns - Design of square, rectangular and circular columns.

UNIT V LIMIT STATE DESIGN OF FOOTINGS 6+6

Design of footing for masonry and reinforced walls - Design of axially and eccentrically loaded square, rectangular footings - sloped footing (design principles only) - Design of combined rectangular footing (for two columns only).

TOTAL: 30+30 = 60 PERIODS

G. Learning Resources:

a) Text Books:

1. Varghese P.C, Limit State Design of Reinforced Concrete, Prentice Hall of India, Pvt. Ltd., New Delhi, 2008.
2. Punmia B.C, Ashok K. Jain and Arun K. Jain, Limit State design of Reinforced Concrete, Laxmi Publications (P) Ltd., New Delhi, 2016.
3. Raju N. Krishna, Reinforced Concrete Design: Principles and Practice, CBS Publishers & Distributors Pvt. Ltd., New Delhi, 2012.

b) References:

1. Unnikrishna Pillai and Devdas Menon, Reinforced Concrete Design (Third Edition), Tata Mc Graw Hill Publishing Company Ltd., New Delhi, 2017.
2. Gambhir M.L, Fundamentals of Structural Steel Design, McGraw Hill Education India Pvt Limited, 2017

3. Subramanian N, Design of Reinforced Concrete Structures, Oxford University Press, New Delhi, 2014.
4. Sinha S.N, Reinforced Concrete Design, Tata McGraw-Hill, New Delhi, 2002.

c) Online Resources:

1. https://nptel.ac.in/courses/105/105/105105105/
2. https://nptel.ac.in/courses/105/105/105105104/
3. http://www.nptelvideos.in/2012/11/design-of-reinforced-concrete-structures.html
4. https://nptel.ac.in/content/storage2/courses/105105104/pdf/m9l20.pdf

d) IS Codes:

1. IS 456:2000 Plain and Reinforced Concrete - Code of Practice.
2. SP 16:1980 Design Aids for Reinforced Concrete to IS 456:1978.
3. SP 34:1987 Handbook of concrete reinforcement and detailing.
4. IS 875(1-5):1987 Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures.
5. National Building Code of India 2016 (NBC 2016).

10211CE106	TRANSPORTATION ENGINEERING	L	T	P	C
		3	0	0	3

Course Category / Type: Programme Core / Theory

A. Preamble:

- To impart basic knowledge on highway alignment along with of geometric design.
- To identify about the selection of suitable materials for highway pavements and pavement design.
- To analyze about the traffic planning and fundamentals of traffic operations.
- To explain about the various components of railway and basis of geometric design.
- To discuss about the planning and basics of airport and harbour engineering.

B. Prerequisite:

- Nil

C. Link to other Courses:

- Nil

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Outline the basic concepts of planning and designing of geometrics for an efficient highway.	K2
CO2	Design a flexible and rigid pavement using IRC provisions to meet safety, efficient and durability.	K3
CO3	Interpret the traffic characteristics and planning accordingly.	K2
CO4	Classify the various types of rail transport including geometric design and construction of railways.	K2
CO5	Explain about the basic concept of planning and designing and construction of an airport and harbour construction.	K3

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L					L	L				L	L	L	
CO2		H	M					L						
CO3					H	L					M	M	L	
CO4	L		L		L	H					L	M	L	
CO5	L	H				L	L				L	M	L	

F. Course Content:

UNIT I HIGHWAY PLANNING AND GEOMETRIC DESIGN 9

Introduction to transportation systems, historical development of road construction, classifications of roads, highway planning, alignment and surveys – Road ecology - Highway cross section elements, camber, gradient, super elevation - Sight distance - Horizontal and vertical curve.

UNIT II HIGHWAY MATERIALS AND PAVEMENT DESIGN 9

Highway materials, properties, testing methods - CBR test for subgrade, tests on aggregate and bitumen - Types of pavements, design principles, pavement components and their functions, design practice for flexible and rigid Pavements (IRC methods only) – Pavement construction and maintenance.

UNIT III TRAFFIC ENGINEERING 9

Traffic characteristics - Road user characteristics - PIEV theory- Traffic studies and analysis - Traffic operation - Traffic regulation - Traffic control devices - Highway lighting- Traffic planning – Urban transportation planning process – Introduction to Intelligent transportation System (ITS) – Role of ITS in Traffic management.

UNIT IV RAILWAY PLANNING AND GEOMETRIC DESIGN 9

History and general features of Indian railways – Other rail transportation in India – Suburban rail, MRTS, Metro, Monorail, High-speed rail – Case Studies - Permanent way - Rails, sleepers, ballast and subgrade - Components and functions - Geometric design of railway track - Curves and superelevation - Points and crossings - Railway stations and yards - Signaling and interlocking – Underground metro construction.

UNIT V AIRPORT AND HARBOUR ENGINEERING 9

Airport planning: Objectives, components, layout characteristics, airport classifications - Runway Design - Runway length - Geometric design of runways - Water transportation - Harbours, ports and docks - Classification - Features of harbour - Location and Design Principles - Harbour Layout and Terminal Facilities.

TOTAL: 45 PERIODS

G. Learning Resources:

a) Text Books:

1. Khanna S.K., Justo C.E.G and Veeraragavan A., "Highway Engineering", Nemchand Publishers, 10th Edition, 2014.
2. Kadiyali L.R., "Traffic Engineering and Transport Planning", Khanna Publishers, Delhi, 2013.
3. Subramanian K.P., "Highways, Railways, Airport and Harbour Engineering", Scitech Publications (India), Chennai, 2018.

b) References:

1. Indian Road Congress (IRC), Guidelines and Special Publications of Planning and Design. 2013.
2. Khanna S.K., Arora M.G. and Jain S.S., “Airport Planning and Design", Nemchand and Brothers, Roorkee, 2017.

c) Online Resources:

1. https://nptel.ac.in/courses/105/105/105105107/
2. https://nptel.ac.in/courses/105/101/105101087/
3. https://nptel.ac.in/courses/105/107/105107123/

10211CE107	DESIGN OF STEEL STRUCTURES	L	T	P	C
		2	2	0	3

Course Category / Type: Programme Core / Theory

A. Preamble:
Students undergoing this course are expected

- To introduce the limit state design of structural steel members subjected to compressive, tensile and bending loads, including connections and to provide the tools necessary for designing structural systems such as roof trusses and gantry girders as per provisions of current code (IS 800 - 2007) of practice.

B. Prerequisite:

- 10211CE201 – Strength of Materials

C. Link to other Courses:

- NIL

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Understand the design philosophy of steel structures and design of connections	K3
CO2	Design the most suitable section shape and size for tension members according to specific design criteria	K3
CO3	Design the most suitable section shape and size for compression members and gusset bases according to specific design criteria	K3
CO4	Design the most suitable section of steel beams and plate girders	K3
CO5	Design the purlins, elements of trusses and gantry girders	K3

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	L	M	L				L				H	L	
CO2	M	L	H	M				M				M	M	
CO3	M	L	H	M				M				M	M	
CO4	M	L	H	M				M				M	M	
CO5	M	L	H	M				L				H	M	

F. Course Content:

UNIT I INTRODUCTION TO STRUCTURAL STEEL AND CONNECTIONS 6+6
Properties of steel – Structural steel sections – Limit State Design Concepts – BIS codal provisions on material and geometrical standards -Loads on Structures – Metal joining methods and design - welding, bolting – Eccentric connections - Efficiency of joints - High Tension bolts – Use of Medium & High tensile steel – Cold formed steel – advantages and disadvantages.

UNIT II TENSION MEMBERS 6+6

Types of sections – Net area – Net effective sections for angles and Tee in tension – Design of connections in tension members – Use of lug angles – Splice - Design of tension splice – Concept of shear lag – cold formed tension members.

UNIT III COMPRESSION MEMBERS 6+6

Types of compression members – Basis of current codal provision for compression member design – Slenderness ratio – Design of single section and compound section compression members – Design of lacing and battening type columns – Design of column bases – Gussets – cold formed compression members.

UNIT IV BEAMS 6+6

Design of laterally supported and unsupported beams – Built up beams – Beams subjected to biaxial bending – Design of plate girders - Riveted and welded – Intermediate and bearing stiffeners – Web splices – Design of beam columns – cold formed beams.

UNIT V ROOF TRUSSES AND INDUSTRIAL STRUCTURES 6+6

Roof trusses – Roof and side coverings – Design loads, design of purlins and elements of truss; end bearing – Design of gantry girders-analysis of probabilities for different combination of forces and contribution of critical stress – Introduction to pre-engineered buildings.

TOTAL : 30+30 = 60 PERIODS

G. Learning Resources:

a) Text Books:

1. Bhavikatti S.S, Design of Steel Structures, Ik International Publishing House, NewDelhi, 2017.
2. Subramanian N, Design of Steel Structures, Oxford University Press, New Delhi, 2016.

b) References:

1. Duggal S.K., Design of Steel Structures, Tata McGraw Hill, Publishing Co. Ltd., New Delhi, 2010.
2. Gambhir M L, Fundamentals of Structural Steel Design, McGraw Hill Education India Pvt Limited, 2013.
3. R.Agor, Steel Table (M.K.S Units and S.I Units), Birla Publications.

c) Online Resources:

1. http://nptel.ac.in/courses/105106112/
2. http://nptel.ac.in/courses/105105162/

d) IS Codes:

1. IS 800:2007 General Construction in Steel - Code of Practice, (Third Revision), Bureau of Indian Standards, New Delhi, 2007.
2. IS 875:2015 (part 3) Wind Loads on Buildings and Structures, Bureau of Indian Standards, 2015.

10211CE108	CONSTRUCTION MATERIALS AND TECHNIQUES	L	T	P	C
		3	0	0	3

Course Category/Type: Programme Core /Theory

A. Preamble :

- To impart knowledge on basic conventional materials, Modern materials, their properties and applications for construction practices and Techniques involved in construction of sub and superstructure.

B. Prerequisites:

- NIL

C. Link to other Course:

- 10211CE203 - Concrete Technology

D. Course outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Classify the properties of bricks and Lime, quality of stones for Construction Practices	K2
CO2	Demonstrate the properties and testing of different ingredients of concrete.	K2
CO3	Explain the importance and applications of modern materials from Conventional Materials	K2
CO4	Illustrate the appropriate method from various techniques of sub structure in construction.	K2
CO5	Illustrate the methods involved in various techniques of Superstructure in construction	K2

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M			M			M					M		M
CO2	M			H			M	M				H		M
CO3	M			M			M					L		M
CO4	M						M			H		L		L
CO5	M						M			H		L		L

F. Course Content:

UNIT I BASIC CONSTRUCTION MATERIALS 9

Stones – As a Building material – Classification - Testing - Deterioration and Preservation of stone work -Bricks –Manufacturing process - Classification - Properties and Testing – Lime- Preparation of Lime Mortar –Masonry Types - Brick and Stone Masonry.

UNIT II STRUCTURAL MATERIALS 9

Concrete – Ingredients – Cement – Different Types – Chemical Composition & properties – Aggregates – Classification – Mechanical Properties – Test on Aggregates as per BIS – Concrete properties - Cement Mortar – Structural Steel – Steel for Reinforcement – Steel for Pre - Engineered Building.

UNIT III NON - STRUCTURAL MATERIALS 9

Glass – Ceramics –Sealants for Joints – Fibre Reinforced plastic - Composite materials - Types – Timber - Plywood – Veneer – Thermacol – Panels of laminate - Steel , Aluminium - Composition – Uses – Paints – Green Certified Materials.

UNIT IV SUBSTRUCTURE TECHNIQUES 9

Box jacking - Pipe jacking techniques - Underwater construction - Diaphragm walls – Cofferdam - Tunneling techniques - Piling techniques - Well and Caisson - Sheet piles – Offshore system - Shoring –Dewatering.

UNIT V SUPERSTRUCTURE TECHNIQUES 9

Launching girders, bridge decks, offshore platforms – Special forms for shells - Techniques for heavy decks – Mivan Technology – Tunnel Forming Technology – Shear wall Structures- Erecting light weight components on tall structures - Erection of articulated structures, braced domes and space decks.

TOTAL: 45 PERIODS

G. Learning Resources:

a) Text Books:

1. Varghese, P.C., “Building Construction”, Prentice Hall of India Pvt. Ltd, New Delhi, 2016.
2. Shetty.M.S. Concrete Technology (Theory and Practice), S Chand and company limited 2015.
3. Arora S.P. and Bindra S.P., “Building Construction, Planning Techniques and Method of Construction”, Dhanpat Rai and Sons, 19th edition, 2000.

b) Reference:

1. Punmia ,B.C Building construction , Laxmi publication (p)ltd, 2008.
2. Rangwala, (2016), Building construction, Charotar Publishers.
3. Neville. A.M,. J.J Brooks, “Concrete Technology”, Pearson publisher, 2019.

c) Online Resources:

1. https://nptel.ac.in/courses/124/105/124105013/
2. https://nptel.ac.in/courses/105/106/105106206/
3. https://nptel.ac.in/courses/105/106/105106053/
4. https://nptel.ac.in/courses/105/106/105106144/

10211CE109	SURVEYING	L	T	P	C
		3	0	0	3

Course Category / Type: Programme Core / Theory

A. Preamble :

- This course will introduce the fundamentals of conventional surveying methods and principles, different geodetic surveying to solve the real world problems in civil engineering, basics of astronomical surveying and modern surveying techniques.

B. Pre-Requisites:

- NIL

C. Link to other Course:

- 10211CE301 - Surveying Practical
- 10211CE303 - Survey Camp

D. Course Outcomes: After successful completion of the course, the students will be able

CO Nos	Course Outcomes	Bloom's Taxonomy level
CO1	Understand the fundamentals of plane surveying and geodetic principles	K2
CO2	Determine the measurement of distance, angles, leveling, and curve setting	K3
CO3	Measure the distance, angles and heights of objects using theodolite	K3
CO4	Illuminate the importance of concepts and working principles of GPS and Total station surveying	K2
CO5	Understand the concepts of astronomical surveying methods to determine time, longitude, latitude and azimuth	K3

E. Correlation of COs with POs

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H					L		L				L		
CO2	M	H				M		M				M		
CO3	M	M				M		M				M		
CO4	M	M			H	M		H				M	M	
CO5	M	M			H	M		H				M	M	

F. Course Content:

UNIT I FUNDAMENTAL OF CONVENTIONAL SURVEYING 9

Classifications and basic principles of surveying - Equipment and accessories for ranging and chaining - Methods of ranging - Compass - Types of Compass - Basic Principles- Bearing – Types - True Bearing - Magnetic Bearing – Datum - Bench Marks - Plane Table Surveying: Plane table instruments and accessories – merits and demerits – methods.

UNIT II LEVELLING AND CONTOURING 9

Leveling- Principles of Leveling –Temporary and Permanent Adjustments- Methods of Leveling- Booking – Reduction - Sources of errors in Leveling - Contouring- Characteristics – types of contour - Methods of calculation of areas and volume – uses - Measurement and Earthwork. Calculations - Curves: setting out of simple and compound curves.

UNIT III TACHEOMETRIC AND CONTROL SURVEYING 9

Theodolite - Horizontal and vertical angle measurements - Temporary and permanent adjustments - Heights and distances - Tacheometer - Stadia Constants - Analytic Lens - Tangential and Stadia Tacheometry surveying - Satellite Stations- Reduction to centre - Most probable values- Normal equation – Correlates.

UNIT IV MODERN SURVEYING METHODS 9

GPS Surveying: Different segments - space, control and user segments - satellite configuration - signal structure - Orbit determination and representation - Anti Spoofing and Selective Availability - Task of control segment - Hand Held and Geodetic receivers - data processing - Traversing and triangulation - Total Station: Parts and accessories - Classifications - Working Principle- Sources of Error- Comparison between Electro-optical and Microwave system.

UNIT V ADVANCED TOPICS IN SURVEYING 9

Introduction to remote sensing techniques - Route Surveying - Reconnaissance - Route surveys for highways, railways and waterways -Sight distances - Hydrographic surveying – Tides - MSL – astronomical Surveying: Astronomical terms and definitions - Motion of sun and stars - Celestial coordinate systems - different time systems - Nautical Almanac - field observations and determination of Azimuth by altitude and hour angle methods.

TOTAL: 45 PERIODS

G. Learning Resources:

a) Text Books:

1. Kanetkar.T.P and Kulkarni.S.V, Surveying and Levelling, Parts 1 & 2, Pune Vidyarthi Griha Prakashan, Pune, 2008
2. Punmia.B.C., Ashok K.Jain and Arun K Jain , Surveying Vol. I & II, Lakshmi Publications Pvt Ltd, New Delhi, 2005
3. Subramaniyan R. , Surveying and Levelling, Oxford University Press,2007.

b) Reference Books

1. James M. Anderson and Edward M. Mikhail, "Surveying, Theory and Practice", 7th Edition, McGraw Hill, 2001.
2. Alfred Leick, “GPS satellite surveying”, John Wiley & Sons Inc., 3rd Edition, 2004.

c) Online Resources:

1. https://nptel.ac.in/courses/105/107/105107122/
2. https://nptel.ac.in/courses/105/103/105103176/
3. https://nptel.ac.in/courses/105/104/105104100/
4. https://nptel.ac.in/courses/105/107/105107157/
5. https://nptel.ac.in/courses/105/107/105107158/

10211CE110	STRUCTURAL ANALYSIS – II	L	T	P	C
		2	2	0	3

Course Category / Type: Programme Core / Theory

A. Preamble:

Students undergoing this course are expected

- To analyze indeterminate structures using a matrix approach. It further develops skills in analyzing suspension bridges, and space trusses.

B. Prerequisite:

- 10211CE104 - Structural Analysis – I

C. Link to other Courses:

- Nil

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Analyze the continuous beams and frames by flexibility method.	K3
CO2	Analyze the continuous beams and frames by stiffness method.	K3
CO3	Apply the concept of finite element method to structural analysis.	K3
CO4	Employ plastic analysis to calculate the collapse loads for beams and frames.	K3
CO5	Determine the member forces in suspension bridges and space truss.	K3

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	M		L								L	M	
CO2	H	M		L								L	M	
CO3	M	L		M								L	M	
CO4	H	M		L								L	M	
CO5	H	M		L								L	M	

F. Course Content:

UNIT I MATRIX FLEXIBLITY METHOD 6+6

Equilibrium and compatibility - Determinate vs. indeterminate structures - Static and Kinematic Indeterminacy - primary structure - Compatibility conditions - Analysis of indeterminate pin -jointed plane frames, rigid frames and continuous beams.

UNIT II MATRIX STIFFNESS METHOD 6+6

Element and global stiffness matrices– Co-ordinate transformations – Rotation matrix - Compatibility matrix – transformations of stiffness matrices, load vectors and displacement vectors– Analysis of Continuous beams -Analysis of pin-jointed plane frames and rigid frames by direct stiffness method.

UNIT III FINITE ELEMENT METHOD 6+6

Introduction – Discretization of a structure –-Introduction of shape function- Displacement functions – Truss element – Beam element – Plane stress and plane strain conditions – Triangular elements.

UNIT IV PLASTIC ANALYSIS OF STRUCTURES 6+6

Statically indeterminate axial problems – Beams in pure bending – Plastic moment of resistance – Plastic modulus – Shape factor – Load factor – Upper and lower bound theorems-Plastic hinge and mechanism – Plastic analysis of indeterminate beams and frames.

UNIT V SPACE AND CABLE STRUCTURES 6+6

Analysis of Space trusses using method of tension coefficients – Beams curved in plan - Suspension cables – Suspension bridges with two and three hinged stiffening girders.

TOTAL: 30+30 =60 PERIODS

G. Learning Resources:

a) Text Books:

1. Bhavikatti,S.S, Structural Anal ysis, Vol.1, Vikas Publishing House Pvt. Ltd., NewDelhi-4, 2010.
2. Bhavikatti,S.S, Structural Analysis, Vol.2, Vikas Publishing House Pvt. Ltd., NewDelhi-4, 2013.
3. Punmia.B.C, Ashok Kumar Jain and Arun Kumar Jain, Theory of structures, Laxmi Publications, 2004.
4. Vazrani.V.N And Ratwani,M.M, Analysis of Structures, Vol.II, Khanna Publisers,2015.
5. Vaidyanathan.R and Perumal.P, Structural Analysis, Vol.I&II, Laxmi Publications, 2016.
6. Bhavikatti,S.S, Finite Element Analysis, New age international publishers, 2015.

b) References:

1. Negi.L.S and Jangid R.S ., Structural Analysis , Tata McGraw-Hill Publishers, 2004.
2. Reddy C.S., Basic Structural Analysis, Tata McGraw Hill Publishing Co. Ltd. 2002.
3. Gambhir.M.L., Fundamentals of Structural Mechanics and Analysis, PHI Learning Pvt. Ltd., 2011.
4. Prakash Rao D.S., Structural Analysis, Universities Press, 1996.

c) Online Resources:

1. https://nptel.ac.in/courses/105/105/105105109/
2. https://nptel.ac.in/courses/105/107/105107209/

10211CE111	FOUNDATION ENGINEERING	L	T	P	C
		3	0	0	3

Course Category / Type: Programme Core / Theory

A. Preamble :

Students undergoing this course are expected

- To develop an appreciation of geologic processes that influence civil engineering works.
- The course will focus on the design of shallow foundation and axially loaded pile foundation.
- The field and laboratory soil testing methods will be discussed to determine the required design parameters.
- Lateral earth pressures theories and design of various retaining structures will be covered. The selection of proper foundation or characteristics of foundations for different soils will be discussed.

B. Pre-Requisites:

- 10211CE202 - Soil Mechanics

C. Link to other Courses:

- 10212CE114 - Geotechnical Earthquake Engineering

D. COURSE OUTCOMES: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Infer the details of soil stratum by various field techniques.	K2
CO2	Choose appropriate bearing capacity theory and settlement method	K3
CO3	Make use of the concepts of bearing capacity theories and settlement for the design of shallow foundation	K3
CO4	Employ the concepts of bearing capacity theories and settlement for the design of pile foundation	K3
CO5	Apply the knowledge of earth pressure theory in stabilization of retaining walls.	K3

E. Correlation of COs with POs

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M					H		M				M	M	
CO2		H				H		M				M	M	
CO3		H	M			H		L				L	M	
CO4		H	M			H		M				M	M	
CO5		H	M			H		M				M	M	

F. Course Content:

UNIT I FIELD TESTS AND SELECTION OF FOUNDATION 9

Penetration tests (SPT, SCPT & DCPT) Dilatometer test, - Bore log report Data interpretation-Geophysical Exploration - Seismic refraction-Reflection - strength parameters and Liquefaction potential - Types of Foundation-Selection of foundation based on soil condition.

UNIT II BEARING CAPACITY AND SETTLEMENT OF SHALLOW FOUNDATION 9

Introduction - Location and depth of foundation - Codal provisions -bearing capacity of shallow foundation on homogeneous deposits - Terzaghi‟s formula and BIS formula - factors affecting bearing capacity - problems - Allowable bearing pressure -Seismic considerations in bearing capacity evaluation. Determination of Settlement of foundations on granular and clay deposits - Total and differential settlement - Allowable settlements - Codal provision - Methods of minimizing total and differential settlements.

UNIT III DESIGN OF FOOTING AND RAFT 9

Bearing capacity from in-situ tests (SPT, SCPT and plate load) - Contact pressure distribution: Isolated footing - Combined footings -Types and proportioning - Mat foundation - Types and applications - Proportioning - Floating foundation-Seismic force consideration - Codal Provision.

UNIT IV PILE FOUNDATION 9

Types of piles and their function - Factors influencing the selection of pile - Carrying capacity of single pile in granular and cohesive soil - static formula -dynamic formulae (Engineering news and Hileys) - Capacity from insitu tests (SPT and SCPT) -Negative skin friction - uplift capacity- Group capacity by different methods (Feld‟s rule, Converse - Labarra formula and block failure criterion) - Settlement of pile groups -Interpretation of pile load test (routine test only) - Under reamed piles - Capacity under compression and uplift.

