DEPARTMENT OF CIVIL ENGINEERING

CURRICULUM AND SYLLABI

PROGRAMME CORE AND PROGRAMME ELECTIVE COURSES

SEPTEMBER 24, 2020

VEL TECH RANGARAJAN DR. SAGUNTHALA R&D INSTITUTE OF SCIENCE AND TECHNOLOGY

PROGRAMME CORE						
Code	**Course**	**L**	**T**	**P**	**C**	**(Applicable for)**
THEORY COURSES						
1151CE101	Engineering Geology	2	0	0	2	2016-20
1151CE102	Construction Materials	2	0	0	2	
1151CE103	Surveying - I	3	0	0	3	
1151CE104	Engineering Mechanics	2	2	0	3	All
1151CE105	Fluid Mechanics	2	2	0	3	All
1151CE106	Mechanics of Solids	2	2	0	3	All
1151CE107	Structural Analysis – I	2	2	0	3	All
1151CE108	Construction Techniques, Equipments and Practice	3	0	0	3	2016-20
1151CE109	Design of RC Elements	2	2	0	3	All
1151CE110	Basics of Dynamics and Aseismic Design of Structures	2	2	0	3	All
1151CE111	Design of Steel Structures	2	2	0	3	All
1151CE112	Estimation and Quantity Surveying	3	0	0	3	2016-20
1151CE113	Construction Materials and Techniques	3	0	0	3	Batches 2017 onwards
1151CE114	Surveying	3	0	0	3	
1151CE115	Structural Analysis – II	2	2	0	3	
1151CE116	Geotechnical Engineering – II	3	0	0	3	
1151CE117	Estimation and Quantity Surveying	2	0	0	2	
					Sub Total 35	2017
					Sub Total 34	2016
INTEGRATED COURSES						
1151CE201	Strength of Materials	2	2	2	4	All
1151CE202	Geotechnical Engineering - I	2	2	2	4	All
1151CE203	Concrete Technology	3	0	2	4	2016-20
1151CE204	Environmental Engineering	2	2	2	4	
1151CE205	Applied Hydraulic Engineering	2	2	2	4	All
1151CE206	Environmental Engineering	3	0	2	4	Batches 2017 onwards
1151CE207	Concrete Technology	3	0	2	4	
					Sub Total 20	2017
					Sub Total 20	2016

LABORATORY COURSES						
1151CE301	Surveying Practical – I	0	0	2	1	All
1151CE302	Building Drawing	0	0	2	1	All
1151CE303	Survey Camp	0	0	2	1	All
1151CE304	Environmental and Irrigation Drawing	0	0	2	1	All
1151CE305	Computer Applications in Civil Engineering	0	0	2	1	All
1151CE306	Material Testing Laboratory	0	0	2	1	2016
				Sub Total	5	2017
				Sub Total	6	2016
				Total	**60**	**All**

1151CE101	ENGINEERING GEOLOGY	L	T	P	C
		2	0	0	2

Course Category / Type : Programme Core / Theory

A. Preamble:

Students undergoing this course are expected

- To understand the geologic processes that influence civil engineering works.
- To acquire knowledge about the properties of rocks and minerals and the ability to identify them.
- To understand the different geological factors affecting the civil engineering works.

B. Prerequisite:

- NIL

C. Link to other Courses:

- Nil

D. Course Educational Objectives:

- After undergoing the course the students will be able to understand the geological process and structures used to deal the adequate structures for civil engineering works.

E. 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 geomorphological process and interior of the earth	K2
CO2	Understand the description, occurrence and properties of minerals	K2
CO3	Understand the description, occurrence and properties of rocks	K2
CO4	Understand the geological structures and subsurface investigation through geophysical methods	K2
CO5	Understand the geological conditions for construction of civil engineering projects.	K2

F. Correlation of COs with POs:

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

G. Course Content:

UNIT I GENERAL GEOLOGY 6

Introduction: Various 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.

UNIT II MINERALOGY 6

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 6

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 breccias, Metamorphic rocks-Quartzite, Marble, Gneiss and Schist.

UNIT IV STRUCTURAL GEOLOGY AND GEOPHYSICAL METHOD 6

Definition-outcrop-stratification-dip and strike, Folds-definition- parts of fold-classification-relevance to civil engineering, Faults-definition-parts of a fault-classification- relevance to civil engineering - Joints-definition- classification, Geophysical methods – Seismic and electrical methods for subsurface investigations.

UNIT V GEOLOGICAL INVESTIGATIONS IN CIVIL ENGINEERING 6

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, Reservoirs - Coastal protection structures. Landslide - types, causes and mitigation.

TOTAL: 30 PERIODS

H. Learning Resources:

a) Text Books:

1. Parbin Singh, "Engineering and General Geology", S. K. Kataria & Sons, New Delhi, 2009.

2. Dimitri P Krynine and William R. Judd, "Principles of Engineering Geology and Geotechnique", McGraw-Hill Book Company, New Delhi, 2005.

b) References:

1. Robert Ferguson Legget and Allen W. Hatheway, "Geology and Engineering", McGraw-Hill Book Company, New Delhi, 1998

2. Blyth F.G.H and Michael de Freitas, "Geology for Engineers", ELBS, Mumbai 2006.

c) Online Resources:

1. https://nptel.ac.in/courses/105105106/

2. https://onlinecourses.nptel.ac.in/noc16_ce01/preview

1151CE102	**CONSTRUCTION MATERIALS**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**

Course Category / Type: Programme Core / Theory

A. Preamble:

- After undergoing the course, the students shall be able to select, check, utilize and apply the various materials for construction.

B. Prerequisite:

- 1150CE101 – Basic Civil Engineering

C. Link to other Courses:

- 1151CE203 / 1151CE207 – Concrete Technology

D. Course Educational Objectives:

Students undergoing this course are expected to

- Gain knowledge about materials used for various types of constructions.
- Acquire knowledge about the cement concrete.
- Impart knowledge about the mix design of concrete.
- Gain knowledge about timber and other modern material used in construction.

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

CO Nos.	**Course Outcomes**	**Bloom's Taxonomy level**
CO1	Select and use the stones in various buildings.	K2
CO2	Check the quality of bricks and cement.	K2
CO3	Check the quality of concrete.	K2
CO4	Utilize timber and other materials for various applications in buildings.	K2
CO5	Adopt of Modern materials in the construction of buildings.	K2

F. Correlation of COs with POs:

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

G. Course Content:

UNIT I STONES 6

Classification - Selection - Use of stone in buildings - Requirement and testing of stones– Deterioration and preservation of stone work - Artificial stones.

UNIT II BRICKS AND CEMENT 6

Manufacture of bricks - Classification - Qualities - Tests on Brick - Application of bricks - Cement – Types of cement – Tests on cement – Application of cement.

UNIT III CONCRETE 6

Concrete - Proportioning of concrete mixes - Introduction to mix design - Factors affecting the Mix Design - Water-cement ratio – Mixing, placing and compacting - Fresh concrete - Properties of fresh concrete - Properties of hardened concrete – Tests on fresh and hardened concrete – Light Weight Concrete – Self Compacting Concrete .

UNIT IV TIMBER AND OTHER MATERIALS 6

Timber – Market forms – Plywood – Veneer – Thermacol – Steel – Aluminum and other Metallic Materials – Composition – Aluminium composite panel – Uses – Market forms – Paints – Varnishes.

UNIT V MODERN MATERIALS 6

Glass – Ceramics – Sealants for joints - Glass fiber reinforced polymers – Carbon fiber reinforced polymers - Clay products – Composite materials – Types – Applications of laminar composites – Fibre textiles – admixtures – additives – Case Study on Recycling of construction waste materials and Environmental friendly materials - Smart Materials – Nano Materials.

TOTAL: 30 PERIODS

H. Learning Resources:

a) Text Books:

1. Rangwala, S.C., “Engineering Materials”, Charotar Publishing House, Anand, India , 28th edition 2011.

2. Varghese.P.C, “Building Materials”, PHI Learning Pvt. Ltd, New Delhi, 2012.

b) References:

1. Rajput. R.K., “Engineering Materials”, S. Chand and Company Ltd. New Delhi, 2008.
2. Jagadish.K.S, “Alternative Building Materials Technology”, New Age International Publishers, New Delhi, 2007.
3. Gambhir. M.L and Neha Jamwal., “Building Materials”, Products, Properties and Systems, Tata McGraw Hill Educations Pvt. Ltd, New Delhi, 2012.
4. Santhakumar A R., “Concrete Technology”, Oxford University Press, India, 2006
5. Shetty.M.S., “Concrete Technology”, (Theory and Practice), S.Chand and Company Ltd., New Delhi, 2008.
6. Gambhir.M.L., “Concrete Technology”, 5th Edition, Tata McGraw Hill Education, New Delhi, 2013.

c) Online Resources:

1. http://nptel.ac.in/courses/105102088/
2. http://nptel.ac.in/courses/105106053/
3. https://onlinecourses.nptel.ac.in/noc16_ce05/preview

1151CE103	SURVEYING I	L	T	P	C
		3	0	0	3

Course Category / Type: Programme Core / Theory

A. Preamble:

- To provide the conceptual knowledge of the principles and methods of understanding of surveying and equipment used in surveying.

B. Prerequisite:

- Nil

C. Link to other Courses:

- 1152CE137 – Surveying II

D. Course Educational Objectives:

Students undergoing this course are expected to

- Gain knowledge about various forms of surveying such as chain surveying, compass surveying, plane table surveying.
- Acquire knowledge about the most important instruments used for surveying such as theodolite, dumpy-level.
- Impart the ideas of levelling through various methods.

E. 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 fundamentals in surveying and to apply the knowledge of chain surveying.	K3
CO2	Understand angular measurement systems.	K3
CO3	Understand the methods and processes in levelling and levelling instruments.	K2
CO4	Apply the different levelling methods and concepts.	K3
CO5	Use theodolite for surveying.	K3

F. 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
CO2			H								H		L	
CO3			H								M		M	
CO4													L	
CO5			H										M	

G. Course Content:

UNIT I FUNDAMENTALS AND CHAIN SURVEYING 9

History of Surveying – Surveying Definition- Classifications - Basic principles-Equipment and accessories for ranging and chaining – Methods of ranging - Well conditioned triangles – Errors in linear measurement and their corrections - Traversing – Applications - Enlarging and reducing the figures – Areas enclosed by straight line - irregular figures- digital planimeter.

UNIT II COMPASS AND PLANE TABLE SURVEYING 9

Compass – Basic principles - Types - Bearing - Systems and conversions- Sources of errors - Local attraction - Magnetic declination-Dip-Traversing - Plotting - Adjustment of closing error – applications - Plane table and its accessories - Merits and demerits - Radiation - Intersection – Resection – (Two point problem - Three point problem) – Traversing – Advantages and uses - sources of errors – Applications.

UNIT III LEVELLING 9

Level line - Horizontal line - Datum - Bench marks -Levels and staves - Temporary and permanent adjustments – Methods of levelling - Fly levelling - Check levelling - Procedure in levelling - Booking -Reduction - Curvature and refraction - Reciprocal levelling – Sources of Errors in levelling- Precise levelling - Types of instruments - Adjustments - Field procedure

UNIT IV LEVELLING APPLICATIONS 9

Longitudinal and Cross-section-Plotting - Contouring - Methods - Characteristics and uses of contours - plotting – Methods of interpolating contours – Computations of cross sectional areas and volumes - Earthwork calculations - Capacity of reservoirs - Mass haul diagrams.

UNIT V THEODOLITE SURVEYING 9

Theodolite - Types - Description - Horizontal and vertical angles - Temporary and permanent adjustments – Heights and distances– Tangential and Stadia Tacheometry – Subtense method - Stadia constants - Anallactic lens.

TOTAL: 45 PERIODS

H. Learning Resources:

a) Text Books:

1. Kanetkar. T. P., and Kulkarni. S. V., "Surveying and Levelling", Part I, 24th edition, Pune Vidyarthi Griha Prakashan., 2014.
2. Punmia. B.C., Ashok Kumar Jain., and Arun Kumar Jain., "Surveying - Vol I", Laxmi Publications Pvt. Ltd., 2005.

b) References:

1. Anne Mary J, "Surveying I", Sci Tech Publications Pvt. Ltd., 2016.
2. Duggal S. K, "Surveying", McGraw Hill Education. 2013.
3. Basak N. N, "Surveying & Levelling", McGraw Hill Education. 2014.
4. Bannister A, Raymond. S and Baker. R, "Surveying", Pearson India., 2011.

c) Online Resources:

1. http://nptel.ac.in/courses/105107122/
2. http://nptel.ac.in/courses/105104101/

1151CE104	ENGINEERING MECHANICS	L	T	P	C
		2	2	0	3

Course Category / Type: Programme Core / Theory

A. Preamble:

- This course provides the fundamentals of engineering phenomena which are essential for understanding and solving the engineering problems.

B. Prerequisite:

- Basic knowledge in Mathematics and Physics

C. Link to other Courses:

- 1151CE106 – Mechanics of Solids

D. Course Educational Objectives:

In this course, the students will gain the knowledge about,

- Vector and scalar representation of forces and moments, static equilibrium of particles and rigid bodies in two and three dimensions.
- Principle of work and energy, the effect of friction in equilibrium, the kinematics and laws of motions and the dynamic equilibrium.
- Geometric properties of planes and solids.
- Dynamics of particles, Displacement, Velocity, Acceleration and their relationship.
- Friction in belts, rollers and rotating bodies.

E. 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 principles of statics of particles	K2
CO2	Establish various forces and moments acting on rigid bodies.	K2
CO3	Define properties and theories related to surfaces and solids.	K2
CO4	Understand the principles of dynamics of particles to solve engineering problems.	K2
CO5	Describe the principles of various types of friction.	K2

F. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO1	M													
CO2	M	M	M	M										
CO3	M		M	M										
CO4	M		M	M										
CO5	M			M										

G. Course Content:

UNIT I BASICS AND STATICS OF PARTICLES 6+6

Introduction – Units and Dimensions – Laws of Mechanics: Lami's Theorem, Parallelogram and Triangular Law of forces – Vectors – Vectorial representation of forces and couples – Vector operations: Additions, Subtraction, Dot product, Cross product – Coplanar Forces – Resolution and Composition of forces – Equilibrium of a particle – Forces in space – Equilibrium of a particle 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 supports and their reactions – Requirements of stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis –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

Determination of Areas and Volumes – First moment of area and the Centroid of sections –Second and product moments of plane area – Parallel axis theorem and perpendicular axis theorem – Polar moment of inertia – Principal moments of inertia of plane areas – Principal axes of inertia – Mass moment of inertia.

UNIT IV DYNAMICS OF PARTICLES 6+6

Displacement, Velocity and Acceleration, their relationship – Relative motion – Circular motion - Curvilinear motion – Newton's laws – Work-Energy Equation of particles – Impulse and Momentum – Impact of elastic bodies.

UNIT V FRICTION 6+6

Frictional force – Laws of Coloumb friction – Simple contact friction – Belt friction – Roller friction - Translation and Rotation of Rigid Bodies - General Plane motion

TOTAL: 30+30 = 60 PERIODS

H. Learning Resources:

a) Text Books:

1. Kottiswaran N., Engineering Mechanics, Sri Balaji Publications Pvt. Ltd., 2015.

2. Palanichamy M. S., and Nagan S., Engineering Mechanics (Statics and Dynamics), Tata McGraw Hill, New Delhi, 2012.

b) References:

1. Timoshenko S,Young D.H, J.V.Rao, Sukumar Pati, Engineering Mechanics, McGraw Hill Education (India) Private Limited., 2013.

2. Beer F. P., and Johnston E. R., Vector Mechanics for Engineers – Dynamics and Statics, Tata McGraw-Hill, New Delhi, 2011.

3. Natarajan K.V., Engineering Mechanics, Dhanalakshmi Publishers, 2011.

4. Shames I. H., and Krishna Mohana Rao G., Engineering Mechanics (Statics and Dynamics), Dorling Kindersley India Pvt. Ltd. (Pearson Education), 2011.

5. Kumar K. L., Engineering Mechanics, Tata McGraw- Hill, New Delhi, 2011.

6. Hibbeller R.C., Engineering Mechanics, Vol. 1 Statics, Vol. 2 Dynamics, Pearson Education Asia Pvt. Ltd., 2015.

7. Rajasekaran S. and Sankarasubramanian G., Engineering Mechanics, Vikas Publishing House Pvt Ltd, 2011.

1151CE105	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.

B. Prerequisite:

- 1151CE104 – Engineering Mechanics

C. Link to other Courses:

- 1151CE205 – Applied Hydraulic Engineering

D. Course Educational Objectives:

- Students undergoing this course are expected to gain knowledge about fluid behavior for different conditions
- Acquire knowledge about the various kinds of flows
- Impart knowledge about the Bernoulli's principle

E. 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 basic concepts and principles in Fluid properties.	K2
CO2	Discuss the kinematics of fluid and applications of continuity equation	K3
CO3	Enumerate the application of Bernoulli's equation	K3
CO4	Differentiate between laminar and turbulent flows in circular pipes	K3
CO5	Understand the dimensional aspects of fluid flow.	K2

F. Correlation of COs with POs:

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

G. Course Content:

UNIT I DEFINITIONS AND FLUID PROPERTIES 6+6

Definitions – Fluid and fluid mechanics – Dimensions and units – Fluid properties – Continuum concept of system and control volume

UNIT II FLUID STATICS AND KINEMATICS 6+6

Pascal's law and Hydrostatic equation - Forces on plane and curved surfaces - Buoyancy - Pressure Measurement-Stream, streak and path lines - Classification of flows - Continuity equation - Stream and potential functions -Flow nets - Velocity measurement

UNIT III FLUID DYNAMICS 6+6

Euler and Bernoulli's equations - Application of Bernoulli's equation – Discharge measurement - Laminar flows through pipes and between plates – Hagen-Poiseuille’s equation - Turbulent flow - Darcy Weisbach formula -Moody diagram - Momentum Principle

UNIT IV BOUNDARY LAYER AND FLOW THROUGH PIPES 6+6

Definition of boundary layer - Thickness and classification - Displacement and momentum thicknesses -Development of Laminar and Turbulent flows in circular pipes - Major and minor losses of flow in pipes - Pipes in series and in parallel - Pipe network

UNIT V SIMILITUDE AND MODEL STUDY 6+6

Dimensional Analysis – Rayleigh’s method, Buckingham’s π-theorem – Similitude and models – Scale effect and distorted models

TOTAL: 30+30 = 60 PERIODS

H. Learning Resources:

a) Text Books:

1. Yunus A. Cengel and John M. Cimbala “Fluid Mechanics (Fundamentals and Applications)”, McGraw-Hill Higher Education, New Delhi, 2006

2. Bansal R.K., A “Textbook of Fluid Mechanics”, Laxmi Publications, New Delhi, 2005.

3. Rajput R. K., “A Textbook of Fluid Mechanics and Hydraulic Machines”, Sixth Edition. Publisher: S Chand & Company, New Delhi, 2016.

b) References:

1. Modi P.N and Seth S.M, "Hydraulics and Fluid Mechanics Including Hydraulics Machines", 14th Edition, Standard Book House, Nai Sarak, Delhi, 2002
2. Streeter, Victor L. and Wylie, Benjamin E., "Fluid Mechanics", McGraw-Hill Ltd., New Delhi, 2017.
3. Natarajan M.K., "Principles of Fluids Mechanics", Anuradha Agencies, Kumbakonam, 1995.
4. Kumar K.L., "Engineering Fluid Mechanics", Eurasia Publishing House (P) Ltd., New Delhi, 1995.

c) Online Resources:

1. www.youtube.com/playlist?list=PLbMVogVj5nJTZJHsH6uLCO00I-ffGyBEm
2. http://nptel.ac.in/courses/112105171/1
3. http://nptel.ac.in/courses/103104043/1
4. https://nptel.ac.in/courses/105103095/
5. http://nptel.ac.in/courses/112105183/

1151CE106	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:

- 1151CE104 - Engineering Mechanics

C. Link to other Courses:

- 1151CE201 - Strength of Materials

D. Course Educational Objectives:

- To understand the stresses and strains in structural components.
- To determine the shear force and bending moment for beams.
- To analyse the trusses and cylinders.
- To determine the deflection of beams by various methods.
- To recognise the deformation of components subjected to pure torsion and shear.

E. 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

F. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	M	M		L										
CO2	M	M		L										
CO3	M	M		L										
CO4	M	M		L										
CO5	M	M		L										

G. Course Content:

UNIT I STRESS STRAIN AND DEFORMATION OF SOLIDS, STATES OF STRESS 6+6

Rigid bodies and deformable bodies – Stability, strength, stiffness – 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 – Mohr's circle of stresses.

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

Beams – Types of supports – Simple and fixed - Types of load – Concentrated, uniformly distributed, varying distributed load, combination of above loading – Relationship between bending moment and shear force – Bending moment, shear force diagrams for simply supported, Cantilever and over hanging beams – 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 – Shear centre.

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

H. Learning Resources:

a) Text Books:

1. Bansal R.K., “Strength of Materials”, Laxmi Publications, 6th Edition, New Delhi, 2017.
2. 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, New Delhi, 2003.
2. William A.Nash, “Theory and Problems of Strength of Materials”, Tata McGraw-Hill publishing Co., New Delhi, 2007.
3. 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/105102090/
4. http://nptel.ac.in/courses/105106116/38

1151CE107	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 structures and introduces the analysis of statically indeterminate structures. It further develops skills in determining reactions and loads on structures and familiarizes the students with the basic concepts of truss analysis

B. Prerequisite:

- 1151CE201 – Strength of Materials

C. Link to other Courses:

- 1152CE101–Structural Analysis - II

D. Course Educational Objectives:

Students undergoing this course are expected to:

- Analyze and design structural members subjected to tension, compression, deflection and rotation using the fundamental concepts of stress and strain
- Identifying determinate, indeterminate, stable and unstable structures.
- Learn to derive shear and moment expressions from loading functions.
- Develop a basic understanding of influence lines.

E. 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 principle of virtual work and compute the deflection of pin jointed & rigid jointed frames	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	K4
CO4	Analyze the continuous beam and frame structure by slope deflection method	K4
CO5	Understand moment distribution method.	K4

F. 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		M										
CO3		H		M										
CO4		H		M										
CO5		H		M										

G. 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 – Begg's deformeter

UNIT III ARCHES 6+6

Arches as 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.

UNIT IV SLOPE DEFLECTION METHOD 6+6

Continuous beams and rigid frames(with and without sway) – Symmetrical and unsymmetrical – Simplification for hinged end – Support displacements.

UNIT V MOMENT DISTRIBUTION METHOD 6+6

Stiffness and carry over factors - Distribution and carryover of moments – Analysis of continuous beams – Plane rigid frames with and without sway - Naylor's simplification.

TOTAL: 30+30 = 60 PERIODS

H. Learning Resources:

a) Text Books:

1. Vaidyanadhan R and Perumal P., "Comprehensive Structural Analysis –Vol.1 & Vol.2", Laxmi Publications, New Delhi, Third Edition, 2016.

2. Bhavikatti S.S., "Structural Analysis - Volume I and II", Vikas Publishing House, New Delhi, Fourth Edition, 2018.

b) References:

1. Timoshenko and Young D.H, "Theory of Structures", Second edition, McGraw-Hill, 1965.
2. Devdas Menon, "Structural Analysis", Alpha Science International Limited, 2018.
3. Wang C.K., "Analysis of Indeterminate Structures", Tata McGraw-Hill, 2005.
4. Negi L.S., & Jangid R.S., "Structural Analysis", Tata McGraw-Hill Publications, New Delhi, Sixth Edition, 2003.
5. Reddy C.S, "Basic Structural Analysis", Tata McGraw-Hill, 1994.

c) Online Resources:

1. http://nptel.ac.in/downloads/105101085/
2. http://nptel.ac.in/courses/105105166/
3. http://nptel.ac.in/courses/105106050/

1151CE108	CONSTRUCTION TECHNIQUES EQUIPMENTS AND PRACTICES	L	T	P	C
		3	0	0	3

Course Category / Type: Programme Core / Theory

A. Preamble:

- This course is useful for a detailed study of the techniques applied in construction industry.

B. Prerequisite:

- 1151CE102 – Construction Materials

C. Link to other Courses:

- 1152CE119 – Repair and Rehabilitation of Structures

D. Course Educational Objectives:

Students undergoing this course are expected to

- Study the various practices involved in the construction industry.
- Know the appropriate techniques used for sub-structure constructions.
- Have exposure on various innovative technologies involved in super structure constructions.
- Study the characteristics and suitability of equipment employed in different works.
- Give knowledge on the idea about the repair and rehabilitation of deteriorated structures.

E. 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 sequence of building construction	K2
CO2	Illustrate the various equipments used for substructure construction	K2
CO3	Get exposure on construction techniques involved in super structure	K2
CO4	Choose and adopt the suitable equipment in the mechanized construction towards speedy completion of projects.	K2
CO5	Implement the latest techniques in the repair and rehabilitation of structures.	K2

F. 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					H	M		M						
CO3					H	M		M						
CO4					H	M		M						
CO5					M	M		M						

G. Course Content:

UNIT I - CONSTRUCTION PRACTICES 9

Specifications, details and sequence of activities and Construction co-ordination – Site clearance – Marking – Earthwork - Masonry – Stone masonry – Bond in masonry - Concrete hollow block Masonry – Flooring – Damp proof courses – Construction joints – Movement and expansion joints – Pre cast pavements – Building foundations – Basements – Temporary shed – Centering and shuttering – Slip forms – Scaffoldings – De-shuttering forms – Fabrication and erection of steel trusses – Frames – Braced domes – Laying brick – Weather and water proof – Roof finishes – Acoustic and fire protection.

UNIT II - SUB STRUCTURE CONSTRUCTION 9

Techniques of box jacking – Pipe jacking - Under water construction of diaphragm walls and basement - Tunneling techniques – Piling techniques - Well and caisson - Sinking cofferdam – Cable anchoring and grouting - Driving diaphragm walls, Sheet piles - Shoring for deep cutting – Well points - Dewatering and stand by Plant equipment for underground open excavation.

UNIT III - SUPER STRUCTURE CONSTRUCTION 9

Launching girders, bridge decks - Off shore platforms – Special forms for shells - Techniques for heavy decks – In-situ pre-stressing in high rise structures, Material handling - Erecting light weight components on tall structures - Support structure for heavy Equipment and conveyors – Erection of articulated structures, Braced domes and space decks.

UNIT IV - CONSTRUCTION EQUIPMENTS 9

Selection of equipment for earth work - Earth moving operations - Types of earthwork equipment - tractors, motor graders, scrapers, front end waders and earth movers – Equipment for foundation and pile driving - Equipment for compaction, batching, mixing and concreting - Equipment for material handling and erection of structures - Equipment for dredging, trenching and tunneling.

UNIT V - REPAIR AND REHABILITATION 9

Facets of Maintenance, Importance of Maintenance - Various aspects of Inspection - Estimation of residual strength of damaged structures - Assessment procedure for evaluating a damaged structure - Causes of deterioration – NDT - Quality assurance for concrete construction concrete properties - Strength, permeability, thermal properties and cracking - Effects due to climate, temperature, chemicals, corrosion - Design and construction errors - Effects of cover thickness and cracking - Repair of structures distressed due to earthquake – Strengthening using FRP - Strengthening and stabilization techniques for repair - Vacuum concrete, Gunite and shotcrete, epoxy injection, mortar repair for cracks, shoring and underpinning - Methods of corrosion protection - Corrosion inhibitors, corrosion resistant steels and cathodic protection - Case studies.

TOTAL: 45 = PERIODS

H. Learning Resources:

a) Text Books:

1. Peurifoy R.L., Ledbetter W.B. and Schexnayder C., Construction Planning, Equipment and Methods, McGraw Hill, Singapore, 8th Edition, 2011.