UNIT V EARTH PRESSURE THEORIES AND STABILITY OF RETAINING WALLS 9

Plastic equilibrium in soils -active and passive states - Rankine‟s theory - cohessionless and cohesive soil - Coulomb‟s wedge theory - Condition for critical failure plane - Earth pressure on retaining walls of simple configurations - Culmann Graphical method -pressure on the wall due to line load - Stability analysis of retaining walls.

TOTAL: 45 PERIODS

G. Learning Resources:

a) Text Books

1. Murthy, V.N.S., “Soil Mechanics and Foundation Engineering”, CBS Publishers and Distributers Ltd., New Delhi, 2007.
2. Gopal Ranjan and RaoA.S.R. “Basic andApplied soil mechanics”, NewAge International Pvt. Ltd, New Delhi, 2005.

b) Reference Books

1. Purushothama Raj. P., “Soil Mechanics and Foundation Engineering”, 2nd Edition, Pearson Education, 2013.
2. Varghese, P.C., “Foundation Engineering”, Prentice Hall of India Private Limited, New Delhi, 2005.

c) Online Resources

1. https://nptel.ac.in/courses/105/105/105105176/

10211CE112	COST ESTIMATION AND VALUATION	L	T	P	C
		3	0	0	3

Course Category / Type: Programme Core/Theory

A. Preamble:

- To understand the aspects of estimating the quantities of various items of works involved in buildings, water supply and sanitary works, road works and irrigation structures.
- To impart knowledge in tender practices, report preparation and, valuation of civil engineering works. And also acquire knowledge in rate analysis and process of preparation of bills.

B. Prerequisite:

- 10211CE302 – Computer Aided and Building Drawing
- 10211CE113 – Water Supply Engineering
- 10211CE204 – Wastewater Treatment and Recycling

C. Link to other Courses:

- **Nil**

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Explain the basic fundamentals of estimation, SI unit‟s measurements and method of estimates in different structures.	K2
CO2	Apply the concepts and estimate the quantity of various items of works involved in buildings.	K3
CO3	Prepare an estimate for civil engineering structures like septic tank, road works and irrigation works.	K3
CO4	Make use of tender, contract documents thereby they can analyze the rate of any civil works.	K2
CO5	Apply the principles of valuation in practical problems and report preparation for estimated structure.	K3

E. Correlation of COs with POs

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L	L						M		L		L		M
CO2	M	M	L					M				M		M
CO3	M	M	L					M				M		M
CO4	L	L		M				M				L		M
CO5	M	M	L	M				M				L		M

F. Course Content:

UNIT I INTRODUCTION TO ESTIMATION & QUANTITY SURVEYING 9

Introduction to estimation – Purpose and Types of estimates – General items of work in buildings – Standard units of measurements for works and materials – Method of measurements as per IS 1200 – Principles of working-out quantities for detailed & abstract estimates – Cost analysis and scheduled rate.

UNIT II ESTIMATION OF BUILDING 9

Estimation of building – Short wall and long wall method – Centre line method – Calculation of quantities of brick work, RCC, PCC, Plastering, white washing, color washing and painting / varnishing for shops, rooms, residential buildings with flat and pitched roof – Detailed estimate of masonry buildings and R.C.C works – Steel requirement and Bar bending schedule – Types of arches – Calculation of brick work and RCC works in arches.

UNIT III ESTIMATION OF OTHER STRUCTURES 9

Road estimation – earthwork fully in banking – cutting – partly cutting & partly filling – Detailed estimate and cost analysis for roads – Estimation of septic tank, soak pit – sanitary and water supply installations – water supply pipe line – sewer line – tube well – open well

UNIT IV SPECIFICATION, RATE ANALYSIS AND TENDERS 9

Purpose and basic principles of General and Detailed Specifications – Detailed specifications for various items of work – Rate analysis & preparation of bills – Data analysis of rates for various items of works – Tenders – TTT Act – e-tender – Preparation of Tender Notice and Document – Contracts – Types of contracts – Drafting of contract documents – Arbitration and legal requirements.

UNIT V VALUATION AND REPORT PREPARATION 9

Necessity – Basics of value engineering – Capitalized value – Depreciation – Escalation – Value of building – Calculation of Standard rent – Mortgage – Lease – Principles for report preparation – report on estimate of residential building – Culvert – Roads – Water supply and sanitary installations.

TOTAL: 45 PERIODS

G. Learning Resources.

a) Text Books:

1. Dutta, B.N., "Estimating and Costing in Civil Engineering (Theory & Practice)", UBS Publishers & Distributors Pvt. Ltd., 28th Revised Edition, Chennai, 2017.
2. Kohli, D.D and Kohli, R.C., "A Text Book of Estimating and Costing (Civil)", S. Chand & Company Ltd., New Delhi, 2014.

b) References:

1. Hand Book of Consolidated Data – 8/2000, Vol.1, TNPWD.
2. Tamil Nadu Transparency in Tenders Amendment Act, 2012.
3. Arbitration and Conciliation Amendment Act, 2015
4. Standard Bid Evaluation Form, Procurement of Good or Works, the World Bank, 2014
5. Standard Data Book for Analysis and Rates, IRC, New Delhi, 2017.
6. SP 7: 2016 National Building Code of India 2016 (NBC 2016).

c) Online Resources:

1. https://onlinecourses.swayam2.ac.in/nou20_cs11/preview

10211CE113	WATER SUPPLY ENGINEERING	L	T	P	C
		3	0	0	3

Course Category/Type: Programme Core/Theory

A. Preamble

- This course aims to make the students get exposed and practiced in the concepts of water demand calculation and in the design of water treatment facilities.

B. Prerequisite

- Nil

C. Links to other Courses

- 10211CE114 - Wastewater Treatment and Recycling

D. Course Outcomes

With the completion of the course, students are expected to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's)
CO1	Outline the water resources development project in Indian context	K2
CO2	Interpret the existence of surface and groundwater	K2
CO3	Plan a public water supply scheme for a given community	K3
CO4	Construct water treatment unit operations and processes	K3
CO5	Solve the water flow in distribution network and examine water losses	K3

E. Correlation of COs with POs

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1					L	H	H					L	M	L
CO2	M				L	H		M				L	M	L
CO3	M					M	H					L	M	L
CO4	M		M			H	H					L	M	L
CO5	M				L	M	H					L	M	L

F. Course Content

UNIT 1 PRINCIPLES OF WATER RESOURCES ENGINEERING 9

Hydrologic cycle and its components - Concept of basin and major river basins of India – Tools for water resources planning and management – National Policy for water resources planning, water allocation priorities, management strategies for excess and deficit water imbalances – Remote sensing and GIS for water resources management.

UNIT II SCIENCE OF SURFACE AND GROUNDWATER 9

Surface and subsurface sources of water – Water quality characteristics: physical, chemical and biological - Drinking water standards – Darcy‟s law for groundwater flow - Well hydraulics and pumping tests – Introduction to modelling and management of water sources.

UNIT III PUBLIC WATER SUPPLY SYSTEM 9

Introduction - Water demands, variation and estimation, design period, population forecasting methods – Source identification - Water intakes, types of intakes, factors governing location of intake, types of pipes, pipe materials, installation of water supply pipes and pipe appurtenances – Pumps and types of pumps.

UNIT IV WATER TREATMENT TECHNOLOGIES 9

Layout of water treatment plant – Unit operation and unit processes - Working principles and design of water treatment units: screening, plain sedimentation, sedimentation aided with coagulation, filtration, disinfection, defluoridation, water softening, desalination.

UNIT V WATER DISTRIBUTION SYSTEM 9

Requirements of a good distribution system, methods of distribution, layout of distribution system – Design of distribution system, analysis of pipe networks – Water losses in distribution system, water balance for water loss assessment, water loss detection and control - Software tools for design of distribution networks, Demonstration on open software - Concept of smart water supply system for smart cities.

TOTAL: 45 PERIODS

G. Learning Resources

a) Text Books:

1. Peavy. H.S, Rowe. D.R, and G. Tchobanoglous, Environmental Engineering,McGraw Hill Inc., New York, 2015.
2. P.N. Modi, Water supply Engineering – Environmental Engineering (Vol.I),Standard Book House, 2018.
3. S.K. Garg, Water supply Engineering – Environmental Engineering (Vol.I),Khanna Publishers, 2018.

b) Reference:

1. Manual on Water Supply and Treatment, Central Public Health & EnvironmentalEngineering Organisation (CPHEEO), Ministry of Housing and Urban Affairs – Govt. of India, 1999.
2. G.S. Asawa, Irrigation and Water Resources Engineering, New Age InternationalPublishers, 2015.

c) Online Resources:

1. NPTEL :: Civil Engineering - NOC:Water Supply Engineering
2. NPTEL :: Civil Engineering - Water Resources Systems Planning and Management
3. NPTEL :: Civil Engineering - Water Resources Engineering
4. NPTEL :: Civil Engineering - NOC:Water and waste water treatment5. NPTEL :: Civil Engineering - Ground Water Hydrology

10211CE114	STRENGTH OF MATERIALS I	L	T	P	C
		2	2	0	3

Course Category / Type: Programme Core / Theory

A. Preamble:

- This course deals with the fundamental concepts of stress, strain and deformation of solids, basics of dynamics. It also deals with the analysis of determinate beams, and trusses.

B. Prerequisite:

- Nil

C. Link to other Courses:

- Strength of Materials II

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Determine the stress, strain and deformation characteristics of materials	K3
CO2	Analyse truss members and determine the deformation in cylinders	K3
CO3	Apply theorems related to surfaces and solids	K3
CO4	Determine the shear force and bending moments	K3
CO5	Understand the principles of dynamics and effects of friction	K3

E. Correlation of COs with POs

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	H	M	L								L	M	
CO2	M	H	M	L								L	M	
CO3	M	H	M	L								L	M	
CO4	M	H	M	L								L	M	
CO5	M	H	M	L								L	M	

F. Course Content:

UNIT I BASICS, EQULIBRIUM AND STRESSES 6+6

Units and Dimensions – System of Forces- Laws of Mechanics – Free body Diagram- Equations of Equilibrium - Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions- Types of stresses – Strain, Elasticity- Hooke's law, Limit of proportionality, Modulus of elasticity, Stress-Strain curve, Lateral strain – Deformation of simple and compound bars –Relationship between elastic constants. Principal stresses and principal planes. Theories of failures (Concept only)

UNIT II ANALYSIS OF PLANE TRUSS, THIN CYLINDERS AND SHELLS 6+6

Stability and equilibrium of plane frames – Types of trusses – Analysis of forces in truss members –Method of joints, Method of sections – Thin cylinders and shells under internal pressure – Deformation of thin cylinders and shells

UNIT III PROPERTIES OF SURFACES AND SOLIDS 6+6

Significance of geometric properties of Sections -Determination of Areas and Volumes – First moment of area and the Centroid of sections –Parallel axis theorem and perpendicular axis theorem – Polar moment of inertia – Principal moments of inertia of plane areas – Principal axes of inertia – Significance of mass moment of inertia (concept only)

UNIT IV TRANSVERSE LOADING ON BEAMS 6+6

Bending moment, shear force diagrams for simply supported, Cantilever and over hanging beams – Under Concentrated, uniformly distributed, varying distributed load, combination of above loading – Moments and Couples- Relationship between bending moment and shear force – Theory of simple bending – Analysis of stresses – Load carrying capacity of beams – Proportioning of sections

UNIT V BASICS OF DYNAMICS AND FRICTION 6+6

Displacement, Velocity and Acceleration, their relationship –Newton's laws of motion – Work-Energy Equation of particles – Impulse and Momentum – Impact of elastic bodies. Frictional force – Laws of Coloumb friction – Simple contact friction – Sliding Friction - Inclined planes - Angle of Repose - Belt friction – Ladder friction - Roller friction

TOTAL: 30+30=60 PERIODS

G. Learning Resources:

a) Text Books:

1. Bansal R.K., "Strength of Materials", Laxmi Publications, 6th Edition, New Delhi, 2017.
2. Rajput.R.K. "Strength of Materials (Mechanics of Solids)", S.Chand and Co, New Delhi, 2015
3. Beer, F.P and Johnson Jr. E.R., "Vector Mechanics for Engineers", Statics and Dynamics, McGraw–Hill International Edition, 2019.
4. Natarajan K.V., Engineering Mechanics, Dhanalakshmi Publishers, 2011.

b) References:

1. Egor. P.Popov, Engineering Mechanics of Solids, Prentice Hall of India, Second Edition,New Delhi 2015..
2. Timoshenko, S.P. and Gere, J.M. Mechanics of Materials, Tata McGraw Hill, 1992
3. William A.Nash, "Theory and Problems of Strength of Materials", Tata McGraw-Hill publishing Co., New Delhi, 2007.
4. Srinath L.S, "Advanced Mechanics of Solids", Tata McGraw-Hi publishing Co., New Delhi, 2007.
5. Subramanian R., "Strength of Materials", Oxford University Press, 3rd Edition New Delhi, 2016
6. Hibbeller R.C., Engineering Mechanics, Vol. 1 Statics, Vol. 2 Dynamics, Pearson Education Asia Pvt. Ltd., 2015.
7. Kottiswaran N., Engineering Mechanics, Sri Balaji Publications Pvt. Ltd., 2015.

c) Online Resources:

1. https://nptel.ac.in/courses/105106116/
2. http://nptel.ac.in/courses/112107147/
3. http://nptel.ac.in/courses/105106116/38
4. https://nptel.ac.in/courses/112/106/112106286/
5. https://nptel.ac.in/courses/122/104/122104015/

10211CE115	TECHNIQUES OF REPAIR AND REHABILITATION OF STRUCTURES	L	T	P	C
		3	0	0	3

Course Category / Type: Programme Core/ Theory

A. Preamble:

- This course deals with the concepts of maintenance, repair and strengthening techniques of building structures. It also deals with the properties of materials and materials used for repair.

B. Pre-Requisites:

- NIL

C. Link to other Courses:

- 10211CE105 – Design of R.C Elements.
- 10211CE108 – Construction Materials and Techniques
- 10211CE203 – Concrete Technology.

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Describe the maintenance and assessment method of distressed structures.	K2
CO2	Comprehend strength and durability properties, and their effects due to climate and temperature.	K2
CO3	Learn the recent development in concrete.	K2
CO4	Understand the techniques for repair and protection.	K2
CO5	Describe various strengthening techniques of structures.	K2

E. Correlation of COs with POs

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	POS1	POS2
CO1	H				H	L	L					M		M
CO2	M	M			M	M	L					M		M
CO3	H	M			H	L	M					M		M
CO4	H	M			M	M	L					M		H
CO5	M	M			H	M	M					M		H

F. Course Content:

UNIT I MAINTENANCE AND REPAIR STRATEGIES 9

Maintenance - Repair and Rehabilitation - Facets of maintenance, importance of maintenance, Various aspects of inspection - Assessment procedure for evaluating a damaged structure - Causes of deterioration. Diagnosis of construction failures- use of non-destructive testing techniques for evaluation for repair.

UNIT II SERVICEABILITY AND DURABILITY OF CONCRETE 9

Quality assurance for concrete - Concrete properties - Strength, permeability, thermal properties and cracking - Effects due to climate, temperature, chemicals, Corrosion - Corrosion damage of reinforced concrete, corrosion resistant steels, coatings, rust eliminators. - Design and construction errors - Effects of cover thickness and cracking.

UNIT III MATERIALS FOR REPAIR IN STRUCTURAL ELEMENTS 9

Special concretes and mortar - Concrete chemicals – Special elements for accelerated strength gain - Expansive cement – Polymer concrete - Sulphur infiltrated concrete - Ferro cement - Fiber reinforced concrete, High performance concrete, Vacuum concrete, Self-compacting concrete, Geopolymer concrete, Methods of repair in masonry and timber structures.

UNIT IV TECHNIQUES FOR REPAIR AND DEMOLITION 9

Polymers coating for rebars during repair - Foamed concrete, mortar and dry pack - Gunite and Shotcrete - Epoxy injection - Mortar repair for cracks - Shoring - Methods of corrosion protection - Corrosion inhibitors - Coatings and cathodic protection - Engineered demolition techniques for dilapidated structures - Case studies.

UNIT V STRENGTHENING TECHNIQUES 9

Repairs to overcome low member strength, deflection, cracking, chemical disruption, weathering corrosion, wear, fire, leakage and marine exposure, - coatings for set concrete and steel reinforcement, - Strengthening of Superstructures: Jacketing, adding steel plates, reinforcement addition and post stressing - Strengthening of Substructures: Underpinning methods.

TOTAL: 45 PERIODS

G. Learning Resources:

a) Text Books

1. Guha, P.K, "Maintenance and Repairs of Buildings", New Central Book Agency (P) Ltd, Calcutta, 2011.
2. Denison Campbell, Allen and Harold Roper, "Concrete Structures, Materials, Maintenance and Repair", Longman Scientific and Technical UK, 1991
3. Dodge woodson, "Concrete structures - protection, Repair and Rehabilitation", Butterworth-Heinmann, imprint of Elsevier, 2009.
4. Vidivelli.B, Rehabilitation of Concrete Structures Standard Publishes Distribution.1st edition 2009.

b) Reference Books

1. Macdonald, S, "Concrete - Building Pathology", Blackwell Science Limited, Oxford, 2008.
2. Shetty, M.S, "Concrete Technology – Theory and Practice", S. Chand and Company Ltd, New Delhi, 2012.
3. Chudley, R, "The Maintenance and Adaptation of Buildings", Longman Group Ltd, New York, 2002.
4. Ghosh, S.K, "Repair and Rehabilitation of Steel Bridges", Oxford and IBH Publishing Co., New Delhi, 1988.
5. A.R. Santa kumar, "Concrete Technology", Oxford University Press, New Delhi, 2006.
6. P.K. Mehta and P.J.M. Monteiro, "Concrete - Microstructure, Properties and Materials", McGraw-Hill, New York, 2014.
7. CPWD and Indian Buildings Congress, Hand book on Seismic Retrofit of Buildings, Narosa Publishers, 2008.

c) Online Resources

1. https://nptel.ac.in/courses/105/106/105106202/
2. https://onlinecourses.nptel.ac.in/noc21_ce13/preview\

10211CE201	STRENGTH OF MATERIALS	L	T	P	C
		2	0	2	3

Course Category /Type: Programme Core / Integrated Course

A. Preamble:

Students understanding this course are expected:

- To impart knowledge on theory, laboratory experiments in order to identify deflection, energy principles, theories of failure and unsymmetrical bending.

B. Prerequisite:

- 10211CE103 - Mechanics of Solids

C. Course Outcomes:

Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Interpret the concepts of stress and strain at a point as well as the energy principles for analysis of structural elements.	K3
CO2	Analyze of the indeterminate beams associated with Theorem of three moments	K3
CO3	Demonstrate about the columns and cylinders the behaviour of the materials and structures under applied loads.	K3
CO4	Determine the state of stress in 3D and design concepts based on failure theories.	K3
CO5	Analyze the stress strain behaviour of beams of unsymmetrical bending and curved beams.	K3

D. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	M	M	L								L	M	
CO2	M	M	M	M								L	M	
CO3	M	M	M	L								L	M	
CO4	M	M	M	L								L	M	
CO5	M	L	L	M								L	M	

E. Course Content:

UNIT I ENERGY PRINCIPLES 6

Strain energy method for determinate beams— Castigliano‟s theorems – Principle of virtual work – Application of energy theorems for computing deflections in beams and trusses – Maxwell‟s reciprocal theorems - Different failure theories for ductile and brittle materials.

UNIT II INDETERMINATE BEAMS 6

Types of beams for various loading conditions maximum at centre and maximum at end – Theorem of three moments – Analysis of continuous beams – Shear force and bending moment diagrams for continuous beams.

UNIT III COLUMNS 6

Eccentrically loaded short columns – Middle third rule – Core section – Columns of unsymmetrical sections (angle and channel sections) – Euler‟s theory of long columns – Critical loads for prismatic columns with different end conditions; Rankine-Gordon‟s formula for eccentrically loaded columns – Thick cylinders – Compound cylinders.

UNIT IV STATE OF STRESS IN THREE DIMENSIONS 6

Spherical and deviatory components of stress tensor - Determination of principal stresses and principal planes – Volumetric strain – Dilatation and Distortion- Theories of failure – Principal Stress dilatation –Principal Strain –Shear stress – Strain energy and distortion energy theories — Residual stresses

UNIT V ADVANCED TOPICS IN BENDING OF BEAMS 6

Unsymmetrical bending of beams of symmetrical and unsymmetrical sections – Curved beams – Winkler-Bach formula – Stress concentration.

LIST OF EXPERIMENTS

1. Tension Test on steel bars
2. Double shear test on mild steel
3. Torsion test on mild steel
4. Brinell and Rockwell Hardness tests
5. Charpy and Izod Impact tests on mild steel
6. Test on springs (Both closed coil and open coiled helical springs)
7. Deflection Tests on steel beams

TOTAL: 30+30 = 60 PERIODS

F. Learning Resources:

a) Text Books:

1. Rajput.R.K. “Strength of Materials (Mechanics of Solids)”, S.Chand and Co, New Delhi, 2015.
2. Bansal R.K. ”Strength of materials”, Laxmi Publications, New Delhi, 2018.

b) Reference Book:

1. Subramanian R. ”Strength of materials”, Oxford University Press, New Delhi, 2016.
2. Ramamrutham, S.,”Strength of Materials”, DhanpatRai& Sons, 2011.
3. Bhavikatti. S., "Solid Mechanics", Vikas publishing house Pvt. Ltd, New Delhi, 2010.
4. William A. Nash, ”Theory and Problems of Strength of Materials”, Schaum‟s Outline Series, Tata McGraw-Hill publishing co., New Delhi, 2014.
5. Srinath L.S,” Advanced Mechanics of Solids”, Tata McGraw-Hill Publishing Co., New Delhi, 2017.

c) Online resources:

1. https://nptel.ac.in/courses/105/105/105105108/

10211CE202	SOIL MECHANICS	L	T	P	C
		2	0	2	3

Course Category / Type: Programme Core/ Integrated Course

A. Preamble :

- Soil is a construction material and typically the natural foundation that supports the man- made structure.
- In designing a structure, engineering the properties of the soil greatly influences the stability of the structure.
- Understanding the problems involved in soil mechanics is of paramount importance.

B. Pre-Requisites:

- NIL

C. Link to other course

- 10211CE111 - Foundation Engineering

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Classify soil and identify the various engineering properties.	K2
CO2	Assess the effect of water in soil.	K3
CO3	Ascertain the stress distribution in soil under influence of various loads and thus compute the consolidation.	K3
CO4	Experiment with the shear strength parameters in the laboratory.	K3
CO5	Select the various site exploration methods.	K3

E. Correlation of COs with POs

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	H										L	M	
CO2	M	H										L	M	
CO3	M	H	H	M								L	M	
CO4	M	H		M								L	M	
CO5	M					L						M	M	

F. Course Content:

UNIT I ORIGIN OF SOIL AND ITS PROPERTIES 6

Geomorphic processes - Rock weathering - Formation of soils - soil profiles - soils of India, Geologic work and engineering significance of wind, rivers and oceans - Interior constitution of the earth - composition of different layers - SIMA & SIAL. Nature of soil - Soil description and classification for engineering purposes - IS Classification system - Phase relationships.

UNIT II SOIL WATER 6

Soil compaction - Theory, comparison of laboratory and field compaction methods. Soil water – pore pressure- Effective stress concepts in soil– capillarity- Permeability measurement in the laboratory and field- Factors influencing permeability - Seepage – Flow nets - Characteristics – Application.

UNIT III STRESS DISTRIBUTION AND SETTLEMENT 6

Stress distribution in soil media - Use of influence charts - Components of settlement - Immediate and consolidation settlement - √t and log t methods– e-log p relationship Terzaghi's one dimensional consolidation theory.

UNIT IV SHEAR STRENGTH 6

Shear strength of cohesive and cohesion less soils - Mohr - Coulomb failure theory -Measurement of shear strength - Direct shear, Triaxial compression, Un-Confined Compressive tests and Vane shear tests.

UNIT V SITE EXPLORATION 6

Scope and objectives -Methods of exploration -auguring and boring -Wash boring and rotary drilling -Depth of boring -Spacing of bore hole -Sampling techniques -Representative and undisturbed sampling -methods - Split spoon sampler, Thin wall sampler, Stationery piston sampler.

LIST OF EXPERIMENTS:

1. Determination of
   (a) Grain Size Distribution (Dry sieve analysis)
   (b) Specific gravity of soil grains.
   (c) Determination of moisture - density relationship using standard Proctor Method.
2. Atterberg Limits.
   (a). Shrinkage limit
   (b). Plastic limit
   (c). Liquid limit.
3. Determination of
   (a) Permeability by constant head method.
   (b) Field Density by Sand replacement method.
4. Determination of
   (a) Shear strength by Direct shear test on cohesion less soil.
   (b) Shear strength by Unconfined Compression test on cohesive soil.

Total: 30 + 30 = 60 Periods

G. Learning Resources:

a) Text Books

1. Parbin Singh, Engineering and General Geology, S. K. Kataria& Sons, New Delhi, 2014.
2. Gopal Ranjan and Rao A.S.R., “Basic and Applied Soil Mechanics”, New Age International, 2007.
3. Punmia B.C., “Soil Mechanics and Foundations”. Laxmi Publications Pvt. Ltd., New Delhi, 2005.

b) References

1. Arora K.R., "Soil Mechanics and Foundation Engineering" , Standard Publishers and Distributors, New Delhi, 2011
2. Holtz R.D., Kovacs W.D. and Sheahan T.C., "Introduction to Geotechnical Engineering",Pearson, 2011
3. Sutten B.H.C., "Solving Problems in Soil Mechanics", Longman Group Scientific and Technical, U.K. England, 2007.
4. Khan I.H., "A Text book of Geotechnical Engineering", Prentice Hall of India, New Delhi, 2012.

c) Online resources

1. http://nptel.ac.in/courses/105101084/
2. https://nptel.ac.in/courses/105103097/
3. https://onlinecourses.nptel.ac.in/noc18_ce05/preview
4. http://www.nptelvideos.in/2012/11/soil-mechanics.html
5. http://nptel.ac.in/downloads/105106142/
6. http://nptel.ac.in/downloads/105101001/

d) Codes

1. SP 36-1 (1987) Compendium of Indian Standards on Soil Engineering: Part-1 Laboratory Testing of Soils for civil Engineering Purposes

2. SP 36-2 (1988) Compendium of Indian Standards on Soil Engineering: Part-2 Field Testing of Soils for Civil Engineering Purposes

10211CE203	CONCRETE TECHNOLOGY	L	T	P	C
		2	0	2	3

Course Category / Type: Programme Core / Integrated

A. Preamble:

- To acquire knowledge of the materials used for concrete.
- To acquire knowledge of the concrete mix design and properties of concrete.
- To understand about the various types of concrete.

B. Prerequisite:

- 10211CE108 – Construction Materials and Techniques

C. Link to other Courses:

- NIL

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Explain the properties and testing of cement and aggregates.	K2
CO2	Design the mix proportion using various methods.	K3
CO3	Demonstrate the fresh and hardened properties of concrete.	K2
CO4	Explain various process involved in concrete and concreting methods.	K2
CO5	Illustrate the applications of various special concretes.	K2

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L					L	M		M			L		L
CO2	L	M	M			M		M				M		M
CO3	L					L	L		H					M
CO4	L					L	M					L		M
CO5	L						M					L		M

F. Course Content:

UNIT I CONSTITUENT MATERIALS 6

Cement - Grade of cement - Different types - Chemical composition - Hydration of cement - Tests on cement - Aggregates - classification - Properties - Grading - Testing of aggregates - Water - Quality of water for use in concrete - Chemical admixtures - Mineral admixtures.

UNIT II PROPORTIONING OF CONCRETE MIX 6

Principles of mix proportioning - Physical properties of materials required for mix design - Methods of concrete mix design - Design mix - Nominal mix - Mix design computation based on BIS Method, ACI Method.

UNIT III FRESH AND HARDENED PROPERTIES OF CONCRETE 6

Workability - Tests for workability of concrete - Segregation - Bleeding - Determination of strength properties of hardened concrete - Compressive strength - Split tensile strength -

Flexural strength - NDT - Durability of concrete - Water absorption - Permeability - Corrosion test - Acid resistance.

UNIT IV CONCRETING METHODS 6

Process of manufacturing of concrete - Batching - Mixing - Transportation - Placing - Curing - Extreme weather concreting - Special concreting methods - Vacuum dewatering - Underwater Concrete - Ready mix concrete.

UNIT V SPECIAL CONCRETE 6

Light weight concrete - Foam concrete - Self compacting concrete - High strength concrete - High volume fly ash concrete - Fibre reinforced concrete - Ferrocement - Polymer Concrete - High performance concrete - Geopolymer concrete - Bacterial concrete.

LIST OF EXPERIMENTS:

1. Tests on cement
    a. Consistency
    b. Setting time
    c. Fineness
    d. Soundness
2. Determination of Properties of fresh concrete
    a. Slump Cone Test
    b. Vee - Bee Consistometer
    c. Flow Table Test
    d. Compaction Factor
3. Determination of Properties of Hardened Concrete
    a. Compression Test
    b. Tension Test
    c. Flexural Test
    d. Water absorption
    e. Permeability

4. Non-Destructive Tests on Concrete
    a. Rebound Hammer Test.
    b. Ultrasonic Pulse Velocity Test.
    c. Profometer.

TOTAL : 30+30 = 60 PERIODS

G. Learning Resources:

a) Text Books:

1. Shetty M.S., Concrete Technology, S.Chand and Company Ltd, New Delhi, 2018.
2. Mehta K.P., Concrete - Microstructure, properties and materials, McGraw Hill Education, New Delhi, 2017.

b) References:

1. Santhakumar A.R., Concrete Technology, Oxford University Press, 2018.
2. Neville A.M., Properties of Concrete, Prentice Hall, London, 2012.
3. Gambhir M.L., Concrete Technology, McGraw Hill Education, 2017.
4. Gupta B.L., Amit Gupta, Concrete Technology, Jain Book Agency, 2014.

5. IS:10262-2019, Guidelines for Concrete Mix Proportioning, Bureau of Indian Standards, New Delhi.
6. IS:383-2016, Specification for coarse and fine aggregates from natural sources for concrete, Bureau of Indian Standards, New Delhi.
7. IS:456-2000, Code of practice for plain and reinforced Concrete, Bureau of Indian Standards, New Delhi.

c) Online Resources:

1. https://nptel.ac.in/courses/105/102/105102012/
2. https://nptel.ac.in/content/syllabus_pdf/105106176.pdf

10211CE204	WASTEWATER TREATMENT AND RECYCLING	L	T	P	C
		2	0	2	3

Course Category: Programme Core / Integrated Course

A. Preamble :

- Students undergoing this course are expected, to estimate sewage generation and design sewer system including sewage pumping station and its characteristics and composition of sewage and design of the unit operations and processes that are used in sewage treatment

B. Pre-Requisites:

- 10211CE113 - Water Supply Engineering

C. Link to other courses:

- NIL

D. Course outcomes:

Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Explain the basics of sewage, types of sewers and sewer material.	K2
CO2	Illustrate the features of various sewer appurtenances.	K3
CO3	Design the methods of sewage treatment and study the features and function of different primary treatment units.	K3
CO4	Utilize the features and function of different secondary treatment units.	K3
CO5	Explain the objectives and methods of sewage disposal and methods of sludge management.	K2

E. Correlation of COs with POs

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	L	L			M	M							
CO2	M	M	H			H	H						H	
CO3	M	M	H			H	M						M	L
CO4	M	M	M			M	H						M	L
CO5	M	M	M			M	M							

F. Course Content:

UNIT I PLANNING FOR SEWERAGE SYSTEMS 6

Sources of wastewater generation – Effects – Estimation of sanitary sewage flow – Estimation of storm runoff – Factors affecting characteristics and composition of sewage and their significance – Effluent standards – Legislation requirements.

UNIT II SEWER DESIGN 6

Sewerage – Hydraulics of flow in sewers – Objectives – Design period - Design of sanitary and storm sewers – Computer applications – Laying, joining & testing of sewers – appurtenances – Pumps – selection of pumps and pipe drainage - Plumbing system for buildings – One pipe and two pipe system.

UNIT III PRIMARY TREATMENT OF SEWAGE 6

Objective – Selection of treatment processes – Principles, functions, design and drawing of units - Onsite sanitation – Primary treatment – Principles, functions design and drawing of screen, grit chambers and primary sedimentation tanks.

UNIT IV SECONDARY TREATMENT OF SEWAGE 6

Objective – Selection of treatment methods – Principles, functions, design and drawing of units - Activated sludge process and trickling filter – Oxidation ditches, UASB – Waste stabilization ponds – Reclamation and reuse of sewage - Recent advances in sewage treatment.

UNIT V DISPOSAL OF SEWAGE AND SLUDGE MANAGEMENT 6

Standards for disposal - methods – dilution – Self-purification of surface water bodies – Oxygen sag curve – Land disposal – Sludge characterization – Thickening – Sludge digestion – Biogas recovery – Sludge conditioning and dewatering – Advances in sludge disposal.

LIST OF EXPERIMENTS

1. Coagulation and Precipitation process for treating wastewater.
2. Determination of Solids in wastewater.
3. Biochemical oxygen demand.
4. Chemical oxygen demand.
5. Determination of Calcium, Potassium and Sodium in wastewater.

TOTAL: 30 + 30 = 60 PERIODS

G. Learning Resources:

1. Text Books:

1. Garg, S.K., "Environmental Engineering" Vol. II, Khanna Publishers, New Delhi, 2019.
2. Punmia, B.C., Jain, A.K., and Jain. A., "Environmental Engineering", Vol.II, Lakshmi Publications, News letter, 2018.

2. References:

1. Manual on Sewerage and Sewage Treatment, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2013.
2. Metcalf & Eddy, "Wastewater Engineering" – Treatment and Reuse, Tata McGraw Hill Company, New Delhi, 2014.
3. Karia G L & Christian R A, "Wastewater Treatment", Prentice Hall of India, New Delhi, 2013

3. Online Resources:

1. http://nptel.ac.in/courses/103107084/
2. http://nptel.ac.in/courses/105106119/
3. http://nptel.ac.in/courses/105105048/
4. http://www.vssut.ac.in/lecture_notes/lecture1424353637.pdf

10211CE205	APPLIED HYDRAULIC ENGINEERING	L	T	P	C
		2	0	2	3

Course Category / Type: Programme Core / Integrated Course

A. Preamble:

- Student will understand basis of open channel flow characteristics including hydraulic jump and surges and design hydraulic machines.

B. Prerequisite:

- 11211CE102 - Fluid Mechanics

C. Link to other Courses:

- NIL

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Construct basics of open channel flows, its classification with specific energy concept and its application in open channels	K3
CO2	Apply the uniform flow in steady state condition and best hydraulic sections.	K3
CO3	Develop the gradually varied flow with with exposure to positive and negative surges.	K3
CO4	Identify the momentum principle to impact of jets and to design turbines with work done.	K3
CO5	Experiment with the pumps and relate working principle of various pumps with design of centrifugal and reciprocating pump.	K3

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	H	L				L						L	
CO2	M	H	M				L					L	L	
CO3	M	H	M	L			L					L	L	
CO4	M	H	M	M								M		L
CO5	M	H	M	M								M		L

F. Course Content:

UNIT I OPEN CHANNEL FLOW 6

Difference between pipe and open channel flow –Properties of open channel – Classification of flows- Effect of viscosity and gravity-Subcritical, supercritical and critical flow – Fundamental equations -Velocity distribution- Velocity measurement -Pressure distribution – Wide open channel – Specific energy –Specific force- Critical flow and its computation – Vertical and horizontal channel transition.

UNIT II UNIFORM FLOW 6

Introduction – Chezy‟s and Manning‟s equations –Significance and relationship between different roughness coefficients – Determination of normal depth and velocity for rectangular, trapezoidal, triangular and circular sections – Hydraulically efficient channel sections.

UNIT III VARIED FLOW 6

Dynamic equations of gradually varied flow – Classification and characteristics of flow profiles – Control section- Break in grade-Profile determination by direct and standard step methods – Application of momentum equation to RVF-Hydraulic jump – Types – Energy dissipation – Surges.

UNIT IV TURBINES 6

Impact of jets on flat plate and curved vanes-Euler‟s head - Classification of turbines-Head and efficiencies of hydraulic turbines-Working principle and work done by Pelton wheel, Francis and Kaplan turbine- Draft tube theory -Specific speed- Unit quantities- Characteristic curves.

UNIT V PUMPS 6

Classification of pumps- Head and efficiencies of centrifugal pump-Working principle and work done-Priming-Minimum speed to start the pump- NPSH –Multistage pumps – Working of submersible and jet pumps - Reciprocating pump - negative slip - flow separation conditions - Indicator diagram and its variations - air vessels - savings in work done.

LIST OF EXPERIMENTS

1. Determination of Coefficient of discharge of the given Orifice meter
2. Determination of Coefficient of discharge of the given Venturi meter
3. Determination of coefficient of discharge for a Rectangular Notch
4. Determination of Friction Factor of fluid flow through pipes (Major Losses)
5. Determination of characteristics of Kaplan Turbine
6. Determination of characteristics of Pelton Wheel Turbine
7. Determination of characteristics of Francis Turbine
8. Determination of characteristics of Submersible Pump
9. Determination of characteristics of Jet Pump
10. Determination of characteristics of Reciprocating Pump
11. Determination of characteristics of Centrifugal Pump

TOTAL: 30+30 = 60 PERIODS

G. Learning Resources:

a) Text Books:

1. Subramanya K., “Flow in Open channels”, Tata McGraw-Hill Publishing Company, New Delhi, 2009.Modi, P.N, and Seth S.M., “Hydraulic and Fluid Mechanics”,19th edition, Standard Book House, New Delhi, 2013.
2. Jain A.K., "Fluid Mechanics (including Hydraulic Machines)", 8th edition, Khanna Publishers, New Delhi, 2010.

b) References:

1. Ven Te Chow, Open Channel Hydraulics, McGraw Hill, New York, 2009.
2. Chandramouli P N, Applied Hydraulic Engineering, Yes Dee Publisher, 2017
3. Subramanya K., "Hydraulic Machines", Tata McGraw-Hill Publishing Company, New Delhi, 2013.

c) Online Resources:

1. http://nptel.ac.in/courses/105103021/
2. http://nptel.ac.in/courses/105107059/

10211CE206	STRENGTH OF MATERIALS II	L	T	P	C
		2	0	2	3

Course Category /Type: Programme Core / Integrated Course

A. Preamble:

- This course deals with the analysis of columns, deflection in beams and torsion in shafts with theory and practical knowledge. It also deals with the fundamental concepts of energy principles and their applications.

B. Prerequisite:

- Strength of Materials I

C. Link to other Courses:

- Design of RC Elements

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Utilize the energy principles for the analysis of structural elements	K3
CO2	Analyse the indeterminate beams	K3
CO3	Analyse the columns and thick cylinders	K3
CO4	Determine the slope and deflection of beams and shear stresses in beams	K3
CO5	Determine the stresses and deformation in shafts and in springs	K3

E. Correlation of COs with Pos

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	H	M	L								L	M	
CO2	M	H	M	L								L	M	
CO3	M	H	M	L								L	M	
CO4	M	H	M	L								L	M	
CO5	M	H	M	L								L	M	

F. Course Content:

UNIT I ENERGY PRINCIPLES 6

Strain energy method for determinate beams - Castigliano's theorems – Principle of virtual work – Application of energy theorems for computing deflections in beams and trusses – Maxwell's reciprocal theorems - Different failure theories for ductile and brittle materials.

UNIT II INDETERMINATE BEAMS 6

Types of beams for various loading conditions maximum at centre and maximum at end – Theorem of three moments – Analysis of continuous beams – Shear force and bending moment diagrams for continuous beams.

UNIT III COLUMNS AND THICK CYLINDERS 6

Eccentrically loaded short columns – Middle third rule – Core section – Columns of unsymmetrical sections (angle and channel sections) – Euler's theory of long columns – Critical loads for prismatic columns with different end conditions; Rankine-Gordon's formula for eccentrically loaded columns – Thick cylinders – Compound cylinders.

UNIT IV DEFLECTION OF BEAMS AND SHEAR STRESSES 6

Deflection of beams – Double integration method – Macaulay's method – Conjugate Beam method – Variation of shear stress – Shear stress distribution in Rectangular, I sections, Solid circular sections, Hollow circular sections, Angle and channel sections

UNIT V TORSION AND SPRINGS 6

Stresses and deformation in circular (solid and hollow shafts) – Shafts fixed at both ends – Leaf springs – Stresses in helical springs – Deflection of springs.

LIST OF EXPERIMENTS

1. Tension Test on steel bars
2. Double shear test on mild steel
3. Torsion test on mild steel
4. Brinell and Rockwell Hardness tests
5. Charpy and Izod Impact tests on mild steel
6. Test on springs (Both closed coil and open coiled helical springs)
7. Deflection Tests on steel beams

TOTAL: 30+30 = 60 PERIODS

G. Learning Resources:

a) Text Books:

1. Rajput.R.K. "Strength of Materials (Mechanics of Solids)", S.Chand and Co, New Delhi, 2015.
2. Bansal R.K. "Strength of materials", Laxmi Publications, New Delhi, 2018.

b) Reference Book:

1. Subramanian R. "Strength of materials", Oxford University Press, New Delhi, 2016.
2. Ramamrutham, S.,"Strength of Materials", DhanpatRai& Sons, 2011.
3. Bhavikatti. S., "Solid Mechanics", Vikas publishing house Pvt. Ltd, New Delhi, 2010.
4. William A. Nash, "Theory and Problems of Strength of Materials", Schaum's Outline Series, Tata McGraw-Hill publishing co., New Delhi, 2014.
5. Srinath L.S," Advanced Mechanics of Solids", Tata McGraw-Hill Publishing Co., New Delhi, 2017.

c) **Online resources:**

1. https://nptel.ac.in/courses/105/105/105105108/

10211CE301	SURVEYING PRACTICAL	L	T	P	C
		0	0	2	1

Course Category / Type: Programme Core / Laboratory Course

A. Preamble:

- To provide the understanding for various basic methods of surveying and survey equipments.

B. Prerequisite:

- 10211CE109 - Surveying

C. Link to other Courses:

- 10211CE303 - Survey camp

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Utilize the linear, angular and graphical methods of measurements for plotting areas.	K3
CO2	Apply the leveling methods and working principles of various levels and theodolite.	K3
CO3	Apply tacheometry concepts in finding horizontal angle, vertical angle, heights and distances between points in a field.	K3

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	H				L			M	L			M	
CO2	H	H		L	M	L		L	M	L		L	M	
CO3	H	H			H	L			M	L		L	M	

F. LIST OF EXPERIMENTS

1. Ranging and Chaining of a line
2. Compass Traversing (open and closed)
3. Plane table surveying: Radiation, Intersection, Traversing.
4. Study of levels and levelling staff
5. Fly leveling , Check levelling
6. Study of theodolite
7. Measurement of horizontal angles and vertical angles *(Reiteration and repetition methods)*
8. Heights and distances - Single plane method- Double plane method.
9. Tacheometry - Tangential system - Stadia system - Subtense system *(any two methods)*

TOTAL: 30 PERIODS

G. Learning Resources:

a) Text Books:

1. Punmia B.C. Surveying, Vols. I, II and III, Laxmi Publications, 2005
2. Kanetkar T.P., Surveying and Levelling, Vols. I and II, Pune Vidyarthi Griha Prakashan, 24th edition, 2010.

b) References:

1. Clark D., Plane and Geodetic Surveying, Vols. I and II, C.B.S. Publishers and Distributors, Delhi, Sixth Edition, 2004.
2. James M.Anderson and Edward M.Mikhail, Introduction to Surveying, McGraw-Hill Book Company, 1990.
3. Heribert Kahmen and Wolfgang Faig, Surveying, Walter de Gruyter, 1995.
4. Bannister A. and Raymond S., Surveying, ELBS, 7th Edition, 1998.
5. Raymond Paul and Walter Whyte., Basic Surveying, Taylor & Francis, 2012.

c).Online Resources:

1. https://youtu.be/I1KCZCyNWbA NPTEL lecture notes
2. https://www.youtube.com/watch?v=j8poe2vvD2Q levelling lecture notes.
3. https://www.youtube.com/watch?v=irNlaNP63nA profile and crossectional leveling notes.

10211CE302	COMPUTER AIDED BUILDING DRAWING	L	T	P	C
		0	0	2	1

Course Category / Type: Programme Core / Laboratory Course

A. Preamble:

- To learn the orientation and provide basic principles of drawing the plan, sectional elevation and perspective view for one and two storey buildings.

B. Prerequisite:

- 10210ME201 - Engineering Graphics

C. Link to other Courses:

- 10211CE112 - Cost Estimation and Valuation

Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Demonstrate the orientation basics ,building planning , plan, elevation and sectional view of the residential buildings	K3
CO2	Apply the basic principles of drawing the plan, section and elevation of various RC and Steel structures	K3
CO3	Illustrate the perspective projections and sections of buildings	K3

D. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L				H			M		M	L	M	M	
CO2	L				H			M		M	M	M	M	
CO3	L				H			M		M	M	M	M	

E. List of Experiments:

1. Introduction to building planning - Vastu shastra and architecture
2. Buildings with load bearing walls and RCC roof -Line Sketch, Plan, Elevation, Section
3. Drawing of simple residential building -Line Sketch, Plan, Elevation, Section
4. Framed office building - Line Sketch, Plan, Section and Elevation.
5. Workshop building - Line Sketch, Plan, Elevation, Section
6. Perspective view of single and two storied building

TOTAL: 30 PERIODS

F. Learning Resources:

a) Text Books:

1. Deodhar .S.V, "Building Science and Planning", Anna publishers, 2011.
2. David S. Cohn, "AutoCAD 2000", Tata McGraw Hill, Publishing Company, New Delhi, 2000.
3. Yarwood, A., "An Introduction to AutoCAD, 2000", Pearson Education Limited, England, 2000.

b) References:

1. Bhatt N. D, "Engineering Drawing", Charotar Publishing, 50th Edition, 2011.
2. Kumara swamy N and Kameswara Rao, "Building Planning and Drawing", 7th Edition, 2013.

c) Online Resources:

1. https://nptel.ac.in/courses/105/104/105104148/

10211CE303	SURVEY CAMP	L	T	P	C
		0	0	2	1

Course Category / Type: Programme Core / Laboratory Course

A. Preamble:

- The camp is useful for the learners to apply the surveying methods and concepts on practical in large scale to get the real time field exposure.

B. Prerequisite:

- 10211CE109 - Surveying
- 10211CE301 - Surveying Practical

C. Link to other courses

- Nil

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Demonstrate the methods to measure larger irregular area and to identify the location using GPS	K3
CO2	Solve the methods of cutting and filling for a gradient.	K3
CO3	Organize the methods to calculate the volume of a basin and to carry out foundation marking	K3

E. Correlation of Cos with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L				M			M	M	M	L		L	M
CO2	H				H			M	M	M	L		L	M
CO3	H				H			M	M	M	L		L	M

F*. List of Experiments:** ***(minimum one week)

1. Triangulation using electronic theodolite / total station (Area : not less than 10000 m^2)
2. Use of D-GPS to determine latitude and longitude (demonstration only).
3. Longitudinal and cross sectioning (For a distance not less than 1 km and interval not greater than 5 m) and calculation of cutting and filling for a gradient.
4. Block contouring (Area of not less than 10000 m^2 and horizontal interval not greater than 20 m) and calculation of volume.
5. Setting out of foundation work using total station.
6. Setting out of simple curve.

TOTAL: 30 PERIODS

G. Learning Resources:

a) Text Books:

1. Punmia B.C., "Surveying, Vols. I, II and III", Laxmi Publications,16th edition, New Delhi, 2005.

b) References:

1. Clark D., "Plane and Geodetic Surveying, Vols. I and II", C.B.S. Publishers and Distributors, Delhi, Sixth Edition, 2017.
2. Kanetkar T.P., "Surveying and Levelling, Vols. I and II", United Book Corporation, Pune, 2006.

c) Online Resources:

1. https://nptel.ac.in/courses/105/107/105107122/
2. https://nptel.ac.in/courses/105/104/105104101/
3. https://youtu.be/y-GMVrWKrm8

10211CE304	COMPUTER AIDED DESIGN AND DRAFTING LABORATORY	L	T	P	C
		0	0	2	1

Course Category / Type: Programme Core / Laboratory

A. Preamble:

Students undergoing this course are expected

- To impart knowledge to analysis the structures.
- To develop skills to design and drafting of various reinforced concrete elements using computer software package STAAD Pro.