2. Arora S.P. and Bindra S.P., Building Construction, Planning Techniques and Method of Construction, Dhanpat Rai and Sons, 19th Edition, 2000.

b) References:

1. Shetty M.S., “Concrete Technology - Theory and Practice”, S. Chand and Company Ltd., New Delhi, 2005.

2. Jha J and Sinha S.K., “Construction and Foundation Engineering”, Khanna Publishers, New Delhi, 2000.

3. Sharma S.C., “Construction Equipment and Management”, Khanna Publishers, New Delhi, 6th Edition, 2003.

4. Gambhir M.L., “Concrete Technology”, Tata McGraw - Hill Publishing Company Ltd., New Delhi, 2004.

5. Varghese P.C., “Building Construction”, Prentice Hall of India Pvt. Ltd., New Delhi, 2007.

c) Online Resources:

1. https://www.youtube.com/watch?v=j04CtMzo_0Y
2. https://www.youtube.com/watch?v=FQvFzdFIp08
3. https://www.youtube.com/watch?v=9VUTBRdKZGs
4. https://www.youtube.com/watch?v=RY2jStGljO0
5. https://www.youtube.com/watch?v=Yqu21vPBylY

1151CE109	DESIGN OF RC ELEMENTS	L	T	P	C
		2	2	0	3

Course Category / Type: Programme Core / Theory

A. Preamble:

- To introduce the various philosophies related to design of basic structural elements and design of slab, beam, column, footing which form part of any structural system with reference to IS code of practice.

B. Prerequisite:

- 1151CE201 - Strength of Materials

C. Link to other Courses:

- 1152CE147 - Design of Reinforced Concrete and Brick Masonry Structures

D. Course Educational Objectives:

- To understand the concept of elastic method, ultimate load method and limit state method.
- To design the structural members with reference to IS code of practice.
- To gain knowledge on detailing of structural members.

E. 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 concept of elastic method and design of flexural members.	K6
CO2	Design one way and two way rectangular slabs subjected to uniformly distributed load for various boundary conditions and design of beams.	K6
CO3	Understand the concepts of bond, anchorage, shear and torsion and design of beams subjected to shear and torsion.	K6
CO4	Classify the types of columns and design of short and long columns.	K6
CO5	Design the different types of footing and detailing of structural elements.	K6

F. 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	
CO2		M	H			M							M	
CO3		M	H			M							M	
CO4		M	H			M							M	
CO5		M	H			M							M	

G. Course Content:

UNIT I METHODS OF DESIGN OF CONCRETE STRUCTURES 6+6

Concept of Elastic method, ultimate load method and limit state method – Advantages of Limit State Method over other methods – Design codes and specification – Limit State philosophy as detailed in IS code – Design of flexural members and slabs by working stress method - Introduction to prestressed concrete.

UNIT II LIMIT STATE DESIGN FOR FLEXURE 6+6

Analysis and design of singly and doubly reinforced rectangular and flanged beams **-** Analysis and design of one way and two way slab subjected to uniformly distributed load for various boundary conditions and corner effects.

UNIT III LIMIT STATE DESIGN FOR BOND, ANCHORAGE, SHEAR AND TORSION 6+6

Behaviour of RC members in bond and Anchorage - Design requirements as per current code - Behaviour of RC beams in shear and torsion - Design of RC members for combined bending shear and torsion.

UNIT IV LIMIT STATE DESIGN OF COLUMNS 6+6

Types of columns – Braced and unbraced columns – Design of short column for axial, uniaxial and biaxial bending – Design of long columns.

UNIT V LIMIT STATE DESIGN OF FOOTING AND DETAILING 6+6

Design of wall footing – Design of axially and eccentrically loaded rectangular footing – Design of combined rectangular footing (for two columns only) – Standard method of detailing, RC beams, slabs and columns – Special requirements of detailing with reference to erection process.

TOTAL: 30 + 30 = 60 PERIODS

H. Learning Resources:

a) Text Books:

1. Krishna Raju N., "Design of Reinforced Concrete Structures", CBS Publishers & Distributors, New Delhi, 2012.

2. Varghese P.C., "Limit State Design of Reinforced Concrete", Prentice Hall of India, Pvt. Ltd., New Delhi, 2009.

b) References:

1. Jain A.K., "Limit State Design of RC Structures", 7th Edition, Nemchand Publications, Roorkee.

2. Sinha S.N., "Reinforced Concrete Design", Tata McGraw-Hill Publishing Company Ltd., 2014, New Delhi.

3. Ramamrutham.S., "Design of Reinforced Concrete Structures", Dhanpat Rai Publishing Company, 2007.

4. Unnikrishna Pillai S., Devadas Menon., "Reinforced Concrete Design", Tata McGraw-Hill Publishing Company Ltd., 2009, New Delhi.

5. IS: 456-2000, "Plain and Reinforced Concrete Code of Practice", Bureau of Indian Standards, New Delhi.

6. SP16: 1980 Design Aids to IS 456:1978, "Bureau of Indian Standards", New Delhi.

c) Online Resources:

1. http://ce-notes-vg.blogspot.in/2011/05/design-of-reinforced-concrete.html

1151CE110	BASICS OF DYNAMICS AND ASEISMIC DESIGN OF STRUCTURES	L	T	P	C
		2	2	0	3

Course Category / Type: Programme Core / Theory

A. Preamble:

- This course is useful in distinguishing dynamic forces from static ones. The student learns to make mathematical models of different degrees of freedom subjected to earthquake forces.

B. Prerequisite:

- 1151CE109 – Design of RC Elements

C. Link to other Courses:

- 1151CE104 – Engineering Mechanics
- 1151CE107 – Structural Analysis

D. Course Educational Objectives:

Students undergoing this course are expected to:

- Learn the basic concept of dynamic loading
- Determine the effect of earthquake loading on the behaviour of structures.
- Learn the codal provision to design the structure as earthquake resistant.

E. 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 phenomena of earthquakes and their measurements.	K1
CO2	Analyze the response of various SDOF systems.	K3
CO3	Analyze the response of MDOF System.	K3
CO4	Describe the soil-structure phenomena and the concepts of modeling.	K2
CO5	Identify the various codes for applying earthquake forces on structures.	K2

F. Correlation of COs with POs:

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

G. Course Content:

UNIT I SEISMOLOGY 6+6

Elements of Engineering Seismology - Characteristics of Earthquakes - Earthquake History - Indian Seismicity.

UNIT II SINGLE DEGREE OF FREEDOM SYSTEMS 6+6

Formulation of equation of motion - Free and forced vibrations – Damping - Types of Damping – Damped and undamped vibrations - Response to dynamic loading.

UNIT III 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 Vectors

UNIT IV BEHAVIOUR OF STRUCTURES AND SOIL 6+6

Performance of structures during past earthquakes - Lessons learnt from past earthquakes – liquefaction – Resistance against liquefaction –Soil types and strength - Soil-Structure Interaction (SSI) effects.

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

H. Learning Resources:

a) Text Books:

1. Anil K.Chopra, "Dynamics of Structures", 3rd Edition, Pearson Education, Chennai, 2007.
2. Dhamodarasamy S.R, and Kavitha S, "Basics of Structural Dynamics and Aseismic Design", PHI Learning Pvt. Ltd., Delhi, 2009.

b) References:

1. Clough R.W. and Penzien J, "Dynamics of Structures", Second Edition, McGraw – Hill International Edition, London, 1993.
2. Mario Paz, "Structural Dynamics – Theory and Computations", Third Edition, CBS Publishers, 1991.
3. Humar J L, "Dynamics of Structures", Prentice Hall, Delhi, 1990.
4. C V R Moorthy, "Earthquake Tips", NICEE, IIT Kanpur, 2004
5. IS 1893 (Part I): 2016 - Criteria for Earthquake Resistant Design of Structures – Part I – General Provisions and Buildings, Bureau of Indian Standards, New Delhi.
6. IS 13920:2016 – Ductile Design and Detailing of Reinforced Concrete Structures, Bureau of Indian Standards, New Delhi.

c) Online Resources:

1. http://nptel.ac.in/courses/105101004/3
2. http://nptel.ac.in/syllabus/105101006/
3. http://nptel.ac.in/courses/105101004/

1151CE111	DESIGN OF STEEL STRUCTURES	L	T	P	C
		2	2	0	3

Course Category / Type: Programme Core / Theory

A. Preamble:

- This course is useful for a detailed study of the techniques applied in designing of steel structures

B. Prerequisite:

- 1151CE107 - Structural Analysis-I

C. Link to other Courses:

- Nil

D. Course Educational Objectives:

Students undergoing this course are expected

- Gain knowledge on the different types of structural steel members
- Acquire skills in the method of designing structural systems as per different code specifications
- Learn the Problem solving techniques
- Learn the concepts and techniques in designing structural steel members
- Learn the structural systems like trusses, gantry girders and gussets.

E. 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 limit state design concepts and design joints	K2
CO2	Design the connection in tension members, tension splices and understand the concept of shear lag	K2
CO3	Understand the theory of columns and design the compression members	K3
CO4	Design steel beams, plate girders and beam-columns	K3
CO5	Understand the design procedure of roof truss, can able to design purlins and elements of trusses and gantry girders	K3

F. Correlation of COs with POs:

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

G. Course Content:

UNIT I INTRODUCTION 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 - Rivets, welding, bolting – Eccentric connections - Efficiency of joints - High Tension bolts – Use of Medium & High tensile steel

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.

UNIT III COMPRESSION MEMBERS 6+6

Types of compression members – Theory of columns – 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.

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

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.

TOTAL: 30 + 30 = 60 PERIODS

H. Learning Resources:

a) Text Books:

1. Bhavikatti.S.S, "Design of Steel Structures by Limit State Method as per IS: 800–2007", IK International Publishing House Pvt. Ltd., New Delhi, 2009.

2. Subramanian N, “Design of Steel Structures”, Oxford University Press, New Delhi, 2013.

b) References:

1. Ramachandra S., “Design of Steel Structures – Vol. I & II”, Standard Publication, New Delhi, Tenth Edition, 2011.
2. Dayaratnam P., “Design of Steel Structures”, S. Chand & Company, Second Edition, 2010.
3. Ramachandra S., “Teaching Resources for Structural Steel Design – Vol. I & II”, INSDAG, Kolkatta.
4. Gaylord E.H., Gaylord, N.C., and Stallmeyer J.E., “Design of Steel Structures”, McGraw-Hill Publications, Third Edition, 1992.
5. IS 800 :2007, “General Construction In Steel - Code of Practice”, (Third Revision), Bureau of Indian Standards, New Delhi, 2007
6. Shiyekar M.R., “Limit State Design in Structural Steel”, PHI Learning Private Limited, New Delhi, 2011.

c) Online Resources:

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

1151CE112	ESTIMATION AND QUANTITY SURVEYING	L	T	P	C
		3	0	0	3

Course Category / Type: Programme Core / Theory

A. Preamble:

- This course provides the knowledge to estimate the quantities of item of works involved in buildings, water supply and sanitary works, road works and irrigation works. Also equips to perform rate analysis, valuation of properties and preparation of reports for estimation of various items.

B. Prerequisite:

- 1151CE109 - Design of RC Elements
- 1151CE206 - Environmental Engineering

C. Link to other Courses:

- Nil

D. Course Educational Objectives:

- 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 compute the rate analysis, valuation of properties and preparation of reports for estimation of various structures.
- To estimate the material quantities, prepare the bill of quantities, make specifications and prepare tender documents.

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

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Estimate the quantity of various items of works involved in buildings.	K3
CO2	Estimate the quantity of various items of works involved in roads, retaining walls, culverts, water supply and sanitary works.	K3
CO3	Prepare tenders, contract documents and rate analysis.	K3
CO4	Estimate the valuation of buildings and standard rent.	K3
CO5	Prepare report on estimate of various civil engineering works.	K3

F. Correlation of COs with POs:

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

G. Course Content:

UNIT I ESTIMATION OF BUILDINGS 11

Load bearing and framed structures – Calculation of quantities of brick work, RCC, PCC, Plastering, white washing, colour washing and painting / varnishing for shops, rooms, residential building with flat and pitched roof – Various types of arches – Calculation of brick work and RCC works in arches – Estimate of joineries for panelled and glazed doors, windows, ventilators, handrails, etc.

UNIT II ESTIMATION OF OTHER STRUCTURES 10

Estimation of septic tank, soak pit – sanitary and water supply installations – water supply pipe line – sewer line – tube well – open well – estimation of bituminous and cement concrete roads – estimation of retaining walls – culverts – estimation of irrigation works – aqueduct, syphon and fall.

UNIT III SPECIFICATIONS AND TENDERS 8

Data – Schedule of rates – Analysis of rates – Specifications – sources – Preparation of detailed and general specifications – Tenders – TTT Act – e-tender – Preparation of Tender Notice and Document – Contracts – Types of contracts – Drafting of contract documents – Arbitration and legal requirements.

UNIT IV VALUATION 8

Necessity – Basics of value engineering – Capitalised value – Depreciation – Escalation – Value of building – Calculation of Standard rent – Mortgage – Lease.

UNIT V REPORT PREPARATION 8

Principles for report preparation – report on estimate of residential building – Culvert – Roads – Water supply and sanitary installations – Tube wells – Open wells.

TOTAL: 45 PERIODS

H. Learning Resources:

a) Text Books:

1. Dutta, B.N., "Estimating and Costing in Civil Engineering (Theory & Practice)", UBS Publishers & Distributors Pvt. Ltd., 28^{th} Revised Edition, 2016.

2. Kohli, D.D and Kohli, R.C., “A Text Book of Estimating and Costing (Civil)”, S. Chand & Company Ltd., New Delhi, 2011.

b) References:

1. Hand Book of Consolidated Data – 8/2000, Vol.1, TNPWD.
2. Tamil Nadu Transparency in Tenders Act, 1998.
3. Arbitration and Conciliation Act, 1996.
4. Standard Bid Evaluation Form, Procurement of Good or Works, the World Bank, April 1996.
5. Standard Data Book for Analysis and Rates, IRC, New Delhi, 2003.

1151CE113	CONSTRUCTION MATERIALS AND TECHNIQUES	L	T	P	C
		3	0	0	3

Course Category / Type: Programme Core / Theory

A. Preamble:

- This course is useful for a detailed study of the construction materials and techniques applied in construction industry.

B. Prerequisite:

- 1154CE104 - Building Materials

C. Link to other Courses:

- 1151CE203 / 1151CE207 - Concrete Technology

D. Course Educational Objectives:

Students undergoing this course are expected to

- Know the various conventional construction materials, properties and their uses
- Know the various latest and modern construction materials, properties and their uses
- Know and understand the general construction processes and their sequences
- Know and understand the various techniques which are useful for the substructure construction
- Know and understand the various techniques which are useful for the superstructure construction

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

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Learn and identify the relevant physical properties pertaining to the construction industry	K2
CO2	Develop ability to choose the modern construction material appropriate to the climate and functional aspects of the buildings.	K2
CO3	Understand various techniques and practices on masonry construction, flooring and roofing.	K2
CO4	Plan the requirements for substructure construction	K2
CO5	Know the methods and techniques involved in the construction of various types of super structures.	K2

F. Correlation of COs with POs:

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

G. Course Content:

UNIT I CONVENTIONAL MATERIALS 9

Stones - Classification - Selection - Requirement and testing of stones– Deterioration and preservation of stone work – clay-uses. Bricks –Manufacturing process - Classification - Qualities - Tests on Brick - Application of bricks - Cement – Types of cement – Tests on cement – Application of cement - Timber- cross section -classification – properties.

UNIT II MODERN MATERIALS 7

Plywood – Veneer – Thermacol – Steel- Paints –Varnishes - Glass – Ceramics – Plastics-Aluminium - manufacturing – types - uses. Fibre reinforced polymers. Geosynthetic material – types - Nano Materials.

UNIT III CONSTRUCTION PRACTICES 11

Specifications, details and sequence of activities and construction co-ordination – Site Clearance– Temporary shed – Marking – Earthwork-Termite Proof- Building foundations - Plinth beam-Basements - Damp proof courses - Masonry – Stone masonry –Brick masonry- Bond in masonry - Concrete block masonry – Load bearing walls- - Framed construction -Partition walls – Columns-Beams- Lintel and Sunshade- Doors and windows- Flooring –Centering and shuttering – Scaffoldings – de-shuttering forms– Roof and roof finishes - Weather and water proof course– Plastering – Pointing - Acoustic and fire protection.

UNIT IV SUBSTRUCTURE CONSTRUCTION 9

Box jacking – Pipe jacking techniques - Under water construction diaphragm walls – Cofferdam - Tunnelling techniques - Piling techniques - Well and caisson - sheet piles - Shoring for deep cutting, Dewatering - Well points.

UNIT V SUPERSTRUCTURE CONSTRUCTION 9

Launching girders, bridge decks, Offshore platforms – Special forms for shells - Techniques for heavy decks – In-situ pre-stressing in high rise structures, Material handling - Erecting light weight components on tall structures - Support structure for heavy Equipment and conveyors – Erection of articulated structures, braced domes and space decks

TOTAL: 45 PERIODS

H. Learning Resources:

a) Text Books:

1. Arora S.P. and Bindra S.P., "Building Construction, Planning Techniques and Method of Construction", Dhanpat Rai and Sons, 19th edition, 2000.
2. Varghese, P.C., "Building Construction", Prentice Hall of India Pvt. Ltd, New Delhi, 2007.

b) References:

1. Gambhir, M.L, "Concrete Technology", Tata McGraw – Hill Publishing Company Ltd, New Delhi, 2013
2. Sheety, M.S, "Concrete Technology, Theory and Practice", S. Chand and Company Ltd, New Delhi, 2008
3. Jha J and Sinha S.K., "Construction and Foundation Engineering", Khanna Publishers, New Delhi, 2000.

1151CE114	SURVEYING	L	T	P	C
		3	0	0	3

Course Category / Type: Programme Core / Theory

A. Preamble:

- This course will be useful to know and understand the essential types and concepts of surveying and their applications.

B. Prerequisite:

- Nil

C. Link to other Courses:

- 1151CE301 - Surveying Practical – I
- 1152CE301 - Surveying practical – II
- 1151CE303 - Survey camp

D. Course Educational Objectives:

Students undergoing this course are expected to

- To understand surveying principles and various types of surveying like levelling, tacheometric and advanced surveying using equipments like total station and GPS**.**

E. 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 principles and conventional methods of surveying.	K2
CO2	Understand the methods and applications of levelling.	K2
CO3	Describe the methods and applications of tacheometry and control surveying	K2
CO4	Describe the concepts and working principles of GPS and Total Station	K2
CO5	Illustrate the various advanced engineering surveys and the processes involved in the same.	K3

F. 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			
CO2			H	M						H	M			
CO3	M		H	M							M			
CO4			H	M						H	M			
CO5			M	M						H	M			

G. Course Content:

UNIT I FUNDAMENTAL SURVEYING 9

Surveying - Classifications - Basic principles- – Methods of chaining and ranging - Errors in linear measurement and their corrections - Compass – Basic principles - Bearing and systems - Local attraction-Plane table surveying-Methods of traversing.

UNIT II LEVELLING AND APPLICATIONS 9

Levelling - Terminologies- Adjustments – Methods of levelling – Levelling - Booking – Correction-Contouring- Characteristics and uses of contours plotting- Methods of calculation of areas and volumes.

UNIT III TACHEOMETRY AND CONTROL SURVEYING 9

Theodolite – Construction – Adjustments- Measurement of angles- Heights and distances- Triangulation- Satellite Stations- Reduction to centre - Sources and classification of errors- Most probable values- Normal equation – Correlates.

UNIT IV GPS AND TOTAL STATION SURVEYING 9

GPS- Concepts-Segments- Anti Spoofing and Selective Availability – Hand Held and Geodetic receivers - Traversing and triangulation- Total Station- Classifications - Working Principle- Sources of Error- Comparison between Electro-optical and Microwave system.

UNIT V ADVANCED TOPICS IN SURVEYING 9

Route Surveying - Reconnaissance - Route surveys for highways, railways and waterways -Sight distances - Hydrographic surveying – Tides - MSL – Field observations and determination of Azimuth by altitude and hour angle methods.

TOTAL: 45 PERIODS

H. Learning Resources:

a) Text Books:

1. Kanetkar. T. P., and Kulkarni. S. V., "Surveying and Levelling", Part I, 24th edition, Pune Vidyarthi Griha Prakashan,1988.

2. Punmia. B.C., Ashok Kumar Jain., and Arun Kumar Jain., "Surveying (Vol - 1)", 18th Edition by Laxmi Publications Pvt. Ltd., New Delhi, 2011.

3. Punmia. B.C., Ashok Kumar Jain., and Arun Kumar Jain., "Surveying, (Vol - 2)", 18th Edition by Laxmi Publications Pvt. Ltd., New Delhi, 2011.

4. Satheesh Gopi.R, Sathishkumar, N. Madhu, "Advanced Surveying, Total Station GPS and Remote Sensing" Pearson education, Chennai, 2007.

b) References:

1. Basak N.N., "Surveying & Levelling", McGraw Hill Education, New Delhi, 2014.

2. Punmia. B.C., Ashok Kumar Jain., and Arun Kumar Jain., "Surveying, (Vol - 3)", 18th Edition by Laxmi Publications Pvt. Ltd., New Delhi, 2015.

3. James M.Anderson and Edward M.Mikhail, "Surveying theory & Practice", Seventh Edition, McGraw Hill, 2001.

4. Bannister and Raymond, "Surveying", Seventh Edition, Longman, 2004.

1151CE115	STRUCTURAL ANALYSIS – II	L	T	P	C
		2	2	0	3

Course Category / Type: Programme Core / Theory

A. Preamble:

- This course will be an extension of the structural analysis - I and useful to analyse indeterminate structures using modern methods like matrix methods and finite element method.

B. Prerequisite:

- 1151CE107 - Structural Analysis – I

C. Link to other Courses:

- Nil

D. Course Educational Objectives:

- Analyse statically indeterminate structures by imposing boundary conditions on flexibility matrix.
- To formulate the element stiffness matrix and assemble the structure stiffness matrix for solving indeterminate problems.
- Understand the basics of finite element method and its application to structural analysis.
- To introduce the importance of plastic analysis to calculate the collapse loads for beams and frames.
- Analyse suspension bridges and space truss.

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

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Analyse statically indeterminate structures by imposing boundary conditions on flexibility matrix.	K3
CO2	Form the element stiffness matrices and assemble the structure stiffness matrix for solving indeterminate problems.	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

F. Correlation of COs with POs:

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

G. Course Content:

UNIT I FLEXIBILITY METHOD 6+6

Equilibrium and compatibility – Determinate vs Indeterminate structures – Indeterminacy – Primary structure – Compatibility conditions – Analysis of indeterminate pin-jointed plane frames, continuous beams, rigid jointed plane frames (with redundancy restricted to two).

UNIT II STIFFNESS MATRIX METHOD 6+6

Element and global stiffness matrices – Analysis of continuous beams – Co-ordinate transformations – Rotation matrix – Transformations of stiffness matrices, load vectors and displacements vectors – Analysis of pin-jointed plane frames and rigid frames (with redundancy limited to two).

UNIT III FINITE ELEMENT METHOD 6+6

Introduction – Discretization of a structure – Displacement functions – Truss element – Beam element – Plane stress and plane strain – 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 – Plastic hinge and mechanism – Plastic analysis of indeterminate beams and frames – Upper and lower bound theorems.

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

H. Learning Resources:

a) Text Books:

1. Vaidyanathan R. and Perumal P., “Comprehensive Structural Analysis – Vol. I & II”, Laxmi Publications, New Delhi, 2003.

2. BhavaiKatti S.S., "Structural Analysis – Vol. I & Vol. II", Vikas Publishing House Pvt. Ltd., New Delhi, 2008.

b) References:

1. Punmia B.C., Ashok Kumar Jain and Arun Kumar Jain, "Theory of Structures", Laxmi Publications, New Delhi, 2004.

2. Negi L.S. and Jangid R.S., "Structural Analysis", Tata McGraw-Hill Publications, New Delhi, 2003.

3. Ghali A, Nebille A.M. and Brown T.G., "Structural Analysis, A unified classical and Matrix approach", Spon Press, London and New York, 6th Edition, 2013.

4. Coates R.C., Coutie M.G. and Kong F.K., "Structural Analysis", ELBS and Nelson, 1990

5. Pandit G.S. and Gupta S.P., "Structural Analysis - A Matrix Approach", Tata McGraw-Hill, 2004.

6. William Weaver Jr. and James M. Gere., "Matrix Analysis of Framed Structures", CBS Publishers and Distributors, Delhi, 2004

7. Gambhir M.L., "Fundamentals of Structural Mechanics and Analysis", PHI Learning Pvt. Ltd., New Delhi, 2011.

1151CE116	GEOTECHNICAL ENGINEERING- II	L	T	P	C
		3	0	0	3

Course Category / Type: Programme Core / Theory

A. Preamble:

- The students will learn the various site exploration techniques and design and analysis of different foundations.

B. Prerequisite:

- 1151CE202 - Geotechnical Engineering – I

C. Link to other Courses:

- Advanced Foundation Engineering
- Ground Improvement Techniques

D. Course Educational Objectives:

Students undergoing this course are expected to choose, design and analyse various foundations & check the stability of retaining walls.

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

CO Nos.	Course Outcome	Bloom's Taxonomy level
CO1	Apply the appropriate site exploration method to determine the in-situ properties.	K3
CO2	Determine the bearing capacity of shallow foundation by different methods including IS code.	K3
CO3	Design footings against different types of loading including seismic forces.	K3
CO4	Design single pile and pile group by different methods.	K3
CO5	Apply different earth pressure theories to design retaining walls.	K3

F. Correlation of COs with POs:

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

G. Course Content:

UNIT I SITE INVESTIGATION AND SELECTION OF FOUNDATION 9

Scope and objectives – Methods of exploration – Augering 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 – Penetration tests (SPT and SCPT) - Bore log report – Data interpretation – strength parameters and Liquefaction potential - Selection of foundation based on soil condition.

UNIT II SHALLOW FOUNDATIONS 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 – Bearing capacity from in-situ tests (SPT, SCPT and plate load) 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 FOOTINGS AND RAFTS 9

Types of footings – 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 RETAINING WALLS 9

Plastic equilibrium in soils – active and passive states – Rankine's theory – cohesionless 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

H. Learning Resources:

a) Text Books:

1. Murthy V.N.S., "Soil Mechanics and Foundation Engineering", CBS Publishers and Distributers Ltd., New Delhi, 2009.
2. Gopal Ranjan and Rao A.S.R. "Basic and Applied Soil Mechanics", New Age International Pvt. Ltd,2nd Edition, New Delhi, 2007.

b) References:

1. Purushothama Raj P., “Soil Mechanics and Foundation Engineering”, 2nd Edition, Pearson Education, Chennai, 2013.

2. Varghese P.C., “Foundation Engineering”, Prentice Hall of India Private Limited, New Delhi, 2005.

3. IS 2950(Part-I):1981, Code of Practice for Design and Construction of Raft Foundations [Reaffirmed 2008]., Bureau of Indian Standards, New Delhi.

1151CE117	ESTIMATION AND QUANTITY SURVEYING	L	T	P	C
		2	0	0	2

Course Category / Type: Programme Core / Theory

A. Preamble:

- This course provides the knowledge to estimate the quantities of item of works involved in buildings, water supply and sanitary works, road works and irrigation works, and also equips to do rate analysis, valuation of properties and preparation of reports for estimation of various items.

B. Prerequisite:

- 1151CE109 - Design of RC Elements
- 1151CE204 – Environmental Engineering

C. Link to other Courses:

- Nil

D. Course Educational Objectives:

- 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 compute the rate analysis, valuation of properties and preparation of reports for estimation of various structures.
- To estimate the material quantities, prepare the bill of quantities, make specifications and prepare tender documents.

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

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Estimate the quantity of various items of works involved in buildings.	K3
CO2	Estimate the quantity of various items of works involved in roads, retaining walls, culverts, water supply and sanitary works.	K3
CO3	Prepare tenders, contract documents and rate analysis.	K3
CO4	Estimate the valuation of buildings and standard rent.	K3
CO5	Prepare report on estimate of various civil engineering works.	K3

F. Correlation of COs with POs:

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

G. Course Content:

UNIT I ESTIMATION OF BUILDINGS 7

Load bearing and framed structures – Calculation of quantities of brick work, RCC, PCC, Plastering, white washing, colour washing and painting / varnishing for shops, rooms, residential buildings with flat and pitched roof – Various types of arches – Calculation of brick work and RCC works in arches – Estimate of joineries for panelled and glazed doors, windows, ventilators, handrails etc.

UNIT II ESTIMATION OF OTHER STRUCTURES 7

Estimation of septic tank, soak pit – sanitary and water supply installations – water supply pipe line – sewer line – tube well – open well – estimate of bituminous and cement concrete roads – estimation of retaining walls – culverts – estimation of irrigation works – aqueduct, syphon, fall.

UNIT III SPECIFICATION AND TENDERS 6

Data – Schedule of rates – Analysis of rates – Specifications – sources – Preparation of detailed and general specifications – Tenders – TTT Act – e-tender – Preparation of Tender Notice and Document – Contracts – Types of contracts – Drafting of contract documents – Arbitration and legal requirements.

UNIT IV VALUATION 5

Necessity – Basics of value engineering – Capitalised value – Depreciation – Escalation – Value of building – Calculation of Standard rent – Mortgage – Lease.

UNIT V REPORT PREPARATION 5

Principles for report preparation – report on estimate of residential building – Culvert – Roads – Water supply and sanitary installations – Tube wells – Open wells.

TOTAL: 30 PERIODS

H. 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, 2016.

2. Kohli, D.D and Kohli, R.C., "A Text Book of Estimating and Costing (Civil)", S. Chand & Company Ltd., New Delhi, 2011.

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, April 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).

INTEGRATED COURSES

1151CE201	STRENGTH OF MATERIALS	L	T	P	C
		2	2	2	4

Course Category / Type : Programme Core / Integrated Course

A. Preamble:

- This course encompasses theory and laboratory experiments of elastic behavior of materials and analysis of stress-strain state.

B. Prerequisite:

- 1151CE106 - Mechanics of Solids

C. Link to other Courses:

- 1151CE107 - Structural Analysis-I
- 1151CE109 - Design of RC Elements

D. Course Educational Objectives:

- To analyze structural members subjected to tension, compression, torsion, bending and combined stresses using the fundamental concepts of stress, strain and elastic behavior of materials.
- To utilize appropriate materials in design considering engineering properties.

E. 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 analysis of structural elements.	K2
CO2	Analyse the indeterminate beams.	K3
CO3	Analyse the columns and cylinders	K3
CO4	Understand the state of stress in 3D and design concepts based on failure theories.	K2
CO5	Analyse stress-strain behavior of beams of unsymmetrical bending and curved beams.	K3

F. Correlation of COs with POs:

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

G. Course Content:

UNIT I ENERGY PRINCIPLES 6+6

Strain energy and strain energy density – Strain energy in traction, shear in flexure and torsion – Castigliano's theorems – Principle of virtual work – Application of energy theorems for computing deflections in beams and trusses – Maxwell's reciprocal theorems

UNIT II INDETERMINATE BEAMS 6+6

Propped cantilever and fixed beams-fixed end moments and reactions for concentrated load, Uniformly distributed load, Gradually varied load of 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+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+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 – Application in analysis of stress, load carrying capacity and design of members – Residual stresses

UNIT V ADVANCED TOPICS IN BENDING OF BEAMS 6+6

Unsymmetrical bending of beams - 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. Compression (Parallel as well as perpendicular to the grains) and shear tests on timber specimens
7. Test on springs (Both closed coil and open coiled helical springs)
8. Deflection Tests on steel beams

TOTAL: 30+30+30 = 90 PERIODS

H. Learning Resources:

a) Text Books:

1. Bansal R.K., “Strength of Materials”, Laxmi Publications, New Delhi – 2010
2. Rajput R.K., “Strength of Materials (Mechanics of Solids)”, S.Chand & Company Ltd., New Delhi, 2010.

b) References:

1. Kazimi S.M.A, “Solid Mechanics”, Tata McGraw-Hill Publishing Co., New Delhi, 2010
2. William Nash, “Theory and Problems of Strength of Materials”, Schaum’s Outline Series, McGraw-Hill International Edition.2008
3. Khurmi R.S, “Strength of Materials”, S. Chand & Company Ltd, New Delhi, 2010
4. Subramanian R., “Strength of Materials”, Oxford Institute Press, New Delhi – 2005
5. Hibbeler R. C, “Mechanics of Materials”, Prentice Hall, 8th Edition, USA, 2011.
6. Punmia. B. C, Ashok Kumar Jain and Arun Kumar Jain, “Mechanics of Materials”, Laxmi publications (P) Ltd, Chennai, 2001.

1151CE202	GEOTECHNICAL ENGINEERING - I	L	T	P	C
		3	0	2	4

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 building, engineering the properties of the soil greatly influence the stability of the structure. Thus understanding the problems involved in soil mechanics is of paramount importance.

B. Prerequisite:

- Nil

C. Link to other Courses:

- 1151CE116 - Geotechnical Engineering-II
- 1151CE116 - Advanced Foundation Engineering

D. Course Educational Objectives:

- After undergoing this course, the student gains adequate knowledge on the behavior of soil and its application for construction purposes. The course examines the concepts and fundamentals of Soil Mechanics, the testing methods to classify the soil and for assessing its stability for various projects.
- At the end of the course students will be able to evaluate the settlement problems related to soil, encountered in day to day life.

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

CO Nos.	Course Outcome	Bloom's Taxonomy level
CO1	Classify soil and identify the various engineering properties.	K2
CO2	Understand the effect of water in soil.	K2
CO3	Infer the stress distribution in soil under influence of various loads and thus compute the consolidation.	K3
CO4	Establish the shear strength parameters in the laboratory.	K2
CO5	Compute the stability of different type of slopes.	K3

F. Correlation of COs with POs:

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

G. Course Content:

UNIT I ORIGIN OF SOIL AND ITS PROPERTIES 6+6

Nature of soil - Soil description and classification for engineering purposes - IS Classification system - Phase relationships - Soil compaction - Theory, comparison of laboratory and field compaction methods.

UNIT II SOIL WATER 6+6

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+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+6

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

UNIT V SLOPE STABILITY 6+6

Slope failure mechanisms - Types - Infinte slopes - Finite slopes -Method of slices - friction circle method - Use of stablity number - Slope protection measures.

LIST OF EXPERIMENTS:

1. (a) Grain Size Distribution (Dry sieve analysis and Hydrometer Analysis Demo).

   (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. (a) Permeability Determination (Constant head)

   (b) Determination of field Density by Sand replacement method.
4. One Dimensional Consolidation Tests (Demonstration only for c_c).
5. Determination of shear strength parameters.

   (a) Direct shear test on cohesionless soil.

   (b) Unconfined compression test on cohesive soil.

   (c) Triaxial compression test (Demonstration only).

TOTAL: 30+30+30 = 90 PERIODS

H. Learning Resources:

a) Text Books:

1. Gopal Ranjan and Rao A.S.R., "Basic and Applied Soil Mechanics", New Age International, 2007.
2. 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:

i. http://nptel.ac.in/courses/105101084/

ii. https://nptel.ac.in/courses/105103097/

iii. https://onlinecourses.nptel.ac.in/noc18_ce05/preview

iv. http://www.nptelvideos.in/2012/11/soil-mechanics.html

v. http://nptel.ac.in/downloads/105106142/

vi. http://nptel.ac.in/downloads/105101001/

1151CE203	CONCRETE TECHNOLOGY	L	T	P	C
		3	0	2	4

Course Category / Type: Programme Core / Integrated Course

A. Preamble:

- This course explains about the materials used for various types of constructions, their behavior and concreting methods.

B. Prerequisite:

- 1151CE102 - Construction Materials

C. Link to other Courses:

- 1152CE119 - Repair and Rehabilitation of Structures
- 1152CE201 - Advanced Concrete Technology

D. Course Educational Objectives:

Students undergoing this course are expected to

- Gain knowledge about materials used for various types of constructions.
- Acquire knowledge about the cement mortar and concrete.
- Gain knowledge about Concreting Methods.
- Impart knowledge about the mix design of concrete.

E. 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 aggregates, cement and concrete	K2
CO2	Design the mix proportion using various methods.	K3
CO3	Illustrate the applications of various special concretes.	K2
CO4	Learn various process involved in concrete and concreting methods	K2
CO5	Illustrate the applications of various composite materials	K2

F. Correlation of COs with POs:

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

G. Course Content:

UNIT I CONCRETING MATERIALS 9

Aggregates classification - IS Specifications - Properties, Grading - Methods of combining aggregates, specified grading - Testing of aggregates - Cement - Grade of cement - Chemical composition - Testing of cement - Hydration of cement - special cements – Concrete – Types of Concrete.

UNIT II MIX DESIGN 9

Principles of concrete mix design - Methods of concrete mix design - Mix design computation based on IS Method, ACI Method and DOE Method – Statistical quality control – Sampling and acceptance criteria.

UNIT III SPECIAL CONCRETE 9

Light weight concrete, Fly ash concrete, Fibre reinforced concrete, Sulphur impregnated concrete, Polymer Concrete – High performance concrete. High performance fiber reinforced concrete, Self-Compacting Concrete, Geo Polymer Concrete, Waste material based concrete – Ready mixed concrete.

UNIT IV CONCRETING METHODS 9

Concrete - Methods of batching, mixing, transportation, placing and curing. Extreme weather concreting - Special concreting methods - Vacuum dewatering – Underwater Concrete.

UNIT V COMPOSITES 9

Types of Plastics – Properties and Manufacturing – Advantages of Reinforced polymers – Types of Fibre Reinforced Polymers – FRP on different structural elements – Applications of FRP

LIST OF EXPERIMENTS:

1. Tests on concrete
    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

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

TOTAL: 45+30 = 75 PERIODS

H. Learning Resources:

a) Text Books:

1. Shetty M.S., “Concrete Technology”, S.Chand and Company Ltd. Delhi, 2008.
2. Santhakumar.A.R. “Concrete Technology”, Oxford University Press, 2018.

b) References:

1. IS 10262:2009 Guidelines for Concrete Mix Proportioning, Bureau of Indian Standards, New Delhi.
2. IS 383:1970 – Specification for coarse and fine aggregates from natural sources for concrete, Bureau of Indian Standards, New Delhi.
3. IS 1199:1959 Methods of sampling and analysis of Concrete, Bureau of Indian Standards, New Delhi.
4. IS 456: 2000 Code of practice for plain and reinforced Concrete, Bureau of Indian Standards, New Delhi.

5. Gambhir.M.L., Concrete Technology, 5th Edition, Tata McGraw Hill Education, New Delhi, 2013.

6. Gupta.B.L., Amit Gupta, Concrete Technology, Jain Book Agency, Delhi, 2010.

7. Neville, A.M., Properties of Concrete, Prentice Hall, London, 1995.

1151CE204	ENVIRONMENTAL ENGINEERING	L	T	P	C
		2	2	2	4

Course Category / Type: Programme Core / Integrated Course

A. Preamble:

- This course deals about water demand, treatment, distribution, wastewater generation and its treatment and disposal concepts.

B. Prerequisite:

- Nil

C. Link to other Courses:

- 1152CE136 - Solid Waste Management

D. Course Educational Objectives:

- The course objective is to identify the sources and quantity of surface and ground water bodies and their demand for the public and also to study the quality of water and their treatment techniques.
- To impart knowledge on characteristics of sewage, primary and secondary treatment of sewage as well as disposal of sludge and treated wastewater.

E. 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 forecasting of population and the respective water demands.	K2
CO2	Illustrate the water conveyance systems.	K2
CO3	Apply and analyze the water treatment and distribution methods.	K3
CO4	Construct wastewater conveyance and design wastewater treatment units.	K3
CO5	Compare and analyse the waste sludge disposal techniques.	K2

F. Correlation of COs with POs:

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

G. Course Content:

UNIT I PLANNING FOR WATER SUPPLY SYSTEM 6+6

Public water supply system - Planning - Objectives -Design period - Population forecasting -Water demand -Sources of water and their characteristics -Surface and Groundwater- Impounding Reservoir Well hydraulics -Development and selection of source - Water quality - Characterization and standards- Impact of climate change.

UNIT II CONVEYANCE SYSTEM 6+6

Water supply -Intake structures -Functions and drawings -Pipes and conduits for water- Pipe materials - Hydraulics of flow in pipes -Transmission main design -Laying, jointing and testing of pipes - Drawings appurtenances - Types and capacity of pumps -Selection of pumps and pipe materials -Requirements of water distribution -Components -Service reservoirs -Functions and drawings - Network design -Economics -Computer applications - Analysis of distribution networks - Appurtenances -Operation and maintenance - Leak detection, Methods - Principles of design of water supply in buildings -House service connection - Fixtures and fittings - Systems of plumbing and drawings of types of plumbing.

UNIT III WATER TREATMENT 6+6

Objectives - Unit operations and processes - Principles, functions design and drawing of Chemical feeding, Flash mixers, flocculators, sedimentation tanks and sand filters - Disinfection- Residue Management - Construction and Operation & Maintenance aspects of Water Treatment Plants. Principles and functions of Aeration - Iron and manganese removal, Defluoridation and demineralization -Water softening - Desalination - Membrane Systems - Recent advances.

UNIT IV SEWERAGE SYSTEMS AND DESIGN 6+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. Sewerage – Hydraulics of flow in sewers – Objectives – Design period - Design of sanitary and storm sewers – Small bore systems - 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 V SEWAGE TREATMENT AND DISPOSAL METHODS 6+6

Objective – Selection of treatment processes – Principles, Functions, Design and Drawing of Units - Onsite sanitation - Septic tank with dispersion - Grey water harvesting – Primary treatment –

Principles, functions design and drawing of screen, grit chambers and primary sedimentation tanks – Construction, Operation and Maintenance aspects. 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 - Sewage recycle in residential complex - Recent Advances in Sewage Treatment – Construction and Operation & Maintenance of Sewage Treatment Plants. 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 – disposal – Advances in Sludge Treatment and disposal.

LIST OF EXPERIMENTS

1. Determination of Ammonia Nitrogen in wastewater.

2. Coagulation and Precipitation process for treating waste water

3. Determination of suspended, volatile, fixed and settleable solids in wastewater.

4. Determination of B.O.D in wastewater.

5. Determination of C.O.D in wastewater.

6. Determination of Nitrate in wastewater.

7. Determination of Phosphate in wastewater.

8. Determination of Calcium, Potassium and Sodium in water.

9. Heavy metals determination - Chromium, Lead and Zinc in water.

(Demonstration only)

TOTAL: 30+30+30= 90 PERIODS

H. Learning Resources:

a) Text Books:

1. Garg, S.K., “Environmental Engineering Vol.I”, Khanna Publishers, New Delhi, 2005.
2. Modi, P.N., “Water Supply Engineering Vol. I” Standard Book House, New Delhi, 2005.
3. Punmia, B.C., Ashok K Jain and Arun K Jain, “Water Supply Engineering”, Laxmi Publications Pvt. Ltd., New Delhi, 2005

b) References:

1. Government of India, Manual on Water Supply and Treatment, CPHEEO, Ministry of Urban Development, New Delhi, 2003

2. Syed R. Qasim and Edward M. Motley Guang Zhu, "Water Works Engineering Planning, Design and Operation", Prentice Hall of India Private Limited, New Delhi, 2006.

3. Manual on Sewerage and Sewage Treatment, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1999.

4. Metcalf & Eddy, "Wastewater Engineering – Treatment and Reuse", Tata McGraw Hill Company, New Delhi, 2003.

5. Garg, S.K., "Environmental Engineering Vol. II", Khanna Publishers, New Delhi, 2003.

6. Punmia, B.C., Jain, A.K., and Jain. A., "Environmental Engineering - Vol.II", Lakshmi Publications, 2005.

7. Standards Methods for the Examination of Water and Wastewater, 17th Edition, WPCF, APHA and AWWA, USA, 1989.

c) 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

1151CE205	APPLIED HYDRAULIC ENGINEERING	L	T	P	C
		2	2	2	4

Course Category / Type: Programme Core / Integrated Course

A. Preamble:

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

B. Prerequisite:

- 1151CE105 - Fluid Mechanics

C. Link to other Courses:

- 1151CE204 / 1151CE206 - Environmental Engineering
- 1152CE130 - Irrigation and Water Resource Engineering

D. Course Educational Objectives:

The successful completion of this course, learners will be able to

- Learn fundamental principles of designing hydraulic systems and components for water supply and storm water drainage
- Gain factual knowledge on terminology and use of methods of hydraulic engineering
- Apply course material to specific hydraulic engineering problems typically encountered in the professional world.

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

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Calculating flow in open channels	K3
CO2	Calculation of normal depth and velocity of fluid under uniform flow	K3
CO3	Understand the Characteristics of flow profiles, Flow through transitions and Hydraulic jump	K2
CO4	Visualize the usage of pump depending on the twining between its characteristics and hydraulic profile of the water table.	K2
CO5	Correlate the characteristics of different types of turbines.	K3

F. 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		M							L			
CO3		M							L					
CO4			H			L								
CO5	L									M				

G. Course Content:

UNIT I OPEN CHANNEL FLOW 6+6

Flow in open channels: Definition of channel – Difference between pipe and open channel flow, Classification – Types of flows, Regimes of flow – Velocity distribution in open channel – Wide open channel – Specific energy – Critical flow and its computation – Channel transition

UNIT II UNIFORM FLOW 6+6

Uniform flow – Velocity measurement – Manning's and Chezy's formula – Determination of roughness coefficients – Determination of normal depth and velocity – Most economical sections – Non-erodible channels

UNIT III VARIED FLOW 6+6

Dynamic equations of gradually varied flow – Assumptions – Characteristics of flow profiles – Draw down and back water curves, Profile determination, Graphical integration, Direct and Standard step methods – Flow through transitions - Hydraulic jump – Types – Energy dissipation – Surges

UNIT IV PUMPS 6+6

Definition, classification general principle, Centrifugal pump - minimum speed to start the pump – multistage Pumps – Jet and submersible pumps - Positive displacement pumps - reciprocating pump - negative slip - flow separation conditions - air vessels -indicator diagram and its variation - savings in work done – rotary pumps

UNIT V TURBINES 6+6

Impact of Jet on plane and curved plates - Impulse and Reaction - Definition, classification of Pelton turbine, theory, equation for work done and efficiency, Francis turbine, Kaplan turbine, theory, equation for work done and efficiency, Specific speed, unit quantities, characteristic curves -

draft tube and cavitations – Application of momentum principle - Impact of jets on plane and curved plates - Impulse and Reaction

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+30 = 90 PERIODS

H. Learning Resources:

a) Text Books:

1. Subramanya K., “Flow in Open channels”, Tata McGraw-Hill Publishing Company, New Delhi, 1994.
2. Modi, P.N, and Seth S.M., “Hydraulic and Fluid Mechanics”, Standard Book House, 2000.
3. Bansal R.K, “Fluid mechanics & Hydraulic machines”, Laxmi Publishing Pvt Ltd, New Delhi –2007.
4. Rajput R. K., “A Textbook of Fluid Mechanics and Hydraulic Machines”, Sixth Edition, S Chand & Company, Chennai, 2016.

b) References:

1. Jain A.K., "Fluid Mechanics (including Hydraulic Machines)", 8th edition, Khanna Publishers, New Delhi, 1995.
2. Ranga Raju, K.G., “Flow through Open Channels”, Tata McGraw-Hill, New Delhi, 1985.

c) Online Resources:

1. https://easyengineering.net/ce6403-applied-hydraulic-engineering_15/
2. http://nptel.ac.in/courses/105103021/
3. http://nptel.ac.in/courses/105107059/

1151CE206	ENVIRONMENTAL ENGINEERING	L	T	P	C
		3	0	2	4

Course Category / Type: Programme Core / Integrated Course

A. Preamble:

- This course deals about the water requirements, wastewater generation and its conveyance, design concepts of unit process water and wastewater treatments and the disposal methods of wastewater in different forms.

B. Prerequisite:

- Nil

C. Link to other Courses:

- 1152CE129 - Rural water supply and onsite sanitation

D. Course Educational Objectives:

The course objective is to

- Identify the sources and quantity of surface and groundwater bodies and their demand for the public and also to study the quality of water and their treatment techniques.
- To impart knowledge on characteristics of sewage, primary and secondary treatment of sewage as well as disposal of sludge and treated wastewater.

E. 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 concept of public water supply scheme, types of sources, determination of storage capacity and estimation of yield of wells	K2
CO2	Learn about types of conduits, pipes as well as to understand the method of laying and testing of pipe and the pump selection.	K2
CO3	Understand the working, principles involved in the preliminary treatment process and distribution systems.	K2
CO4	Construct wastewater conveyance and ability to perform basic design of the unit operations and processes that are used in sewage treatment	K2
CO5	Perceive of various disposal methods of Sewage.	K2

F. Correlation of COs with POs:

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

G. Course Content:

UNIT I PLANNING FOR WATER SUPPLY SYSTEMS 9

Public water supply - Objectives - Design period - Population forecasting - Water demand – Surface, sub-surface sources of water and their characteristics - Impounding reservoir – Well hydraulics- Recuperation test, Pumping test- Legislation requirements for water quality standards – IS 10500 (2012).

UNIT II WATER CONVEYANCE 9

Intake structures – Functions and drawings – Pipes and conduits – Pipe materials – Laying, jointing and testing of pipes – Pipe appurtenances and drawings – Types, capacity and selection of pumps.

UNIT III WATER TREATMENT AND DISTRIBUTION 9

Objectives – Unit operations and processes – Principles and functions of sedimentation tanks, sand filters – Principles and functions of aeration, iron and manganese removal, defluoridation and water softening – Membrane filtration – Advanced treatment - Requirements and components of distribution system – Leak detection – Analysis of distribution networks.

UNIT IV WASTEWATER CONVEYANCE AND TREATMENT 9

Sources, composition and characteristics of sewage – Significance - Estimation of sanitary sewage flow and storm runoff – Design of sanitary sewers - Plumbing system for buildings – One pipe and two pipe system. Sewer appurtenances - Sewage treatment objectives – Selection of treatment processes – Principles and functions of septic tank with dispersion, screen, grit chambers – Principles and design of activated sludge process, trickling filters, oxidation ditch, waste stabilization ponds – Introduction to 4R policy.

UNIT V SLUDGE MANAGEMENT 9

Sludge disposal methods - Dilution – Land disposal – Sewage farming - Self-purification of surface water bodies – Oxygen sag curve – Sludge characterization – Sludge thickening, digestion, conditioning and dewatering – Biogas recovery.

LIST OF EXPERIMENTS

1. Determination of water quality parameters (pH, electrical conductivity, turbidity, fluoride)

2. Coagulation and Precipitation process for treating waste water.

3. Determination of solids in wastewater.
4. Determination of BOD in waste water.
5. Determination of COD in waste water
6. Determination of Calcium, Potassium and Sodium in wastewater.

TOTAL: 45+30=75 PERIODS

H. Learning Resources:

a) Text Books:

1. Venugopal Rao.P., "Textbook of Environmental Engineering", Eastern Economy Edition, 2002.
2. Modi, P.N., "Water Supply Engineering", Vol. I Standard Book House, New Delhi, 2005.
3. Punmia, B.C., Ashok K Jain and Arun K Jain, "Water Supply Engineering", Laxmi Publications Pvt. Ltd., New Delhi, 2005

b) References:

1. Government of India, Manual on Water Supply and Treatment, CPHEEO, Ministry of Urban Development, New Delhi, 2003
2. Syed R. Qasim and Edward M. Motley Guang Zhu, "Water Works Engineering Planning, Design and Operation", Prentice Hall of India Private Limited, New Delhi, 2006.
3. Manual on Sewerage and Sewage Treatment, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1999.
4. Metcalf & Eddy, "Wastewater Engineering – Treatment and Reuse", Tata McGraw Hill Company, New Delhi, 2003.
5. Garg, S.K., "Environmental Engineering Vol. II", Khanna Publishers, New Delhi, 2003.
6. Punmia, B.C., Jain, A.K., and Jain. A., "Environmental Engineering, Vol.II", Lakshmi Publications, 2005.
7. Standards Methods for the Examination of Water and Wastewater, 17th Edition, WPCF, APHA and AWWA, USA, 1989.

c) 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

1151CE207	CONCRETE TECHNOLOGY	L	T	P	C
		3	0	2	4

Course Category / Type: Programme Core / Integrated Course

A. Preamble:

- This course explains about the materials used for various types of constructions, their behaviour and concreting methods.

B. Prerequisite:

- 1151CE102 - Construction Materials

C. Link to other Courses:

- 1152CE119 - Repair and Rehabilitation of Structures
- 1152CE201 - Modern Construction Materials

D. Course Educational Objectives:

Students undergoing this course are expected to

- Gain knowledge about materials used for various types of constructions.
- Acquire knowledge about the cement mortar and concrete.
- Gain knowledge about Concreting Methods.
- Impart knowledge about the mix design of concrete.

E. 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, aggregates and water.	K2
CO2	Explain the properties of fresh and hardened concrete.	K2
CO3	Design the mix proportion using various methods.	K3
CO4	Explain the features of special concretes.	K2
CO5	Explain the different concreting methods.	K2

F. Correlation of COs with POs:

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

G. Course Content:

UNIT I CONSTITUENT MATERIALS 9

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

UNIT II FRESH AND HARDENED PROPERTIES OF CONCRETE 9

Workability-Tests for workability of concrete- Segregation and Bleeding-Determination of Compressive and Flexural strength as per BIS – Properties of Hardened concrete

UNIT II MIX DESIGN 9

Principles of concrete mix design – Methods of concrete mix design – Mix design based on IS Method, ACI Method and BS Method – Statistical quality control – Sampling and acceptance criteria.

UNIT III SPECIAL CONCRETES 9

Light weight concrete, Fly ash concrete, Fibre reinforced concrete, Sulphur impregnated concrete, Polymer Concrete – High performance concrete – High performance fiber reinforced concrete, Self-Compacting Concrete, Geo Polymer Concrete, Waste material based concrete – Ready mixed concrete.

UNIT IV CONCRETING METHODS 9

Concrete – Methods of batching, mixing, transportation, placing and curing. Extreme weather concreting – Special concreting methods – Vacuum dewatered Concrete – Underwater Concrete.

LIST OF EXPERIMENTS:

1. Determination of Properties of Aggregate

   a) Crushing Strength
   b) Impact Strength
   c) Elongation and Flakiness Index
   d) Water Absorption
   e) Abrasion Test
   f) Specific Gravity.

g) Sieve Analysis.

2. Determination of Properties of fresh concrete

h) Slump Cone Test
i) Vee – Bee Consistometer
j) Flow Table Test
k) Compaction Factor

3. Determination of Properties of Hardened Concrete

a) Compression Test
b) Tension Test

TOTAL: 45+30 = 75 PERIODS

H. Learning Resources:

a) Text Books:

1. Shetty M.S., "Concrete Technology", S.Chand and Company Ltd. Delhi, 2008.

2. Santhakumar.A.R. "Concrete Technology", Oxford University Press, New Delhi, 2018.

b) References:

1. IS 10262:2009 Guidelines for Concrete Mix Proportioning, Bureau of Indian Standards, New Delhi.

2. IS 383:1970 – Specification for coarse and fine aggregates from natural sources for concrete, Bureau of Indian Standards, New Delhi.

3. IS 1199:1959 Methods of sampling and analysis of Concrete, Bureau of Indian Standards, New Delhi.

4. IS 456: 2000 Code of practice for plain and reinforced Concrete, Bureau of Indian Standards, New Delhi.

5. Gambhir.M.L., "Concrete Technology",5th Edition, Tata McGraw Hill Education, New Delhi, 2013.

6. Gupta.B.L., Amit Gupta, "Concrete Technology", Jain Book Agency, New Deli, 2010.

7. Neville, A.M., "Properties of Concrete", Prentice Hall, London, 1995.

LABORATORY COURSES

1151CE301	SURVEYING PRACTICAL – I	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:

- 1151CE114 - Surveying

C. Link to other Courses:

- 1152CE301 - Surveying practical – II
- 1151CE303 - Survey camp

D. Course Educational Objectives:

- To make the students capable to conduct survey using fundamental surveying techniques
- To make the students to operate the fundamental linear and angular measuring instruments.