B. Prerequisite:

- 10211CE105 - Design of Reinforced Concrete Elements

C. Link to other Courses:

- NIL

D. Course Outcomes:

Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Level of learning domain
CO1	Utilize the appropriate software tools for assigning properties, supports and loadings for a structural model.	K3
CO2	Apply the different support and loading conditions for beams and frames.	K3
CO3	Design the RC beams and columns in a simple framed structure and multi-storey framed structure.	K3

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1					H							M		
CO2		H			H					M		M		
CO3			H		H			M		M		M	H	M

F. List of Experiments:

1. Introduction to STAAD.Pro. Connect Edition.
2. Assigning properties, Assigning materials and Assigning supports.
3. Assigning different types of loads and their combinations.
4. Analysis of simply supported, cantilever and fixed beam under application of different types of loads and their combinations.
5. Analysis of 2D rigid jointed frames.
6. Analysis of 2D pin jointed frames.
7. Analysis of 3D rigid jointed frames and pin jointed frames.
8. Analysis of 3D multistorey framed structure.
9. Design of RC beams and columns for 2D RC portal frame.
10. Analysis, design and drafting of 3D RC multistorey framed structure.

TOTAL: 30 PERIODS

G. Learning Resources:

a) Text Books:

1. Krishnamoorthy C.S, and Rajeev S, Arunachalam Rajaraman, Computer Aided Design Software and Analytical tools, Alpha Science International Ltd., 2009.
2. Sarma T.S, STAAD Pro V8i for Beginners with Indian Examples, Notion Press, Chennai, 2014.
3. Sivakumar Naganathan, Structural Analysis and Design using STAAD.Pro V8i, LAP LAMBERT Academic Publishing, Republic of Moldova, 2012.

b) References:

1. Sham Tickoo, Exploring Bentley STAAD Pro. Connect Edition, Tickoo-CADCIM Series, USA.

4. Online Resources:

1. https://docs.bentley.com/LiveContent/web/STAAD.Pro%20Help-v9/en/GUID-926983A6-E633-4406-8F02-82DE8F2F9FF2.html
2. https://caddcentre.org/cctsfiles/manual/staadpro.pdf
3. https://www.nairaland.com/4891442/free-staad-pro-connect-edition

d) IS Codes:

1. IS 456:2000 Plain and Reinforced Concrete - Code of Practice.
2. SP 34:1987 Handbook of concrete reinforcement and detailing.
3. IS 875(1-5):1987 Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures.
4. National Building Code of India 2016 (NBC 2016).

e) Online Resources :

1. https://nptel.ac.in/courses/124/105/124105013/
2. https://nptel.ac.in/courses/105/106/105106206/
3. https://nptel.ac.in/courses/105/106/105106053/
4. https://nptel.ac.in/courses/105/106/105106144/

PROGRAMME ELECTIVE

Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)

School of Mechanical and Construction
Department of Civil Engineering
Programme Elective

S.No	Course Code	Course Name	Credits	Prerequisite	Remarks
Structural Engineering					
1	10212CE101	Prestressed Concrete Design	3	10211CE105 - Design of Reinforced Concrete Elements	
2	10212CE102	Design of Advanced Concrete and Masonry Structures	3	10211CE105 - Design of Reinforced Concrete Elements	
3	10212CE103	Prefabricated Structures	3	10211CE108- Construction Materials and Techniques.	
4	10212CE104	Basics of Dynamics and Earthquake Engineering	3	10211CE101 -Engineering Mechanics	
5	10212CE105	Repair and Rehabilitation of Structures	3	NIL	Added in Programme Core
6	10212CE142	Finite Element Method and Modelling	3	NIL	
7	10212CE143	Advanced Strength of Materials	3	10211CE206 - Strength of Materials II	
Water Resources and Environmental Engineering					
8	10212CE106	Solid and Hazardous Waste Management	3	NIL	
9	10212CE107	Air Pollution Monitoring and control	3	NIL	
10	10212CE108	Hydrology	3	NIL	
11	10212CE109	Plastic and E-Waste Management	3	NIL	
12	10212CE110	Irrigation Engineering	3	NIL	
13	10212CE144	Environmental Management System	3	NIL	
Geotechnical Engineering					
14	10212CE111	Remediation of contaminated sites	3	10211CE202 - Soil Mechanics.	
15	10212CE112	Ground Improvement Techniques	3	10211CE202 - Soil Mechanics.	
16	10212CE113	Advanced Foundation Engineering	3	10211CE111- Foundation Engineering	
17	10212CE114	Geotechnical Earthquake Engineering	3	10211CE202 - Soil Mechanics.	

18	10212CE115	Soil Structure Interaction	3	10211CE111- Foundation Engineering	
19	10212CE145	Rock Engineering	3	10211CE202 - Soil Mechanics	
Construction Engineering andManagement					
20	10212CE116	Construction Planning, Scheduling and Control	3	NIL	
21	10212CE117	Construction Equipment and Practices	3	NIL	
22	10212CE118	Modern Building Technology	3	NIL	
23	10212CE119	Green Built Environment	3	NIL	
24	10212CE120	Construction Safety Management	3	NIL	
25	10212CE146	Failure Assessment and Rehabilitation of Structures	3		
Remote Sensing & GISand Transportation Engineering					
26	10212CE121	Engineering Geology	3	NIL	
27	10212CE122	Introduction to Remote Sensing	3	NIL	
28	10212CE123	Geographical Information System	3	NIL	
29	10212CE124	Pavement Engineering	3	10211CE106 -Transportation Engineering	
30	10212CE125	Intelligent Transportation Systems	3	10211CE106 - Transportation Engineering	
31	10212CE147	Remote Sensing and GIS in Transportation Development	3	10211CE106 - Transportation Engineering	

10212CE101	PRESTRESSED CONCRETE DESIGN	L	T	P	C
		2	2	0	3

Course Category: Programme Elective / Theory

A. Preamble:

Students undergoing this course are expected:

- To learn the principles, materials, methods and systems of prestressing.
- To know the different types of losses and deflection of prestressed concrete members.
- To provide an exposure to the analysis and design of prestressed concrete structures and various structural elements.

B. Prerequisite:

- 10211CE105 - Design of Reinforced Concrete Elements

C. Link to other Courses:

- Nil

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Use basic fundamentals of prestressing and design a prestressed concrete beam accounting for losses.	K3
CO2	Design prestressed concrete flexural and shear members.	K3
CO3	Design the anchorage zone for post tensioned members and deflection in beams.	K3
CO4	Analyze and design composite members and continuous beams.	K3
CO5	Understand the concept of partial prestressing and design a prestressed concrete sleepers, pipes and poles.	K3

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	L	M	M				L				M	H	
CO2	H	L	M	M				L				M	H	
CO3	H	L	M	M				L				M	H	
CO4	H	L	M	M				L				M	H	
CO5	H	L	M	M				L				M	H	

F. Course Content:

UNIT I FUNDAMENTALS DESIGN CONCEPTS OF PRESTRESSING 6+6

Historical developments – Basic principles of prestressing – Classification and types – Advantages over ordinary reinforced concrete – Materials – High strength concrete and high tensile steel – Methods of prestressing – Freyssinet, Magnel, Lee-McCall and Gifford Udall anchorage systems – Analysis of sections of stresses by stress concept, strength concept and load balancing concept – Losses of prestress in post - tensioned and pre-tensioned members.

UNIT II DESIGN OF FLEXURE AND SHEAR 6+6

Basic assumptions for calculating flexural stresses – Permissible stresses in steel and concrete as per IS 1343 Code – Design of sections of Type I and Type II post-tensioned and pre-tensioned beams – Check for strength based on IS 1343:2012 Code – Layout of cables in post-tensioned beams – Location of wires in pre-tensioned beams – Design for shear based on IS 1343:2012 Code.

UNIT III DEFLECTION AND DESIGN OF ANCHORAGE ZONE 6+6

Factors influencing deflections – Short term deflections of uncracked members – Prediction of long term deflections due to creep and shrinkage – Check for serviceability limit state of deflection - Determination of anchorage zone stresses in post-tensioned beams by Magnel‟s method - Guyon‟s method and IS 1343 code - Design of anchorage zone reinforcement – Check for transfer bond length in pre-tensioned beams.

UNIT IV COMPOSITE BEAMS AND CONTINUOUS BEAMS 6+6

Analysis and design of composite beams – Shrinkage strain and its importance – Methods of achieving continuity in continuous beams – Analysis for secondary moments – Concordant cable and linear transformation – Calculation of stresses – Principles of design.

UNIT V MISCELLANEOUS STRUCTURES 6+6

Design of tension and compression members – sleepers, pipes and poles – Partial prestressing – Definition, methods of achieving partial prestressing, merits and demerits of partial prestressing.

TOTAL : 30+30 = 60 PERIODS

G. Learning Resources:

a) Text Books:

1. Krishna Raju N, Prestressed Concrete, 6th Edition, Tata McGraw Hill Education, New Delhi, 2018.
2. Pandit G. S. and Gupta S. P. Prestressed Concrete, CBS Publishers and Distributers, Pvt. Ltd, 2019.

b) References:

1. Rajagopalan N, Prestressed Concrete, Narosa Publishing House, 2002.
2. Dayaratnam P and Sarah P, Prestressed Concrete Structures, Medtech, 2017.
3. Lin T. Y. and Ned. H. Burns, Design of Prestressed Concrete Structures, Wiley India Pvt. Ltd., New Delhi, 2013.

c) Online Resources:

1. https://nptel.ac.in/courses/105/106/105106117/
2. https://nptel.ac.in/courses/105/106/105106118/
3. http://www.nptelvideos.in/2012/11/prestressed-concrete-structures.html

d) IS Codes:

1. IS: 1343-2012, "Code of Practice for Prestressed concrete".
2. IS: 784-2019, "IS Specification for Prestressed Concrete Pipes".

10212CE102	DESIGN OF REINFORCED CONCRETE AND MASONRY STRUCTURES	L	T	P	C
		2	2	0	3

Course Category / Type: Programme Elective / Theory

C. Preamble:

Students undergoing this course are expected**:**

- To bring about an exposure to advanced topics in structural design comprising of retaining walls, water tanks, flat slabs and grid slabs.
- To understand the concept of yield line theory for design of various cross section of slabs.
- To classify the types of masonry walls and design of unreinforced masonry walls in accordance with the IS code of practice concerned.

B. Prerequisite:

- 10211CE105 - Design of Reinforced Concrete Elements

C. Link to other Courses:

- NIL

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Apply the principles, procedures and code requirements to design a retaining wall and draw the reinforcement details.	K3
CO2	Classify the types of water tank and design and draw the reinforcement details.	K3
CO3	Design a flat-slab and grid-slab floor system and draw the reinforcement details.	K3
CO4	Design a different type of slabs based on the concept of yield line theory.	K3
CO5	Classify the types of masonry walls and design a brick masonry wall.	K3

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	M	H					M		M		M	M	
CO2	M	M	H					H		M		M	M	
CO3	M	M	H					H		M		M	M	
CO4	M	M	H					H		M		M	M	
CO5	M	M	H					H		M		M	M	

F. Course Content:

UNIT I DESIGN OF RETAINING WALLS 6+6

Retaining walls - Types - Earth pressure - Effects of surcharge - Stability requirements - Design of cantilever type retaining wall and counterfort type retaining wall - Detailing of reinforcement.

UNIT II DESIGN OF WATER TANKS 6+6

Water tank - Types - General design requirements - Circular and rectangular tanks - Underground tanks and tanks resting on ground - Overhead tanks - Design of water tanks using working Stress method - Detailing of reinforcement.

UNIT III DESIGN OF FLAT SLABS AND GRID SLABS 6+6

Flat slab - Types - Components - Applications - Design Methods - Design of interior and exterior panels for floor system - Grid slab - Design Methods - Design of grid slab for floor system - Detailing of reinforcement.

UNIT IV YIELD LINE THEORY 6+6

Yield line theory of slabs - Assumptions - Characteristics - Upper bound and lower bound theories - Application of virtual work - Determination of collapse load / plastic moment - Design of square, rectangular, circular and triangular slabs - Boundary conditions - Fixed and simply supported only.

UNIT V DESIGN OF UNREINFORCED BRICK MASONRY 6+6

Introduction - Classification of walls - Lateral supports and stability - Effective height of wall and column - Effective length of walls - Design loads, load dispersion - Permissible stresses - Design of axially and eccentrically loaded brick walls.

TOTAL: 30+30 =60 PERIODS

G. Learning Resources:

a) Text Books:

1. Unnikrishna Pillai S, Devdas Menon, Reinforced Concrete Design, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2017.
2. Dayaratnam P, Sarah P, Brick and Reinforced Brick Structures, Medtech, 2018.
3. Krishnu Raj N, Structural Design and Drawing - Reinforced Concrete and Steel, Universities Press (India) Private Limited, 2006.

b) References:

1. Sinha S.N, Reinforced Concrete Design, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2017.
2. Varghese P.C, Advanced Reinforced Concrete Design, Prentice Hall of India Pvt. Ltd., New Delhi, 2012.

c) Online Resources:

1. https://onlinecourses.nptel.ac.in/noc20_ce55/preview
2. https://nptel.ac.in/content/storage2/courses/105105104/pdf/m12l30.pdf
3. https://nptel.ac.in/content/storage2/courses/105108075/module8/Lecture31.pdf
4. https://nptel.ac.in/content/storage2/courses/105101083/download/lec26.pdf
5. https://nptel.ac.in/content/storage2/courses/105105104/pdf/m8l18.pdf
6. https://nptel.ac.in/courses/105/105/105105105/
7. https://nptel.ac.in/courses/105/105/105105104/
8. http://www.nptelvideos.in/2012/11/design-of-reinforced-concrete-structures.html
9. https://nptel.ac.in/content/storage2/courses/105105104/pdf/m9l20.pdf
10. https://nptel.ac.in/courses/105/106/105106197/

d) IS Codes:

1. IS 456:2000 Plain and Reinforced Concrete - Code of Practice.
2. SP 16:1980 Design Aids for Reinforced Concrete to IS 456:1978.
3. SP 34:1987 Handbook of Concrete Reinforcement and Detailing.
4. IS 1905:1987 Code of Practice for Structural use of Unreinforced Masonry.
5. IS 3370(Part1):2009 Concrete Structures for Storage of Liquids.

10212CE103	PREFABRICATED STRUCTURES	L	T	P	C
		3	0	0	3

Course Category /Type: Programme Elective / Theory

A. Preamble:

- To impart knowledge on prefabricated components during fabrication, erection and get familiarized with the modular construction
- To formulate dimensioning and detailing of joints of structural connections and progressive collapse analysis.

B. Prerequisite:

- 10211CE108 - Construction Materials and Techniques.

C. Link to other Courses:

- NIL

D. Course Outcomes:

Upon the successful completion of the course, learners will be able to

CO Nos	Course Outcomes	Bloom's Taxonomy level
CO1	Understand the basic principles of prefabrication design considerations of prefabrication structures.	K2
CO2	Learn the behavior of prefabricated structures. Calculation of handling and erection stresses.	K2
CO3	Design the cross section and joints of prefabricated units.	K3
CO4	Exhibit their knowledge in designing and detailing of prefabrication units.	K2
CO5	Design the structures for abnormal loads using the codal provisions and economical prefabrication units.	K3

E. Correlation of COs with POs:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L				M	M			L					M
CO2	L				M	M			L			M		M
CO3	L		M	M	M	M			L				M	M
CO4	L				M	H			L			M		M
CO5	L		M	M	M	M			L				M	M

F. Course Content:

UNIT I INTRODUCTION 9

Need for prefabrication – Principles – Materials – Modular coordination – Standardization – Systems – Production – Transportation – Erection - Economy of prefabrication -Structural behavior of precast structures -Prefabrication systems and structural schemes.

UNIT II PREFABRICATED COMPONENTS 9

Behavior of structural components – Large panel constructions – Construction of roof and floor slabs – Wall panels – Columns – Shear walls.

UNIT III DESIGN PRINCIPLES 9

Disuniting of structures- Design of cross section based on efficiency of material used – Problems in design because of joint flexibility – Allowance for joint deformation.

UNIT IV JOINTS IN STRUCTURAL MEMBERS 9

Joints for different structural connections – Dimensions and detailing – Design of expansion joints.

UNIT V DESIGN FOR ABNORMAL LOAD 9

Progressive collapse – Code provisions – Equivalent design loads for considering abnormal effects such as earthquakes, cyclones, etc., - Importance of avoidance of progressive collapse - Prefabricated units for Industrial structures.

TOTAL: 45 PERIODS

G. Learning Resources:

a) Text Books:

1. Hubert Bachmann, Alfred Steinle, “Precast Concrete Structures”, Ernst and Sohn GMBH & Co., K.G., 2018.
2. "Structural design manual", Precast concrete connection details, Society for the studies in the use of precast concrete, Netherland Betor Verlag, 2009.

b) References:

1. Kim S. Elliott, “Multi-Storey Precast Concrete Framed Structures” Wiley-Blackwell, 2014.
2. Levitt, M., “Precast concrete materials, Manufacture properties and usage", Applied Science Publishers, London, 2004.

c) Online Resources :

1. https://nptel.ac.in/courses/124/105/124105013/

10212CE104	BASICS OF DYNAMICS AND EARTHQUAKE ENGINEERING	L	T	P	C
		2	2	0	3

Course Category / Type: Programme Elective / Theory

A. Preamble:

Students undergoing this course are expected

- To distinguish dynamic forces from static ones. The student learns to make mathematical models of different degrees of freedom subjected to earthquake forces.

B. Prerequisite:

- **10211CE101** – Engineering Mechanics

C. Link to other Courses:

- Nil

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Analyze the response of SDOF systems.	K3
CO2	Analyze the response of MDOF System.	K3
CO3	Understand the phenomena of earthquakes and their measurements.	K2
CO4	Understand the phenomena of the effect of earthquakes on different types of structures.	K2
CO5	Apply various codes for earthquake resistant design.	K3

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	H		L								M	M	
CO2	H	H		L								M	M	
CO3	L			L								M	L	
CO4	M			L								M	L	
CO5	M	M	M	M								M	M	

F. Course Content:

UNIT I SINGLE DEGREE OF FREEDOM SYSTEMS 6+6

Formulation of equation of motion - Free and forced vibration - D‟Alemberts Principles - Damping - Types of Damping – Damped and undammed vibrations - Response to dynamic loading.

UNIT II MULTI DEGREE OF FREEDOM SYSTEMS 6+6

Free and forced vibration of undamped and damped MDOF systems - Equation of motions - Evaluation of natural frequencies and mode shapes - Eigen Values and Eigen Vector.

UNIT III INTRODUCTION TO EARTHQUAKE ENGINEERING 6+6

Elements of Engineering Seismology - Characteristics of Earthquakes - Earthquake History - Indian Seismicity- Seismo tectonics – Seismic Instrumentation – Estimation of Earthquake Parameters.

UNIT IV EARTHQUAKE EFFECTS ON STRUCTURES 6+6

Effect of earthquake on different types of structures – Behaviour of RCC, Steel and prestressed

Concrete Structures under earthquake loading – Pinching Effect – Bouchinger Effects – Evaluation of Earthquake forces –Lessons learnt from past earthquakes.

UNIT V EARTHQUAKE RESISTANT DESIGN 6+6

Concept of Earthquake Resistant Design - Provisions of IS 1893 (Part I) : 2016, NBC of India, Euro Codes, ATC specifications - Response Spectrum - Design Spectrum, Design of Buildings - Reinforcement Detailing - Provisions of IS 13920:2016 - Calculation of design forces.

TOTAL: 30+30 =60 PERIODS

G. Learning Resources:

a) Text Books:

1. Mario Paz, Structural Dynamics – Theory and Computations, Fourth Edition, CBS publishers, 1997.
2. Agarwal.P and Shrikhande.M. Earthquake Resistant Design of Structures, Prentice Hall of India Pvt. Ltd. 2007.

b) References:

1. Clough.R.W, and Penzien.J, Dynamics of Structures, Second Edition, McGraw Hill
2. International Edition, 1995.
3. Jai Krishna, Chandrasekaran.A.R., and Brijesh Chandra, Elements of Earthquake
4. Engineering, South Asia Publishers, 1994.
5. Minoru Wakabayashi, Design of Earthquake Resistant Buildings, Mc Graw – Hill Book
6. Company, 1986
7. Humar.J.L, Dynamics of Structures, Prentice Hall Inc., 1990.
8. Anil K Chopra, Dynamics of structures – Theory and applications to Earthquake
9. Engineering, Prentice Hall Inc., 2007.
10. Moorthy.C.V.R., Earthquake Tips, NICEE, IIT Kanpur,2002. of Indian Standards, New Delhi.

11. Dhamodarasamy S.R, and Kavitha S, "Basics of Structural Dynamics and Aseismic Design", PHI Learning Pvt. Ltd., Delhi, 2009.

c) Online Resources:

1. https://nptel.ac.in/courses/105/104/105104189/
2. https://nptel.ac.in/courses/105/102/105102016/

10212CE105	REPAIR AND REHABILITATION OF STRUCTURES	L	T	P	C
		3	0	0	3

Course Category / Type: Programme Elective / Theory

A. Preamble:

- The strategies of repair and maintenance.
- The importance of assessment of serviceability and durability of concrete. & Understanding the suitable repair material.
- The exposure on the repair techniques & The strengthening techniques for existing structures.

B. Pre-Requisites:

- NIL

C. Link to other Courses:

- 10211CE105 – Design of R.C Elements.
- 10211CE108 – Construction Materials and Techniques
- 10211CE203 – Concrete Technology.

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Understand the cause of deterioration and aspects of inspection.	K2
CO2	Interpret the quality of concrete and the effect of serviceability of concrete.	K2
CO3	Select appropriate Repair materials to various types of deterioration.	K2
CO4	Infer the suitable techniques to eliminate distressing in steel members	K2
CO5	Demonstrate the appropriate techniques for Strengthening of existing structures.	K2

E. Correlation of COs with POs

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	POS1	POS2
CO1	H				H	L	L					M		M
CO2	M	M			M	M	L					M		M
CO3	H	M			H	L	M					M		M
CO4	H	M			M	M	L					M		H
CO5	M	M			H	M	M					M		H

F. Course Content:

UNIT I MAINTENANCE AND REPAIR STRATEGIES 9

Maintenance - Repair and Rehabilitation - Facets of maintenance, importance of maintenance, Various aspects of inspection - Assessment procedure for evaluating a damaged structure - Causes of deterioration. Diagnosis of construction failures- use of non-destructive testing techniques for evaluation for repair.

UNIT II SERVICEABILITY AND DURABILITY OF CONCRETE 9

Quality assurance for concrete - Concrete properties - Strength, permeability, thermal properties and cracking - Effects due to climate, temperature, chemicals, Corrosion - Corrosion damage of reinforced concrete, corrosion resistant steels, coatings, rust eliminators. - Design and construction errors - Effects of cover thickness and cracking.

UNIT III MATERIALS FOR REPAIR IN STRUCTURAL ELEMENTS 9

Special concretes and mortar - Concrete chemicals – Special elements for accelerated strength gain - Expansive cement – Polymer concrete - Sulphur infiltrated concrete - Ferro cement - Fiber reinforced concrete., High performance concrete, Vacuum concrete, Self-compacting concrete, Geopolymer concrete. Methods of repair in masonry and timber structures.

UNIT IV TECHNIQUES FOR REPAIR AND DEMOLITION 9

Polymers coating for rebars during repair - Foamed concrete, mortar and dry pack - Gunite and Shotcrete - Epoxy injection - Mortar repair for cracks - Shoring - Methods of corrosion protection - Corrosion inhibitors - Coatings and cathodic protection - Engineered demolition techniques for dilapidated structures - Case studies.

UNIT V STRENGTHENING TECHNIQUES 9

Repairs to overcome low member strength, deflection, cracking, chemical disruption, weathering corrosion, wear, fire, leakage and marine exposure, - coatings for set concrete and steel reinforcement, - Strengthening of Superstructures: Jacketing, adding steel plates, reinforcement addition and post stressing - Strengthening of Substructures: Underpinning methods.

TOTAL: 45 PERIODS

G. Learning Resources:

d) Text Books

1. Guha, P.K, “Maintenance and Repairs of Buildings”, New Central Book Agency (P) Ltd, Calcutta, 2011.
2. Denison Campbell, Allen and Harold Roper, “Concrete Structures, Materials, Maintenance and Repair”, Longman Scientific and Technical UK, 1991
3. Dodge woodson, "Concrete structures - protection, Repair and Rehabilitation", Butterworth- Heinmann, imprint of Elsevier, 2009.
4. Vidivelli.B, Rehabilitation of Concrete Structures Standard Publishes Distribution.1st edition 2009.

e) Reference Books

1. Macdonald, S, "Concrete - Building Pathology", Blackwell Science Limited, Oxford, 2008.
2. Shetty, M.S, "Concrete Technology – Theory and Practice", S. Chand and Company Ltd, New Delhi, 2012.
3. Chudley, R, "The Maintenance and Adaptation of Buildings", Longman Group Ltd, New York, 2002.
4. Ghosh, S.K, "Repair and Rehabilitation of Steel Bridges", Oxford and IBH Publishing Co., New Delhi, 1988.
5. A.R. Santa kumar, "Concrete Technology", Oxford University Press, New Delhi, 2006.
6. P.K. Mehta and P.J.M. Monteiro, "Concrete - Microstructure, Properties and Materials", McGraw-Hill, New York, 2014.
7. CPWD and Indian Buildings Congress, Hand book on Seismic Retrofit of Buildings, Narosa Publishers, 2008.

f) Online Resources

1. https://nptel.ac.in/courses/105/106/105106202/
2. https://onlinecourses.nptel.ac.in/noc21_ce13/preview\

10212CE142	FINITE ELEMENT METHOD AND MODELLING	L	T	P	C
		3	0	0	3

Course Category: Programme Elective / Theory

A. Preamble:

- To study the basics of Finite Element Technique and its solutionsfor different classes of problems.

B. Prerequisite:

- Nil

C. Link to other Courses:

- 10211CE110 - Structural Analysis – II

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Solve the boundary value problems and apply the methods of Finite Difference and Finite Element	K3
CO2	Analyse the 1D and 2D triangular elements using FEM	K3
CO3	Analyse the 2D rectangular elements using FEM	K3
CO4	Analyse the 3D elements using FEM	K3
CO5	Comprehend the mesh generation technique	K2

E. Correlation of COs with POs

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	M		M	L								M	
CO2	M	M		M	L								M	
CO3	M	M		M	L								M	
CO4	M	M		M	L								M	
CO5	M	L		L	L								M	

F. Course Content:

UNITI INTRODUCTION 9

Boundary value problems-Concept of piece wise approximation – Variational Methods-Rayleigh Ritz method - Methods of weighted residual - Collocation, sub domain, Galerkin, least square methods - Finite Difference Method - Concept of Finite element method - Displacement model, stress model and hybrid models

UNIT II BAR AND TRIANGULAR ELEMENTPROPERTIES 9

Displacement field - compatibility and convergence criteria - Bar elements -2D and 3D truss and Beam elements–Introduction to analysis of plane strain/plane stress conditions - CST, LST and QST elements.

UNIT III RECTANGULAR ELEMENTPROPERTIES 9

Lagrangian, serendipity and Hermitian family elements - Rectangular and quadrilateral element - degenerated elements - sub-Iso-super parametric elements - Numerical integration techniques

UNIT IV THREE DIMENSIONAL ELEMENTPROPERTIES 9

3D brick elements - eight and twenty nodded elements - plate bending elements - thin plates - Mindlin's plate theory - thick plate elements

UNIT V - MESH GENERATION ANDSOLUTIONPROBLEMS 9

Convergence: Requirements for convergence – p and h Methods of Mesh Refinement – ill conditioned Elements – Discretisation Errors – Auto and Adaptive Mesh Generation Techniques ErrorEvaluation.

TOTAL: 45 PERIODS

G. Learning Resources:

a) Text Books:

1. Krishnamoorthy C.S, "Finite Elements Analysis - Theory and Programming", Tata McGraw Hill publishing company limited, New Delhi,2008.
2. Zienkiewicz. O. C, Taylor. R. L, Zhu. J.Z, "The Finite Element Method: Its Basis and Fundamentals: Its Basis and Fundamentals", Butterworth-Heinemann, Sixth Edition, 2005.

b) References:

1. Krishnamoorthy. C. S, Rajeev. S, Arunachalam Rajaraman.," Computer Aided Design: Software And Analytical Tools", U.K,2005.
2. Rajesekaran .S, “Finite Element Methods in Engineering Design”, Wheeler Publishers, Allahabad,1999.
3. Chandrapatla. R.T, and Belagundu, A.D., "Introduction to Finite Elements in Engineering", Second Edition, Prentice Hall of India,1997.
4. Bathe. K.J, "Finite Element Procedures in Engineering Analysis", PHI, New Delhi,1990.
5. Robert Davis Cook, David. S, Malkus, Michael. E, Plesha.,“Concepts and Applications of Finite Element Analysis”, John Wiley, New York, Third Edition, 1989.
6. Zienkiewicz .O.C, and Taylor. R.L, "The Finite Element Method", Vol.1, Basic Formulation and linear problems, McGraw Hill Limited, U.K.1989.
7. Hans. R, Schwarz, "Finite Element Methods", Academic Press,1988.
8. Bruce Irons and Shrire .N, "Finite Element Primer", Ellis Howood Limited,1983.
9. Ernest Hinton. D. R. J, Owen, "Finite Element Programming", ACADEMIC Press INC, London, Fifth Edition,1979.
10. Gallagher. R.H, "Finite Element Analysis - Fundamentals", Prentice Hall Inc.1975.

c) Online Resources

1. https://nptel.ac.in/courses/112104116

10212CE143	ADVANCED STRENGTH OF MATERIALS	L	T	P	C
		2	2	0	3

Course Category / Type: Programme Elective / Theory

A. Preamble:

- This course deals with vector mechanics, the state of stress in 3D and special topics include unsymmetrical bending, shear centre advanced material properties. It also deals with the fundamentals of vibration.

B. Prerequisite:

- Course code – Strength of Materials II

C. Link to Other Courses:

- 10211CE105 - Design of Reinforced Concrete Elements
- 10211CE107 - Design of Steel Structures

D. Course Content: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Apply the vector mechanics to analyse the statics of particles	K3
CO2	Understand the state of stress in 3D and design concepts based on failure theories	K3
CO3	Analyse stress-strain behaviour of beams for unsymmetrical bending and curved beams	K3
CO4	Understand the significance of symmetry and shear centre	K3
CO5	Analyse the response of various SDOF systems	K3

E. Correlation of COs with POs

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	M		M										
CO2	M	M		M										
CO3	M	M		M										
CO4	M	M		M										
CO5	M	M		M										

F. Course Content:

UNIT I VECTOR MECHANICS 6+6

Vectors — Vector operations: Additions, Subtraction, Dot product, Cross product – Forces in Vector form–Rectangular components of forces-Position vector-Force vector in terms of coordinates-Resultant force of coplanar concurrent forces-Direction cosines- Resultant of force system in space-Moment of a force- Couple in Vector form- Resultant of non-concurrent, non-parallel forces.

UNIT II STATE OF STRESS IN THREE DIMENSIONS 6+6

Spherical and deviatory components of stress tensor - Determination of principal stresses and principal planes – Volumetric strain – Dilatation and Distortion- Theories of failure – Principal Stress dilatation – Principal Strain –Shear stress – Strain energy and distortion energy theories - Residual stresses.

UNIT III UNSYMMETRICAL BENDING 6+6

Properties of unsymmetrical sections - Circle of inertia - Dyadic circle - Momental ellipse- Stresses and deflection due to unsymmetrical bending - Concept and relevance of Z polygon. Curved beams – Winkler-Bach formula – Stress concentration.

UNIT IV SHEAR CENTER 6+6

Concept and significance - Shear flow for thin walled open sections-Location of shear centre for singly symmetric sections. Stresses in curved flexural members-Winkler Bach Formula - Crane hooks - rings and links.

UNIT V MATERIAL PROPERTIES AND FUNDAMENTALS OF VIBRATION6+6

Elastic and Plastic Deformation - Brittle and Ductile Failures of Materials - Mechanical Tests like Surface Hardness, Fatigue, Creep etc. Free vibration of single degree of freedom systems - Undamped and damped free vibration with different types of damping.- Resonance-Harmonic response of single degree of freedom systems with and without damping.

TOTAL: 30+30 =60 PERIODS

G. Learning Resources:

a) Text Books:

1. Beer, F.P and Johnson Jr. E.R., "Vector Mechanics for Engineers", Statics and Dynamics, McGraw–Hill International Edition, 2019.
2. Bansal R.K., "Strength of Materials", Laxmi Publications, 6th Edition, New Delhi, 2017.
3. Rajput.R.K. "Strength of Materials (Mechanics of Solids)", S.Chand and Co, New Delhi, 2015
4. Kazimi, S.M.A., Solid Mechanics, Tata McGraw Hill, 1976.
5. Punmia, B.C., Strength of Materials Part II, Standard Publishers and Distributors, 1991.
6. Shames I.H., Engineering Mechanics, Prentice Hall of India,1996

b) References:

1. Egor. P.Popov, Engineering Mechanics of Solids, Prentice Hall of India, Second Edition,New Delhi 2015.
2. Timoshenko, S.P. and Gere, J.M. Mechanics of Materials, Tata McGraw Hill, 1992
3. William A.Nash, "Theory and Problems of Strength of Materials", Tata McGraw-Hill publishing Co., New Delhi, 2007.
4. Srinath L.S, "Advanced Mechanics of Solids", Tata McGraw-Hi publishing Co., New Delhi, 2007.
5. Subramanian R., "Strength of Materials", Oxford University Press, 3rd Edition New Delhi, 2016.
6. Hibbeller R.C., Engineering Mechanics, Vol. 1 Statics, Vol. 2 Dynamics, Pearson Education Asia Pvt. Ltd., 2015.
7. Kottiswaran N., Engineering Mechanics, Sri Balaji Publications Pvt. Ltd., 2015.

c) Online Resources:

1. https://nptel.ac.in/courses/105106116/
2. http://nptel.ac.in/courses/112107147/
3. http://nptel.ac.in/courses/105106116/38
4. https://nptel.ac.in/courses/112/106/112106286/
5. https://nptel.ac.in/courses/122/104/122104015/

10212CE106	SOLID AND HAZARDOUS WASTE MANAGEMENT	L	T	P	C
		3	0	0	3

Course Category / Type: Programme Elective / Theory

A. Preamble:

- To develop an understanding of various systems available for collection, transportation, recycling, resource recovery and disposals.
- To study and prepare municipal solid waste & Hazardous waste management plans in the light of the potential problems and issues which may become apparent during project development. ·
- To provide operational guidelines for the efficient municipal solid waste & Hazardous waste management systems.

B. Prerequisite:

- NIL

C. Link to other Courses:

- NIL

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Understand the nature and characteristics of municipal solid wastes and the regulatory requirements regarding municipal solid waste management	K2
CO2	Illustrate the storage, collection methods and transport modes of generated solid waste.	K2
CO3	Demonstrate the various processing technologies for Municipal solid waste management.	K2
CO4	Explain the disposal facility for municipal solid waste generated by a community	K2
CO5	Understand the anatomy and anomalies of Hazardous waste management.	K2

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L					H	M	M		L			L	
CO2	L					M	H	M	L	L			L	
CO3	L			L		M	H	M	L	L				
CO4	L			L		M	H	L	L	L				
CO5	L			L		M	H	L	L	L				

F. Course Content:

UNIT I SOURCES AND TYPES 9

Introduction – Sources and types of municipal solid wastes – Waste generation rates – Factors affecting generation – characteristics – Methods of sampling and characterization – Effects of improper disposal of solid wastes – Public health and environmental effects – Elements of solid waste management – Social and financial aspects – Municipal solid waste (M&H) rules – Integrated waste management – Public awareness – Role of NGOs in waste management.

UNIT II STORAGE COLLECTION AND TRANSFER 9

On-site storage methods – Materials used for containers – On-site segregation of solid wastes – Public health and economic aspects of storage – Methods of Collection – Types of vehicles – Manpower requirement – Collection routes – Transfer stations – Selection of location – Operation & maintenance – Options under Indian conditions.

UNIT III PROCESSING TECHNOLOGY 9

On site processing – Off-site Resource recovery from solid wastes composting, Vermin composting, Incineration – Types of Incinerators, Pyrolysis – Options under Indian conditions – Critical Evaluation of Options.

UNIT IV WASTE DISPOSAL 9

Dumping of solid waste and its effects – Sanitary Landfills – Design and Operation of Landfill liner – Management of leachate and landfill gas – Landfill closure and environmental monitoring – Landfill bioreactor – Dumpsite rehabilitation – Case studies on developed and developing countries.

UNIT V HAZARDOUS WASTE MANAGEMENT 9

Introduction to Hazardous wastes – Definition of Hazardous waste – The magnitude of the problem – Hazardous waste – Risk assessment – Environmental legislation – Characterization and site assessment – Waste minimization and resource recovery – Transportation of hazardous waste – Ground water contamination – Current Management Practices – Site Remediation - Site and subsurface characterization, Containment – Remedial alternatives.

TOTAL: 45 PERIODS

G. Learning Resources:

a) Text Books:

1. Tchobanoglous G, Theisen H. M, and Eliassen R, Solid Wastes: Engineering Principles and Management Issues, McGraw Hill, New York. 1993.
2. Vesilind P.A. and Rimer A.E, Unit Operations in Resource Recovery Engineering, Prentice Hall, Inc. 1981.
3. Paul T Willams, Waste Treatment and Disposal, John Wiley and Sons, New Jersey, 2000.
4. Bilitewski B, HardHe G, Marek K, Weissbach A, and Boeddicker H, Waste Management, Springer, 1994.
5. Ramachandra T.V, Management of Municipal Solid waste, Teri Press, 2009.

b) References:

1. Government of India, Manual on Municipal Solid Waste Management, CPHEEO, Ministry of Urban Development, New Delhi, 2000.
2. Bhide A.D, Sundaresa, B.B, Solid Waste Management Collection, Processing and Disposal, 2001.
3. Manser A.G.R, Keeling A.A, Practical Handbook of Processing and Recycling of Municipal solid Wastes, Lewis Publishers, CRC Press, 1996.
4. George Tchobanoglous and Frank Kreith, Handbook of Solid waste Management, McGraw Hill, New York, 2002.
5. Landreth R.E, PRebers P.A, Municipal Solid Wastes – Problems and Solutions, Taylor and Francis Inc, 2019.

c) Online Resources:

1. https://nptel.ac.in/courses/120/108/120108005/

10212CE107	AIR POLLUTION MONITORING AND CONTROL	L	T	P	C
		3	0	0	3

Category: Programme Elective / Theory

A. Preamble:

Students undergoing this course are expected

- To understand the principle and effects of Air pollutants/Control of Indoor/Particulate/gaseous pollutants and its ambient regulatory standards.

B. Prerequisite:

- NIL

C. Link to other courses:

- NIL

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Understand the background basics of air pollution and its facets.	K2
CO2	Illustrate the plume behavior for different atmospheric stability conditions.	K2
CO3	Explain the controlling methods involved and its design concepts to avert air pollution	K2
CO4	Understand the legislative measures and environmental impact assessment guidelines related to air pollution	K2
CO5	Explain the basic concepts of noise pollution and its various branches.	K2

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1			M		L	L	L							
CO2	M	L		L		L	M						L	
CO3			M	M	H	H	H						M	
CO4			M	L	M	M	H						M	
CO5				M	L	M	M						L	

F. Course Content:

UNIT I SOURCES AND EFFECTS OF AIR POLLUTANTS 9

Classification of air pollutants – Particulates and gaseous pollutants – Sources of air pollution – Source inventory – Effects of air pollution on human beings, materials, vegetation, animals – global warming - ozone layer depletion, Sampling and Analysis – Basic Principles of Sampling – Source and ambient sampling – Analysis of pollutants – Principles.

UNIT II AIR POLLUTION MODELLING 9

Effects of meteorology on Air Pollution - Fundamentals, Atmospheric stability, Inversion, Wind profiles and stack plume patterns- Transport & Dispersion of Air Pollutants – Concepts of modeling Techniques.

UNIT III AIR POLLUTION CONTROL 9

Concepts of control – Principles and design of control measures – Particulates control by gravitational, centrifugal, filtration, scrubbing, electrostatic precipitation – Selection criteria for equipment - gaseous pollutant control by adsorption, absorption, combustion – Biological air pollution control technologies - bioscrubbers, biofilters, and Indoor air quality.

UNIT IV AIR QUALITY MANAGEMENT 9

Air quality standards – Air quality monitoring – Preventive measures - Air pollution control efforts – Zoning – Town planning regulation of new industries – Legislation and enforcement – Environmental Impact Assessment and Air quality - Air sampling & pollution measurement methods - Ambient air quality and emission standards - Air pollution indices - Air Act

UNIT V CASE STUDIES 9

Air pollution in Metro cities - Magnitude and effects on health – Valuation of urban air Pollution – Case study of Metropolitan city.

TOTAL: 45 PERIODS

G. Learning Resources:

a) Text Books:

1. Anjaneyulu, D., “Air Pollution and Control Technologies”, Allied Publishers, Mumbai, 2018.
2. Rao, C.S. Environmental Pollution Control Engineering, Wiley Eastern Ltd., New Delhi, 2018.
3. Rao M.N., and Rao H. V. N., Air Pollution Control, Tata McGraw Hill, New Delhi, 2017.

b) References:

1. Heumann. W.L., "Industrial Air Pollution Control Systems", McGraw Hill, New York, 1997.
2. Mahajan S.P., "Pollution Control in Process Industries", Tata McGraw Hill Publishing Company, New Delhi, 2017.
3. Peavy S.W., Rowe D.R. and Tchobanoglous G. "Environmental Engineering", McGraw Hill, New Delhi, 2017.
4. Garg, S.K., “Environmental Engineering Vol. II”, Khanna Publishers, New Delhi, 2018
5. Thod Godesh, "Air Quality, Lewis India Edition, 2013.

c) Online Resources:

1. https://nptel.ac.in/courses/105/102/105102089/
2. https://nptel.ac.in/courses/105/104/105104099/

10212CE108	HYDROLOGY	L	T	P	C
		3	0	0	3

Course Category: Programme Elective / Theory

A. Preamble:

- This subject aims at making the students to understand the relevance of various components of hydrologic cycle, which are responsible for spatial and temporal distribution of water availability in any region.
- The objective of this course is enabling to the student to understand the basic empirical knowledge of the residence and movement of groundwater, as well as a number of quantitative aspects.
- At the end of the course, the student should be able to evaluate the aquifer parameters and groundwater resources for different hydro-geological boundary conditions.

B. Pre-Requisites:

- Nil

C. Links to other Courses

- 10212CE110 - Irrigation Engineering

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Understand the knowledge on hydrologic cycle, hydrometeorology and formation of precipitation.	K2
CO2	Explain the Direct Measurement of Evapotranspiration.	K2
CO3	Utilize the concept of infiltration and Hydrograph.	K3
CO4	Enumerate the various methods of Flood Routing.	K3
CO5	Classify the concepts of Ground Water Hydrology.	K2

E. Correlation of COs with POs

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L					M	L					L	L	
CO2	L						M						L	
CO3	L	M					L	H				L	L	
CO4	L	L					H					M	L	
CO5	L					M	L				L	L	L	

F. Course Content:

UNIT I PRECIPITATION 9

Hydrological cycle – Types of precipitation – Forms of precipitation – Measurement of Rainfall – Frequency analysis of point rainfall – Intensity, duration and frequency relationship – Probable maximum precipitation.

UNIT II EVAPORATION AND EVAPOTRANSPIRATION 9

Evaporation – Factors affecting evaporation – Estimating evaporation: energy balance methods, mass transfer methods, water budget methods, evaporation pan methods–Direct Measurement of Evapotranspiration- Potential evapotranspiration.

UNIT III INFILTRATION AND HYDROGRAPH 9

Infiltration–Measurement of infiltration –SCS curve – Stream flow measurements: stage-discharge relationships, Area velocity method, Dilution methods – Hydrograph – Runoff hydrograph – Derivation of unit hydrograph – S curve hydrograph – Baseflow separation.

UNIT IV FLOODS AND FLOOD ROUTING 9

Flood frequency studies – Recurrence interval – Gumbel‟s method – Flood routing – Reservoir flood routing – Muskingum‟s Channel Routing – Flood control.

UNIT V GROUNDWATER 9

Groundwater - Types of aquifers –Dupuit‟s assumptions – Confined Aquifer – Unconfined Aquifer – Recuperation test and Pumping test – Steady flow analysis only.

TOTAL: 45 PERIODS

G. Learning Resources:

a) Text Books:

1. Subramanya, K., “Engineering Hydrology”, Tata McGraw Hill Publishing Co. Ltd, 2000
2. Raghunath, H.M., “Hydrology”, Wiley Eastern Ltd., 2000.
3. Jeyaram Reddy.P, "Hydrology, Laximi Publications, New Delhi, 2004

b) References:

1. Chow, V.T. and Maidment D.R., “Hydrology for Engineers”, McGraw-Hill Inc. Ltd, 2000
2. Singh, V.P., “Hydrology”, McGraw Hill Inc. Ltd, 2000.
3. Madan Mohan Das and Mimi Das Saikia, Hydrology, Prentice Hall of India, 2013.
4. Todd D.K.,”Groundwater Hydrology", John Wiley & Sons, Inc, New York, 1976.
5. A.K. Rastogi, "Numerical Groundwater Hydrology", 2011.

c) Online Resources:

3. http://nptel.ac.in/courses/105103021/
4. http://nptel.ac.in/courses/105107059/

10212CE109	PLASTIC AND E-WASTE MANAGEMENT	L	T	P	C
		3	0	0	3

Course Category/Type: Programme Elective/Theory

A. Preamble

- This course aims to make the students get exposed in the concepts of waste management practices regarding plastic and e-waste in Indian context.

B. Prerequisite

- Nil

C. Links to other Courses

- 10212CE106 Solid and Hazardous Waste Management

D. Course Outcomes

With the completion of the course, students are expected to:

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Explain the scope of plastic and E-waste in global context	K2
CO2	Illustrate the impacts of plastic waste on health and environment	K2
CO3	Outline the recycling strategies for waste plastic	K2
CO4	Illustrate the impacts of E-waste on health and environment	K2
CO5	Outline the recovering strategies for E-waste	K2

E. Correlation of COs with POs

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						H	H					L	M	
CO2						H	H					L	M	
CO3	M					M	H					L	M	
CO4						H	H					L	M	
CO5	M					M	H					L	M	

F. Course Content

UNIT 1 INTRODUCTION 9

Indian and global scenario for plastic and E-waste generation – Need for effective waste management in line with SDGs – Environment and health issues related to improper disposal of plastic and E-waste.

UNIT II BASIC CONCEPTS IN PLASTIC WASTE 9

Plastic and types – Sources of plastic waste – Impact of plastic pollution on: marine life, environment and human health – Plastic ban – Plastic Waste Management Rules, 2016 (India)

UNIT III PLASTIC WASTE RECYCLING AND ALTENATIVES 9

Recycling plastic waste: mechanical and feedstock recycling, waste to energy approach, landfilling and other applications – Plastic waste in road construction – Greener alternatives to plastic: biodegradable plastics, greener plastic products and biobased plastic products. Entrepreneurship in plastic waste management.

UNIT IV BASIC CONCEPTS IN E-WASTE 9

Definition, categories – Sources of E-waste – Impacts of E-waste on: social, environment and economy – E-Waste (Management & Handling) Rules, 2016 - Extraction of precious and rare earth metals from End of Life (EoL) electronic products.