E. 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 study of chains and their accessories.	K3
CO2	Understand the study of bearing using prismatic and surveyors compass.	K3
CO3	Understand the Plane table surveying: Radiation, Intersection.	K3
CO4	Understand the Fly leveling, Check levelling using Dumpy level and Tilting level.	K3

F. Correlation of COs with POs:

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

G. Course Content:

LIST OF EXPERIMENTS

1. Study of chains and their accessories
2. Ranging and Chaining of a line
3. Study of bearing using prismatic and surveyors compass
4. Compass Traversing
5. Plane table surveying: Radiation, Intersection
6. Plane table surveying: Resection –Two point problem
7. Plane table surveying: Resection –Three point problem
8. Study of levels and levelling staff
9. Fly leveling , Check levelling using Dumpy level and Tilting level

TOTAL: 30 PERIODS

H. 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.

1151CE302	BUILDING DRAWING (Drawing Hall Practice Followed by CADD LAB)	L	T	P	C
		0	0	2	1

Course Category / Type: Programme Core / Laboratory Course

A. Preamble:

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

B. Prerequisite:

- Engineering Graphics

C. Link to other Courses:

- Estimation and Quantity Surveying – 1151CE112

D. Course Educational Objectives:

- To make the student able to draw building drawings (Plan, elevation and sectional views) in accordance with development and control rules satisfying orientation and functional requirements using computer.

E. 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 drawing the plan, section and elevation of Buildings with load bearing walls (Flat and pitched roof) including details of doors and windows .	K3
CO2	Understand the basic principles of drawing the plan, section and elevation of RCC framed structures.	K3
CO3	Understand the basic principles of drawing the plan, section and elevation of various RC structures.	K3
CO4	Understand the basic principles of drawing the plan, section and elevation of various steel structures.	K3
CO5	Understand the basic principles of drawing the plan, section and elevation of one and two storey building.	K3

F. Correlation of COs with POs:

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

G. List of Experiments:

Note:

Unit I and Unit II are to be practiced in Drawing Hall and Units III to V to be practiced in CAD Laboratory.

UNIT I BASICS OF BUILDING DRAWING

(Drawing Hall Practice with Instruments)

Drawing – Normal Residential Building - Plan – Front view – Section. Types of Doors and Windows. Dimensioning all parts – Labelling all facilities, Conventional Signs of Materials in Sections, Symbols, Building Bye-laws and Building Rules.

UNIT II RESIDENTIAL BUILDINGS

General arrangement – site plan – floor plans – section details – elevation – specifications. Flat Roof Building with Load bearing walls

Pitched Roof Building with Load bearing walls.

UNIT III RCC STRUCTURES

Detailing for Framed Structures - Columns – Beams – Footing. Column – beam Junctions – Slabs – specifications –Standards.

Any one type from the following to be prepared.

Library Building, Hospital, Primary Health Centre, Any School Building.

UNIT IV STEEL STRUCTURES

Detailing of full structural works. Welds – Bolts – Joints - Developing a North light Roof Structure.

UNIT V ARCHITECTURAL DRAWING

Perspective view of single and double storied building consisting of all components.

TOTAL: 30 PERIODS

H. Learning Resources:

a) b) References:

1. Bhatt N. D, "Engineering Drawing", Charotar Publishing, 50th Edition, 2011.

2. Kumara swamy N and Kameswara Rao, "Building Planning and Drawing, 4th Edition.

1151CE303	SURVEY CAMP	L	T	P	C
		0	0	2	1

Course Category / Type: Programme Core / Laboratory Course

A. Preamble:

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

B. Prerequisite:

- Surveying Practical – I & II

C. Link to other Courses:

- Nil

D. Course Educational Objectives:

- After undergoing the course the students will be able to do survey works for the large area.

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

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Measure larger irregular area	K3
CO2	Measure different elevation & carryout contouring	K3
CO3	Measure azimuth angle of stars	K3
CO4	Locate latitude and longitude of a point	K3

F. Correlation of COs with POs:

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

G. List of Experiments:

i. Triangulation (Area: not less than 2500 m^2)

ii. Trilateration (Area: not less than 2500 m^2)

iii. Sun / Star observation to determine azimuth

iv. Use of GPS to determine latitude and longitude

v. Block contouring (Area of not less than 10000 m^2 and horizontal interval not greater than 20 m)

vi. Longitudinal and cross sectioning (For a distance not less than 1 km and interval not greater than 5 m)

vii. Radial Contouring (minimum of 12 radial lines)

H. 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, 1971.
2. Kanetkar T.P., “Surveying and Levelling, Vols. I and II”, United Book Corporation, Pune, 1994.

1151CE304	ENVIRONMENTAL AND IRRIGATION DRAWING	L	T	P	C
		0	0	2	1

Course Category / Type: Programme Core / Laboratory Course

A. Preamble:

- To make the students to design various environmental and irrigation structures.

B. Prerequisite:

- 1151CE204 / 1151CE206 - Environmental Engineering

C. Link to other Courses:

- 1152CE130 - Water resource and Irrigation Engineering

D. Course Educational Objectives:

- To make the students to design various concept of reinforced concrete structures regarding environmental and irrigation operations.
- The student acquires hands on experience in design and analysis of concrete structures in environmental and irrigation engineering practice.

E. 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 and drawing of RC sand filters and septic tank with reinforcement details	K3
CO2	Understand the Design and drawing of RC Trickling filter and sedimentation tank reinforcement details	K3
CO3	Understand the Design and drawing of RC Tank sluice and canal drop with reinforcement details	K3
CO4	Understand the Design and drawing of RC siphon aqueduct, canal escape and intake tower with reinforcement details	K3

F. Correlation of COs with POs:

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

G. LIST OF EXPERIMENTS

Design and drawing of

1. Slow sand filter bed
2. Rapid sand filter for wastewater treatment
3. Coagulation and sedimentation tank
4. Trickling filter
5. Septic tank
6. Tank sluice with tower head
7. Tank Surplus Weir
8. Notch type canal Headwork
9. Syphon aqueduct
10. Canal Regulator
11. Concrete dam

TOTAL: 30 PERIODS

H. Learning Resources:

a) Text Books:

1. Modi P.N, “Environmental Engineering Vol. I & II”, Standard Book House, Delhi, 1990.
2. Sathyanarayana Murthy, “Irrigation Design and Drawing”, New Age International Publishers, New Delhi, 2002.
3. Sharma R.K, “Irrigation Engineering and Hydraulic structures” Oxford and IBH Publishing Co., New Delhi, 2002.

b) References:

1. Garg S.K., “Irrigation Environmental Engineering and Design structures” Khanna Publishers, New Delhi, 17th Reprint 2003.
2. Manual on Water Supply and Treatment, CPHEEO, Government of India, New Delhi, 1999.
3. Manual on Sewerage and Sewage Treatment Plant, CPHEEO, Government of India, New Delhi, 1993.

1151CE305	COMPUTER APPLICATIONS IN CIVIL ENGINEERING	L	T	P	C
		0	0	2	1

Course Category / Type: Programme Core / Laboratory Course

A. Preamble:

- Students undergoing this course are expected to design various reinforced concrete elements and structures using STAAD Pro.

B. Prerequisite:

- 1151CE109 - Design of RC Elements

C. Link to other Courses:

- 1151CE111 – Design of Steel Structures
- 1152CE147 – Design of Reinforced Concrete and Brick Masonry Structures

D. Course Educational Objectives:

- To make the students to design various concept of reinforced concrete structures and steel structures using STAAD Pro.

E. 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 tools for assigning properties, supports and loadings for a structural model.	K2
CO2	Analyze Simply Supported Beam and Framed Structure.	K4
CO3	Design RC Beams and Columns.	K6
CO4	Design RC one way slab and two way slab.	K6
CO5	Design RC water tanks.	K6

F. Correlation of COs with POs:

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

G. LIST OF EXPERIMENTS

1. Introduction to STAAD.Pro.V8i
2. Assigning Properties, Assigning Supports
3. Assigning different types of loads, Creating Load Combinations.
4. Analysis of Simply Supported Beam, Analysis of Framed Structure
5. Concrete Design and Report Generation: Beam and Column design
6. Concrete Design and Report Generation: Slab Design – One-way Slab, Two-way Slab.
7. Concrete Design and Report Generation: Water Tank Design

TOTAL: 30 PERIODS

H. Learning Resources:

a) Text Books:

1. T.S Sarma., “Staad Pro V8i for Beginners”, Notion Press, Chennai, 2014.
2. Sivakumar Naganathan, “Structural Analysis and Design using STAAD.Pro V8i”, LAP LAMBERT Academic Publishing, 2012.
3. Exploring Bentley STAAD Pro.(Connect Edition), 3rd edition, Sham Tickoo,CADCIM Technologies, USA, 2017.

1151CE306	MATERIAL TESTING LABORATORY	L	T	P	C
		0	0	2	1

Course Category / Type: Programme Core / Laboratory Course

A. Preamble:

- This laboratory course will help the students to conduct test on engineering materials to identify and evaluate the properties.

B. Prerequisite:

a. Nil

C. Link to other Courses:

Strength of Materials

D. Course Educational Objectives:

- To understand the behavior of engineering materials.
- To know the properties of engineering materials.
- To examine the various strength of engineering materials.

E. 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 young's modulus, modulus of rigidity and double shear strength of engineering materials.	K3
CO2	Determine the fineness and soundness of the cement.	K3
CO3	Determine the hardness of the steel, brass and aluminum.	K3
CO4	Determine the compressive strength and water absorption of various materials.	K3
CO5	Determine the flexural strength of tiles.	K3

F. 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				
CO2	M	M			H					M				
CO3	M	M			H					M				
CO4	M	M			H					M				
CO5	M	M			H					M				

G. List of Experiments

1. Determination of Young's modulus for
    a. Wood
    b. Steel materials using beam deflection test.
2. Determination of modulus of rigidity for mild steel bar using torsion test.
3. Determination of the fineness of cement using Blains Permeability apparatus.
4. Soundness test on cement by Autoclave method.
5. Determination of Rockwell and Brinell hardness for
    a. Mild steel
    b. Brass
    c. Aluminum.
6. Determination of compressive strength of wood.
7. Determination of double shear strength of mild steel bar.
8. Determination compressive strength of bricks and solid blocks.
9. Water absorption test on Bricks and pressed tiles.
10. Flexure test on Tiles

H. Learning Resources:

a) Text Books:

1. Rangwala, S.C., "Engineering Materials", Charotar Publishing House, Anand, India, 28th edition. 2011.
2. Varghese.P.C, "Building Materials", PHI Learning Pvt. Ltd, New Delhi. 2012.
3. Rajput. R.K. "Engineering Materials", S. Chand and Company Ltd. New Delhi. 2008.

Programme Elective

Specialization / Domain	Course Code	Course Title	L	T	P	C	Applicable to
Group I **Structural Engineering**	1152CE101	Structural Analysis II	2	2	0	3	2016
	1152CE102	Theory of Elasticity and Plasticity	2	2	0	3	All
	1152CE103	Prestressed Concrete	2	2	0	3	
	1152CE104	Smart Structures	3	0	0	3	
	1152CE105	Earthquake Resistant Design of Structures	2	2	0	3	
	1152CE106	Application of Finite Element Methods	2	2	0	3	
	1152CE107	Industrial Structures	2	2	0	3	
	1152CE108	Analysis and Design of Tall Buildings	2	2	0	3	
	1152CE109	Offshore Structures	3	0	0	3	
	1152CE110	Bridge Structures	2	2	0	3	
	1152CE147	Design of Reinforced Concrete and Brick Masonry Structures	2	2	0	3	2017
	1152CE148	Prefabricated Structures	3	0	0	3	
	1152CE151	Tall Structures	3	0	0	3	
Group II **Geotechnical Engineering**	1152CE111	Geo Technical Engineering II	2	2	0	3	2016
	1152CE112	Ground Improvement Techniques	3	0	0	3	All
	1152CE113	Soil - Structure Interaction	3	0	0	3	
	1152CE114	Pavement Engineering	3	0	0	3	
	1152CE140	Geotechnical Earthquake Engineering	3	0	0	3	
	1152CE141	Advanced Foundation Engineering	2	2	0	3	
	1152CE146	Remediation of Contaminated Sites	3	0	0	3	2017
Group III **Construction Engineering and Management**	1152CE115	Computer Applications in Construction Engineering and Planning	3	0	0	3	All
	1152CE116	Construction Planning, Scheduling and Control	3	0	0	3	
	1152CE117	Contract Law and Regulation	3	0	0	3	
	1152CE118	Project Safety Management	3	0	0	3	
	1152CE119	Repair and Rehabilitation of Structures	3	0	0	3	
	1152CE143	Construction Equipment and Management	3	0	0	3	2017
	1152CE144	Techniques of Building Construction	3	0	0	3	
	1152CE145	Basics of Detailing					
	1152CE201	Advance Concrete Technology	3	0	0	3	
	1152CE302	Material Testing Laboratory	0	0	2	1	
	1152CE303	Highway Engineering Laboratory	0	0	2	1	
Group IV **Transportation Engineering**	1152CE120	Traffic Engineering and Management	3	0	0	3	All
	1152CE121	Urban Transportation Policy and Planning for Sustainable Development	3	0	0	3	
	1152CE122	Transportation Infrastructure Design	3	0	0	3	
	1152CE123	Transportation Planning	3	0	0	3	
	1152CE124	Highway Engineering	3	0	0	3	
	1152CE125	Intelligent Transportation Systems	3	0	0	3	
	1152CE126	Pavement Analysis and Design	3	0	0	3	
	1152CE127	Railways, Airport, Docks and Harbour Engineering	3	0	0	3	
Group V **Water Resources and Environmental Engineering**	1152CE128	Water Quality Modelling	3	0	0	3	All
	1152CE129	Rural Water Supply and on Site Sanitation	3	0	0	3	
	1152CE130	Water Resources and Irrigation Engineering	3	0	0	3	
	1152CE131	Air Pollution Monitoring and control	3	0	0	3	
	1152CE132	Hydrology	3	0	0	3	
	1152CE133	Environmental Impact Assessment	3	0	0	3	
	1152CE134	Environmental Nanotechnology	3	0	0	3	
	1152CE135	Resource and Energy Recovery From Waste	3	0	0	3	
	1152CE136	Solid Waste Management	3	0	0	3	
	1152CE149	Emerging Environment	3	0	0	3	2017

	1152CE150	E-Waste Management	3	0	0	3	
	1152CE152	Sustainable Engineering	3	0	0	3	
	1152CE153	Disaster Management and Mitigation	3	0	0	3	
***Group VI* Surveying & Geology**	1152CE137	Surveying – II	3	0	0	3	2016
	1152CE138	Remote Sensing and GIS	3	0	0	3	All
	1152CE139	Urban Planning	3	0	0	3	
	1152CE142	Engineering Geology	2	0	0	2	
	1152CE301	Surveying Practical- II	0	0	2	1	

1152CE101	STRUCTURAL ANALYSIS II	L	T	P	C
		2	2	0	3

Course Category / Type: Programme Elective / Theory

A. Preamble:

- This course will be an extension of the Structural Analysis - I and will be useful to analyse indeterminate structures using modern approaches like matrix methods and finite element method.

B. Prerequisite:

- Structural Analysis - I – 1151CE107

C. Link to other Courses:

- Nil

D. Course Educational Objectives:

- To analysis statically indeterminate structures by imposing boundary conditions on flexibility matrix.
- To formulate the element stiffness matrix and assemble the structure stiffness matrix for solving indeterminate problems.
- To understand the basics of finite element method and its application to structural analysis.
- To introduce the importance of plastic analysis to calculate the collapse loads for beams and frames.
- To analysis suspension bridges and space truss.

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

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Analyse statically indeterminate structures by imposing boundary conditions on flexibility matrix.	K4
CO2	Form the element stiffness matrices and assemble the structure stiffness matrix for solving indeterminate problems.	K4
CO3	Apply the concept of finite element method to structural analysis.	K3
CO4	Compute collapse loads for beams and frames using plastic analysis.	K4
CO5	Determine the member forces in suspension bridges and space truss.	K4

F. Correlation of COs with POs:

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

G. Course Content:

UNIT I FLEXIBILITY METHOD 6+6

Equilibrium and compatibility – Determinate vs Indeterminate structures – Indeterminacy – Primary structure – Compatibility conditions – Analysis of indeterminate pin-jointed plane frames, continuous beams, rigid jointed plane frames (with redundancy restricted to two).

UNIT II STIFFNESS MATRIX METHOD 6+6

Element and global stiffness matrices – Analysis of continuous beams – Co-ordinate transformations – Rotation matrix – Transformations of stiffness matrices, load vectors and displacements vectors – Analysis of pin-jointed plane frames and rigid frames (with redundancy limited to two)

UNIT III FINITE ELEMENT METHOD 6+6

Introduction – Discretization of a structure – Displacement functions – Truss element – Beam element – Plane stress and plane strain - 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 – Plastic hinge and mechanism – Plastic analysis of indeterminate beams and frames – Upper and lower bound theorems

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

H. Learning Resources:

a) Text Books:

1. Vaidyanathan R. and Perumal P., Comprehensive Structural Analysis – Vol. I & II, Laxmi Publications, New Delhi, 2003

2. Bhavaikatti, S.S, Structural Analysis – Vol. I & II, Vikas Publishing House Pvt. Ltd., New Delhi, 2008

b) References:

1. Punmia.B.C., Ashok Kumar Jain and Arun Kumar Jain, Theory of Structures, Laxmi Publications, 2004.

2. Negi L.S. and Jangid R.S., Structural Analysis, Tata McGraw-Hill Publications, New Delhi, 2003.

3. Ghali.A, Neville A.M. and Brown,T.G., Structural Analysis A unified classical and Matrix approach, 6th edition. Spon Press, London and New York, 2013.

4. Coates R.C, Coutie M.G. and Kong F.K., Structural Analysis, ELBS and Nelson, 1990

5. Pandit G.S. and Gupta S.P., Structural Analysis – A Matrix Approach, Tata McGraw-Hill, 2004.

6. William Weaver Jr. and James M. Gere., Matrix Analysis of Framed Structures, CBS Publishers and Distributors, Delhi, 2004

7. Gambhir. M.L., Fundamentals of Structural Mechanics and Analysis, PHI Learning Pvt. Ltd., New Delhi, 2011.

1152CE102	THEORY OF ELASTICITY AND PLASTICITY	L	T	P	C
		2	2	0	3

Course Category / Type: Programme Elective / Theory

A. Preamble:

Students undergoing this course are expected

- To understand the concepts of elasticity and plasticity and equip them with the knowledge to independently handle the problems.

B. Prerequisite:

- Strength of Materials – 1151CE201

C. Link to other Courses:

- Nil

D. Course Educational Objectives:

- To impart knowledge of Principal stresses and strains
- To develop analytical skills of solving problems using plane stress and plane strain.
- To impart knowledge on engineering application of plasticity
- To inculcate the habit of researching and practicing in the field of elasticity and plasticity.

E. 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 Stress-Strain equations and Compatibility relationship.	K2
CO2	Analyze 2D problems in Cartesian and Polar Coordinates.	K4
CO3	Solve problems in torsion of thin walled sections by various approaches.	K4
CO4	Solve problems in Beams on Elastic Foundations.	K3
CO5	Understand failure theories and Elasto-Plastic problems.	K3

F. Correlation of COs with POs:

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

G. Course Content:

Course Content:

UNIT I ELASTICITY 6+6

Analysis of stress and strain, Equilibrium equations - Compatibility equations - stress strain relationship - Generalized Hooke’s law.

UNIT II ELASTICITY SOLUTION 6+6

Plane stress and plane strain - Simple two dimensional problems in Cartesian and polar co-ordinates.

UNIT III TORSION OF NON-CIRCULAR SECTION 6+6

St.Venant’s approach - Prandtl’s approach – Membrane analogy - Torsion of thin walled open and closed sections.

UNIT IV BEAMS ON ELASTIC FOUNDATIONS 6+6

Beams on Elastic foundations – Methods of analysis – Elastic line method – Idealization of soil medium – Winkler model – Infinite beams – Semi infinite and finite beams – Rigid and flexible – Uniform cross section – Point load and UDL – Solution by finite differences.

UNIT V PLASTICITY 6+6

Physical Assumptions – Yield criteria – Failure theories – Applications of thick cylinder – Plastic stress strain relationship. Elasto-plastic problems in bending and torsion.

TOTAL: 30+30 = 60 PERIODS

H. Learning Resources:

a) Text Books:

1. Timoshenko and Goodier, ‘Theory of Elasticity’, McGraw Hill Book Company, New Delhi, 2010.
2. Sadhu Singh, ‘Theory of Plasticity’, 2008, Khanna Publishers, New Delhi.

b) References:

1. Ansel.C.Ugural and Saul.K.Fenster, “Advanced Strength and Applied Elasticity,” Fourth Edition, Prentice Hall Professional technical Reference, New Jersy, 2003.
2. Chakrabarty.J, “Theory of Plasticity”, Third Edition, Elsevier Butterworth - Heinmann – UK, 2006.
3. Mendelson, A., Plasticity: ‘Theory & Applications’, Krieger Publishing Co., 1986.

1152CE103	PRESTRESSED CONCRETE	L	T	P	C
		2	2	0	3

Course Category / Type: Programme Elective / Theory

A. Preamble:

Students undergoing this course are expected

- To analyse and design various structural elements using prestressed concrete.

B. Prerequisite:

- Design of RC Elements – 1151CE109

C. Link to other Courses:

- Nil

D. Course Educational Objectives:

- To introduce the need for prestressing in a structure
- To explain the methods, types and advantages of prestressing to the students.
- To make the students to design a prestressed concrete structural elements and systems
- To introduce the students the effect of prestressing in the flexural and shear behaviour of structural elements.

E. 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 concept and general mechanical behavior of prestressed concrete.	K3
CO2	Analyze and design prestressed concrete flexural and shear members.	K3
CO3	Compute the deflections and design of anchorage zone for prestressed concrete members.	K3
CO4	Analyse and design the composite beams and continuous beams.	K3
CO5	Design miscellaneous structures such as tanks, pipes and poles and understand the concept of partial prestressing.	K3

F. Correlation of COs with POs:

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

G. Course Content:

UNIT I INTRODUCTION – THEORY AND BEHAVIOUR 6+6

Basic concepts – Advantages – Materials required – Systems and methods of prestressing –Analysis of sections – Stress concept – Strength concept – Load balancing concept – Effect of loading on the tensile stresses in tendons – Effect of tendon profile on deflections – Factors influencing deflections – Calculation of deflections – Short term and long term deflections –Losses of prestress – Estimation of crack width.

UNIT II DESIGN FOR FLEXURE AND SHEAR 6+6

Basic assumptions for calculating flexural stresses – Permissible stresses in steel and concrete as per IS 1343:2012 codal provisions – 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 IS1343-2012 - 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 – 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 – Tanks, pipes and poles – Partial prestressing – Definition, methods of achieving partial prestressing - Merits and demerits of partial prestressing.

TOTAL: 30+30 = 60 PERIODS

H. Learning Resources:

a) Text Books:

1. Krishna Raju N., Prestressed Concrete, 6th Edition, Tata McGraw Hill Education, New Delhi, April 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, Third Edition, Wiley India Pvt. Ltd., New Delhi, 2013.
4. IS 1343:2012, Indian Standard Prestressed Concrete Code of Practice, Bureau of Indian Standards, New Delhi, 2012.

1152CE104	SMART STRUCTURES	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 functions of smart structures like sensors, actuators and signal processing systems.

B. Prerequisite:

- Construction Materials and Techniques – 1151CE113

C. Link to other Courses:

- Nil

D. Course Educational Objectives:

- To learn the principles of smart materials and actuation systems.
- To learn the various sensing elements and uses
- To learn the various actuating materials, elements and uses
- To learn the signal processing systems, operation and its control.

E. 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 smart materials and structures	K2
CO2	Understand application of instrumentation	K2
CO3	Articulate structural assessment using sensors	K3
CO4	Demonstrate actuator techniques	K3
CO5	Apply signal processing system to smart materials	K3

F. Correlation of COs with POs:

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

G. Course Content:

UNIT I INTRODUCTION 9

Introduction to Smart Materials and Structures Instrumented structures functions and response – Sensing systems – Self - diagnosis – Signal processing consideration Actuation systems and effectors.

UNIT II MEASURING TECHNIQUES 9

Strain Measuring Techniques using Electrical strain gauges, Types – Resistance Capacitance – Inductance – Wheatstone bridges – Pressure transducers – Load cells- Temperature Compensation, Strain Rosettes.

UNIT III SENSORS 9

Sensing Technology, Types of Sensors, Physical Measurement using Piezo Electric Strain measurement – Inductively Read Transducers – The LVDT – Fiber optic Techniques Chemical and Bio-Chemical sensing in structural Assessment – Absorptive chemical sensors – Spectroscopes – Fibre Optic Chemical Sensing Systems and Distributed measurement.

UNIT IV ACTUATORS 9

Actuator Techniques-Actuator and actuator materials Piezoelectric and Electrostrictive Material – Magnetostrictive Material – Shape Memory Alloys – Electro-rheological Fluids Electromagnetic actuation – Role of actuators and Actuator Materials.

UNIT V SIGNAL PROCESSING AND CONTROL SYSTEMS 9

Data Acquisition and Processing – Signal Processing and Control for Smart Structures – Sensors as Geometrical Processors – Signal Processing – Control System – Linear and Non- Linear.

TOTAL: 45 PERIODS

H. Learning Resources:

a) Text Books:

1. Brain Culshaw., Smart Structures and Materials, Artech House Publishers, Boston-2004.
2. Sadhu Singh., Experimental Stress Analysis, Khanna Publishers (2009).
3. Srinath L.S., Experimental Stress Analysis, Tata McGraw-Hill, 1998.

b) References:

1. Dally J. W and Riley W. F., Experimental Stress Analysis, Tata McGraw-Hill, 1998.
2. Hetyeni M., Hand Book of Experimental Stress Analysis, John Wiley and Sons Inc., New York 1972.

1152CE105	EARTHQUAKE RESISTANT DESIGN OF STRUCTURES	L	T	P	C
		2	2	0	3

Course Category / Type: Programme Elective / Theory

A. Preamble:

- Designing structures against earthquake forces is indispensable since in the event of a strong ground motion precious lives and properties are lost. This course would lead a student to design structures against anticipated seismic forces adopting appropriate codal provisions.
- To the design concepts of earthquake resistant structures.

B. Prerequisite:

- NIL

C. Link to other Courses:

- Basics of Dynamics and Aseismic Design of Structures – 1151CE110

D. Course Educational Objectives:

- To understand the phenomena, earthquake and ground motion.
- To idealize the structures and earthquake force to get mathematical modeling.
- To learn design concepts and lateral load resisting systems and vibration controlling devices.

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

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Understand basics of engineering seismology	K2
CO2	Apply the IS codal provisions to analyse structures.	K3
CO3	Design masonry structures against earthquake forces.	K3
CO4	Design shear walls and other RC elements against seismic forces.	K3
CO5	Understand the concept of base isolation.	K2

F. 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										
CO3		L	H	L		L	L							
CO4		M	M	M		L	L						M	
CO5				M	M	M								M

G. Course Content:

UNIT I EARTHQUAKE AND GROUND MOTION 6+6

Engineering Seismology (Definitions, Introduction to Seismic hazard, Earthquake Phenomenon), Seismotectonics and Seismic Zoning of India, Earthquake Monitoring and Seismic Instrumentation - Characteristics of Strong Earthquake Motion - Estimation of Earthquake Parameters – Microzonation.

UNIT II EFFECTS OF EARTHQUAKE ON STRUCTURES 6+6

Dynamics of Structures (SDOF/ MDOF), Response Spectra - Evaluation of Earthquake Forces as per codal provisions IS 1893: (Part – I) 2016 - Effect of Earthquake on Different Types of Structures - Lessons learnt during past earthquakes

UNIT III EARTHQUAKE RESISTANT DESIGN OF MASONRY STRUCTURES 6+6

Structural Systems - Type of Buildings - Causes of damage - Planning Considerations - Philosophy and Principle of Earthquake Resistant Design - Earthquake Resistant Masonry Buildings - Design consideration – Guidelines.