UNIT V MATERIAL RECOVERY FROM E-WASTE 9

Process description – Disassembly, upgrading, refining – E-waste recycling techniques: CRT recycling, glass to glass recycling, glass to lead recycling, pyro metallurgical process, hydro metallurgical process, bio metallurgical process and hybrid technology – Recovery of gold. Entrepreneurship in e-waste management

TOTAL: 45 PERIODS

G. Learning Resources

a) Text Books:

1. Rakesh J, E-waste: Implications, Regulations and Management in India and Current Global best Practices, Third Edition, TERI Press, 2009.
2. Dr. Muralisrinivasan Natamai Subramanian, Plastic Waste Management: Processing and Disposal, Smithers Rapra Publications, 2016.

b) References:

1. E-Waste (Management&Handling) Rules, 2016.
2. The Plastic Waste Management Rules, 2016
3. Recycled Plastics Manufacture & Usage Rules and Amendments, 2003.

c) Online Resources:

1. NPTEL :: Civil Engineering - NOC:Electronic Waste Management - Issues And Challenges
2. NPTEL :: Civil Engineering - NOC:Plastic Waste Management

10212CE110	IRRIGATION ENGINEERING	L	T	P	C
		3	0	0	3

Course Category / Type: Programme Elective / Theory

A. Preamble:

- This course deals about the Irrigation methods and impounding structures and behavior for different conditions involved in it.

B. Prerequisite:

- Nil

C. Link to other Courses:

- Nil

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcome	Bloom's Taxonomy level
CO1	Understand the need for irrigation and crop water management.	K2
CO2	Classify the various method of irrigation	K2
CO3	Develop the design of impounding structures	K3
CO4	Understand the classification of canal irrigation and its operation	K2
CO5	Summarize the various elements of irrigation water management	K2

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L					L	M						L	
CO2	L					L	M						L	L
CO3		M	M	L			M						L	
CO4	L						M					L	L	
CO5	L					L	M				M	L	L	

F. Course Content:

UNIT I INTRODUCTION 9

Introduction – Need and Mode of Irrigation – Merits and Demerits – Crops and crop Seasons - Irrigation efficiencies - Conjunctive use of water and methods – Duty – Factors affecting Duty - Delta and Base period – Crop water Requirement - Planning and Development of irrigation projects.

UNIT II IRRIGATION METHODS 9

Canal irrigation - Surface Irrigation & its classifications - Lift irrigation - Tank irrigation - Furrow Irrigation - Drip irrigation - Sprinkler irrigation - Flooding methods - Border & check flooding

UNIT III DIVERSION AND IMPOUNDING STRUCTURES 9

Weirs – elementary profile of a weir - Types of impounding structures - Percolation ponds – Tanks, Sluices & Spillways - Gravity dams - Earth dams - Arch dams - Factors affecting location and type of dams – Forces on a dam

UNIT IV CANAL IRRIGATION 9

Classification of canals - Alignment of canals - Canal drops - Cross drainage works - Hydraulic design of cross drainage works - Canal Head works and its design - Canal regulators - River Training works.

UNIT V IRRIGATION WATER MANAGEMENT 9

Need for optimisation of water use - Minimizing irrigation water losses - Improvement in irrigation efficiencies - On farm development works - Crop rotation - Irrigation scheduling – Participatory irrigation management with a case study - Performance evaluation

TOTAL: 45 PERIODS

G. Learning Resources:

a) Text Books:

1. Garg S. K., "Irrigation Engineering and Hydraulic structures", Khanna Publishers, 25th Revised Edition, New Delhi, 2018.
2. Punmia B.C., "Irrigation and Water Power Engineering", Laxmi Publications, 16th Edition, New Delhi, 2009.
3. Linsley R.K. and Franzini J.B, "Water Resources Engineering", McGraw-Hill, 2000.

b) References:

1. Chaturvedi M.C., "Water Resources Systems Planning and Management", Tata McGraw-Hill Inc., New Delhi, 2017.
2. Michael A.M., Irrigation Theory and Practice, 2nd Edition, Vikas Publishing House Pvt. Ltd., Noida, UP, 2008.
3. Dilip Kumar Majumdar, "Irrigation Water Management", Prentice-Hall of India, New Delhi, 2008.
4. Asawa, G.L., "Irrigation Engineering", New Age International Publishers, New Delhi, 2000.

c) Online Resources:

1. https://nptel.ac.in/courses/105/105/105105110/

2. https://nptel.ac.in/content/storage2/courses/105105110/pdf/m3l04.pdf
3. https://nptel.ac.in/content/storage2/courses/105105110/pdf/m3l01.pdf

10212CE111	REMEDIATION OF CONTAMINATED SITES	L	T	P	C
		3	0	0	3

Course Category / Type: Programme Elective / Theory

A. Preamble:

The students are expected

- To acquire the knowledge on the Geotechnical engineering problems associated with soil contamination, safe disposal of waste and remediate the contaminated soils by different techniques thereby protecting environment.

B. Prerequisite:

- 10211CE202 – Soil Mechanics

C. Link to other Courses:

- 10212CE112 – Ground Improvement Techniques

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcome	Bloom's Taxonomy level
CO1	Understand the various chemical processes associated with contamination.	K2
CO2	Illustrate the risk involved.	K2
CO3	Explain the concepts of remediation of contaminated ground water.	K2
CO4	Classify the different methods of soil remediation.	K2
CO5	Learn the essential components of landfill.	K2

E. Correlations of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L		H	M		L	L						L	
CO2			H	L		L	M						L	
CO3			M		H	L	L						L	
CO4			M		M	L	L						L	
CO5			M		M	L	L						L	

F. Course Content:

UNIT I CONTAMINANT TRANSPORT AND SITE CHARACTERISATION 9

Wastes – sources, generation and classification – Transport of contaminant in subsurface – Advection, diffusion, dispersion – Chemical process – Biological process, sorption, desorption, precipitation, dissolution, oxidation, complexation, ion exchange, volatization, biodegradation – Characterization of contaminated sites – Case studies.

UNIT II RISK ASSESSMENT 9

Introduction – Steps in Human Health Risk Assessment – Data Collection and Evaluation – Exposure Assessment – Toxicity Assessment – Risk Characterization – Risk Management and Risk Communication – Ecological Risk Assessment – Risk – based corrective action. Introduction to hazardous waste laws and risk assessment.

UNIT III REMEDIAL MEASURES FOR GROUNDWATER 9

Introduction– Administrative Options – Groundwater: Plume Containment, Pump and Treat, Source Control, Permeable Reactive Barriers and Monitored Natural Attenuation. Contaminant Transportation and its rate of degradation.

UNIT IV REMEDIAL MEASURES FOR SOIL 9

Introduction – Excavation – Landfill – Containment – Solidification/Stabilization – surfactant extraction – Soil vapour extraction – Bioremediation – Thermal processes – soil washing and chemical treatment. Remediation in hazardous waste disposal sites. Role of admixtures and binders in soil remediation.

UNIT V LANDFILLS 9

Source and characteristics of waste – Site selection for landfills – Land reclaimation – Components of landfills – Liner system – Soil, geomembrane, geosynthetic clay, geo composite liner system – Leachate collection – Final cover design. Monitoring landfill – Case studies.

TOTAL: 45 PERIODS

G. Learning Resources:

a) Text Books

1. Daniel B.E, "Geotechnical Practice for waste disposal", Chapman & Hall, London, 1993.
2. Hari D. Sharma and Krishna R.Reddy, "Geo–Environmental Engineering" – John Wiley and Sons, INC, USA, 2004.
3. Coduto D.P., "Geotechnical Engineering – Principles and practices", Prentice Hall of India Pvt. Ltd., New Delhi, 2002.

b) References

1. Westlake K., "Landfill Waste pollution and Control", Albion Publishing Ltd., England, 1995.
2. Wentz C.A., "Hazardous Waste Management", McGraw Hill, Singapore, 1989.
3. "Proceedings of the International symposium of Environmental Geotechnology (Vol.I and II)", Environmental Publishing Company, 1986 and 1989.
4. LaGrega M.D., Buckingham P.L. and Evans J.C., "Hazardous Waste Management", McGraw–Hill, 1994.

5. Haas C.N. and Vamos R.J., "Hazardous and Industrial Waste Treatment", Prentice Hall, Englewood Cliffs, NJ, 1995.

c) Online resources

1. https://nptel.ac.in/noc/courses/noc21/SEM1/noc21–ce36/

10212CE144	ENVIRONMENTAL MANAGEMENT SYSTEM	L	T	P	C
		3	0	0	3

Course Category / Type: Programme Elective

A. Preamble:

- To provide a basic understanding regarding the anatomy of Environmental management system that enables an organization to reduce its environmental impacts and increase its operating efficiency.

B. Prerequisite:

- NIL

C. Link to other Courses:

- NIL

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Understand the context of EMS through definitions, concepts guidelines	K2
CO2	Set out the requirements for an environmental management system by understanding the stages involved in ISO 14001:2015.	K2
CO3	Understand the Assessment procedures towards continual improvement through auditing guidelines.	K2
CO4	Understand the framework of LCA by performing robust assessments of the environmental characteristics of the system.	K2
CO5	Tradeoffs in relationship between products and Environmental impacts	K2

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						M	M		H	H				
CO2				L		H	H							
CO3							H		H	M				
CO4			H			M	H							
CO5						M	H							

F. Course Content:

UNIT I INTRODUCTION 9

Context of environmental management - Overview of the state of global environment - Sustainable development - Introduction to the evaluation tools - Environmental management system (EMS) - Organizational barriers - Management responsibility - Elements and extent of application - EMS structure.

UNIT II GLOBAL PROCEDURES 9

ISO 14000 – Introduction - ISO 14000 in US, Europe & Developing world - ISO 14001:2015 – Terms and Definitions – Context of the Organization – Organization and its context – Needs and expectations of interested parties – Scope of the EMS – Leadership & commitment – Environmental Policy – Organizational roles - responsibilities and authorities – Planning – Support – Operation.

UNIT III AUDITING GUIDELINES 9

Scope and objectives - Standards for auditing – Registration - Implementing the audit - Monitoring measurement analysis and evaluation of compliance – Internal audit programme – Management review – Nonconformity and corrective action – Continual improvement – Case study.

UNIT IV IMPACT AND LIFE CYCLE ASSESSMENT 9

Introduction to environmental impact assessment – EIA Procedures – Public involvement in EIA – Introduction to life cycle assessment - Components of LCA – Measuring Environmental impact - Life cycle stages of the product - Issues at each life cycle stages - Strategic framework – Case Study.

UNIT V GREEN ASPECTS IN PRODUCT DEVELOPMENT 9

Introduction to ISO/TR 14062:2002 – Product stewardship – Principles of Clean Production – Packaging – Sustainable procurement - Social responsibility and functions of corporations – Eco labelling - Ecological and carbon footprints (ISO 14064 – 65) – A case study.

TOTAL: 45 PERIODS

G. Learning Resources:

a) Text Books:

1. S. Christopher and Y. Mark Environmental Management Systems, 3rd ed. Earthscan Publications, 2007.
2. R.M. Harrison Pollution: Sources, Effects and Control, (selected chapters), Royal Society of Chemistry. 2001.
3. M.D., LaGrega P.L. Buckingham and J.C. Evans Hazardous Waste Management, McGraw-Hill International Edition, New York. 1994.
4. C.N. Madu Environmental Planning and Management, Imperial College Press, (Chapters 2, 3, 4, 6, 7, 8, 10). 2007.

b) References:

1. Cases in Environmental Management and Business Strategy Richard Welford.
2. Environmental Management Strategies: The 21st Century Perspective, Gabriele Crognale (Prentice Hall Ptr Environmental Management Series, Vol 5).
3. H.D.Virginia and R.E. Mary (eds.) Tools to Aid Environmental Decision Making, New York, Springer. 1999.
4. ISO 14064-1:2018 - Greenhouse gases — Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals.
5. ISO 14064-2:2019 - Greenhouse gases — Part 2: Specification with guidance at the project level for quantification, monitoring and reporting of greenhouse gas emission reductions or removal enhancements.
6. ISO 14064-3:2019 - Greenhouse gases — Part 3: Specification with guidance for the verification and validation of greenhouse gas statements.

c) References:

1. https://nptel.ac.in/courses/120108004

10212CE112	GROUND IMPROVEMENT TECHNIQUES	L	T	P	C
		3	0	0	3

Course Category / Type: Programme Elective / Theory

A. Preamble:

Students undergoing this course are expected

- To learn the various processes that improves the weak soil by increasing its shear strength properties.

B. Prerequisite:

- 10211CE202 - Soil Mechanics

C. Link to other Courses:

- 10211CE111 - Foundation Engineering

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcome	Bloom's Taxonomy level
CO1	Identify the characteristics of problematic soils and the appropriate ground improvement technique.	K2
CO2	Understand the concepts of Dewatering techniques.	K2
CO3	Understand the concepts of In–situ Densification by different methods.	K2
CO4	Relate Soil Reinforcement concepts for different applications.	K2
CO5	Summarize the different grouting techniques.	K2

E. Correlation of COs with POs:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1			L	H			L						L	
CO2			L	M			L					L	L	
CO3			L		H		L						L	
CO4			L		H		L					L	L	
CO5			L		H		L					L	L	

F. Course Content:

UNIT I PROBLEMATIC SOIL AND IMPROVEMENT TECHNIQUES 9

Role of ground improvement in foundation engineering–methods of ground improvement– Geotechnical problems in alluvial, lateritic and black cotton soils–Selection of suitable ground improvement techniques based on soil conditions

UNIT II DEWATERING 9

Dewatering Techniques – Well points – Vacuum and electro–osmotic methods – Seepage analysis for two – dimensional flow for fully and partially penetrated slots in homogeneous deposits – Simple cases

UNITIII IN–SITU TREATMENT OF COHESIONLESS AND COHESIVE SOILS 9

Insitu densification of cohesioness soils and consolidation of cohesive soils: Dynamic compaction, Vibro flotation, Sand compaction piles and deep compaction – Consolidation: Preloading with sand drains and fabric drains, Stone columns and Lime piles – installation techniques – relative merits and their limitations.

UNIT IV EARTH REINFORCEMENT 9

Concept of reinforcement – Types of reinforcement material – Reinforced earth wall – Mechanism – simple design – applications of reinforced earth – Role of Geotextiles in filtration, drainage, separation, road works and containment

UNIT V GROUTING TECHNIQUES 9

Types of grouts – Grouting equipment and machinery – injection methods – Grout monitoring – stabilization with cement, lime and chemicals – stabilization of expansive soil

TOTAL: 45 PERIODS

G. Learning Resources:

a) Text Books:

1. Purushothama Raj P, “Ground Improvement Techniques”,Laxmi Publications, Second edition, 2016.
2. Koerner R.M. “Construction and Geotechnical Methodsin Foundation Engineering”, McGraw Hill, 1994.
3. Mittal S, “An Introduction to Ground Improvement Engineering”, Medtech Publisher, 2013.
4. Coduto D.P. “Geotechnical Engineering–Principles and Practices”, Prentice Hall of India Pvt. Ltd. New Delhi, 2011.

b) References:

1. Jones J.E.P., Earth Reinforcement and Soil Structure, Butter worths, London, 1985.
2. WinterkornH.F.and Fang H.Y., Foundation Engineering Hand Book, Van Nostrand Reinhold, 1994.
3. Das B.M., Principles of Foundation Engineering, 7th,Edition, Cengage learning, 2010.
4. Koerner R.M. “Designing with Geosynthetics”, 6th Edition,Xlibris Corporation, 2012.

c) Online resources:

1. https://nptel.ac.in/courses/105/108/105108075/

d) IS Codes:

1. IS–9759:1981, Guidelines for Dewatering During Construction, Bureau of Indian Standards, New Delhi, Reaffirmed 2008.
2. IS–15284 (Part1):2003, Design and Construction for Ground Improvement– Guidelines, (Stone Column), Bureau of Indian Standards, New Delhi, 2003

10212CE113	ADVANCED FOUNDATION ENGINEERING	L	T	P	C
		3	0	0	3

Course Category / Type: Programme Elective / Theory

A. Preamble:

Students undergoing this course are expected

- To understand the advanced concepts of foundation engineering.

B. Prerequisite:

- 10211CE111 - Foundation Engineering

C. Link to other Courses:

- 10211CE202 - Soil Mechanics

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcome	Bloom's Taxonomy level
CO1	Analyse the different type of footings and their settlement characteristics.	K3
CO2	Apply the load carrying capacity of single pile and pile group.	K3
CO3	Apply the concepts of well foundation and its design.	K3
CO4	Design various types of retaining walls.	K3
CO5	Understand the design concepts of foundations resting on difficult soil.	K2

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	M	M	L								M	M	
CO2	H	H	M	L								M	M	
CO3	H	H	M	L								M	M	
CO4	H	H	M	L								M	M	
CO5	H	H	L	M								M	M	

F. Course Content:

UNIT I SHALLOW FOUNDATION 9

Methods for bearing capacity estimation – Design of individual footings, strip footing – Combined footing – Rigid and flexible mat – Buoyancy raft – Basement raft – Under pinning.

UNIT II PILE FOUNDATION 9

Estimation – Load carrying capacity of single and pile group under various loading conditions – Pile load testing (static, dynamic methods and data interpretation) – Design of single pile and pile groups – pile caps.

UNIT III WELL FOUNDATION 9

Types – Components – Construction methods – Design – Check for stability – Base pressure – side pressure and deflection.

UNIT IV RETAINING WALL 9

Types of Retaining wall. Support systems for flexible retaining walls (struts, anchoring), construction methods stability calculations – Design of flexible and rigid retaining walls – Design of cantilever and anchored sheet pile walls.

UNIT V FOUNDATION ON COLLAPSIBLE SOILS 9

Collapsible soil – types – physical parameters for identification – calculation of collapse settlement. Foundation considerations for expansive soils. Nature of landfills – Settlement of landfills.

TOTAL: 45 PERIODS

G. Learning Resources:

a) Text Books

1. Arora K.R., Soil Mechanics and Foundation Engineering, Standard Publishers and Distributors, New Delhi, 2011
2. Holtz R.D., Kovacs W.D. and Sheehan T.C., Introduction to Geotechnical Engineering, Pearson, 2011.

b) References

1. Das B.M., Principles of Foundation Engineering, 7th, Edition, Cengage learning, 2010.

c) Online resources

1. https://nptel.ac.in/courses/105/108/105108069/

d) Codes:

1. IS: 3955 –1967– Code of Practice for design and construction of well foundation. BIS, New Delhi.
2. IRC: 45–1972 – Recommendations for estimating the Resistance of soil below the maximum scour level in the Design of well foundations of bridges.

10212CE114	GEOTECHNICAL EARTHQUAKE ENGINEERING	L	T	P	C
		3	0	0	3

Course Category / Type: Programme Elective/ Theory

A. Preamble :

Students undergoing this course are expected

- This course provides basic concepts of earthquakes and dynamic properties of soils and the response of soils to earthquake loads.
- The course also deals with various earthquake hazards including liquefaction, procedures to evaluate them and methods of mitigation.
- The syllabus covers subject content that is expected to be useful for students from several disciplines including civil engineering, seismology and earthquake engineering.

B. Pre-Requisites:

- 10211CE202 - Soil Mechanics

C. Link to other Courses:

- 10211CE111 - Foundation Engineering

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	To infer the concept of earthquake loading and its effects.	K2
CO2	To interpret the basics of vibration and mathematical models.	K2
CO3	To illustrate plate tectonics, theory and engineering seismology.	K2
CO4	To develop the various parameters of associated with earthquakes.	K2
CO5	To built the concept of wave propagation in layered media.	K2

E. Correlation of COs with POs

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L					L							M	
CO2	L	L				L							M	
CO3	L	L	L			L							M	
CO4	L		H	L		L							M	
CO5	L	L	H	L		L							M	

F. Course Content:

UNIT I INTRODUCTION TO GEOTECHNICAL EARTHQUAKE ENGINEERING 9

Scope and objective; Nature and types of earthquake loading; Importance of Geotechnical Earthquake Engineering.

UNIT II BASICS OF VIBRATION THEORY 9

Concept of dynamic load, Earthquake load, Single degree of freedom system, multiple degree of freedom system, Free and forced vibrations, Damped and undamped systems, Equation of Motion, Response spectra.

UNIT III ENGINEERING SEISMOLOGY 9

Basic Seismology, Earthquake- List of major earthquakes-Causes of earthquakes- Sources of earthquake data- Elastic rebound Theory- Faults, Plate tectonics, Seismograph and Seismogram, Prediction of Earthquakes, Protection against earthquake damage, Origin of Universe, Layers of Earth, Theory of Continental Drift, Hazards due to Earthquakes.

UNIT IV STRONG GROUND MOTION 9

Size of Earthquake: Magnitude and Intensity of Earthquake, Modified Mercalli Intensity Scale, Measuring of Earthquake, Earthquake Magnitude- Local (Richter) magnitude, surface wave magnitude, Moment magnitude, Seismic energy, Correlations. Spectral Parameters: Peak Acceleration, Peak Velocity, Peak Displacement, Frequency Content and duration, Spatial Variability of Ground Motion, Attenuation Relationships, Fourier Amplitude Spectra, Arias Intensity.

UNIT V WAVE PROPAGATION 9

Elastic response of continua (one, two and three dimensional wave equations); Waves in unbound media; Waves in semi-infinite media; Waves in layered media, Mohorovicic Discontinuity and Gutenberg Discontinuity, Seismic Travel Time Curve, Three Circle Method for locating an Earthquake‟s epicenter.

TOTAL: 45 PERIODS

G. Learning Resources:

a) Text Books

3. Kramer S.L., “Geotechnical Earthquake Engineering”, Pentice Hall, International Series, Pearson Education (Singapore) Pvt. Ltd.2004.
4. Saran S., “Soil Dynamics and Machine Foundation”, Galgotia publications Pvt. Ltd., New Delhi. 1999.

b) Reference Books

1. Dhamodarasamy S.R, and Kavitha S, “Basics of Structural Dynamics and Aseismic Design”, PHI Learning Pvt. Ltd., 2009.
2. C V R Moorthy, Earthquake Tips, NICEE, IIT Kanpur, 2004.

c) Online Resources

1. https://nptel.ac.in/courses/105/101/105101134/

10212CE115	SOIL STRUCTURE INTERACTION	L	T	P	C
		3	0	0	3

Course Category: Programme Elective / Theory

A. Preamble :

Students undergoing this course are expected

- The course will focus on the different soil-structure interaction models for shallow foundation under various loading conditions and subgrade characteristics.
- Piles uplift and lateral loading conditions will also be discussed.
- Beams and plates on elastic foundation problems and their solution with the help of Finite Difference Method will be discussed.

B. Pre-Requisites:

- 10211CE111 - Foundation Engineering

C. Link to other Courses:

- 10212CE113 - Advanced Foundation Engineering

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy Level
CO1	Infer the response of soil structure interaction behavior.	K2
CO2	Infer the response of various soil models.	K2
CO3	Get the knowledge of members subjected to loads is supported on continuous foundations.	K2
CO4	Get the knowledge of Group action of pile, Elastic Analysis, settlement of pile group under compressive load.	K2
CO5	Interpret the behavior of pile foundation for lateral load.	K2

E. Correlation of COs with POs

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L	M		L									M	
CO2	L	M		L									M	
CO3	L	H		L		M							M	
CO4	L	H		L		M							M	
CO5	L	H		L		M							M	

F. Course Content:

UNIT I SOIL RESPONSE MODELS OF INTERACTION ANALYSIS 9

Introduction to soil - Foundation interaction problems, Soil behavior, Foundation behavior, Interface behavior, soil-foundation interaction analysis.

UNIT II SOIL RESPONSE MODELS 9

Soil response models, Elastic continuum, Winkler, Two parameter elastic models, Elastic - plastic behavior, Time dependent behavior.

UNIT III INFINITE AND FINITE BEAMS ON ELASTIC FOUNDATIONS 9

Infinite beam, General solution of the elastic line - concentrated and distributed loads on beams -Idealization of semi-infinite and finite beams. Classification of finite beams, different end conditions and loads -solutions by general method, finite difference.

UNIT IV ANALYSIS OF PILE AND PILE GROUPS 9

Elastic analysis of single pile - Methods of analysis for settlement of pile - Solutions for settlement and load distribution in pile - Pile tip load - settlement of pile groups Analysis - Interaction between piles - bearing and floating piles - Effect of pile cap -Piled raft.

UNIT V LATERALLY LOADED PILE 9

Load - deflection prediction for laterally loaded piles - subgrade reaction and elastic analysis, Interaction analysis, pile raft system, solutions through influence charts

TOTAL: 45 PERIODS

G. Learning Resources:

a) Text Books:

1. Salgado, R., "The Engineering of Foundations", Tata McGraw Hill Education Private Limited, New Delhi, 2011.
2. Murthy, V.N.S., "Advanced Foundation Engineering", CBS Publishers, New Delhi, 2007.
3. Saran, S, "Analysis and Design of Substructures", Taylor & Francis Publishers, 2006.

b) References:

1. McCarthy, D.F. "Essentials of Soil Mechanics and Foundations", Basic Geotechnics, Sixth Edition, Prenticce Hall, 2002.
2. Hemsley, J.A, "Elastic Analysis of Raft Foundations", Thomas Telford, 1998.
3. ACI 336, "Suggested Analysis and Design Procedures for Combined Footings and Mats", American Concrete Institute, Dehit, 1988.

c) Online Resources:

1. https://nptel.ac.in/courses/105/105/105105200/

10212CE145	ROCK ENGINEERING	L	T	P	C
		3	0	0	3

Course Category/Type: Programme Elective / Theory

A. Preamble :

The construction industry has extended its horizon in all aspects. The maximum usage of all land area is the need of the current scenario, which includes construction in hard substrata (rocks). Thus this course is designed to expose the students to understand the properties and insitu strength of rocks.

B. Pre-Requisites:

- 10211CE202 - Soil Mechanics

C. Link to other course

- 10211CE111 - Foundation Engineering

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's taxonomy Level
CO1	Classify rocks and identify the various engineering properties.	K2
CO2	Understand the strength and behaviour of hard strata.	K2
CO3	Infer the stress distribution under influence of various conditions	K2
CO4	Establish the shear strength parameters and stability in slopes.	K2
CO5	Do understand the various stabilization techniques.	K2

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1				L			L							
CO2	M	M	M											
CO3		M	M											
CO4	M	M	M	L	L									
CO5	L	M	H	L		L	L	L						

F. Course Content:

UNIT I SUBSTRATUM ANALYSIS 9

Introduction to Geo morphology- Types of substratum layers- Types of Rocks - Index properties of hard strata minerals and classification of rock masses based on stratification, composition and morphology - Rock mass ratings and its significance in field estimations.

UNIT II CHARACTERISTIC STRENGTH OF HARD STRATUM 9

Behaviour of rock under hydrostatic compression and deviatric loading - Modes of rock failure - planes of weakness and joint characteristics - joint testing, Mohr - Coulomb failure criterion and tension cut-off, Hoek and Brown Strength criteria for rocks with discontinuity sets.

UNIT III ONSITE STRESSES IN SUBSTRATA LAYERS 9

Insitu stresses and their measurements, Hydraulic fracturing, flat jack, over coring and under coring methods - stress around underground excavations – Design aspects of openings in rocks - case studies.

UNIT IV SLOPE STABILITY AND BEARING CAPACITY **9**

Slope stability in rocks - role of discontinuities in slope failure, slope analysis and factor of safety - remedial measures for critical slopes – Bearing capacity of foundations on rocks – case studies.

UNIT V SUBSTRATA STABILIZATION **9**

Instability in rocks.Reinforcement of fractured and joined rocks. Techniques - shotcreting, bolting, anchoring; its significance and installation methods, operation and maintenance - case studies.

TOTAL: 45 PERIODS

G. LEARNING RESOURCES:

a) Text book

1. T. Ramamurthy, Editor, Engineering in Rocks for Slopes Foundations and Tunnels, PHI Learning Pvt. Ltd., 2007.

b) References

1. A.Hudson, and P. Harrison, Engineering Rock mechanics – An introduction to the principles, Pergamon publications,1997.
2. R.E. Goodman, Introduction to rock mechanics, John Willey and Sons,1989.
3. E. Hoek and J. Bray, Rock slope Engineering, Institute of Mining and Metallurgy, U.K.1981.
4. E. Hoek and E.T. Brown, Underground Excavations in Rock, Institute of Mining and Metallurgy,U.K. 1981.
5. L. Obvert and W. Duvall, Rock Mechanics and the Design of structures in Rock, John Wiley,1967.
6. Z.P. Bazant, Mechanics of Geomaterials Rocks, Concrete and Soil, John Wiley and Sons, Chichester,1985.
7. W. Wittke, Rock Mechanics. Theory and Applications with case Histories, Springerverlag, Berlin, 1990.
8. T. Waltham, Foundations of Engineering Geology, Second Edition, Spon Press, Taylor & Francis Group, London and New York,2002.

c) Online resources

1. https://nptel.ac.in/courses/105106055
2. https://nptel.ac.in/courses/105105212
3. https://www.youtube.com/watch?v=-1jQ6qLDir8

10212CE116	CONSTRUCTION PLANNING, SCHEDULING AND CONTROL	L	T	P	C
		3	0	0	3

Course Category / Type: Programme Elective / Theory

A. Preamble:

- To understand the various steps involved in the planning, scheduling, quality, cost and safety management for a project.

B. Prerequisite:

- NIL

C. Link to other Courses:

- NIL

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Identify the appropriate planning techniques in construction projects.	K3
CO2	Apply the suitable scheduling technique for the particular project.	K3
CO3	Practice the modern cost account and financial systems prevalent in departments.	K3
CO4	Illustrate the quality control and safety during construction	K2
CO5	Explain organization information in centralized database management systems	K2

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		M		M				M	H		H	M		M
CO2		M		M	M			M	H		H	M		M
CO3		M		M				M	H		H	M		M
CO4								M	H		H	M		M
CO5									H		H	M		M

F. Course Content:

UNIT I CONSTRUCTION PLANNING 9

Basic Concepts in the Development of Construction Plans – Choice of Technology and Construction Method – Defining Work Tasks – Defining Precedence Relationships among Activities – Estimating Activity Durations – Estimating Resource Requirements for Work Activities – Coding Systems.

UNIT II SCHEDULING PROCEDURES AND TECHNIQUES 9

Introduction – Types of project plans - Work breakdown structure – Planning techniques - Bar charts - Preparation of network diagram - Critical path method - Program Evaluation and Review technique - Introduction to project scheduling software demo - Preparation of schedule for a project by using software.

UNIT III COST CONTROL AND ACCOUNTING 9

The Cost Control Problem – The Project Budget – Forecasting for Activity Cost Control – Schedule Control – Schedule and Budget Updates – Relating Cost and Schedule Information. Departmental accounting procedure - Administrative and technical sanction - Payment of bills - Types of accounts in Department - Books and registers maintenance - Work charged establishment - Nominal muster roll - Daily labour reports

UNIT IV QUALITY CONTROL AND SAFETY DURING CONSTRUCTION 9

Quality and Safety Concerns in Construction – Organizing for Quality and Safety – Work and Material Specifications – Total Quality Control – Statistical Methods, Sampling by Attributes and Variables.

UNIT V ORGANIZATION AND USE OF PROJECT INFORMATION 9

Types of Project Information – Accuracy and Use of Information – Computerized Organization and Use of Information – Organizing Information in Databases – Relational Model of Databases – Other Conceptual Models of Databases – Centralized Database Management Systems – Databases and Applications Programs – Information Transfer and Flow.

TOTAL: 45 PERIODS

G. Learning Resources:

a) Text Books:

1. Calin M. Popescu, Chotchai Charoenngam, “Project Planning, Scheduling and Control in Construction: An Encyclopedia of terms and Applications”, Wiley, New York, 1995.
2. Chitkara K.K “Construction Project Management Plan” (English) 3rd Edition, Tata Mcgraw Hill Education Private Limited, 2014.
3. Srinath, L.S, “PERT and CPM, principles and Applications”, Affiliated East west press, 2001.

b) References:

1. Chris Hendrickson and Tung Au, Project Management for Construction - Fundamental Concepts for Owners, Engineers, Architects and Builders, Prentice Hall, Pittsburgh,2000.
2. Willis. E.M., “Scheduling Construction projects”, John Wiley and Sons, 2015.
3. Halpin.D.W., “Financial and cost concepts for construction Management”, John Wiley and Sons, New York, 2010.

c) Online Resources:

1. https://nptel.ac.in/courses/105/103/105103093/
2. https://nptel.ac.in/courses/105/106/105106149/

10212CE117	CONSTRUCTION EQUIPMENT AND PRACTICES	L	T	P	C
		3	0	0	3

Course Category / Type: Programme Elective / Theory

A. Preamble:

- To make the students aware of various Construction practices and impart knowledge on equipment needed for various construction activities from foundation to Substructure & Sub structure to Superstructure.

B. Prerequisite:

- NIL

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C. Link to other Courses:

- 10211CE108 - Construction Materials and Techniques.

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Summarize the techniques and Practices on various Construction procedures	K2
CO2	Demonstrate the working principle, operations and applications of various earthwork equipment	K2
CO3	Illustrate the working principle, operations and applications of substructure and superstructure equipment	K2
CO4	Illustrate the working principle, operations of aggregate production, concreting equipment.	K2
CO5	Relate the selection, cost control, Maintenance and replacement of equipment in projects.	K2

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L						H			L		M		M
CO2	L									H	L	M		M
CO3	L									H	L	M		M
CO4	L									H	L	M		M
CO5	L							L			H	M		M

F. Course Content:

UNIT I CONSTRUCTION PRACTICES 9

Site clearance – Marking – Earthwork – Masonry –Types- Flooring – Damp Proof Courses – Construction joints - Movement and expansion joints – Precast pavements – Building foundations – Basements – Temporary shed – Centering and shuttering – Slip forms – Scaffoldings – De-shuttering forms – Weather and water proof – Roof finishes – Acoustic and fire protection.

UNIT II EQUIPMENT FOR EARTH WORK 9

Fundamentals of Earth Work Operations - Earth Moving Operations - Types of Earth Work Equipment - Tractors, Motor Graders, Scrapers, Front end Waders – Dozer, Excavators, Rippers, Loaders, Trucks and Hauling equipment, Compacting Equipment, Finishing equipment.

UNIT III SUBSTRUCTURE & SUPERSTRUCURE 9

Equipment for Dredging, Trenching, Drag line and clamshells, Tunnelling – Equipment for Drilling and Blasting - Pile driving Equipment – Forklifts and related equipment - Portable Material Bins – Material Handling Conveyors – Material Handling Cranes- Industrial Trucks.

UNIT IV EQUIPMENT FOR CONCRETE PLANTS 9

Aggregate production – Different crushers – Feeders - Screening equipment - Handling equipment - Batching and Mixing equipment - Pumping equipment – Ready mix concrete equipment, Concrete pouring equipment.

UNIT V CONSTRUCTION EQUIPMENT MANAGEMENT 9

Identification – Planning of equipment – Selection of equipment - Equipment Management in Projects - Maintenance Management – Equipment cost – Operating cost – Cost Control of equipment - Depreciation Analysis – Replacement of equipment- Replacement Analysis - Safety Management.

TOTAL: 45 PERIODS

G. Learning Resources:

a) Text Books:

1. Peurifoy, R.L., Schexnayder, C.J, “Construction Planning, Equipment and Methods”, 9th Edition, McGraw Hill, Singapore, 2018.
2. Sharma S.C. “Construction Equipment and Management”, Khanna Publishers, New Delhi,2019.
3. Varghese, P.C., “Building Construction”, Prentice Hall of India Pvt. Ltd, New Delhi, 2016.

b) References:

1. Deodhar, S.V. “Construction Equipment and Job Planning”, Khanna Publishers, New Delhi,
2. Jerry Irvine, “Advanced Construction Techniques”, CA Rocketry, 2016.
3. Dr..Mahesh Varma, “Construction Equipment and its planning and Application”, Metropolitan Book Company, New Delhi.

c). Online Resources:

1. https://nptel.ac.in/courses/105/103/105103206/

10212CE118	MODERN BUILDING TECHNOLOGY	L	T	P	C
		3	0	0	3

Course Category/Type: Programme Elective/Theory

A. Preamble:

- This course aims to make the students get exposed to the emerging building techniques and concepts pertaining to green, smart and economical construction methods.

B. Prerequisite

- Nil

C. Links to other Courses

- 10211CE108 Construction Materials and Techniques
- 10212CE119 Green Built Environment

D. Course Outcomes

Upon the successful completion of the course, learns will be able to:

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Relate the importance of green building materials and practices in construction industry	K2
CO2	Outline the energy efficient strategies for a building	K2
CO3	Illustrate the components of building automation	K2
CO4	Compare the innovative construction systems for housing	K2
CO5	Demonstrate the understanding on concrete 3D printing techniques	K2

E. Correlation of COs with POs

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1	M					H	H					M		M
CO2	M					H	H					M		M
CO3	M				M	H	H					M		M
CO4	M					H	H					M		M
CO5	M				M							M		M

F. Course Content

UNIT I GREEN CONSTRUCTION 9

Conventional vs green buildings, criteria for a building to be green building – Green design strategies – Green building materials and products: fly ash bricks, recycled concrete aggregates, alternative road aggregate, rapidly renewable materials – Green construction practices: lean construction.

UNIT II NET ZERO ENERGY BUILDINGS (NZEB) 9

Conventional vs NZEB, definition, metrics of NZEB – Energy demand for a residential building– Practical guidelines for achieving net zero energy in buildings: solar residential appliances, refrigerator, ceiling fans, room air conditioner – Renewable energy systems for residential buildings: solar photovoltaics, small wind turbines, biomass – Indian case studies for NZEBs.

UNIT III SMART AND INTELLIGENT BUILDING 9

Conventional vs smart buildings – Smart building trends & buildings enabled with IoT – Definition of intelligent buildings – Intelligent architecture and structure – Digital controllers: data form, sensors, actuators – Building Automation System (BAS) – Progress of BAS – Building management functions.

UNIT IV ALTERNATIVE CONSTRUCTION SYSTEM 9

Requirements of construction system - Prevalent systems, need for new approach, alternative construction systems: jump formwork, tunnel formwork, monolithic concrete construction, light gauged steel frame structure - Modular construction: definition, attributes of modular construction, types and issues in modular construction.

UNIT V 3D PRINTING IN CONSTRUCTION 9

Additive manufacturing - Concept of 3D printing – Classification of printing technologies – Methods of concrete 3D printing: gantry concrete printing, robotic arm extruder, sand print, contour crafting - Benefits of 3D printing in construction and quality issues.

TOTAL: 45 PERIODS

G. Learning Resources

a) Text Books:

4. Krieder J. and Rabi A, Heating and Cooling of buildings: Design for Efficiency, McGraw Hill, 1994.
5. Ursala Eicker, Solar Technologies for buildings, Wiley Publications, 2003.
6. Shengwei Wang, Intelligent buildings and building automation, Spon Press, 2010.
7. Pradeep Tomar and Gurjit Jaur, Green and Smart Technologies for Smart Cities, CRC Press, 2020.

b) References:

3. Gary Santorella, Lean culture for the construction industry, CRC Press, 2017.
4. Lincoln H. Forbes, Syed M. Ahmed, Modern Construction: Lean Project Delivery and Integrated Practices, CRC Press, 2011.
5. Mark Lawson, Ray Ogden, Chris Goodier, Design in Modular Construction, CRC Press, 2014.
6. Alternative and Innovative Construction Systems for Housing, Building Materials & Technology Promotion Council, Ministry of Housing and Urban Affairs, Govt of

India.
7. Arnaud Perrot, 3D Printing of Concrete, Wiley Publications, 2019

c) Online Resources:

1. NPTEL :: Architecture - NOC:Sustainable Architecture
2. NPTEL :: Civil Engineering - NOC:Energy Efficiency, Acoustics and daylighting in Building
3. NPTEL :: Civil Engineering - NOC:Sustainable Materials and Green Buildings

10212CE119	GREEN BUILT ENVIRONMENT	L	T	P	C
		3	0	0	3

Course Category/Type: Programme Elective / Theory

A. Preamble

- This course aims to make the students get exposed to the concepts of green building design, construction and operation to become eligible for getting accredited as IGBC AP Associate

B. Prerequisite

- Nil

C. Links to other Courses

- 10212CE118 - Modern Building Technology

D. Course Outcomes

Upon the successful completion of the course, learns will be able to:

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Outline the sustainable measures in site selection and site planning	K2
CO2	Apply water efficiency strategies to conserve more water in buildings	K3
CO3	Plan the energy efficient performance and evaluation in buildings	K3
CO4	Identify and utilize the waste materials into building construction	K3
CO5	Interpret the impact of indoor air quality on health and productivity	K2

E. Correlation of COs with POs

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M					H	H					M		M
CO2	M					H	H					M		M
CO3	M				M	H	H					M		M
CO4	M					H	H					M		M
CO5						H	H					M		M

F. Course Content

UNIT 1 SUSTAINABLE ARCHITECTURE & SITES 9

Integrated approach for green building design: factors for site selection, understanding site ecology and site analysis - Soil erosion and pollution control measures: types of soil erosion, strategies to mitigate land degradation, design techniques and challenges - Microclimate: factors affecting microclimate and heat islands, strategies to handle heat island in built environment, designing green spaces and enhancing biodiversity in built environment - Universal design: key accessibility issues and design guidelines.

UNIT II WATER MANAGEMENT 9

Water balance and approach for water efficiency: 3R approach for water efficiency, reduce-reuse/recycle-recharge - Water efficient plumbing fixtures, standards and codes – Efficient irrigation practices: hydrozoning, control devices for water supply, irrigation systems: drip & sprinklers – Wastewater treatment & reuse technologies: physical, biochemical and natural – Rainwater harvesting, utilization and groundwater recharge technologies: design considerations.

UNIT III ENERGY MANAGEMENT 9

Introduction - Performance evaluation and approach for energy efficiency in buildings – Energy efficiency standards & codes: ECBC 2017, EPI, ASHRAE 90.1, ASHRAE 62.1, ASHRAE 55, ASHRAE 170, ISHRAE 1001, Star labelling for appliances – Efficient building envelope: heating loads in buildings, building orientation and form, envelope heat transfer and material specification for walls/roof/fenestration – Air conditioning: types of air conditioning systems, design considerations and control systems – Lighting in building: day lighting and artificial lighting, methods to determine ECBC compliance for interior lighting and lighting controls – Renewable energy systems and technology.

UNIT IV SUSTAINABLE BUILDING MATERIALS 9

Attributes of sustainable building materials: recycled content, regional material, renewable material, embodied energy, embodied carbon, material performance, recyclability and elimination of hazardous materials – Eco labeling of products: types of ecolabels: Type I,II&III – Sustainable materials for green buildings: ready mix concrete, construction blocks, glass, steel TMT bars, construction chemicals, insulation materials, cement and paints – Waste management during construction & post-occupancy: Segregation strategies, types of waste management, organic, inorganic, e-waste and hazardous waste.

UNIT V INDOOR ENVIRONMENTAL QUALITY 9

Indoor air quality: codes and standards, fresh air requirements, design considerations – Approach for improving indoor air quality: measures to reduce sick building syndrome, demand control ventilation, CO_2 monitoring in buildings, air quality monitoring – Enhancing occupant‟s comfort, acoustics, ergonomics and olfactory comforts.

TOTAL: 45 PERIODS

G. Learning Resources

a) Text Books:

1. Guide on Green Built Environment, Indian Green Building Council (IGBC),2021.
2. IGBC Green New Buildings rating system, IGBC, 2016.
3. IGBC Green Homes rating system, IGBC, 2019.

b) Reference:

1. National Building Code (NBC), Bureau of Indian Standards, 2016.
2. Energy Conservation Building Code (ECBC), Bureau of Energy Efficiency, 2017.
3. American Society of Heating, Refrigerating and Air-conditioning Engineers (ASHRAE), ASHRAE 55, ASHRAE 62.1, ASHRAE 90.1, 2010.

c) Online Resources:

1. NPTEL :: Architecture - NOC:Sustainable Architecture
2. NPTEL :: Civil Engineering - NOC:Energy Efficiency, Acoustics and daylighting in Building

10212CE120	CONSTRUCTION SAFETY MANAGEMENT	L	T	P	C
		3	0	0	3

Course Category / Type: Programme Elective / Theory

A. Preamble:

- To learn the importance and process of safety management in a construction project.
- To understand about safety procedure in a construction project.
- To understand the role of designer and responsibilities of owner in safety aspect.

B. Prerequisite:

- NIL

C. Link to other Courses:

- NIL

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Outline about construction accident and legal implications.	K2
CO2	Summarize the effective safety program in a construction project.	K2
CO3	Learn the safety in construction contract documents.	K2
CO4	Explain the safety procedure and project coordination.	K2
CO5	Relate the role of designer and owner responsibility.	K2

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						H	L					L		L
CO2						H	L	M				M		L
CO3						M	L	M				L		L
CO4					L	H	L					L		L
CO5						M	L	M			L	M		L

F. Course Content:

UNIT I CONSTRUCTION ACCIDENTS 9

Accidents and their Causes - Human Factors in Construction Safety - Costs of Construction Injuries - Occupational and Safety Hazard Assessment - Legal Implications - Prevention techniques for construction accidents.

UNIT II SAFETY PROGRAMMES 9

Problem Areas in Construction Safety - Elements of an Effective Safety Programme - Job-Site Safety Assessment - Safety Meetings - Safety Incentives - Training for safety awareness and implementation - Safety guidelines for workers.

UNIT III CONTRACTUAL OBLIGATIONS 9

Safety in Construction Contracts - Substance Abuse - Classifications - Public health, Medical, Drug Misuse - Signs and Symptoms - Safety Record Keeping.

UNIT IV DESIGNING FOR SAFETY 9

Safety Culture - Safe Workers - Safety and First Line Supervisors - Safety and Middle Managers - Top Management Practices - Company Activities and Safety - Safety Personnel - Sub contractual Obligation - Project Coordination and Safety Procedures - Workers Compensation.

UNIT V OWNERS' AND DESIGNERS' OUTLOOK 9

Owner‟s responsibility for safety - Owner preparedness - Role of designer in ensuring safety - Safety clause in design document.

TOTAL: 45 PERIODS

G. Learning Resources:

d) Text Books:

4. Jimmy W. Hinze, Construction Safety, Prentice Hall Inc., 2005.
5. Richard J. Coble, Jimmie W. Hinze and Theo C. Haupt, Construction Safety and Health Management, Prentice Hall Inc., 2001.

e) References:

1. Vaid K. N, Construction safety management, National Institute of Construction Management and Research, 2003.
2. Davies V. J and Tomasin K, Construction safety handbook, Thomas Telford, 2019.

f) Online Resources:

1. https://onlinecourses.nptel.ac.in/noc21_ce16/preview

10212CE146	FAILURE ASSESSMENT OF STRUCTURES	L	T	P	C
		3	0	0	3

Course Category / Type: Programme Elective / Theory

A. Preamble:

- To understand the deterioration process of structures.
- To know about repair materials.
- To assess the condition of the structure.

B. Prerequisite:

- NIL

C. Link to other Courses:

- NIL

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Understand the procedure for assessment of fire damaged structures.	K2
CO2	Learn about the settlement of structures.	K2
CO3	Understand the mechanism of corrosion of rebar.	K2
CO4	Learn about design and construction errors.	K2
CO5	Understand the damaged structure due to earthquake.	K2

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L					L		M				M		
CO2	L	M			M	L	M					M		
CO3	L	L				M						M		
CO4	L					M	M	M				M		
CO5	M				M	M	M	H				M		

F. Course Content:

UNIT I FIRE DAMAGES 9

Fire damages mechanism - Surface cracking - Chemical decomposition – Micro cracking and spalling - Assessment methods - Preliminary investigation - Cleaning - Visual inspection - Fire intensity - Field test - Detailed investigation - Non destructive tests - Destructive test methods - case studies - Assessment report.