UNIT IV EARTHQUAKE RESISTANT DESIGN OF RC STRUCTURES 6+6

Earthquake Resistant Design of R.C.C. Buildings - Material properties - Lateral load analysis – Capacity based Design and detailing – Rigid Frames – Shear walls – Codal provisions.

UNIT V VIBRATION ISOLATION TECHNIQUES 6+6

Vibration Control - Tuned Mass Dampers – Principles and application - Basic Concept of Seismic Base Isolation – Various Systems- Case Studies, Important structures.

TOTAL: 30+30 = 60 PERIODS

H. Learning Resources:

a) Text Books:

1. Mohiuddin Ali Khan, Earthquake-Resistant Structures: Design, Build and Retrofit, Elsevier Science & Technology, Butterworth-Heinemann, 2013.
2. Pankaj Agarwal and Manish Shrikhande, Earthquake Resistant Design of Structures, Prentice Hall of India, New Delhi, 2009.

b) References:

1. Bruce A Bolt, Earthquakes, W. H Freeman and Company, New York, 2004.
2. Brebbia C.A, Earthquake Resistant Engineering Structures VIII, WIT Press, 2011.
3. Paulay,T and Priestley, M.J.N., Seismic Design of Reinforced Concrete and Masonry buildings, John Wiley and Sons, 1992.
4. Duggal S K., Earthquake Resistant Design of Structures, Oxford University Press, 2013.
5. NBC–National Building Code, Bureau of Indian Standards, New Delhi, 2016.

1152CE106	APPLICATION OF FINITE ELEMENT METHODS	L	T	P	C
		2	2	0	3

Course Category / Type: Programme Elective / Theory

A. Preamble:

Students undergoing this course are expected

- To understand the importance and applications of finite element method.

B. Prerequisite:

- Structural Analysis – II – 1152CE101

C. Link to other Courses:

- Nil

D. Course Educational Objectives:

- To understand the basics of the Finite Element Technique
- To learn one dimensional and two dimensional problems.
- To learn finite element analysis concept to solve problem using software.

E. 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 different methods involved in the formulation of Finite Element Method.	K2
CO2	Analyze one dimensional element using stiffness matrix method	K3
CO3	Analyze 2D elements using stiffness matrix method.	K3
CO4	Illustrate mesh generation technique to solve problems.	K3
CO5	Apply concepts of FEA to solve problems using software.	K3

F. Correlation of COs with POs:

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

G. Course Content:

UNIT I INTRODUCTION 6+6

Historical Background - Basic Concept of FEM - Engineering problems and governing differential equations – Finite element modeling – Discretization - Node, Element - different types of element – Approximate Solutions – Principle of minimum potential energy, Rayleigh-Ritz method and Galerkin methods.

UNIT II PRINCIPLES OF ONE DIMENSIONAL PROBLEMS 6+6

One dimensional problems - Coordinate systems – global, local and natural coordinate systems, shape functions – Bar and beam element - Generation of Stiffness Matrix and Load Vector.

UNIT III PRINCIPLES OF TWO DIMENSIONAL PROBLEMS 6+6

Two Dimensional problems – Plane Stress, Plane Strain Problems – Truss, Triangular and Quadrilateral Elements – Isoparametric Formulation - Natural Coordinates, Shape function, stiffness matrix- Axisymmetric Problems - Higher Order Elements - Numerical Integration.

UNIT IV MESH GENERATION AND SOLUTION PROBLEMS 6+6

Convergence: Requirements for convergence – p and h Methods of Mesh Refinement – ill conditioned Elements – Discretization Errors – Auto and Adaptive Mesh Generation Techniques - Error Evaluation.

UNIT V SOFTWARE APPLICATION 6+6

Preprocessing - Mesh generation – region and block representation, generation of node numbers, mesh plotting- Post Processing – Types of data available – displaying results graphically – listing nodal and element solution data

TOTAL: 30+30 = 60 PERIODS

H. Learning Resources:

a) Text Books:

1. Reddy J.N., An Introduction to the Finite Element Method, McGraw Hill, Third Edition, 2006.
2. Rao S.S., Finite Element Method in Engineering, Fifth Edition, Pergamon Press, 2011.

b) References:

1. Chandrupatla & Belagundu, Finite Elements in Engineering, Pearson Education India, 2012.
2. Cook, Robert Davisetal, Concepts and Applications of Finite Element Analysis, Wiley, John & Sons,Fourth Edition,2007.
3. Krishnamoorthy C.S, Finite Element Analysis Theory and Programming, Tata McGraw-Hill, Second Edition, 2017.

1152CE107	INDUSTRIAL STRUCTURES	L	T	P	C
		3	0	0	3

Course Category / Type: Programme Elective / Theory

A. Preamble:

- To study the requirements, planning and design of Industrial structures.

B. Prerequisite:

- Design of RC Elements – 1151CE109
- Design of Steel Structures – 1151CE111
- Prestressed Concrete – 1152CE103

C. Link to other Courses:

- Nil

D. Course Educational Objectives:

- To get the required knowledge on industrial structures functions.
- To design requirements of various elements and structures.

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

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Plan and prepare layout for industrial structures.	K3
CO2	Design functional requirements such as lighting and ventilation for industrial structures.	K3
CO3	Design the steel structures such as industrial roofs, crane girders, bunkers and silos.	K3
CO4	Design R.C corbels, brackets, nibs, bunkers and silos.	K3
CO5	Get knowledge on the precast industrial structures.	K3

F. 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	H			M							M	
CO4		M	H			M							M	
CO5		M				M							M	

G. Course Content:

UNIT I PLANNING AND FUNCTIONAL REQUIREMENTS 9

Classification of industries and industrial structures – General requirements of various industries - Planning and layout of buildings and components.

UNIT II FUNCTIONAL REQUIREMENTS 9

Lighting – Ventilation - Acoustics – Fire safety – Guidelines from factories act.

UNIT III DESIGN OF STEEL STRUCTURES 9

Industrial roofs – Crane girders – Mills buildings – Bunkers and Silos - Chimney.

UNIT IV DESIGN OF R.C. STRUCTURES 9

Corbels, Brackets and Nibs - Silos and bunkers - Chimney - Principles of folded plates and shell roofs.

UNIT V PREFABRICATION 9

Principles of prefabrication – Prestressed precast roof trusses - Construction of roof and floor slabs - Wall panels.

TOTAL: 45 PERIODS

H. Learning Resources:

a) Text Books:

1. Ramamrutham.S., Design of Reinforced Concrete Structures, Dhanpat Rai Publishing Company, 2016.
2. Varghese P.C., Limit State Design of Reinforced Concrete, Prentice Hall of India Eastern Economy Editions, 2nd Edition, 2009.
3. Bhavikatti.S.S., Design of Steel Structures by Limit State Method as Per IS: 800-2007, I.K. International Publishing House Pvt. Ltd., 5th Edition, 2017.

b) References:

1. Henn W, Buildings for Industry, Vol. I and II, London Hill Books, 1995.

2. SP32-1986, Handbook on Functional Requirements of Industrial buildings, Bureau of Indian Standards, New Delhi, 1990.
3. Koncz.J., Manual of Precast Construction, Vol. I and II, Bauverlay GMBH, 2nd Revised Edition, 1976.

1152CE108	ANALYSIS AND DESIGN OF TALL BUILDINGS	L	T	P	C
		3	0	0	3

Course Category / Type: Programme Elective / Theory

A. Preamble:

Students undergoing this course are expected

- To learn principles of stability and design of tall buildings with various loading system.

B. Prerequisite:

- Nil

C. Link to other Courses:

- Basics of Dynamics and Aseismic Design of Structures – 1151CE110

D. Course Educational Objectives:

- To understand different types of loading and design principles.
- To understand the various properties of structural elements.
- To analysis and design of tall buildings.

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

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Understand different design principles and materials.	K2
CO2	Describe the different combination of loads and loading techniques.	K2
CO3	Analysis and design of tall buildings.	K4
CO4	Analysis the forces, drift and twist.	K4
CO5	Understand the overall buckling analysis of tall buildings with P-Delta analysis.	K3

F. Correlation of COs with POs:

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

G. Course Content:

UNIT I LOADING AND DESIGN PRINCIPLES 9

Loading- sequential loading, Gravity loading, Wind loading, Earthquake loading, - Equivalent lateral force, modal analysis - combination of loading, – Static and Dynamic approach - Analytical and wind tunnel experimental methods - Design philosophy - working stress method, limit state method and plastic design.

UNIT II BEHAVIOUR OF VARIOUS STRUCTURAL SYSTEMS 9

Factors affecting growth, height and structural form. High rise behaviour, Rigid frames, braced frames, In filled frames, shear walls, coupled shear walls, wall-frames, tubulars, cores, outrigger - braced and hybrid mega systems.

UNIT III ANALYSIS AND DESIGN OF TALL BUILDINGS 9

Modeling for approximate analysis, Accurate analysis and reduction techniques, Analysis of buildings as total structural system considering overall integrity and major subsystem interaction, Analysis for member forces, drift and twist - Computerized three dimensional analysis – Assumptions in 3D analysis – Simplified 2D analysis.

UNIT IV STRUCTURAL ELEMENTS 9

Sectional shapes, properties and resisting capacity, design, deflection, cracking, prestressing, shear flow, Design for differential movement, creep and shrinkage effects, temperature effects and fire resistance.

UNIT V STABILITY OF TALL BUILDINGS 9

Overall buckling analysis of frames, wall-frames, Approximate methods, second order effects of gravity of loading, P-Delta analysis, simultaneous first-order and P-Delta analysis, Translational, Torsional instability, out of plumb effects, stiffness of member in stability, effect of foundation rotation.

TOTAL: 45 PERIODS

H. Learning Resources:

a) Text Books:

1. Beedle L. S., Advances in Tall Buildings, CBS Publishers and Distributors, Delhi, 1986.
2. Bryan Stafford Smith and Alexcoull, Tall Building Structures - Analysis and Design, John Wiley and Sons, Inc., 2005.

b) References:

1. Taranath B.S., Structural Analysis and Design of Tall Buildings, McGraw Hill, New Delhi, 1988.

2. Gupta.Y.P.,(Editor), Proceedings of National Seminar on High Rise Structures –Design and Construction Practices for Middle Level Cities, New Age International Limited, NewDelhi,1995.
3. Lin T.Yand Stotes Burry D, Structural Concepts and systems for Architects and Engineers, John Wiley and Sons, 1988.

1152CE109	OFFSHORE STRUCTURES	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 basic knowledge of offshore structure and analysis and design of offshore structures.

B. Prerequisite:

- NIL

C. Link to other Courses:

- Nil

D. Course Educational Objectives:

- To study the concept of wave theories and forces of offshore structures.
- To understand offshore soil and structure modelling.
- To analysis and design of offshore structures.

E. 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 wave generation process and its theories	K2
CO2	Understand the types of forces in offshore structures	K2
CO3	Understand the types of offshore structure and structure modeling	K2
CO4	Analysis offshore structures	K3
CO5	Design off shore structures	K3

F. Correlation of COs with POs:

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

G. Course Content:

UNIT I WAVE THEORIES 9

Wave generation process – Small finite amplitude and nonlinear wave theories.

UNIT II FORCES OF OFFSHORE STRUCTURES 9

Wind forces, wave forces on small bodies and large bodies - current forces and use of Morison equation.

UNIT III OFFSHORE SOIL AND STRUCTURE MODELLING 9

Different types of offshore structures - Foundation modeling - Fixed jacket platform structural modeling.

UNIT IV ANALYSIS OF OFFSHORE STRUCTURES 9

Static method of analysis - Foundation analysis and dynamics of offshore structures.

UNIT V DESIGN OF OFFSHORE STRUCTURES 9

Design of platforms, helipads, Jacket tower, analysis and design of mooring cables and pipe lines.

TOTAL: 45 PERIODS

H. Learning Resources:

a) Text Books:

1. API RP 2A-WSD, Planning, Designing and Constructing Fixed Offshore Platforms - Working Stress Design - API Publishing Services, 2005
2. Chakrabarti, S.K., Handbook of Offshore Engineering, Elsevier, 2005.

b) References:

1. Chakrabarti, S.K., Hydrodynamics of Offshore Structures,WIT press, 2001.
2. Dawson. T.H., Offshore Structural Engineering, Prentice Hall Inc Englewood Cliffs, N.J. 1983.
3. James F.Wilson, Dynamics of Offshore Structures, John Wiley & Sons, Inc, 2003.
4. Reddy, D.V. and Arockiasamy, M., Offshore Structures, Vol.1 and Vol.2, Krieger Publishing Company, 1991.

1152CE110	BRIDGE STRUCTURES	L	T	P	C
		2	2	0	3

Course Category / Type: Programme Elective / Theory

A. Preamble:

Students undergoing this course are expected

- To learn the fundamental knowledge to analysis and design simple and complex bridge components.

B. Prerequisite:

- NIL

C. Link to other Courses:

- Prestressed Concrete Structures – 1152CE103
- Design of RC Elements - 1152CE147
- Design of Steel Structures - 1151CE111

D. Course Educational Objectives:

- To learn the types of bridges and loading standard.
- To study the design principles of long span RC bridges.
- To selection of appropriate bridge structures and its design for given site conditions.

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

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Analyse Slab Culverts, Tee Beam and Slab Bridges and Design RCC Solid Slab Bridges, Slab Culverts and Tee Beam	K4, K6
CO2	Understand and apply design Principles of Long Span RC Bridges	K2, K3
CO3	Analyse and design the prestressed concrete bridges	K4, K6
CO4	Understand and Design Principles of various types of Steel Bridges	K2,K3
CO5	Design bearings, piers, abutments and bridge foundations	K4

F. 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	
CO2		L	H	M									M	
CO3		L	H	M									M	
CO4		L	H	M									M	
CO5			H	M									M	

G. Course Content:

Course Content:

UNIT I SHORT SPAN RC BRIDGES 6+6

Types of bridges and loading standards - Choice of type - I.R.C. specifications for road bridges – Design of RCC solid slab bridges -analysis and design of slab culverts, Tee beam and slab bridges.

UNIT II DESIGN PRINCIPLES OF LONG SPAN RC BRIDGES 6+6

Continuous girder bridges, box girder bridges, balanced cantilever bridges – Arch bridges – Box culverts.

UNIT III PRESTRESSED CONCRETE BRIDGES 6+6

Flexural and torsional parameters – Courbon's theory – Distribution co-efficient by exact analysis – Design of girder section – maximum and minimum prestressing forces – Eccentricity – Live load and dead load shear forces – Cable Zone in girder – check for stresses at various sections – check for diagonal tension – Diaphragms – End block – short term and long term deflections.

UNIT IV STEEL BRIDGES 6+6

General – Railway loadings – dynamic effect – Railway culvert with steel beams – Plate girder bridges – Box girder bridges – Truss bridges – Vertical and Horizontal stiffeners.

UNIT V BEARINGS AND SUBSTRUCTURES 6+6

Different types of bearings – Design of bearings – Design of piers and abutments of different types – Types of bridge foundations – Design of foundations.

TOTAL: 30+30 = 60 PERIODS

H. Learning Resources:

a) Text Books:

1. Jagadeesh.T.R. and Jayaram.M.A., Design of Bridge Structures, Prentice Hall of India Pvt. Ltd. New Delhi, 2004.
2. Johnson Victor, D., Essentials of Bridge Engineering, Oxford and IBH Publishing Co. New Delhi, 2001.

b) References:

1. Ponnuswamy, S., Bridge Engineering, Tata McGraw Hill, New Delhi, 2008.
2. Raina V.K. Concrete Bridge Practice, Tata McGraw Hill Publishing Company, New Delhi, 1991.

1152CE111	GEOTECHNICAL ENGINEERING- II	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 site exploration techniques and design and analysis of different foundations.

B. Prerequisite:

- Geotechnical Engineering - I - 1151CE202

C. Link to other Courses:

- Advanced Foundation Engineering – 1152CE141

D. Course Educational Objectives:

- To understand site investigation and selection of foundation.
- To analysis and design of various foundations and check the stability of retaining walls.

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

CO Nos.	Course Outcome	Bloom's Taxonomy level
CO1	Apply the appropriate site exploration method to determine the in-situ properties.	K3
CO2	Determine the bearing capacity of shallow foundation by different methods including IS code.	K3
CO3	Design footings against different types of loading including seismic forces.	K3
CO4	Design single pile and pile group by different methods.	K3
CO5	Apply different earth pressure theories to design retaining walls.	K3

F. Correlation of COs with POs:

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

G. Course Content:

UNIT I SITE INVESTIGATION AND SELECTION OF FOUNDATION 9

Scope and objectives – Methods of exploration – augering 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 – Penetration tests (SPT and SCPT) - Bore log report – Data interpretation – strength parameters and Liquefaction potential - Selection of foundation based on soil condition.

UNIT II 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 – Bearing capacity from in-situ tests (SPT, SCPT and plate load) 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 FOOTINGS AND RAFTS 9

Types of footings – 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 RETAINING WALLS 9

Plastic equilibrium in soils – active and passive states – Rankine's theory – cohesionless 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

H. Learning Resources:

a) Text Books:

1. Murthy V.N.S., Soil Mechanics and Foundation Engineering, CBS Publishers and Distributers Ltd., New Delhi, 2009.

2. Gopal Ranjan and Rao A.S.R., Basic and Applied soil mechanics, New Age International Pvt. Ltd, New Delhi, 2007.

b) References:

1. Purushothama Raj P., Soil Mechanics and Foundation Engineering, 2nd Edition, Pearson Education, Delhi, 2013.

2. Varghese P.C., Foundation Engineering, Prentice Hall of India Private Limited, New Delhi, 2005.

3. IS:2950 (PartI)-1981, Code of Practice for Design and Construction of Raft Foundations (Reaffirmed2008), Bureau of Indian Standards, New Delhi.

1152CE112	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 improve the weak soil by increasing its shear strength properties.

B. Prerequisite:

- Geotechnical Engineering - I - 1151CE202

C. Link to other Courses:

- Nil

D. Course Educational Objectives:

- To understand appropriate technique to strengthen the weak soil.
- To study about the earth reinforcement and grouting techniques.

E. 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	Apply Soil Reinforcement for different applications.	K2
CO5	Achieve stabilization of sites applying different grouting techniques.	K2

F. Correlation of COs with POs:

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

G. 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

UNIT III 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

H. 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, 7^{th},Edition, Cengage learning, 2010.
4. Koerner R.M. “Designing with Geosynthetics”, 6^{th} Edition,Xlibris Corporation, 2012.
5. IS-9759:1981, Guidelines for Dewatering During Construction, Bureau of Indian Standards, New Delhi, Reaffirmed 2008.
6. IS-15284 (Part1):2003, Design and Construction for Ground Improvement-Guidelines, (Stone Column), Bureau of Indian Standards, New Delhi, 2003.

1152CE113	SOIL - STRUCTURE INTERACTION	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 importance of soil-structure interaction and design of sub-structures.

B. Prerequisite:

- NIL

C. Link to other Courses:

- Basics of Dynamics and Aseismic Design of Structures – 1151CE110

D. Course Educational Objectives:

- To learn the concepts of soil-structure interaction and soil response.
- To analyse inter-dependent behaviour of soil and structure.
- To analysis lateral loading piles.

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

CO Nos.	Course Outcome	Bloom's Taxonomy level
CO1	Understand different soil-foundation interaction behavior.	K2
CO2	Understand different constitutive time dependent models.	K2
CO3	Understand the behaviour of Infinite and finite beam on Soil under various loading and end conditions.	K2
CO4	Analyse the behavior of pile and pile group interactions.	K3
CO5	Analyse lateral loaded piles.	K3

F. Correlation of COs with POs:

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

G. 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 – end 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

H. 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.

b) References:

1. Poulos, H.G., and Davis, E.H., Pile Foundation Analysis and Design, John Wiley, 1980.
2. Kurien, N.P., Design of Foundation Systems Principles and Practices Narosa, Publishing House, New Delhi, 1999.

1152CE114	PAVEMENT ENGINEERING	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 concept of pavement and design of flexible and rigid pavement.

B. Prerequisite:

- NIL

C. Link to other Courses:

- Highway Engineering – 1152CE124

D. Course Educational Objectives:

- To understand the basic concept of pavement.
- To gain knowledge on various IRC guidelines for designing rigid and flexible pavements.
- To learn the various methods to stabilization of soils for road construction.

E. 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 principles involved in pavement designing.	K2
CO2	Design Flexible Pavements by different codal provisions.	K4
CO3	Design Rigid Pavements using IRC guidelines.	K4
CO4	Understand the concepts of rehabilitation of pavements.	K2
CO5	Design criteria with the application of geosynthetics.	K2

F. Correlation of COs with POs:

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

G. Course Content:

UNIT I BASIC CONCEPTS 9

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

UNIT II 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 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 REHABILITATION 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 STABILIZATION OF SOILS FOR ROAD CONSTRUCTION 9

Need for a stabilized soil – Design criteria – Mechanisms - factors influencing choice of stabilizers - Testing and field control – Applications of Geosynthetics in road construction - Case studies.

TOTAL: 45 PERIODS

H. Learning Resources:

a) Text Books:

1. Wright, P.H., "Highway Engineers", John Wiley & Sons, Inc., New York, 1996.
2. Khanna S.K and Justo C.E.G, "Highway Engineering, 8th Edition, New Chand and Brothers, Roorkee, 2001.

b) References:

1. Yoder R.J and Witchak M.W., Principles of Pavement Design, John Wiley, 2000.
2. Croney,D., Design and Performance of Road Pavements, HMO Stationary Office, 1979.
3. Design and Specification of Rural Roads (Manual), Ministry of rural roads, Government of India, New Delhi, 2001.
4. Guidelines for the Design of Flexible Pavements", IRC:37- 2001, The Indian roads Congress, New Delhi.
5. Guideline for the Design of Rigid Pavements for Highways, IRC:58-1998, The Indian Roads Congress, New Delhi.
6. O'Flaherty,C.A., Highways-The location, Design, Construction & Maintenance of Pavements, Fourth Edition, Elsevier, 2006.
7. Bell.P.S., Developments in Highway Engineering, Applied Science publishers,1978.

1152CE115	COMPUTER APPLICATIONS IN CONSTRUCTION ENGINEERING AND PLANNING	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 application of computers in construction engineering and planning.

B. Prerequisite:

- NIL

C. Link to other Courses:

- Construction Planning, Scheduling and Control – 1152CE116

D. Course Educational Objectives:

- To understand the software requirements of computer, programming, optimization techniques,
- To learn inventory models and scheduling techniques applied to construction engineering.

E. 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 computer application in civil engineering	K3
CO2	Apply the optimization techniques in construction engineering softwares	K3
CO3	Learn the different management softwares used in civil engineering	K3
CO4	Understand the basics of PERT and CPM	K3
CO5	Apply enterprise resource planning in system	K3

F. 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			M	M		H
CO2	L	M			L			M			M	M		H
CO3	L	M			L			M			M	M		H
CO4	L	M			L			M			M	M		H
CO5	L	M			L			M			M	M		H

G. Course Content:

UNIT I INTRODUCTION 9

Overview of IT Applications in Construction – Construction process – Computerization in Construction – Computer aided Cost Estimation – Developing application with database software.

UNIT II OPTIMIZATION TECHNIQUES 9

Linear, Dynamic and Integer Programming - Branch and Bound Techniques – Application to Production Scheduling, Equipment Replacement, Material Transportation and Work Assignment Problems – Software applications.

UNIT III INVENTORY MODELS 9

Deterministic and Probabilistic Inventory Models - Software applications.

UNIT IV SCHEDULING APPLICATION 9

PERT and CPM - Advanced planning and scheduling concepts – Computer applications – Case study.

UNIT V OTHER PROBLEMS 9

Sequencing problems – Simulation – Enterprises – Introduction to Enterprise resource planning (ERP) systems.

TOTAL: 45 PERIODS

H. Learning Resources:

a) Text Books:

1. Billy E.Gillet., Introduction to Operations Research A Computer Oriented Algorithmic Approach, McGraw Hill, New Delhi, 2008.
2. Feigenbaum,L., Construction Scheduling with Primavera Project Planner, Prentice Hall Inc.,2002.

b) References:

1. Ming Sunand Rob Howard., Understanding I.T. in Construction, Spon Press, Taylor and Francis Group, 2004.
2. Paulson,B.R., Computer Applications in Construction, McGraw Hill, New Delhi, 1995.

1152CE116	CONSTRUCTION PLANNING, SCHEDULING AND CONTROL	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 various steps involved in the planning, scheduling, quality, cost and safety management for a project.

B. Prerequisite:

- NIL

C. Link to other Courses:

- Computer Applications in Construction Engineering and Planning – 1152CE115

D. Course Educational Objectives:

- To learn about planning of construction projects, scheduling procedures and techniques.
- To understand the cost and quality control in a projects and use of project information as decision making tool.

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

CO Nos.	Course Outcome	Bloom's Taxonomy level
CO1	Understand basic concepts of construction planning	K3
CO2	Schedule the construction activities	K3
CO3	Forecast and control the cost of a construction project.	K3
CO4	Understand the quality control and safety during construction	K3
CO5	Organize information in centralized database management systems	K3

F. 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						H
CO2		M		M				M			M	H		H
CO3		M		M				M			M	H		H
CO4		M		M		H	M							H
CO5					M			M		M		M		H

G. 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

Construction Schedules – Critical Path Method – Scheduling Calculations – Float – Presenting Project Schedules – Scheduling for Activity-on-Node and with Leads, Lags, and Windows – Scheduling with Resource Constraints and Precedence – Use of Advanced Scheduling Techniques – Scheduling with Uncertain Durations.

UNIT III COST CONTROL, MONITORING AND ACCOUNTING 9

The Cost Control Problem – The Project Budget – Forecasting for Activity Cost Control – Financial Accounting Systems and Cost Accounts – Control of Project Cash Flows –Schedule Control – Schedule and Budget Updates – Relating Cost and Schedule Information.

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 – Safety.

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

H. 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: Planning, Scheduling and Control, McGraw-Hill Publishing Company, New Delhi, 2005.
3. Srinath, L.S, PERT and CPM, principles and Applcations, 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.

1152CE117	CONTRACT LAW AND REGULATION	L	T	P	C
		3	0	0	3

Course Category / Type: Programme Elective / Theory

A. Preamble:

Students undergoing this course are expected

- To learn about tendering, arbitration, laws and regulations of contracts of works.

B. Prerequisite:

- NIL

C. Link to other Courses:

- Nil

D. Course Educational Objectives:

- To study the various types of construction contracts and their legal aspects and provisions.
- To study about tenders, arbitration, legal requirement, and labour regulations

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

CO Nos.	Course Outcome	Bloom's Taxonomy level
CO1	Learn elements of contract and contract documents	K2
CO2	Understand the tender and tender evaluation process	K2
CO3	Understand about laws, powers and duties of arbitration.	K2
CO4	Learn about laws governing sale and purchase	K2
CO5	Understand the relating to wages and labour act	K2

F. 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		H
CO2						M		M			M	M		H
CO3						H		H			M	M		H
CO4						H		H			L	L		H
CO5						M		H			L	L		H

G. Course Content:

UNIT I CONSTRUCTION CONTRACTS 9

Indian Contracts Act – Elements of Contracts – Types of Contracts – Features – Suitability – Design of Contract Documents – International Contract Document – Standard Contract Document – Law of Torts.

UNIT II TENDERS 9

Prequalification – Bidding – Accepting – Evaluation of Tender from Technical, Contractual and Commercial Points of View – Contract Formation and Interpretation – Potential Contractual Problems – World Bank Procedures and Guidelines - Tamil Nadu Transparency in Tenders Act (1998).

UNIT III ARBITRATION 9

Comparison of Actions and Laws – Agreements – Subject Matter – Violations – Appointment of Arbitrators – Conditions of Arbitration – Powers and Duties of Arbitrator – Rules of Evidence – Enforcement of Award – Costs.