UNIT II SETTLEMENT DAMAGES 9

Structural settlement - Causes for structural settlement - Soil settlement - Foundations structural settlement - Types - Immediate structural settlement - Structural settlement due to consolidation - Methods of predicting structural settlement - Methods of settlement control - Case studies Assessment report.

UNIT III CORROSION DAMAGES 9

Causes of corrosion - Mechanism of corrosion - Types - Corrosion process - Formation of white batches - Occurrence of cracks - Formation of multiple cracks - Spalling of cover concrete - Bulging - Delamination - Prevention measure - Repairing technique - Case studies - Assessment report.

UNIT IV DESIGN AND CONSTRUCTION ERRORS 9

Design and detailing errors - Causes - Types of design error - Inadequate structural design - Poor design details - Prevention - Construction errors - Causes - Types of construction errors - Prevention methods - Repairing techniques - Assessment report.

UNIT V DAMAGE DUE TO EARTHQUAKES 9

Earthquake effects - Causes - Ground shaking - Ground failure - Tsunamis - Failure mechanism of earthquakes - Free standing masonry wall - Wall encloser without roof - Roof on two walls - Roof on wall encloser - Roofs and floors - Long building with trusses - Shear wall with opening - Prevention measure - Repairing techniques - Assessment report.

TOTAL: 45 PERIODS

G. Learning Resources:

a) Text Books:

1. Ransom,W.H., Building Failures, Tayloar& Francis, 2002.
2. Perkins.P, Repair, Protection and Waterproofing of Concrete Structures, CRC Press, 2019.
3. Allen R.T. & Edwards S.C, Repair of Concrete Structures, Blakie and Sons, UK, 2014.

b) References:

1. Ravindra.V, Jeffrey.G, Protection of Concrete, CRC Press, 2014.
2. Richardson,B.A., Remedial Treatment of Buildings, Butterworth- Heinemann, 2020.
3. Breysse.D,Non-Destructive Assessment of Concrete Structures: Reliability and Limits of Single and Combined Techniques, Springer Publishers, 2012.

c) Online Resources:

1. https://www.youtube.com/watch?v=cX2FdjV4eOY
2. https://archive.nptel.ac.in/courses/105/106/105106202/
3. https://archive.nptel.ac.in/courses/105/105/105105213/

10212CE121	ENGINEERING GEOLOGY	L	T	P	C
		3	0	0	3

Course Category/Type: Programme Elective/Theory

A. Preamble:

- Engineering Geology is concerned with the importance of geological knowledge such as geomorphology, properties of rocks and minerals, geological structures to perform during the planning of civil engineering works.

B. Prerequisite:

- NIL

C. Link to other Course:

- Nil

D. Course Outcomes: Upon the successful completion of the course, students will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Understand the geomorphological process and interior of the earth	K2
CO2	Classify the origin and engineering properties of minerals.	K2
CO3	Explain the origin, occurrence and engineering properties of rocks.	K2
CO4	Interpret the surface and subsurface geological structures of the earth through geophysical methods	K2
CO5	Demonstrate the geological knowledge in construction of major civil engineering structures.	K2

E. Correlation of COs with POs

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H						M					M	L	
CO2	L			H			M					M	L	
CO3	L			H			M					M	L	
CO4	M			M			M		M		L	M	M	
CO5	L			H		M	H		M		M	M	M	

F. Course Content:

UNIT I GENERAL GEOLOGY 9

Introduction: Branches of geology – Relevance of Geology in Engineering, Physical Geology - Geomorphic processes - Rock weathering - Formation of soils - soil profiles - soils of India, Geologic work and engineering significance of wind, rivers and oceans - Interior constitution of the earth -Various methods to study the interior - crust, mantle, core – lithosphere - Asthenosphere - composition of different layers - SIMA & SIAL, plate tectonics and continental drift.

UNIT II MINERALOGY 9

Elementary knowledge on important crystallographic systems – physical properties of minerals – study of the following rock forming minerals – Quartz family, Feldspar family - Hypersthene group - hypersthene and Augite, Mica – muscovite and biotite, Calcite, Gypsum – properties, behavior and engineering significance of clay minerals.

UNIT III PETROLOGY 9

Classification of rocks, Distinction between igneous, sedimentary and metamorphic rocks, Engineering properties of rocks, Description occurrence, engineering properties and distribution of following rocks - Igneous rocks – Granite, Dolerite and Basalt - Sedimentary rocks sandstone, Limestone, shale, Conglomerate and breccia, Metamorphic rocks- Quartzite, Marble, Gneiss and Schist.

UNIT IV STRUCTURAL GEOLOGY AND GEOPHYSICAL METHOD 9

Definition-outcrop-stratification-dip and strike, Fold - parts -classification- relevance to civil engineering, Faults - parts of a fault - classification- relevance to civil engineering - Joints-definition- classification, Geophysical methods – Seismic and electrical methods for subsurface investigations, Rock Quality Designation (RQD), Geological Strength Index (GSI), Q system for rock mass classification.

UNIT V GEOLOGICAL CONSIDERATIONS FOR ENGINEERING STRUCTURES AND GEOHAZARDS 9

Remote sensing techniques – Study of air photos and satellite images – Remote sensing for civil engineering applications, Geological conditions necessary for design and construction of Dams, Reservoir and Tunnels - Coastal protection structures. Landslide - types, causes and mitigation, Tsunami – causes and mitigation.

TOTAL: 45 PERIODS

G. Learning Resources:

a) Text Books:

1. Parbin Singh. A Text book of Engineering and General Geology, Katson publishing house, Ludhiana 2009.
2. Varghese, P.C., Engineering Geology for Civil Engineering PHI Learning Private Limited, New Delhi, 2012.

b) References:

1. F.G.Bell. Fundamentals of Engineering Geology, B.S. Publications. Hyderabad 2011.
2. Venkatareddy. D. Engineering Geology, Vikas Publishing House Pvt. Ltd. 2010.

3. KVGK Gokhale, Principles of Engineering Geology, BS Publications, Hyderabad 2011.
4. Chenna Kesavulu. Textbook of Engineering Geology, Macmillan India Ltd., 2009.

c) Online resources:

1. https://nptel.ac.in/courses/105/105/105105106/
2. https://nptel.ac.in/courses/105/104/105104191/
3. https://nptel.ac.in/courses/105105106/24
4. https://nptel.ac.in/courses/105105106/23
5. https://nptel.ac.in/courses/105105106/2

10212CE122	INTRODUCTION TO REMOTE SENSING	L	T	P	C
		3	0	0	3

Course Category/Type: Programme Elective/Theory

A. Preamble

- The course deals with the concepts of remote sensing processes and its components.
- It gives the knowledge of various remote sensing platforms, sensors and the basics of image interpretation elements.

B. Prerequisite

- Nil

C. Link to other Course:

- 10212CE123 - Geographic Information System

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

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Understand the concepts and laws related to remote sensing	K2
CO2	Explain the interaction of electromagnetic radiation with atmosphere and earth material	K2
CO3	Classify the knowledge about satellite orbits and different types of satellites platforms	K2
CO4	Understand the different types of remote sensor and its characteristics	K2
CO5	Interpret the satellite images for different civil engineering applications	K2

E. Correlation of COs with POs

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H											M	L	
CO2	M						M					L	L	
CO3	L				M					M		L	L	
CO4	L				H							L	L	
CO5	M		M	H	H		H				M	L	M	

F. Course Content:

UNIT I REMOTE SENSING AND ELECTROMAGNETIC RADIATION 9

Definition – Components of RS – Merits and demerits of data collation between conventional and remote sensing methods - Electromagnetic Spectrum – importance of electromagnetic spectrum - Radiation principles - Wave theory, Planck„s law, Wien‟s Displacement Law, Stefan‟s Boltzmann law, Kirchoff„s law – Radiation sources: active & passive.

UNIT II EMR INTERACTION WITH ATMOSPHERE AND EARTH MATERIAL 9

Standard atmospheric profile – interaction of radiation with atmosphere – Scattering, absorption and refraction – Atmospheric windows – interaction of radiation with earth surface- Specular and diffuse reflectors – Spectral reflectance & emittance – Spectroradiometer – Spectral Signature concepts – Typical spectral reflectance curves for vegetation, soil and water – Factors affecting spectral reflectance of vegetation, soil and water.

UNIT III ORBITS AND PLATFORMS 9

Satellites orbit – Sun synchronous and Geosynchronous satellites orbit – Legrange Orbit - Platform - Ground based, Airborne platforms and Space borne platforms – Characteristics of different platforms: Landsat, SPOT, IRS series, IKONOS, QUICKBIRD – Radar, LIDAR, SAR, MODIS, AMSRE, Sonar remote sensing systems.

UNIT IV SENSING TECHNIQUES 9

Sensor - types – Resolution concept : spatial, spectral, radiometric and temporal resolutions - Scanners - Along and across track scanners – characteristics of sensors: Optical-infrared sensors – Thermal sensors – microwave sensors – High Resolution Sensors - LIDAR , UAV – Orbital and sensor characteristics of Indian earth observation satellites.

UNIT V DATA INTERPRETATION AND CIVIL ENGINEERING APPLICATIONS 9

Types of Data Products – types of image interpretation - Visual interpretation: basic elements and interpretation keys – Digital interpretation – Concepts of Image rectification, Image enhancement and Image classification – Civil Engineering applications: water resource, irrigation, highway and railway alignments, site selection for important civil engineering projects.

TOTAL: 45 PERIODS

G. Learning resources

a) Text books:

1. Lillesand,T.M., Kiefer, R.W. and J.W.Chipman. "Remote Sensing and Image Interpretation" 6th Edition., John Willey and Sons Asia Pvt. Ltd., New Delhi, 2008
2. Anji Reddy, M. "Textbook of Remote Sensing and Geographical Information System" 2nd edition. BS Publications, Hyderabad, 2001.

3. Richards, Remote sensing digital Image Analysis-An Introduction Springer - Verlag 1993.

b) References:

1. Janza, F.Z., Blue H.M. and Johnson,J.E. Manual of Remote Sensing. Vol.I, American Society of Photogrametry, Virginia, USA, 2002.
2. Verbyla, David, Satellite Remote Sensing of Natural Resources. CRC Press, 1995
3. Paul Curran P.J. Principles of Remote Sensing. Longman, RLBS, 2003.

c) Online Resources

1. https://onlinecourses.nptel.ac.in/noc21_ce11/preview
2. https://nptel.ac.in/courses/105/108/105108077/
3. https://nptel.ac.in/courses/105/103/105103193/
4. https://nptel.ac.in/courses/105/101/105101206/

10212CE123	GEOGRAPHICAL INFORMATION SYSTEM (GIS)	L	T	P	C
		3	0	0	3

Course Category/Type: Program Elective/Theory

A. Preamble:

- Students undergoing this course are expected to know the fundamentals of Map and Geographic Information System and also this course gives the knowledge of spatial data structures, input, management and output processes.

B. Prerequisite:

- Nil

C. Link to other Course:

- 10212CE122 - Introduction to Remote sensing

D. Course Outcomes: On completion of the course, the student will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Understand the fundamental concept of maps and GIS characteristics	K2
CO2	Classify the DBMS and various spatial data models	K2
CO3	Interpret the various vector and raster data input to the GIS	K2
CO4	Classify the spatial analysis tools for deriving GIS based outcome	K2
CO5	Interpret the GIS output image for different thematic map	K2

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H						L					L	L	
CO2	M		L									L	L	
CO3	M		H		H							L	M	
CO4	L		H		H		M					L	M	
CO5	L		M		M		L				M	L	M	

F. Course Content:

UNIT I MAPS AND GIS 9

Map: Definition - Scale - Types of Maps – uses – Elements of Map – Projection – purpose - types – Coordinate Systems: Geographic, Rectangular and Polar – Transformations: types and application – GIS: Introduction - Components – Applications of GIS – Open source GIS software.

UNIT II DBMS AND GIS DATA MODEL 9

Database Management system – function – types – advantages - Entity Relationship Model - Normalization - GIS Data Model - Introduction- Data Encoding - Vector Data Structure - Raster Data structure – Network Data Structure - Comparison of Vector and Raster Data Structure – ODBC.

UNIT III GIS DATA INPUT 9

Sources for GIS Data - Vector Data Input – Georeferencing – Topology – Topological Relationship - Raster Data Input – Errors in input – Data Editing – Linking Attribute Data – Raster File Formats – Vector File Formats – Raster to Vector and Vector to Raster Conversion - OGC standards.

UNIT IV GIS DATA ANALYSIS 9

Introduction to spatial analysis - Raster Data Spatial Analysis: Local, Neighbourhood, Zonal Operations - Vector Operations and Analysis: Topological and Non-topological operations - Network Analysis – DEM – Surface Analysis.

UNIT V GIS OUTPUT DESIGN AND PRESENTATION 9

Introduction - Spatial and Non-spatial Data presentation - Map layout – Charts, Graphs and Multimedia output – Elements of Spatial Data Quality – Meta Data - Introduction to Web GIS – Applications in Civil Engineering.

TOTAL: 45 PERIODS

G. Learning Resources

a) Text Books:

1. Anji Reddy M, “Remote sensing and Geographical information system” - B.S Publications, 2011.
2. Burrough P.A, “Principles of GIS for Land Resources Assessment” - Oxford Publication, 1980.
3. Kang-tsung Chang, "Introduction to Geographic Information Systems", 9th Edition, McGraw-Hill Book Company, 2019.

b) References:

1. Chestern, “Geo Informational Systems: Application of GIS and Related Spatial Information Technologies” - ASTER Publications, 1992.
2. Jeffrey Star and John Estes, “Geographical Information System: An Introduction” - Prentice Hall, 1990.

c) Online Resources

1. https://nptel.ac.in/courses/105/107/105107155/
2. https://nptel.ac.in/courses/107/105/107105088/
3. https://onlinecourses.nptel.ac.in/noc21_ce09/preview

10212CE124	PAVEMENT ENGINEERING	L	T	P	C
		3	0	0	3

Course Category / Type: Programme Elective / Theory

A. Preamble:

- To impart basic knowledge on pavement types and stress distribution on pavements.
- To design of various types of pavements and their components using different codal provisions.
- To analyze about the reliability and evaluate the serviceability conditions of pavements.
- To explain about the basic concept of soil stabilization for strengthening the pavements along with case studies.

B. Prerequisite:

- 10211CE106 – Transportation Engineering

C. Link to other Courses:

- Nil

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Identify the principles behind in pavement designing.	K2
CO2	Explain the design of flexible Pavements by adopting various codal provisions.	K2
CO3	Illustrate the design of Rigid Pavements using IRC guidelines.	K2
CO4	Selection of appropriate methods for evaluation and maintenance of pavements.	K2
CO5	Summarize the design criteria with the application of geosynthetics.	K2

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						H	M						L	
CO2		L	H			L	L	M			L		L	
CO3		L	M			L	L	H			L		L	
CO4						L	L				L			
CO5						H	L	L					M	

F. Course Content:

UNIT I PAVEMENT TYPES AND STRESS DISTRIBUTION 9

Historical development of pavements - types, classification, components and principle of load transfer - Approaches to pavement design - behaviour of road materials under repeated loading -Stresses and deflections in layered systems**.**

UNIT II DESIGN OF FLEXIBLE PAVEMENT 9

Factors affecting flexible pavements – material characterization for analytical pavement design – AASHO, CBR, group index methods – Importance of Resilient modulus – Fatigue subsystem – failure criteria for bituminous pavements – IRC design guidelines.

UNIT III DESIGN OF RIGID PAVEMENT 9

Factors affecting rigid pavements - Design procedures for rigid pavement – Slab thickness, dowel bar, tie bar, spacing of joints – IRC guidelines – Airfield pavements – Comparison of highway and airfield pavements.

UNIT IV PAVEMENT EVALUATION AND MAINTENANCE 9

Pavement evaluation – surface and structural - causes and types of failures in flexible and rigid pavements – Presents serviceability index of roads – Overlay design - pavements maintenance, management and construction – Drainage and its importance in pavements.

UNIT V SOIL STABILIZATION FOR PAVEMENT CONSTRUCTION 9

Soil stabilization – Types of soil stabilization - Necessity of soil stabilization - Design criteria -Mechanisms - factors influencing choice of stabilizers - Applications of Geosynthetics in road construction - Case studies.

TOTAL: 45 PERIODS

G. Learning Resources:

1. Text Books:

1. Khanna S.K and Justo C.E.G and Veeraragavan A., "Highway Engineering", 10th Edition, Nemchand Publishers, 2014.
2. R.Srinivasa Kumar., "Pavement Engineering" Universities Press (India) Private Limited, Hyderabad, 2013.

2. References:

1. Design and Specification of Rural Roads (Manual), Ministry of rural roads, Government of India, New Delhi, 2001.
2. Guidelines for the Design of Flexible Pavements", IRC:37- 2001, The Indian roads Congress, New Delhi.
3. Guideline for the Design of Rigid Pavements for Highways, IRC:58-1998, The Indian Roads Congress, New Delhi.
4. O"Flaherty, C.A., Highways-The location, Design, Construction & Maintenance of Pavements, Fourth Edition, Elsevier, 2006.

3. Online Resources:

1. https://nptel.ac.in/courses/105/101/105101087/

10212CE125	INTELLIGENT TRANSPORTATION SYSTEMS	L	T	P	C
		3	0	0	3

Course Category / Type: Programme Elective / Theory

A. Preamble:

- To explain the basic concept of architecture and hardware components of intersection management for integrated traffic systems.
- To explain about the basics of dynamic traffic analysis for advanced traffic management.
- To summarize about the basis of traveler information system and their business opportunities.

B. Prerequisite:

- 10211CE106 – Transportation Engineering

C. Link to other Courses:

- Nil

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Interpret the advanced traveler information system and	K2
CO2	Identify the development of architectures for ITS and its	K2
CO3	Explain about the integrated traffic management system.	K2
CO4	Interpret the dynamic traffic assignment.	K2
CO5	Summarize the concepts of ATIS and its business	K2

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L				H	L	M					M	L	
CO2	L				H	L	M	L				M	L	
CO3	L				L	L	H	L				M		
CO4	L				L	L	M				L	L		
CO5	L				H		H	L				L	L	

F. Course Content:

UNIT I INTRODUCTION TO INTELLIGENT TRANSPORT SYSTEM 9

Overview – Introduction to ITS – ITS User services - Role and Responsibilities – Public Transportation Operation – Commercial Vehicle Operations - Advanced Traveler Information System – Fleet Oriented ITS Services – Electronic Toll Collection – Critical issues – Security – Safety.

UNIT II ARCHITECTURE AND HARDWARE 9

Architecture – ITS Architecture – User Services and their Requirements – Logical Architecture – Physical Architecture – Equipment Packages – Market Package - Framework – Hardware Sensors – Vehicle Detection – Techniques – Dynamic Message Sign – GPRS – GPS – Toll Collection.

UNIT III INTERSECTION MANAGEMENT 9

Principals of Traffic Control – Conflicts at Intersection – Levels of Intersection Control - Video Detection – Virtual Loop - Cameras - ANPR – IR Lighting – Integrated Traffic Management – Control Centre – Junction Management Strategies.

UNIT IV ADVANCED TRANSPORT MANAGEMENT SYSTEM 9

ATMS – Route Guidance – Issues - Travel Information – Pre-Trip and Enroute Methods – Historical – Current – Predictive Guidance – Data Collection – Analysis – Dynamic Traffic Assignment (DTA) – Components – Algorithm.

UNIT V ADVANCED TRAVELLER AND INFORMATION SYSTEM 9

Basic ATIS Concepts – Smart Route System – Smart Car - Data Collection – Information Communications - Process – Dissemination to Travelers – Evaluation of Information – Value of Information – Business Opportunities.

TOTAL: 45 PERIODS

G. Learning Resources:

a) Text Books:

1. Asier Perallos, Unai Hernandez-Jayo, Enrique Onieva, Ignacio Julio García-Zuazola., “Intelligent Transport Systems: Technologies and Applications”, John Wiley & Sons, Ltd, 2015.
2. Henry F.Korth, and Abraham Siberschatz, Data Base System Concepts, McGraw Hill, New Delhi, 1992.
3. Sarkar, PK and Jain, AK., “Intelligent Transport Systems”, PHI Learning, 2018.

b) References:

1. Cycle W. Halsapple and Andrew B.Winston, Decision Support Systems - Theory and Application, Springer Verlog, New York, 1987.
2. Gorden and Robert, Intelligent Transport Systems: Functional Design for Effective Traffic Management, Springer, 2016.

c) Online Resources:

1. https://www.civil.iitb.ac.in/~vmtom/nptel/591_ITS_1/web/web.html
2. https://www.civil.iitb.ac.in/~vmtom/nptel/592_ITS_2/web/web.html
3. https://nptel.ac.in/courses/105/101/105101008/

10212CE147	REMOTE SENSING AND GIS IN TRANSPORTATION DEVELOPMENT	L	T	P	C
		3	0	0	3

Course Category / Type: Programme Elective / Theory

A. Preamble:

- Students undergoing this course are expected to know about the recent techniques of Remote Sensing and GIS and its application in Traffic and Transportation Engineering.
- The students would have knowledge on the basics of Remote Sensing and GIS techniques and their application in the Transport sectors.

B. Prerequisite:

- 10212CE125 - Transportation Engineering

C. Link to other Courses:

- 10212CE122 - Introduction to Remote Sensing
- 10212CE123 - Geographical Information System
- 10212CE125 - Intelligent Transport System

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Understand the basic concepts and components of remote sensing.	K2
CO2	Understand the basic concepts and components of GIS.	K2
CO3	Interpret the various data structures, analysis and techniques for GIS modeling.	K2
CO4	Summarize the basic applications of RS and GIS in transportation sector.	K2
CO5	Summarize the role of advanced applications of RS And GIS in intelligent transportation system.	K2

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L	M		M		M								
CO2	M	M				M								
CO3	M	M	M		L									
CO4	L	M				L								
CO5	M	M		M		M								

F. Course Content:

UNIT I INTRODUCTION TO REMOTE SENSING 9

Definition - Components of Remote Sensing - Energy, Sensor, Interacting Body - Active and Passive Remote Sensing - Platforms - Aerial and Space Platforms - Balloons, Helicopters, Aircraft and Satellites - Electromagnetic Radiation - EMR Spectrum

UNIT II INTRODUCTION TO GIS 9

Basic Concept and Components - Hardware, Software - Data Spatial and non-spatial – Geo referencing - Map Projection - Types of Projection - Simple Analysis - Data retrieval and querying

UNIT III APPLICATION OF RS & GIS TO TRANSPORTATION 9

Highway and Railway Alignment, location of transport terminals and roadside facilities, bus stops -Route optimization - Bus route rationalization - Accident analysis - Applications of Aerial Photography and Satellite Imageries

UNIT IV DATA STRUCTURES AND ANALYSIS 9

Database - Raster and Vector data structures - Data storage - Run length, Chain and Block coding -Vector data storage - Topology - GIS Modelling - Raster and Vector data analysis - Buffering and overlaying techniques - Network Analysis - Spatial Analysis

UNIT V ADVANCED APPLICATIONS IN TRANSPORTATION 9

GIS as an integration technology - Integration of GIS, GPS, GPRS and Remote Sensing Techniques - Advanced Traveler Information System (ATIS) - Automatic Vehicle Location System (AVLS) - Advanced Transport Management System (ATMS) - Route Guidance - Smart Route System

TOTAL: 45 PERIODS

G. Learning Resources:

a) Text Books:

1. Burrough P.A, "Principles of GIS for Land Resources Assessment", Oxford Publication, 1994.

b) References:

1. Anji Reddy, "Remote Sensing and Image Interpretation", John Wiley and Sons Inc. New York, 1987.
2. M.G.Srinivas, "Remote Sensing Applications", Narosa Publishing House, 2001.
3. Jeffrey Star and John Ester, Geographical Information System – An Introduction, Prentice Hall Inc., Englewood Cliffe, 1990.
4. Marble, D.F, Calkins, H.W and Penquest, Basic Readings in GIS, Speed System Ltd., New York, 1984.

c) Online Resources:

1. https://nptel.ac.in/courses/105108073
2. https://archive.nptel.ac.in/courses/105/103/105103193/