UNIT IV LEGAL REQUIREMENTS 9

Insurance and Bonding – Laws Governing Sale, Purchase and Use of Urban and Rural Land – Land Revenue Codes – Tax Laws – Income Tax, Sales Tax, Excise, Custom Duties and GST and their Influence on Construction Costs – Legal Requirements for Planning – Property Law – Agency Law – Local Government Laws for Approval – Statutory Regulations.

UNIT V LABOUR REGULATIONS 9

Social Security – Welfare Legislation – Laws relating to Wages, Bonus and Industrial Disputes, Labour Administration – Insurance and Safety Regulations – Workmen's Compensation Act – Indian Factory Act – Tamil Nadu Factory Act – Child Labour Act - Other Labour Laws.

TOTAL: 45 PERIODS

H. Learning Resources:

a) Text Books:

1. Gajaria G.T., Laws Relating to Building and Engineering Contracts in India.
2. Jimmie Hinze, Construction Contracts, McGraw Hill, New Delhi, 2001.

b) References:

1. Kwaku, A., Tenah, P.E., Jose M. Guevara, P.E., Fundamentals of Construction Management and Organisation, Printice Hall, 1985.M.M.Tripathi Private Ltd., Bombay, 1982.
2. Patil. B.S, Civil Engineering Contracts and Estimates, Universities Press (India) Private Limited, 2006.
3. Joseph T. Bockrath, Contracts and the Legal Environment for Engineers and Architects, McGraw Hill, New Delhi, 2000.

1152CE118	PROJECT SAFETY MANAGEMENT	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 importance and process of safety management in a construction project

B. Prerequisite:

- NIL

C. Link to other Courses:

- Nil

D. Course Educational Objectives:

- To learn the importance of safety and its legal implications for a project.
- To understand about safety procedure in a construction project.
- To understand the role of designer and responsibilities of owner in safety aspect.

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

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

F. 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		M
CO2	M					M		M			M	M		M
CO3		M		M		M		M				M		M
CO4		M		M		M					M	M		M
CO5	M	M		M				M			M	H		M

G. 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.

UNIT II SAFETY PROGRAMMES 9

Problem Areas in Construction Safety – Elements of an Effective Safety Programme – Job-Site Safety Assessment – Safety Meetings – Safety Incentives.

UNIT III CONTRACTUAL OBLIGATIONS 9

Safety in Construction Contracts – Substance Abuse – 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

H. Learning Resources:

a) Text Books:

1. Jimmy W. Hinze, Construction Safety, Prentice Hall Inc., 1997.
2. Richard J. Coble, Jimmie Hinze and Theo C.Haupt, Construction Safety and Health Management, Prentice Hall Inc., 2001

b) References:

1. Tamil Nadu Factory Act, Department of Inspectorate of factories, Tamil Nadu. Health Management, Prentice Hall Inc., 2001.

1152CE119	REPAIR AND REHABILITATION OF STRUCTURES	L	T	P	C
		3	0	0	3

Course Category / Type: Programme Elective / Theory

A. Preamble:

Students undergoing this course are expected

- To possess the knowledge of repair and rehabilitation methods of damaged structures.

B. Prerequisite:

- Concrete Technology – 1151CE203

C. Link to other Courses:

- Nil

D. Course Educational Objectives:

- To understand maintenance and assessment of a structures.
- To learn repairing and corrosion protective technique of a structures.
- To understand rehabilitation and retrofitting of structures.

E. 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 maintenance and assessment method of distressed structures	K2
CO2	Understand strength and durability properties, their effects due to climate and temperature	K2
CO3	Learn the recent development in concrete	K2
CO4	Understand the techniques for repair and protection methods	K2
CO5	Understand the repair, rehabilitation and retrofitting of structures	K2

F. 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
CO2	L							M			M	M		M
CO3	L				M			M			M	M		M
CO4	L				M			M			M	M		M
CO5	L				M			M			M	M		M

G. 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.

UNIT II STRENGTH AND DURABILITY OF CONCRETE 9

Quality assurance for concrete – Strength, Durability and Thermal properties of concrete -Cracks, different types, causes – Effects due to climate, temperature, sustained elevated temperature, Corrosion - Effects of cover thickness.

UNIT III SPECIAL CONCRETES 9

Polymer concrete, Sulphur infiltrated concrete, Fibre reinforced concrete, High strength concrete, High performance concrete, Vacuum concrete, Self-compacting concrete, Geopolymer concrete, Reactive powder concrete - Concrete made with industrial wastes.

UNIT IV REPAIRING AND PROTECTION TECHNIQUES 9

Non-destructive Testing techniques, Epoxy injection, Shoring, Underpinning, Corrosion protection techniques – Corrosion inhibitors, Corrosion resistant steels, Coatings to reinforcement, cathodic protection.

UNIT V REHABILITATION AND RETROFITTING OF STRUCTURES 9

Strengthening of Structural elements, Repair of structures distressed due to corrosion, fire, leakage, earthquake – Demolition techniques - Engineered demolition methods – implosion and explosion – Case studies.

TOTAL: 45 PERIODS

H. Learning Resources:

a) Text Books:

1. Denison Campbell, Allen and Harold Roper, Concrete Structures, Materials, Maintenance and Repair, Longman Scientific and Technical, UK, 1991.
2. Allen R.T. & Edwards S.C, Repair of Concrete Structures, Blakie and Sons, UK, 1987

b) References:

1. Shetty M.S., Concrete Technology - Theory and Practice, S.Chand and Company, 2008.
2. Dov Kominetzky M.S., Design and Construction Failures, Galgotia Publications Pvt. Ltd., 2001
3. Ravishankar.K., Krishnamoorthy.T.S, Structural Health Monitoring, Repair and Rehabilitation of Concrete Structures, Allied Publishers, 2004.
4. CPWD and Indian Buildings Congress, Hand book on Seismic Retrofit of Buildings, Narosa Publishers, 2008.
5. Gambhir.M.L., Concrete Technology, McGraw Hill, New Delhi, 2013.

1152CE120	TRAFFIC ENGINEERING AND MANAGEMENT	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 traffic system and its management.

B. Prerequisite:

- NIL

C. Link to other Courses:

- Highway Engineering – 1152CE124

D. Course Educational Objectives:

- To learn traffic system, safety and management with integrated approach in traffic planning.
- To understand control the traffic flow using different traffic signs and systems.
- To understand the traffic management systems and applications.

E. 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 traffic characteristics and planning accordingly.	K2
CO2	Learn the methods of various traffic surveys, interpretation and its application.	K2
CO3	Understand control the traffic flow using different traffic signs and systems.	K2
CO4	Learn compliances of safety and environment and sustainability	K2
CO5	Understand the traffic management systems and applications	K2

F. Correlation of COs with POs:

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

G. Course Content:

UNIT I TRAFFIC PLANNING AND CHARACTERISTICS 9

Road Characteristics – Road user characteristics – PIEV theory – Vehicle – Performance characteristics – Fundamentals of Traffic Flow – Urban Traffic problems in India – Integrated planning of town country, regional and all urban infrastructure towards Sustainable approach. – Land use, transport and modal integration.

UNIT II TRAFFIC SURVEYS 9

Traffic Surveys – Speed, journey time and delay surveys – Vehicles Volume Survey including nonmotorized transports – Methods and interpretation – Origin Destination Survey – Methods and presentation – Parking Survey – Accident analyses -Methods, interpretation and presentation – Statistical applications in traffic studies and traffic forecasting – Level of service – Concept, applications and significance.

UNIT III TRAFFIC DESIGN AND VISUAL AIDS 9

Intersection Design - channelization, Rotary intersection design – Different signs of traffic -Signal design – Coordination of signals –– Grade separation - Traffic signs including VMS and road markings – Significant roles of traffic control personnel - Networking pedestrian facilities & cycle tracks.

UNIT IV TRAFFIC SAFETY AND ENVIRONMENT 9

Road accidents – Causes, effect, prevention, and cost – Street lighting – Traffic and environment hazards – Air and Noise Pollution causes, abatement measures – Promotion and integration of public transportation – Promotion of non-motorized transport.

UNIT V TRAFFIC MANAGEMENT 9

Area Traffic Management System - Traffic System Management (TSM) with IRC standards – Traffic Regulatory Measures-Travel Demand Management (TDM) – Direct and indirect methods – Congestion and parking pricing – All segregation methods- Coordination among different agencies – Intelligent Transport System for traffic management, enforcement and education.

TOTAL: 45 PERIODS

H. Learning Resources:

a) Text Books:

1. Kadiyali.L.R., Traffic Engineering and Transport Planning, Khanna Publishers, Delhi, 2013
2. Salter. R.I and Hounsell N.B, Highway Traffic Analysis and Design, Macmillan Press Ltd.1996.

b) References:

1. Indian Roads Congress (IRC) Specifications Guidelines and Special Publications on Traffic Planning and Management. 2013
2. Fred L. Mannering, Scott S. Washburn and Walter P.Kilareski, Princi.ples of Highway Engineering and Traffic Analysis, Wiley India Pvt. Ltd., New Delhi, 2011
3. Garber and Hoel., Principles of Traffic and Highway Engineering, CENGAGE Learning, New Delhi, 2010
4. SP: 43-1994, IRC Specification., Guidelines on Low-cost Traffic Management Techniques for Urban Areas, 1994
5. John E Tyworth., Traffic Management Planning, Operations and control, Addison Wesly Publishing Company, 1996.
6. Hobbs.F.D., Traffic Planning and Engineering, University of Brimingham, Peragamon Press Ltd, 2005
7. Taylor MAP and Young W, Traffic Analysis - New Technology and New Solutions, Hargreen Publishing Company, 1998.

1152CE121	URBAN TRANSPORTATION POLICY AND PLANNING FOR SUSTAINABLE DEVELOPMENT	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 urban transportation policies and planning for sustainable development.

B. Prerequisite:

- Traffic Engineering and Management – 1152CE120

C. Link to other Courses:

- Transportation Planning – 1152CE123

D. Course Educational Objectives:

- To learn sustainable development in urban and transportation policies.
- To understand the built-in environment, Environment influence in urban planning.
- To learn the concepts of sustainable transportation system and its development.

E. 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 Sustainable Urban and Transport Principles	K2
CO2	Understand the Urban Planning and its Influence in Environment	K2
CO3	Understand the urban built-in Environment	K2
CO4	Understand the Planning of Sustainable transportation	K2
CO5	Understand and apply the transport system and sustainable development	K2

F. Correlation of COs with POs:

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

G. Course Content:

UNIT I SUSTAINABLE URBAN AND TRANSPORT PRINCIPLES 9

Urban Environmental Sustainability, Urban Development, Urban Sustainable Development, Methods and Tools for Sustainable Appraisal, Sustainable Transportation – Principles, indicators and its implications

UNIT II URBAN PLANNING AND ENVIRONMENT 9

Environment and Resources, Sustainability Assessment, Future Scenarios, Form of Urban Region, Managing the change, Integrated Planning, Sustainable Development

UNIT III THE URBAN BUILT-IN ENVIRONMENT 9

Urban Form, Land Use, Compact Development, Principles of street design- complete streets,Transport Integrated Urban land use Planning, Guidelines for environmentally sound transportation.

UNIT IV PLANNING OF SUSTAINABLE TRANSPORTATION 9

Pedestrian – Planning Principles, Tools, Designs, Methods to measure success, Cycles- Planning Principles, Cycle Track Network, Crossings and intersections and junctions, Transit Planning, Road Side Infrastructure Planning

UNIT V TRAVEL AND TRANSPORT 9

Transport and Environment – Equity Principle, Accessibility, Mobility – Roads, Traffic, Public Transport, Business and Goods Traffic, Relationship to land use, Financing and Pricing – Economic Benefits of Sustainable Transportation – Public Private Partnership.

TOTAL: 45 PERIODS

H. Learning Resources:

a) Text Books:

1. Joe Ravetz, City Region 2020 - Integrated Planning for a Sustainable Environment, 2000.
2. George Godwin; Traffic, Transportation and Urban Planning; Pitmen Press, Great Britain, 1981.

b) References:

1. Sustainable Transportation and TDM - Planning the balances, Economic, Social and Ecological
2. UNCHS, Habitat, Cities in a Globalizing world, Global report on Human Settlement, 2001.
3. Tumlin Jeffrey, "Sustainable Transportation Planning- Tools for Creating Vibrant", Healthy and Resilient Communities, John Wiley & Sons, 2012.

1152CE122	TRANSPORTATION INFRASTRUCTURE DESIGN	L	T	P	C
		3	0	0	3

Course Category / Type: Programme Elective / Theory

A. Preamble:

Students undergoing this course are expected

- To design the various infrastructures required for a transportation facility as part of it.

B. Prerequisite:

- NIL

C. Link to other Courses:

- Transportation Planning – 1152CE123

D. Course Educational Objectives:

- To learn the design concepts involve in different intersection design,
- To design parking facilities and the terminals for road and rail.
- To analysis and design of terminal facilities.

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

CO Nos.	Course Outcome	Bloom's Taxonomy level
CO1	Gain knowledge about various elements involved and to apply that in the intersection design.	K2
CO2	Design the grade intersection and its intersection.	K3
CO3	Design the grade separated intersections.	K3
CO4	Understand the parking and its facilities in transportation.	K2
CO5	Understand and design the elements for bus and rail terminals.	K2

F. Correlation of COs with POs:

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

G. Course Content:

UNIT I PRINCIPLES OF INTERSECTION DESIGN 8

Basic considerations – simplicity – uniformity – Maneouvre Elements – Separation of conflict points – Design Elements – Design Speed – Intersection Curves – Super elevation for curves at Intersection – Intersection Sight Distance

UNIT II DESIGN OF AT-GRADE INTERSECTIONS 10

Capacity and LOS, Design of Rotary and Signalised Intersections, Vehicle Actuated Signals, Signal Co-ordination, Area Traffic Control System (ATCS), Pedestrian Planning at Grade Intersections.

UNIT III DESIGN OF GRADE SEPARATED INTERSECTIONS 10

Design of Grade Separators – Principles , Design Criteria – Layout Design, GAD Preparation – Pedestrian Foot Over-bridge and Subway Design – Pedestrian Planning for Grade Separated Intersections.

UNIT IV PARKING FACILITIES 8

Parking – Demand – Characteristics – Space Inventory – Accumulation – Duration – Turn over – Index – Design of Multi Storeyed and Surface Parking facility.

UNIT V DESIGN OF TERMINAL FACILITIES 9

Bus Terminus – Design Principles – Design Elements – Design and Case Studies of Inter Modal Transfer Facilities – Design – Case Studies of Bus and Rail Terminals.

TOTAL: 45 PERIODS

H. Learning Resources:

a) Text Books:

1. Robert F Baker, (Eds) Hand Book of Highway Engineering, Van Nostrand Reinhold Company, New York, 1975.
2. New Jersy, Transportation and Traffic Engineering Hand Book, Institute of Transportation Engineers, Prentice Hall, INC, 1982.
3. Kanna, S.K. and Justo, C.E.G. Highway Engineering, Nemchand and Brothers, Roorkee, 1998.

1152CE123	TRANSPORTATION PLANNING	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 concepts involve in transportation planning such as data collection, trip generation, trip distribution, mode choice and trip assignment.

B. Prerequisite:

- NIL

C. Link to other Courses:

- Transportation Infrastructure Design – 1152CE122

D. Course Educational Objectives:

- To learn the issues of transportation planning and transportation policy.
- To learn travel survey method for understanding travel behavior.

E. 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 issues of transportation planning and policy	K2
CO2	Apply the system simulation modelling to forecasting travel	K2
CO3	Understand the four stages modelling process as applicable for transportation	K2
CO4	Understand the transportation network planning and simulation modeling	K2
CO5	Analyse the concept of land use transport model and multimodal transportation	K2

F. Correlation of COs with POs:

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

G. Course Content:

UNIT I TRANSPORTATION SYSTEM STATUS 9

Status of existing Transportation System – Systems Approach to Transport Planning - Interdependence of the Land use and Traffic – Stages in Transportation Planning – Transport Systems and Planning Considerations.

UNIT II INVENTORIES AND SIMULATION MODELING 9

Concepts of Zoning – Transportation Surveys – Inventory of Transport and other activities – Travel Forecasting Process – Basics of Systems Simulation Modeling - Application in Travel Forecasting – Critical issues in Travel forecasting.

UNIT III FOUR STAGE MODELING PROCESS 9

Conventional and Four Stage Modeling Process – Trip Generation Models – Trip Distribution Models and Calibration – Methods of Trip Assignment Models –Multi Modal Trip Assignment – Mode Choice and Modal Split Models.

UNIT IV ADVANCED TRAVEL FORECASTING 9

Advanced Travel Demand Forecasting Methods - Activity Based Modeling – Comparison of Conventional and Activity Based Modeling – Integration of Systems Simulation Modeling and Transportation Network Planning for Sustainability.

UNIT V LAND USE TRANSPORT MODEL (LUT) 9

Accessibility Measures and Basic Theories – Lowry Derivatives Model- Garin Model –Approach and Simulation Modeling in LUT Model - Multimodal Transportation Planning.

TOTAL: 45 PERIODS

H. Learning Resources:

a) Text Books:

1. John Khisty C, Kent Lall B, Transportation Engineering - An Introduction, 3rd Edition, Prentice Hall of India, New Delhi, 2002.
2. Papacostas C.S., Prevedouros P.D, Transportation Engineering and Planning, 3rd Edition Prentice Hall of India, New Delhi, 2002.

1152CE124	HIGHWAY ENGINEERING	L	T	P	C
		2	2	0	3

Course Category / Type: Programme Elective / Theory

A. Preamble:

Students undergoing this course are expected

- To understand the basics of geometric design and able to design the flexible and rigid pavement.

B. Prerequisite:

- NIL

C. Link to other Courses:

- Pavement Analysis and Design – 1152CE126

D. Course Educational Objectives:

- Understand the concepts behind the Highway component planning
- Learn the materials characteristics in the design of road pavements
- Understand the concepts of road construction procedures and apply it in maintenance methods

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

CO Nos.	Course Outcome	Bloom's Taxonomy level
CO1	Carry out alignment survey using modern methods.	K2
CO2	Design the different geometrical elements of a highway.	K3
CO3	Design flexible and rigid pavements applying IRC provision.	K3
CO4	Adopt modern methods of highway construction.	K2
CO5	Understand the various parameters used for assessing a pavement and its maintenance.	K2

F. Correlation of COs with POs:

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

G. Course Content:

UNIT I HIGHWAY PLANNING AND ALIGNMENT 6+6

Significance of highway planning – Modal limitations towards sustainability - History of road development in India – Classification of highways – Locations and functions – Factors influencing highway alignment – Soil suitability analysis - Road ecology - Engineering surveys for alignment, objectives, conventional and modern methods.

UNIT II GEOMETRIC DESIGN OF HIGHWAYS 6+6

Typical cross sections of Urban and Rural roads –– Cross sectional elements - Sight distances – Horizontal curves, Super elevation, transition curves, widening of curves – Vertical curves - Gradients, Special consideration for hill roads - Hairpin bends – Lateral and vertical clearance at underpasses.

UNIT III DESIGN OF FLEXIBLE AND RIGID PAVEMENTS 6+6

Design principles – pavement components and their role - Design practice for flexible and rigid Pavements (IRC methods only).

UNIT IV HIGHWAY CONSTRUCTION MATERIALS AND PRACTICE 6+6

Highway construction materials, properties, testing methods – CBR Test for subgrade - tests on aggregate & bitumen – Construction practice including modern materials and methods, Bituminous and Concrete road construction, Polymer modified bitumen, Recycling, Different materials – Glass, Fiber, Plastic, Geo-Textiles, Geo-Membrane– Quality control measures - Highway drainage –– Construction machineries.

UNIT V EVALUATION AND MAINTENANCE OF PAVEMENTS 6+6

Pavement distress in flexible and rigid pavements – Pavement Management Systems - Pavement evaluation, roughness, present serviceability index, skid resistance, structural evaluation, evaluation by deflection measurements – Strengthening of pavements- Widening of Roads–Types of maintenance – Highway Project formulation.

TOTAL: 30+30 = 60 PERIODS

H. Learning Resources:

a) Text Books:

1. Khanna. S.K., Justo.C.E.G and Veeraragavan A., Highway Engineering, Nemchand Publishers, 2014.
2. Subramanian K.P., Highways, Railways, Airport and Harbour Engineering, Scitech Publications (India), Chennai, 2010

b) References:

1. Kadiyali.L.R., Principles and Practice of Highway Engineering, Khanna Technical Publications, 8th edition Delhi, 2013.
2. Yang H. Huang., Pavement Analysis and Design, Pearson Education Inc, Nineth Impression, South Asia, 2012
3. Ian D. Walsh, ICE manual of Highway Design and Management, ICE Publishers, Ist Edition, USA, 2011
4. Fred L. Mannering, Scott S. Washburn and Walter P.Kilareski, Principles of Highway Engineering and Traffic Analysis, Wiley India Pvt. Ltd., New Delhi, 2011
5. Garber and Hoel, "Principles of Traffic and Highway Engineering", CENGAGE Learning, New Delhi, 2010.
6. Indian Road Congress (IRC), Guidelines and Special Publications of Planning and Design. 2013.

		L	T	P	C
1152CE125	**INTELLIGENT TRANSPORTATION SYSTEMS**	**3**	**0**	**0**	**3**

Course Category / Type: Programme Elective / Theory

A. Preamble:

Students undergoing this course are expected

- To understand the surface transportation system through various advanced techniques.

B. Prerequisite:

- NIL

C. Link to other Courses:

- Nil

D. Course Educational Objectives:

- To learn the concepts of traveler information system.
- To learn the dynamic analysis for traffic management.

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

CO Nos.	Course Outcome	Bloom's Taxonomy level
CO1	Define advanced traveler information system, electronic toll collection	K1
CO2	Understand the architectures of ITS and its techniques	K2
CO3	Describe the integrated traffic management system	K2
CO4	Analyse the dynamic traffic assignment	K3
CO5	Discuss the concepts of ATIS and its business opportunities	K2

F. Correlation of COs with POs:

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

G. Course Content:

UNIT I INTRODUCTION TO INTELLIGENT TRANSPORT SYSTEM 8

Definition – Role and Responsibilities – Advanced Traveller Information System – Fleet Oriented ITS Services – Electronic Toll Collection – Critical issues – Security – Safety.

UNIT II ITS ARCHITECTURE AND HARDWARE 9

Architecture – ITS Architecture Framework – Hardware Sensors – Vehicle Detection – Techniques – Dynamic Message Sign – GPRS – GPS – Toll Collection.

UNIT III INTERSECTION MANAGEMENT 10

Video Detection – Virtual Loop - Cameras - ANPR – IR Lighting – Integrated Traffic Management – Control Centre – Junction Management Strategies.

UNIT IV ADVANCED TRANSPORT MANAGEMENT SYSTEM 10

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 8

Basic ATIS Concepts – Smart Route System – Data Collection – Process – Dessemination to Travelers – Evaluation of Information – Value of Information – Business Opportunities.

TOTAL: 45 PERIODS

H. Learning Resources:

a) Text Books:

1. Intelligent Transport Systems, Intelligent Transportation Primer, Washington, US, 2001.
2. Henry F.Korth, and Abraham Siberschatz, Data Base System Concepts, McGraw Hill, New Delhi, 1992.

b) References:

1. Turban E, Decision Support and Export Systems Management Support Systems, Maxwell Macmillan, 1998.
2. Sitausu S.Mittra, Decision Support Systems - Tools and Techniques, John Wiley, New York, 1986.
3. Cycle W. Halsapple and Andrew B.Winston, Decision Support Systems - Theory and Application, Springer Verlog, New York, 1987.

1152CE126	PAVEMENT ANALYSIS AND DESIGN	L	T	P	C
		3	0	0	3

Course Category / Type: Programme Elective / Theory

A. Preamble:

Students undergoing this course are expected

- To design the rigid and flexible pavements and its maintenance with suitable materials.

B. Prerequisite:

- NIL

C. Link to other Courses:

- Highway Engineering (1152CE124)

D. Course Educational Objectives:

- To learn the basis of selecting pavement materials
- To understand the design concepts of flexible and rigid pavements
- To apply the concepts and knowledge of pavement failures in road maintenance and to know the various repair options

E. 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 properties of construction materials used in pavement	K2
CO2	Understand the method of pavement constructions	K2
CO3	Design flexible pavements	K3
CO4	Design rigid pavements	K3
CO5	Predict the performance of a pavement and its maintenance	K2

F. Correlation of COs with POs:

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

G. Course Content:

UNIT I PAVEMENT MATERIALS 9

Aggregates- requirements, properties and testing used in granular layers and bituminous layers, concept of size and gradation-design gradation, aggregate blending to meet specification. Cement-grades, chemical composition, testing, admixtures, fibers, properties and testing of pavement quality concrete, high performance concrete. Bitumen and Tar- origin, preparation, properties and chemical constitution of bituminous road binders. Bituminous emulsions and cutback - preparation, characteristics uses and tests, mechanism of stripping, adhesion failure. Bituminous mixes preparation, design and testing.

UNIT II PAVEMENT CONSTRUCTION 9

Subgrade - Significance and functions, evaluation of soil strength, CBR and plate load test, earth work grading, preparation of subgrade, quality control test, subgrade stabilization. Flexible pavements - specification of materials, construction method and field control checks for various types of flexible pavements, super pave concept, new materials like polymer modified bitumen, geo synthetics. Rigid pavements - specification and method of construction, quality control tests, construction of various types of joints.

UNIT III DESIGN OF FLEXIBLE PAVEMENTS 9

Factors affecting design and performance - Stresses and deflection in homogenous masses, Burmister's 2 layer, 3 layer and multi-layer theories , wheel load stresses, ESWL, pavement behavior under transient traffic loads, problems on above. CBR method, principle, advantages and application, testing as per IRC, AASHTO, and asphalt institute, problems on above.

UNIT IV DESIGN OF RIGID PAVEMENTS 9

Factors affecting design and performance, types of stresses, causes and factors affecting stresses, EWL, Westergaard's analysis, Bradbury's coefficient, wheel load stresses, warping- frictional-combined stresses, problems on above. IRC design chart, design of longitudinal, contraction and expansion joints and design of slabs.

UNIT V PAVEMENT EVALUATION AND MAINTENANCE 9

Failures in pavements- methods of measurement of skid resistance, unevenness, ruts and cracks. Pavement surface condition evaluation by physical measurements methods and their application, Calculation of IRI values - maintenance strategies evaluation by non-destructive tests- Benkelman beam method, overlay design. Pavement performance prediction concepts and models, recycling of pavements, pavement serviceability concepts, maintenance measures- short term and long term.

TOTAL : 45 PERIODS

H. Learning Resources:

a) Text Books:

1. Alkins and Harold, "Highway Material", Prentice Hall, Pearson. 2003.
2. Kerbs and Walkes, "Highway Materials", McGraw Hill Book Co. 2007.
3. Specifications for "Road and Bridge works", Fourth Revision, MORT&H (India), 2001.

1152CE127	RAILWAYS, AIRPORT, DOCKS AND HARBOUR ENGINEERING	L	T	P	C
		3	0	0	3

Course Category / Type: Programme Elective / Theory

A. Preamble:

- To understand the concepts of planning of railway, airport and harbour along with design and its components.

B. Prerequisite:

- NIL

C. Link to other Courses:

- NIL

D. Course Educational Objectives:

- To impart knowledge on railway planning, construction and maintenance.
- To impart knowledge on planning and design of an airport.
- To impart the fundamental knowledge on harbor engineering.

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

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Plan and design railway tracks	K2
CO2	Construct and maintain the railways	K2
CO3	Planning of an airport.	K3
CO4	Design an airport	K3
CO5	Plan and design a harbour	K3

F. Correlation of COs with POs:

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

G. Course Content:

UNIT I RAILWAY PLANNING 10

Significance of Road, Rail, Air and Water transports - Coordination of all modes to achieve sustainability - Elements of permanent way – Rails, Sleepers, Ballast, rail fixtures and fastenings, - Track Stress, coning of wheels, creep in rails, defects in rails – Route alignment surveys, conventional and modern methods- - Soil suitability analysis - Geometric design of railways, gradient, super elevation, widening of gauge on curves- Points and Crossings.

UNIT II RAILWAY CONSTRUCTION AND MAINTENANCE 9

Earthwork – Stabilization of track on poor soil –- Tunneling Methods, drainage and ventilation – Calculation of Materials required for track laying - Construction and maintenance of tracks – Modern methods of construction & maintenance - Railway stations and yards and passenger amenities- Urban rail – Infrastructure for Metro, Mono and underground railways.

UNIT III AIRPORT PLANNING 8

Air transport characteristics-airport classification- Airport planning: objectives, components, layout characteristics, socio-economic characteristics of the Catchment area, criteria for airport site election and ICAO stipulations, typical airport layouts, Case studies, parking and circulation area.

UNIT IV AIRPORT DESIGN 8

Runway Design: Orientation, Wind Rose Diagram - Runway length - Problems on basic and Actual Length, Geometric design of runways, Configuration and Pavement Design Principles –Elements of Taxiway Design – Airport Zones – Passenger Facilities and Services – Runway and Taxiway Markings and lighting.

UNIT V HARBOUR ENGINEERING 10

Definition of Basic Terms: Harbour, Port, Satellite Port, Docks, Waves and Tides – Planning and Design of Harbours: Requirements, Classification, Location and Design Principles – Harbour Layout and Terminal Facilities – Coastal Structures: Piers, Break waters, Wharves, Jetties, Quays, Spring Fenders, Dolphins and Floating Landing Stage – Inland Water Transport – Wave action on Coastal Structures and Coastal Protection Works – Environmental concern of Port Operations Coastal Regulation Zone (CRZ), 2011.

TOTAL: 45 PERIODS

H. Learning Resources:

a) Text Books:

1. Saxena Subhash C and Satyapal Arora, "A Course in Railway Engineering", Dhanpat Rai and Sons, Delhi, 2003.
2. Khanna S K, Arora M G and Jain S S, "Airport Planning and Design", Nemchand and Brothers, Roorkee, 2012.
3. Bindra S P, "A Course in Docks and Harbour Engineering", Dhanpat Rai and Sons, New Delhi, 2013.

b) References:

1. Satish Chandra and Agarwal M.M, "Railway Engineering", 2nd Edition, Oxford University Press, New Delhi, 2013.
2. Rangwala, "Railway Engineering", Charotar Publishing House, 2013.
3. Rangwala, "Airport Engineering", Charotar Publishing House, 2013.
4. Rangwala, "Harbor Engineering", Charotar Publishing House, 2013.

1152CE128	WATER QUALITY MODELING	L	T	P	C
		3	0	0	3

Course Category / Type: Programme Elective / Theory

A. Preamble:

- To introduce the mathematical models and the modeling approach to water quality

B. Prerequisite:

- NIL

C. Link to other Courses:

- Environmental Engineering (1151CE206)

D. Course Educational Objectives:

- To gain knowledge on the characteristics and steps in model development and also for water quality models.
- To assess the types of modeling technique and applications of software packages in modeling.

E. 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 concepts of numerical modeling and time series as applied to water quality modeling.	K2
CO2	Understand of water quality processes and their reaction in kinetics	K2
CO3	Learn the basics of modeling stratified lakes, reservoir and passive turbulent diffusion modeling	K2
CO4	Know the basic concepts about groundwater quality modelling.	K2
CO5	Apply and evaluate sensitivity analysis of models using software.	K2

F. Correlation of COs with POs:

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

G. Course Content:

UNIT I MODELING PERCEPTIONS 9

Engineers and Mathematical models-Water quality models – Historical development - Different types of models - Steps in model development - Importance of model building.- Calibration and verification of models- conservation of mass and momentum - Chemical reaction kinetics – Law of mass action, Rate constants, reaction order, types of reactions, equilibrium principles.

UNIT II POLLUTANT TRANSPORT AND REACTOR MODELING 10

Transport phenomena – Advection, diffusion, dispersion- simple transport models – Plug flow models- Application of PFR and MFR model - Steady state and time variable solutions-completely mixed systems, concept and models in Completely Stirred Tank Reactors, mass balance equations, loading types, feed forward vs. feedback reactor systems.

UNIT III SURFACE WATER QUALITY MODELING 10

Water quality modeling of Streams, Lakes and impoundments and Estuaries – Water quality– model sensitivity – assessing model performance; Models for dissolved oxygen, pathogens and BOD - Streeter Phelps model for point and distributed sources - Modified Streeter Phelps equations - Toxicant modeling in flowing water.

UNIT IV GROUNDWATER QUALITY MODELING 8

Groundwater flow and mass transport of solutes, Degradation of organic compounds, application of concepts to predict groundwater contaminant movement, seawater intrusion – basic concepts and modeling

UNIT V WATER QUALITY MODELING SOFTWARE 8

Exposure to surface water and groundwater quality modeling software's – MIKE 21, QUAL2E and MODFLOW Models and their application, Case studies.

TOTAL: 45 PERIODS

H. Learning Resources:

a) Text Books:

1. Steven C. Chapra, “Surface Water Quality Modeling”, Tata McGraw-Hill Companies, Inc., New Delhi, 2008.

2. Water Quality Modelling for Rivers and Streams” Authors: Benedini, Marcello, Tsakiris, George, Springer, Netherlands 2013.

b) References:

1. Zhen-Gang Ji, “Hydrodynamics and Water Quality: Modeling Rivers, Lakes, and Estuaries”, John Wiley & Sons, 2008.

2. Jacob Bear and Alexander H.D. Cheng, “Modeling Groundwater Flow and Contaminant Transport” Springer Science & Business Media, 2010.

3. Ne-Zheng Sun, “Mathematical Modeling of Groundwater Pollution” Springer New York, 2012.

1152CE129	RURAL WATER SUPPLY AND ONSITE SANITATION	L	T	P	C
		3	0	0	3

Course Category / Type: Programme Elective / Theory

A. Preamble:

- To educate the students on the principles of water supply ad sanitation and to develop the recent trends available for waste (solid & liquid) management to the rural areas.

B. Prerequisite:

- Nil

C. Link to other Courses:

- Environmental Engineering (1151CE206)
- Solid waste Management (1152CE136)

D. Course Educational Objectives:

- To gain knowledge on water supply and wastewater conveyance systems for rural areas.
- To impart knowledge about the wastewater treatment and solid waste management facilities suitable for rural scenarios.

E. 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 planning aspects of water supply scheme in rural areas.	K2
CO2	Analyze the various water treatment unit operations and processes.	K2
CO3	Deliver the benchmarks involved in water distribution and waste water management systems.	K2
CO4	Outline the various onsite wastewater options.	K2
CO5	Place their foot print in solid waste disposal techniques.	K2

F. Correlation of COs with POs:

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

G. Course Content:

UNIT 1 PLANNING OF WATER SUPPLY 9

Magnitude of the problem of water supply and sanitation – population to be covered and difficulties National policy - Various approaches for planning of water supply systems in rural areas - Selection and development of preferred sources of water, springs, wells and infiltration galleries, collection of raw water from surface source.

UNIT II WATER SUPPLY AND TREATMENT 9

Specific problem in rural water supply and treatment e.g. iron, manganese, fluorides - Low cost treatment - appropriate technology for water supply and sanitation - Improvised method and compact system of treatment of surface and ground water - MB settlers, slow and rapid sand filter, chlorine diffusion cartridge - Water supply through spot sources, hand pumps, open dug –well.

UNIT III DISTRIBUTION SYSTEM 9

Planning of distribution system in rural areas - Water supply during emergencies - Treatment and disposal of wastewater/sewage - Various method of collection and disposal of night soil.

UNIT IV SANITATION SYSTEM 9

On site sanitation system and community latrines. Simple wastewater treatment system for rural areas and small communities such as stabilization ponds, septic tanks, soakage pits etc., Different privies – Twin pit pour flush toilets, VIP latrines.

UNIT V SOLID WASTE MANGEMENT 9

Disposal of solids waste: composting, land filling. Biogas plants.

TOTAL: 45 PERIODS

H. Learning Resources:

a) Text Books:

1. Sanjay Gupta, “ Rural water supply and Sanitation” vayu education of India, 2012.

b) References:

1. Manual of water supply and treatment, 3rd edition, CPHEEO, GOI, New Delhi. 1999

1152CE130	WATER RESOURCES AND IRRIGATION ENGINEERING	L	T	P	C
		3	0	0	3

Course Category / Type: Programme Elective / Theory

A. Preamble:

- This course deals about the Water Resources and Irrigation Engineering involved in it.

B. Prerequisite:

- Nil

C. Link to other Courses:

- Nil

D. Course Educational Objectives:

- Students undergoing this course are expected to gain knowledge about water resource and irrigation behavior for different conditions.
- Acquire knowledge about the various kinds of water resources and Irrigation Management.
- Impart knowledge about the Water Resource Management.

E. 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 demand for Water Requirements for Irrigation and Drinking	K2
CO2	Understand the Conjunctive use of surface and groundwater	K2
CO3	Know the need for irrigation and crop water management.	K2
CO4	Gain knowledge on impounding structures by knowing canal irrigation	K2
CO5	Understand methods of irrigation with an eye on its management concepts	K2

F. Correlation of COs with POs:

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

G. Course Content:

UNIT I WATER RESOURCES 9

Water resources survey – Water resources of India and Tamil Nadu – Description of water resources planning – Estimation of water requirements for irrigation and drinking- Single and multipurpose reservoir – Fixation of Storage capacity -Strategies for reservoir operation - Design flood-levees and flood walls.

UNIT II WATER RESOURCE MANAGEMENT 9

Economics of water resources planning – National Water Policy – Consumptive and non-consumptive water use - Water quality – Scope and aims of master plan - Concept of basin as a unit for development - Water budget- Conjunctive use of surface and ground water

UNIT III IRRIGATION ENGINEERING 9

Need – Merits and Demerits – Duty, Delta and Base period – Irrigation efficiencies – Crops and Seasons - Crop water Requirement.

UNIT IV CANAL IRRIGATION 9

Types of impounding structures: Gravity dam – Diversion Head works - Canal drop – Cross drainage works – Canal regulations – Canal outlets – Canal lining - Kennedy's and Lacey's Regime theory

UNIT V IRRIGATION METHODS AND MANAGEMENT 9

Lift irrigation – Tank irrigation – Well irrigation – Irrigation methods: Surface and Sub-Surface and Micro Irrigation - Merits and demerits – Irrigation scheduling – Water distribution – Participatory irrigation management with a case study

TOTAL: 45 PERIODS

H. Learning Resources:

a) Text Books:

1. Linsley R.K. and Franzini J.B, "Water Resources Engineering", McGraw-Hill, 2000.
2. Punmia B.C., "Irrigation and Water Power Engineering", Laxmi Publications, 16th Edition, New Delhi, 2009.
3. Garg S. K., "Irrigation Engineering and Hydraulic structures", Khanna Publishers, 23rd Revised Edition, New Delhi, 2009.

b) References:

1. Duggal, K.N. and Soni, J.P., "Elements of Water Resources Engineering", New Age International Publishers, 2005.
2. Chaturvedi M.C., "Water Resources Systems Planning and Management", Tata McGraw-Hill Inc., New Delhi, 1997.

3. Michael A.M., Irrigation Theory and Practice, 2nd Edition, Vikas Publishing House Pvt. Ltd., Noida, UP, 2008.
4. Dilip Kumar Majumdar, “Irrigation Water Management”, Prentice-Hall of India, New Delhi, 2008.
5. Asawa, G.L., “Irrigation Engineering”, New Age International Publishers, New Delhi, 2000.

1152CE131	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:

- Environmental Engineering (1151CE206)

D. Course Educational Objectives:

- Students undergoing this course are expected to gain knowledge on types of air pollutants and their behavior.
- To understand the legislative measures and concepts of noise pollution.

E. 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	Understand the plume behaviour for different atmospheric stability conditions.	K2
CO3	Understand the controlling methods involved and its design concepts to avert air pollution	K2
CO4	Study and understand the legislative measures and environmental impact assessment guidelines related to air pollution	K2
CO5	Understand the basic concepts of noise pollution and its various branches.	K2

F. Correlation of COs with POs:

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

G. 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 DISPERSION OF POLLUTANTS 9

Elements of atmosphere – Meteorological factors – Wind roses – Lapse rate - Atmospheric stability and turbulence – Plume rise – Dispersion of pollutants – Dispersion models – Applications-Ambient and stack sampling

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, condensation, combustion – Pollution control for specific major industries. 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 Kanpur city.

TOTAL: 45 PERIODS

H. Learning Resources:

a) Text Books:

1. Anjaneyulu, D., “Air Pollution and Control Technologies”, Allied Publishers, Mumbai, 2002.
2. Rao, C.S. Environmental Pollution Control Engineering, Wiley Eastern Ltd., New Delhi, 1996.
3. Rao M.N., and Rao H. V. N., Air Pollution Control, Tata McGraw Hill, New Delhi, 1996.

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, 1991.
3. Peavy S.W., Rowe D.R. and Tchobanoglous G. "Environmental Engineering", McGraw Hill, New Delhi, 1985.
4. Garg, S.K., "Environmental Engineering Vol. II", Khanna Publishers, New Delhi, 1998
5. Thod Godesh, "Air Quality, Lewis India Edition, 2013.

c) Online Resources:

1. http://www.indiaenvironmentportal.org.in.
2. http://www.ncbi.nlm.nih.gov
3. http://www.theicct.org
4. www.mdpi.com

1152CE132	HYDROLOGY	L	T	P	C
		3	0	0	3

Course Category / Type: Programme Elective / Theory

A. Preamble:

- This course deals about the Precipitation, Infiltration, Floods and Ground water Hydrology involved in it.

B. Prerequisite:

- Nil

C. Course Educational Objectives:

- Students undergoing this course are expected to gain knowledge about Precipitation, Infiltration, Floods and Ground water Hydrology behavior for different conditions.
- Acquire knowledge about the various kinds of Hydrological Cycle and Hydrology.
- Impart knowledge about the Surface Water and Ground Water.

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	Estimate the Direct Measurement of Evapotranspiration.	K2
CO3	Demonstrate the concept of infiltration and Hydrograph.	K3
CO4	Enumerate the various methods of Flood Routing.	K3
CO5	Inherit 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				L									
CO2														
CO3				H										
CO4	M	L		M										
CO5					M									

F. Course Content:

UNIT I PRECIPITATION 9

Introduction to hydrological cycle – Types of precipitation – Forms of precipitation – Measurement of Rainfall – Spatial measurement methods – Temporal measurement methods – Frequency analysis of point rainfall – Intensity, duration and frequency relationship – Probable maximum precipitation.

UNIT II PRECIPITATION LOSSES, EVAPOTRANSPIRATION 9

Losses from precipitation – Factors affecting evaporation – Estimating evaporation: energy balance methods, mass transfer methods, water budget methods, evaporation pan methods – Evaporation control – Potential evapotranspiration.

UNIT III INFILTRATION AND STREAM FLOW 9

Infiltration – Infiltration models – Infiltration capacity – Measurement of infiltration – Infiltration indices – SCS curve – Antecedent moisture conditions – Streamflow 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 GROUND WATER HYDROLOGY 9

Types of aquifers – Darcy's law – Dupuit's assumptions – Confined Aquifer – Unconfined Aquifer – Recuperation test – Transmissibility – Specific capacity – 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.

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. Jayarami Reddy .P. Hydrology, Tata McGraw Hill, 2008.

4. Madan Mohan Das and Mimi Das Saikia, Hydrology, Prentice Hall of India, 2013.

1152CE133	ENVIRONMENTAL IMPACT ASSESSMENT	L	T	P	C
		3	0	0	3

Course Category / Type: Programme Elective / Theory

A. Preamble:

- Highlights concepts and important definitions of EIA and the planning and management of EIA study.

B. Prerequisite:

- NIL

C. Link to other Courses:

- Environmental Engineering (1151CE206)

D. Course Educational Objectives:

- To expose to the need, methodology, documentation and usefulness of environmental impact assessment and to develop the skill to prepare environmental management plan.
- To provide knowledge related to the broad field of environmental risk assessment, important processes that control contaminant transport and tools that can be used in predicting and managing human health risks.

E. 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 concepts of EIA.	K2
CO2	Identify methodology and prepare EIA reports.	K2
CO3	Assess the impact on land, air, and water and Socio-Economic environment.	K2
CO4	Mitigate the adverse environment impacts.	K2
CO5	Have a detailed view on the case studies with respect to various types of Civil Engineering projects.	K2

F. 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			M									
CO3					M		M							
CO4					L						M			
CO5							M					L		

G. Course Content:

UNIT I INTRODUCTION 8

Impact of development projects – Sustainable development- Need for Environmental Impact Assessment (EIA) - Environmental Impact Statement (EIS) – EIA capability and limitations – Legal provisions on EIA-Stages of EIA, Types of EIA.

UNIT II METHODOLOGIES 9

Methods of EIA – Check lists – Matrices – Networks – Cost-benefit analysis – Analysis of alternatives.

UNIT III PREDICTION AND ASSESSMENT 9

Assessment of Impact on land, water, air, social & cultural activities and on flora & fauna-Mathematical models- Public participation.

UNIT IV ENVIRONMENTAL MANAGEMENT PLAN 9

Plan for mitigation of adverse impact on environment – Options for mitigation of impact on water, air, land and on flora & fauna - Addressing the people's issues related to the project - Post project monitoring.

UNIT V CASE STUDIES 10

Interlinking of rivers project – Hydrocarbon extraction project – Neutrino Observatory Project.

TOTAL: 45 PERIODS

H. Learning Resources:

a) Text Books:

1. Canter, R.L., "Environmental Impact Assessment", McGraw Hill Inc., New Delhi, 2003.
2. Shukla, S.K. and Srivastava, P.R., "Concepts in Environmental Impact Analysis", Common Wealth Publishers, New Delhi, 2007.

b) References:

1. John G. Rau and David C Hooten (Ed)., "Environmental Impact Analysis Handbook", McGraw Hill, 2000.
2. "Environmental Assessment Source book", Vol. I, II & III. The World Bank, Washington, D.C., -2002.
3. Judith Petts, "Handbook of Environmental Impact Assessment Vol. I & II", Blackwell Science, 2005.

1152CE134	ENVIRONMENTAL NANOTECHNOLOGY	L	T	P	C
		3	0	0	3

Course Category / Type: Programme Elective / Theory

A. Preamble:

To develop an understanding in the creation and use of materials through the control of matter on the nanometer length scale- at the level of atoms, molecules, and supramolecular structures. The essence of nanotechnology is the ability to work at these levels to generate larger structures with fundamentally new properties and molecular organization. Further shifting the verticals an essence of environmental protection by triggering the nano route and its legal implications will be synced.

B. Prerequisite:

- NIL

C. Link to other Courses:

- Environmental Engineering (1151CE206)

D. Course Educational Objectives:

- Students will be able to understand the importance and applications of nanoparticles' and nanomaterial's application in the field of environmental engineering.

E. 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 overview of Nanotechnology.	K2
CO2	Compare the different Nanoparticle synthesis and characterization methods	K3
CO3	Illustrate the existence of Nanoparticles in the environment.	K3
CO4	Explain the fate and behaviour of Nanoparticles in the aquatic environment.	K2
CO5	Illustrate the investigations on Environmental Toxicology	K2

F. Correlation of COs with POs:

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

G. Course Content:

UNIT I NANOTECHNOLOGY AND ENVIRONMENT 9

Introduction-The canvas of Nano - Nano and nature - Recent technologies and the world we live in – Nano-the beginning Investigating and manipulating materials in the nanoscale-Fullerenes-Carbon nanotubes.

UNIT II SYNTHESIS AND CHARACTERIZATION 9

Top-down and bottom-up approach methods – chemical co-precipitation-sol-gel method-Chemical vapour deposition method-–ball mill method- Characterization-X-RAY diffraction, -scanning electron microscope-Transmission electron microscope -BET Surface area analyzer –FTIR

UNIT III NANOPARTICLES BEHAVIOUR IN ENVIRONMENT 9

Physico chemical interactions-Aggregation- deposition-nanoparticle behaviour in heterogeneous systems - airborne nanoparticles- Ground water remediation-Introduction- Reactivity, fate and life time-delivery and transport issues-Targeting-Summary and research needs.

UNIT IV NANOPARTICLES IN AQUATIC CLEAN UP 9

Overview of membrane process-Transport principles for membrane processes- Membrane fabrication using nanomaterials-Nanoparticle membrane reactors- Active membrane systems-Nanomaterials as adsorbents-Introduction-Adsorption at the oxide nanoparticles/solution interface-Nanomaterial-based adsorbents for water and wastewater treatment.

UNIT V TOXICOLOGICAL IMPACTS OF NANOMATERIALS 9

Effects of nanomaterials in microorganisms - Complications in screening assays using carbon based materials-Exposure and risk assessment-Environment impact-life cycle impacts and sustainability-Risk assessment from an insurance industry perspective-Knowledge gaps in the life cycle Assessment of nanomaterials risks.

TOTAL: 45 PERIODS

H. Learning Resources:

a) Text Books:

1. Mark R. Weisner, Jean-Yves Bottero, “Environmental Nanotechnology-Applications and Impacts of Nanomaterials” McGraw Hill. 2007.
2. Pradeep T, “NANO: The Essentials: Understanding Nanoscience and Nanotechnology”, McGraw Hill. 2007.
3. Vineet Kumar, Nandita Dasgupta, Shivendu Ranjan, “Environmental Toxicity of Nanomaterials” CRC Press, Taylor & Francis Group. 2018.
4. M.H.Fulekar, Bhawana Pathak “Environmental Nanotechnology” CRC Press, Taylor & Francis Group. 2017.

1152CE135	RESOURCE AND ENERGY RECOVERY FROM WASTE	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 principles and design of recovering materials and energy from wastes through mechanical, biological and thermal methods and manage the undesirable by-products

B. Prerequisite:

- NIL

C. Link to other Courses:

- Environmental Engineering (1151CE206)
- Solid waste management (1151CE136)

D. Course Educational Objectives:

- After undergoing the course the students will be able to understand the principles and methods of various resources and energy recovery from waste.

E. 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 processes of resource recovery method from various sources of waste.	K2
CO2	Learn about energy plants where biomasses and organic wastes are used.	K2
CO3	Assess the biological reactions and resources recovery under actual conditions for microbial biomass yield.	K2
CO4	Understand the Principles and Design of Energy Recovery Facilities by thermo-chemical conversion process.	K2
CO5	Categorize the various waste recycling by learning pollution prevention, reduction of waste, recycling and reuse of materials and energy.	K2

F. Correlation of COs with POs:

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

G. Course Content:

UNIT I MECHANICAL PROCESSING FOR MATERIAL RECYCLING 9

Resource recovery for a sustainable development- Material and energy flow management and analysis - Systems and processes for reduction, reuse and recycling - Objectives of waste processing - Source segregation and hand Sorting - waste storage and conveyance – Shredding – Pulping - Size separation by screens.

UNIT II BIOLOGICAL PROCESSING FOR RESOURCE RECOVERY 9

Mechanisms of biological processing – Aerobic processing of organic fraction - Composting methods and processes- factors affecting- Design of windrow composting systems - In Vessel Composting - Compost quality control - Vermiculture: definition, scope and importance - Environmental requirements - Culture methods - Applications of vermiculture.

UNIT III BIO-CHEMICAL CONVERSION OF WASTE TO ENERGY 9

Principles and Design of Anaerobic Digesters – Process characterization and control **-** Biochemistry and microbiology of anaerobic treatment - Toxic substances in anaerobic treatment - Methane generation by anaerobic digestion- Single stage and multistage digesters- Digester design and performance-Gas collection systems.

UNIT IV THERMO-CHEMICAL CONVERSION OF WASTE TO ENERGY 9

Principles and Design of Energy Recovery Facilities -Types and principles of energy conversion processes - Incinerator design - Mass burn and RDF Systems- Composition and calorific value of fuels and waste, Determination of the stoichiometric air consumption, Calculation of the flue gas composition - grate firing designs, boiler design, removal of bottom ash, heat recovery- Emission Controls – flue gas cleaning, de-dusting, flue gas scrubbers, DeNOx processes, dioxins and furans – Pyrolysis process-Alterative process

UNIT V CASE STUDIES ON WASTE RECYCLING 9

Recycling technologies for paper, glass, metal, plastic – Used lead acid battery recycling –– Electronic Waste Recycling – Waste Oil Recycling – Solvent recovery -Environmental impacts of waste recycling-DFE.

TOTAL: 45 PERIODS

H. Learning Resources:

a) Text Books:

1. Aarne Veslind and Alan E Rimer, "Unit operations in Resource Recovery Engineering" , Prentice Hall Inc., London. 1981.
2. Charles R Rhyner, "Waste Management and Resource Recovery", Lewis Publishers. 1995.

b) References:

1. Manser A.G.R and Keeling A.A., "Practical handbook of processing and recycling on municipal waste", Pub CRC Lewis London, ISBN 1-56670-164, 1996.
2. Chiumenti, Chiumenti, Diaz, Savage, Eggerth, and Goldstein, "Modern Composting Technologies", JG Press. October 2005.
3. Gary C. Young, "Municipal Solid Waste to Energy Conversion Processes: Economic, Technical, and Renewable Comparisons", John Wiley & Sons, 2010.

1152CE136	SOLID WASTE MANAGEMENT	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 principles of integrated waste management practices for a given community regarding types of waste, on-site, off-site collection and disposal of municipal waste streams.

B. Prerequisite:

- NIL

C. Link to other Courses:

- NIL

D. Course Educational Objectives:

Students undergoing this course are expected to:

- Understand the different types and various sources of solid waste in a community.
- Outline the on-site and off-site waste processing and their significances.
- Illustrate the different waste disposal options for processed and unprocessed solid waste.

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

CO	STATEMENT	K LEVEL
CO1	Deliver a snapshot in Solid waste management.	K2
CO2	Understand the on-site waste segregation.	K2
CO3	Demonstrate the waste collection routes and methods.	K2
CO4	Understand the off-site processing of solid waste.	K2
CO5	Summarize the disposal methods of solid waste.	K2

F. 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							
CO3						M	M							
CO4						M	L							
CO5						M	M	L						

G. Course Content:

UNIT I SOURCES AND TYPES 8

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 ON-SITE STORAGE AND PROCESSING 8

On-site storage methods – Effect of storage, materials used for containers – Segregation of solid wastes – Public health and economic aspects of open storage – Waste segregation and storage – Case studies under Indian conditions – Source reduction of waste – Reduction, reuse and recycling.

UNIT III COLLECTION AND TRANSFER 8

Methods of residential and commercial waste collection – Collection vehicles – Manpower– Collection routes – Analysis of collection systems; Transfer stations – Selection of location, operation & maintenance; options under Indian conditions – Field problem solving.

UNIT IV OFF-SITE PROCESSING 12

Objectives of waste processing – Physical processing techniques and equipment; Resource recovery from solid waste composting and biomethanation - Thermal processing options – Case studies under Indian conditions.

UNIT V DISPOSAL 9

Land disposal of solid waste; Sanitary landfills – Site selection, design and operation of sanitary landfills – Landfill liners – Management of leachate and landfill gas - Landfill bioreactor – Dumpsite rehabilitation.

TOTAL: 45 PERIODS

H. 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.

b) References:

1. Government of India, "Manual on Municipal Solid Waste Management", CPHEEO, Ministry of Urban Development, New Delhi, 2000.

2. Bhide A.D. and Sundaresan, B.B. "Solid Waste Management Collection", Processing and Disposal, 2001.
3. Manser A.G.R. and 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.

1152CE137	SURVEYING – II	L	T	P	C
		3	0	0	3

Course Category / Type: Programme Elective / Theory

A. Preamble:

- Students undergoing this course are expected to get exposed with plane and geodetic surveying.

B. Prerequisite:

- Surveying – I (1151CE114)

C. Link to other Courses:

- Survey Practical – II (1152CE301)
- Survey Camp (1151CE303)

D. Course Educational Objectives:

- To make the students to understand the plane and geodetic surveying with latest instruments like total station and GPS.

E. 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 methods and systems of control surveying and their applications.	K3
CO2	Apply the knowledge of mathematical methods into adjusting the errors in surveying observations.	K3
CO3	Understand the working principle, functions and operations of Total station.	K2
CO4	Get exposure to the application of GPS into the field of surveying.	K2
CO5	Apply the surveying knowledge to construct the various transportation modes and to understand celestial objects direction.	K3

F. Correlation of COs with POs:

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

G. Course Content:

UNIT I CONTROL SURVEYING 9

Horizontal and vertical control – Methods – specifications – triangulation- baseline – instruments and accessories – corrections – satellite stations – reduction to centre – traversing – Gale's table.

UNIT II SURVEY ADJUSTMENT 9

Errors Sources- precautions and corrections – classification of errors – true and most probable values- weighed observations – method of equal shifts –principle of least squares -normal equation – correlates- level nets- adjustment of simple triangulation networks.

UNIT III TOTAL STATION SURVEYING 9

Basic Principle – Classifications -Electro-optical system: Measuring principle, Working principle, Sources of Error, Infrared and Laser Total Station instruments. Microwave system: Measuring principle, working principle, Sources of Error, Microwave Total Station instruments. Comparison between Electro-optical and Microwave system. Care and maintenance of Total Station instruments.

UNIT IV GPS SURVEYING 9

Basic Concepts - 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.

UNIT V ADVANCED TOPICS IN SURVEYING 9

Route Surveying - Reconnaissance - Route surveys for highways, railways and waterways -– Sight distances - Hydrographic surveying – Tides - MSL – Field observations and determination of Azimuth by altitude and hour angle methods.

TOTAL: 45 PERIODS

H. Learning Resources:

a) Text Books:

1. Punmia. B.C., Ashok Kumar Jain., and Arun Kumar Jain., "Surveying", (Vol - 1&2), 18th Edition by Laxmi Publications Pvt. Ltd., New Delhi, 2011.
2. Satheesh Gopi, Rasathishkumar, N. Madhu, "Advanced Surveying, Total Station GPS and Remote Sensing" Pearson education, 2007.

b) References:

1. Punmia. B.C., Ashok Kumar Jain., and Arun Kumar Jain., "Surveying", Vol III, Laxmi Publications Pvt. Ltd. 2015.
2. James M. Anderson and Edward M. Mikhail, "Surveying", Theory and Practice", 7th Edition, McGraw Hill. 2001.
3. Bannister and S. Raymond, "Surveying", 7th Edition, Longman. 2004.

1152CE138	REMOTE SENSING AND GIS	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 basic concept of remote sensing and applications of Geographical Information System in civil engineering.

B. Prerequisite:

- NIL

C. Link to other Courses:

- Nil

D. Course Educational Objectives:

Students undergoing this course are expected to

- Understand the basic remote sensing concepts and its characteristics.
- Analyze and interpret using GIS in different civil engineering projects.

E. 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 concept of Remote Sensing	K2
CO2	Understand the different sensors and satellites characteristics	K2
CO3	Understand the image rectification, analysis and classification of satellite data through digital image processing techniques.	K2
CO4	Understand the fundamentals of GIS and Data Base Management Systems in GIS.	K2
CO5	Understand the application of remote sensing and GIS in various civil engineering fields.	K2

F. Correlation of COs with POs:

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

G. Course Content:

UNIT I EMR AND ITS INTERACTION WITH ATMOSPHERE & EARTH MATERIAL 9

Definition of remote sensing and its components – Electromagnetic spectrum – wavelength regions important to remote sensing – Wave theory, Particle theory, Stefan-Boltzman and Wein's Displacement Law – Atmospheric scattering, absorption – Atmospheric windows – spectral signature concepts – Typical spectral reflective characteristics of water, vegetation and soil.

UNIT II PLATFORMS AND SENSORS 9

Types of platforms – orbit types, Sun-synchronous and Geosynchronous – Passive and Active sensors – resolution concept – Pay load description of important Earth Resources and Meteorological satellites – Airborne and space borne TIR and microwave sensors.

UNIT III IMAGE INTERPRETATION AND ANALYSIS 9

Types of Data Products – types of image interpretation – basic elements of image interpretation - visual interpretation keys – Digital Image Processing – Pre-processing – image enhancement techniques – multispectral image classification – Supervised and unsupervised.

UNIT IV GEOGRAPHIC INFORMATION SYSTEM 9

Introduction – Maps – Definitions – Map projections – types of map projections – map analysis – GIS definition – basic components of GIS – standard GIS softwares – Data type – digitization and scanning, Spatial and non-spatial (attribute) data– Data Base Management Systems (DBMS).

UNIT V APPLICATIONS 9

Merits and demerits of remote sensing – Application of remote sensing and GIS in the following fields; Surveying, Water resources, Geological Mapping, Route Locations – Site selection for major civil engineering projects – Disaster mitigation studies – Coastal zone management.

TOTAL: 45 PERIODS

H. Learning Resources:

a) Text Books:

1. Lillesand,T., Kiefer, R.W. and Chipman J., Remote Sensing and Image Interpretation 7th Edition., John Willey and Sons Asia Pvt. Ltd., New Delhi, 2015.
2. Anji Reddy, M., Textbook of Remote Sensing and Geographical Information System 2nd edition. BS Publications, Hyderabad, 2001.

b) References:

1. Lo C. P and Yeung A.K.W., Concepts and Techniques of Geographic Information Systems, Prentice Hall of India Pvt. Ltd., New Delhi. Second Edition, 2006.
2. Burrough P A., McDonnell R A and Lloyd C D, Principles of Geographic Information Systems, Oxford University Press, Third Edition, 2015.

1152CE139	URBAN PLANNING	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 concepts of urban planning and development.

B. Prerequisite:

- NIL

C. Link to other Courses:

- NIL

D. Course Educational Objectives:

- To impart knowledge on urban planning and its formulation.
- To learn the concept of analysis and design of urban planning.

E. 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 urban planning and development	K2
CO2	Establish of urban modern and redevelopment	K2
CO3	Design urban planning practices and process	K3
CO4	Justify the functions of city and urban development and management system	K2
CO5	Analyse urban planning system	K2

F. Correlation of COs with POs:

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

G. Course Content:

UNIT I URBAN PLANNING 9

Overview of urban planning and town planning – conceptualization of smart cities- scope and objectives of urban design – urban sustainable development – urban environmental sustainability, methods and tools for sustainable transportation.

UNIT II PLANS AND FORMULATION 9

Ancient and modern planning-industrial contribution to modern planning-stages, types of survey, collection of data-objects and principles of zoning-role of density and floor space index- Industrial areas, Parks and play grounds, schools-Master plan. Urban renewal - Conservation, re-establishment and redevelopment - Slum clearance.

UNIT III DESIGN PRACTICE 9

Contemporary case studies from developing and developed economies that offer design guidelines and solutions to address various issues of urban space – Case studies -Various types of plans - Master plan, Structure plan, Comprehensive plan, subject plan, Zonal Development plan- their scope and content, planning process.

UNIT IV SUSTAINABLE DEVELOPMENTS AND MANAGEMENT SYSTEM 9

Design and core infrastructure elements in smart cities – e-governance and waste management - water management and energy management – Urban ecosystem - Selection of location – Infrastructure for economic growth - Bye laws regulations & urban design relationship - Influence of growth and change on forms & functions of city and its impact on the urban design.

UNIT V ANALYSIS OF URBAN PLANNING 9

Urban planning analysis - impact assessment study - Project formulation and land suitability analysis - Report on smart cities – smart solutions - Case studies.

TOTAL: 45 PERIODS

H. Learning Resources:

a) Text Books:

1. Goel S.L Urban,”Development and Management”, Deep and Deep publications, New Delhi,2002.
2. Singh V.B, “Revitalized Urban Administration in India”, Kalpaz publication, New Delhi 2001.

b) References:

1. CMDA, “Second Master Plan for Chennai Metropolitan Area, 2026”, CMDA, Chennai. 2008.
2. Joe Ravetz, “City Region 2020, Integrated Planning for a Sustainable Environment”, Emerald Group Publishing Limited. 2000.
3. Sustainable Transportation and TDM Planning the balances, “Economic, Social and Ecological objectives”, Victoria Transport Policy Institute. 2007.

1152CE140	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

- To understand the response of soil during earthquakes.

B. Prerequisite:

- Geotechnical Engineering – II – (1152CE116)

C. Link to other Courses:

- Basics of Dynamics and Aseismic Design of Structures

D. Course Educational Objectives:

- To understand the behaviour of soil and structures under dynamic, earthquake loading and design the structures as earthquake resistant as per codal provisions.

E. 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 concept of earthquake loading and its effects.	K2
CO2	Understand the basics of vibration and mathematical models.	K2
CO3	Understand plate tectonics, theory and engineering seismology.	K2
CO4	Understand the various parameters of associated with earthquakes.	K2
CO5	Understand the concept of wave propagation in layered media.	K2

F. Correlation of COs with POs:

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

G. 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 epicentre.

TOTAL: 45 PERIODS

H. Learning Resources:

a) Text Books:

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

b) References:

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

1152CE141	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:

- Geotechnical Engineering- II – (1151CE116)

C. Link to other Courses:

- **NIL**

D. Course Educational Objectives:

- On completion of the course the students will be able to design foundation for complex conditions.

E. 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.	K2
CO2	Analyse the load carrying capacity of single pile and pile group.	K3
CO3	Understand the concepts of well foundation and its design.	K2
CO4	Design various types of retaining walls.	K3
CO5	Understand the design concepts of foundations resting on reinforced soil.	K2

F. Correlation of COs with POs:

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

G. Course Content:

UNIT I SHALLOW FOUNDATION 9

Methods for bearing capacity estimation - Total and differential settlements of footing and raft - Code provisions - 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) - Settlement of pile foundation - Code provisions - Design of single pile and pile groups - pile caps.

UNIT III WELL FOUNDATION 9

Types – Components - Construction methods - Design methods (Terzaghi, IS and IRC approaches) - Check for stability - Base pressure - side pressure and deflection.

UNIT IV RETAINING WALL 9

Types (types of flexible and rigid earth retention systems: counterfort, gravity, diaphragm walls, sheet pile walls, soldier piles and lagging). 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.

UNITV REINFORCED EARTH 9

Geotechnical properties of reinforced soil - Shallow foundation on soil with reinforcement - Retaining walls with reinforcements - Design considerations.

TOTAL: 45 PERIODS

H. 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. 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.

1152CE142	ENGINEERING GEOLOGY	L	T	P	C
		2	0	0	2

Course Category / Type: Programme Elective / Theory

A. Preamble:

Students undergoing this course are expected

- To understand the geologic processes that influence civil engineering works and acquire knowledge about the properties of rocks and minerals and to developing the ability to identify them.

B. Prerequisite:

- NIL

C. Link to other Courses:

- Nil

D. Course Educational Objectives:

- After undergoing the course the students will be able to understand the geological process and structures used to deal the adequate structures for civil engineering works.

E. 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 geomorphological process and interior of the earth	K2
CO2	Understand the description, occurrence and properties of minerals	K2
CO3	Understand the description, occurrence and properties of rocks	K2
CO4	Understand the geological structures and subsurface investigation through geophysical methods	K2
CO5	Understand the geological conditions for construction of civil engineering projects.	K2

F. Correlation of COs with POs:

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

G. Course Content:

UNIT I GENERAL GEOLOGY 6

Introduction: Various 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.

UNIT II MINERALOGY 6

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 6

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 breccias, Metamorphic rocks-Quartzite, Marble, Gneiss and Schist.

UNIT IV STRUCTURAL GEOLOGY AND GEOPHYSICAL METHOD 6

Definition-outcrop-stratification-dip and strike, Folds-definition- parts of fold-classification-relevance to civil engineering, Faults-definition-parts of a fault-classification- relevance to civil engineering - Joints-definition- classification, Geophysical methods – Seismic and electrical methods for subsurface investigations.

UNIT V GEOLOGICAL INVESTIGATIONS IN CIVIL ENGINEERING 6

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, Reservoirs - Coastal protection structures. Landslide - types, causes and mitigation.

TOTAL: 30 PERIODS

H. Learning Resources:

a) Text Books:

1. Parbin Singh, "Engineering and General Geology", S. K. Kataria & Sons, New Delhi, 2009.
2. Dimitri P Krynine and William R. Judd, "Principles of Engineering Geology and Geotechnique", McGraw-Hill Book Company, New Delhi, 2005.

b) References:

1. Robert Ferguson Legget and Allen W. Hatheway, “Geology and Engineering”, McGraw-Hill Book Company, New Delhi, 1998
2. Blyth F.G.H and Michael de Freitas, “Geology for Engineers”, ELBS, Mumbai 2006.

c) Online Resources:

1. https://nptel.ac.in/courses/105105106/
2. https://onlinecourses.nptel.ac.in/noc16_ce01/preview

1152CE143	CONSTRUCTION EQUIPMENTS AND MANAGEMENT	L	T	P	C
		3	0	0	3

Course Category / Type: Programme Elective / Theory

A. Preamble:

Students undergoing this course are expected

- To know various types of equipments to be used in construction projects.

B. Prerequisite:

- Construction materials and techniques – (1151CE113)

C. Link to other Courses:

- NIL

D. Course Educational Objectives:

To study and understand the various types of equipment's used for earthwork, tunnelling, drilling, blasting, dewatering, material handling conveyors and its applications in construction projects.

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

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Manage the equipment, cost control and maintenance of a project	K2
CO2	Identify and understand the working principle of earthwork equipments	K2
CO3	Identify and understand the working principle of various equipment's for different construction process	K2
CO4	Understand the working of aggregate production and concreting equipments	K2
CO5	Identify the working principle of material handling equipments	K2

F. 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
CO2					M	M						M		M
CO3					M	M						M		M
CO4					M	M						M		M
CO5					M	M						M		M

G. Course Content:

UNIT I CONSTRUCTION EQUIPMENTS AND 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

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 OTHER CONSTRUCTION EQUIPMENT 9

Equipment for Dredging, Trenching, Drag line and clamshells, Tunnelling – Equipment for Drilling and Blasting - Pile driving Equipment - Erection Equipment - Crane, Mobile crane - Types of pumps used in Construction - Equipment for Dewatering and Grouting – Equipment for Demolition.

UNIT IV ASPHALT AND 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. Asphalt Plant, Asphalt Pavers, Asphalt compacting Equipment

UNIT V MATERIALS HANDLING EQUIPMENTS 9

Forklifts and related equipment - Portable Material Bins – Material Handling Conveyors – Material Handling Cranes- Industrial Trucks.

TOTAL: 45 PERIODS

H. Learning Resources:

a) Text Books:

1. Peurifoy, R.L., Ledbetter, W.B. and Schexnayder, C., “Construction Planning, Equipment and Methods”, 8th Edition, McGraw Hill, Singapore, 2011.
2. Sharma S.C. “Construction Equipment and Management”, Khanna Publishers, New Delhi, 1988.

b) References:

1. Deodhar, S.V. “Construction Equipment and Job Planning”, Khanna Publishers, New Delhi, 1988.
2. Dr.Mahesh Varma, “Construction Equipment and its planning and Application”, Metropolitan Book Company, New Delhi. 1983.

1152CE144	TECHNIQUES OF BUILDING CONSTRUCTION	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 durability tests and characterization of construction materials.
- To introduce students to traditional record-keeping concepts and concepts related to the paper and electronic health records.
- To carry out preventive and corrective maintenance of existing civil structures and to extend their life using mediation techniques.

B. Prerequisite:

- NIL

C. Link to other Courses:

- Repair and Rehabilitation of structures

D. Course Educational Objectives:

- After undergoing the course the students will be able to understand the characterization process and mediation techniques used to deal the adequate structures.

E. 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 characterization of construction materials	K2
CO2	Analyze health record content of the structures.	K2
CO3	Implement the techniques for repairing of structures	K2
CO4	Understand the mediation techniques in construction industry	K2
CO5	Apply their knowledge of structural mechanics in addressing design problems of structural engineering	K2

F. Correlation of COs with POs:

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

G. Course Content:

UNIT I CHARACTERIZATION OF CONSTRUCTION MATERIALS 9

Durability of stones mortars – Physical, chemical and morphological characterization - Monitoring - Artificial ageing tests - Macroscopic characterization - Simulation of degradation

UNIT II HEALTH DATA CONTENT AND STRUCTURE 9

Digital Health record - Historical study - Architectural documentation - Application of the digital health record

UNIT III REPAIR STRATEGIES 9

Remediation Influence on Serviceability and Durability - Materials for Repair - Techniques for Repair - Examples

UNIT IV MEDIATION TECHNIQUES 9

Mediation – Facilitative mediation - Evaluative mediation - Settlement mediation –Therapeutic Transformative mediation - Other techniques.

UNIT V STRUCTURAL MECHANICS 9

Structural mechanics - Stress generated by compression, tension and flexure - Calculation of resulting displacements - Shear stress - Resolution of hyper static structures based on energetic method.

TOTAL: 45 PERIODS

H. Learning Resources:

a) Text Books:

1. V.S. Ramachandran, Ralph M. Paroli, James J., "Thermal Analysis of Construction Materials", William Andrew, New Delhi, 2002
2. Shashank Garg, "Alternative Dispute Resolution: The Indian Perspective", Oxford, 2015.

b) Online Resources:

1. https://onlinecourses.nptel.ac.in/noc20_ce01/preview
2. https://nptel.ac.in/courses/105/106/105106200/

1152CE145 (VTUR15)	BASICS OF DETAILING	L	T	P	C
		3	0	4	3

Course Category: Programme Elective

A. Preamble

This course will be an extension of the Design of RC Elements and will be useful to design and detailing of structures economically using codal provisions.

B. Prerequisites:

- Design of RC Elements

C. Link To Other Courses:

- Nil

D. Course Educational Objectives:

- To introduce the principles of detailing of concrete structures
- Understand the design and detailing of RC structures and its application to structural elements.
- To train the students in the field work so as to have a firsthand knowledge of practical problems related to Structural Engineering in carrying out engineering tasks.
- To develop skills in facing and solving the field problems.
- Understand the design and detailing of the precast elements .

E. Course Outcome:

After the completion of the course the students will be able to

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's)
CO1	Understand the codal standards and principles of RC elements.	K3
CO2	Design and prepare the structural detailing of special structures.	K3
CO3	Prepare the structural detailing of foundation and retaining structural elements.	K3
CO4	Prepare the structural detailing of RC elements and its connecting joints.	K3
CO5	Design and detailing of precast elements with standard codal profession.	K3

F. 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											M
CO3			H										M	M
CO4			H										M	M
CO5			M	H									M	M

G. Course Content

UNIT I Design Principles 3+4

Concrete Cover- standards of concrete cover-reinforcement diameter and spacing standards-chair rods-bond condition- anchorage- bar bending schedule-preparation of cover block.

UNIT II Design & Development of Reinforcement – RCC Structures 3+4

Lap length-standards and design principles- special reinforcement - Formation of yielding hinge in member- Hinge Systems in Steel sleevees- Experiment of HISS ((Hinge Isolation Structural System) Reinforced Concrete Beams- Concept for Fabric Reinforced Concrete - experimental and theoretical investigations on Textile reinforced concrete

UNIT III Detailing Structural Elements – PART I 3+5

Detailing of ordinary foundation- ductile detailing of beam column joint- pile cap reinforcement detailing- detailing of cantilever and counter fort retailing wall- shear wall design and detailing-slipform wall detailing.

UNIT IV Detailing Structural Elements – PART II 3+13

RC - one way and two way slab reinforcement detailing- study on flat slab detailing- RC detailing for flexure and shear beam- column confinement zone reinforcement detailing- reinforcement detailing for punching shear on footing.

UNIT V Miscellaneous Elements 3+4

Precast Columns design and detailing- Precast Wall design and detailing-application of Precast Edge Beam and Precast Upstands

TOTAL: 15+30 Periods

H. Learning Resources

a) Text Books

1. Krishna Raju N., Design of Reinforced Concrete Structures, CBS Publishers & Distributors, 2012, New Delhi.
2. Dr. S.R.Karve & Dr. V.L.Shah., Illustrated Design Of Reinforced Concrete Buildings, 8th Edition, Structures Publications Pune 2001.

b) References

1. Varghese P.C., Limit State Design of Reinforced Concrete, Prentice Hall of India, Pvt. Ltd.2009, New Delhi
2. Ramamrutham.S., Design of Reinforced Concrete Structures, Dhanpat Rai Publishing Company, 2007.
3. Jain A.K., Limit State Design of RC Structures, Nemchand Publications, Roorkee.
4. IS: 456-2000, Plain and Reinforced Concrete Code of Practice, Bureau of Indian Standards, New Delhi-110002.
5. SP16: 1980 Design Aids to IS 456:1978

6. SP-34-1987 Handbook on Reinforcement and Detailing

c) ONLINE RESOURCES

http://www.struengineers.com/reinforced-concrete-detailing

1152CE146	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:

- Geotechnical Engineering- I (1151CE202)

C. Link to other Courses:

- NIL

D. Course Educational Objectives:

- Students are able to assess the contamination in the soil and to select suitable remediation methods based on contamination. Also they are able to prepare the suitable disposal system for particular waste.

E. 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	Assess the risk involved.	K3
CO3	Gain knowledge on remediation of contaminated ground water.	K2
CO4	Apply the different methods of soil remediation.	K2
CO5	Learn the essential components of landfill.	K3

F. Correlations of COs with POs:

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

G. Course Content:

UNIT I CONTAINANT 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.

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.

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.

UNIT V LANDFILLS 9

Source and characteristics of waste - Site selection for landfills – Components of landfills – Liner system – Soil, geomembrane, geosynthetic clay, geocomposite liner system – Leachate collection – Final cover design. Monitoring landfill.

TOTAL: 45 PERIODS

H. 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,

1152CE147	DESIGN OF REINFORCED CONCRETE AND BRICK MASONRY STRUCTURES	L	T	P	C
		2	2	0	3

Englewood Cliffs, NJ, 1995.

Course Category / Type: Programme Elective / Theory

A. Preamble:

- To give an exposure to the design of retaining wall, water tank, staircase, masonry structures and to introduce yield line theory.

B. Prerequisite:

- Design of RC Elements – (1151CE109)

C. Link to other Courses:

- Nil

D. Course Educational Objectives:

- To develop an understanding on the basic concepts in the behavior and design of reinforced concrete structures such as retaining wall, staircases and flat slabs.
- To expose the basic concepts about the yield line theory for the analysis and design of slab of various cross sections.
- To expose the behavior of masonry structures, and be able to design for various loading conditions.
- To provide knowledge on design of various components in the water tank by working stress method.

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

CO	Course Outcomes	Bloom's Taxonomy level
CO1	Apply the principles, procedures and code requirements to the analysis and design of reinforced concrete retaining wall.	K3
CO2	Understand the principles of design of water tanks based on Indian standard code provisions.	K3
CO3	Carry out structural RC design for staircases, flat slabs and principles of design pertaining to box culverts, mat foundation and bridges.	K3
CO4	Understand the concept of yield line theory and application of virtual work method to square, rectangular, circular and triangular slabs.	K3

CO5	Analyze and design of masonry structures and its applications with relevant IS codes.	K3

F. Correlation of COs with POs:

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

G. Course Content:

UNIT I RETAINING WALLS 6+6

Design of cantilever and counter fort retaining walls.

UNIT II WATER TANKS 6+6

Design of rectangular and circular water tanks both below and above ground level - Design of circular slab.

UNIT III SELECTED TOPICS 6+6

Design of staircases (ordinary and doglegged) – Design of flat slabs – Principles of design of mat foundation, box culvert and road bridges.

UNIT IV YIELD LINE THEORY 6+6

Assumptions - Characteristics of yield line - Determination of collapse load / plastic moment - Application of virtual work method - square, rectangular, circular and triangular slabs - Design problems.

UNIT V BRICK MASONRY 6+6

Introduction, Classification of walls, Lateral supports and stability, effective height of wall and columns, effective length of walls, design loads, load dispersion, permissible stresses, design of axially and eccentrically loaded brick walls.

TOTAL: 60 PERIODS

H. Learning Resources:

a) Text Books:

1. Gambhir.M.L., "Design of Reinforced Concrete Structures", Prentice Hall of India Private Limited, 2012.

2. Dayaratnam, P., “Brick and Reinforced Brick Structures”, Oxford & IBH Publishing House, -1997.

3. Punmia B.C, Ashok Kumar Jain, Arun K.Jain, "R.C.C. Designs Reinforced Concrete Structures", Laxmi Publications Pvt. Ltd., New Delhi, 2006.

4. Varghese.P.C., "Advanced Reinforced Concrete Design", Prentice Hall of India Pvt. Ltd., New Delhi, 2012.

b) References:

1. Mallick, D.K. and Gupta A.P., “Reinforced Concrete”, Oxford and IBH Publishing Company, 1997.
2. Syal, I.C. and Goel, A.K., “Reinforced Concrete Structures”, A.H. Wheelers & Co. Pvt. Ltd., 1998.
3. IS 456: 2000, “Plain and Reinforced Concrete - Code of Practice”, Bureau of Indian Standards, New Delhi.
4. SP 16, “Design Aids for Reinforced Concrete to IS 456:1978”, Bureau of Indian Standards, New Delhi.
5. IS 1905: 1987, “Code of Practice for Structural use of Unreinforced Masonry”, Bureau of Indian Standards, New Delhi.

1152CE148	PREFABRICATED STRUCTURES	L	T	P	C
		3	0	0	3

Course Category / Type: Programme Elective / Theory

A. Preamble:

- To gain knowledge on modular construction, fabrication and erection of prefabricated components and joints in structural elements.

B. Prerequisite:

- Construction Materials and Techniques (1151CE113)

C. Link to other Courses:

- Nil

D. Course Educational Objectives:

- To introduce the fabrication and erection techniques and get familiarized with prefabricated components.
- To learn the design principles of prefabricated structures and various types of joints.
- To impart knowledge on progressive collapse analysis.

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

CO	Course Outcomes	Bloom's Taxonomy level
CO1	Understand the basic concepts of prefabrication and their needs in construction industry.	K2
CO2	Learn the behaviour of prefabricated structures.	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.	K2

F. Correlation of COs with POs:

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

G. Course Content:

UNIT I - INTRODUCTION **9**

Need for prefabrication – Principles – Materials – Modular coordination – Standardization – Systems – Production – Transportation – Erection.

UNIT II - PREFABRICATED COMPONENTS **9**

Behaviour 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 LOADS **9**

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

TOTAL: 45 HOURS

H. Learning Resources:

a) Text Books:

1. Gerostiza C.Z., Hendrikson C. and Rehat D.R., “Knowledge based process planning for construction and manufacturing”, Academic Press Inc. 1994.

b) References:

1. CBRI, “Building materials and components”, India. 1990.
2. Koncz T., “Manual of precast concrete construction”, Vols. I, II and III, Bauverlag, GMBH. 1971.
3. “Structural design manual”, Precast concrete connection details, Society for the studies in the use of precast concrete, Netherland Betor Verlag. 1978.

1152CE149	EMERGING ENVIRONMENT	L	T	P	C
		3	0	0	3

Course Category / Type: Programme Elective / Theory

A. Preamble:

- This course deals about the recent and emerging environmental issues and their root causes.

B. Prerequisite:

- Nil

C. Link to other Courses:

- Environmental Engineering (1151CE206)

D. Course Educational Objectives:

Students undergoing this course are expected to:

- Gain knowledge on current impacts on environmental elements ecosystem, air & water.
- Acquire knowledge on solid waste management practices for E-waste and plastic waste.
- Impart knowledge on renewable energy generation technologies.

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

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Contrast the ecosystem and changing food resources.	K2
CO2	Demonstrate the recent issues and trends regarding water, wastewater.	K2
CO3	Explain the local and global perspectives on air pollution.	K2
CO4	Illustrate the emerging practices on solid waste management.	K2
CO5	Outline the latest technologies on renewable energy sources.	K2

F. Correlation of COs with POs:

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

G. Course Content:

UNIT 1 ENVIRONMENT AND LIVING BEINGS 9

Ecosystem - Effect of climate change on ecosystems - Sustainable engineered ecosystems – Biodiversity: definition, conservation, methods - Degradation of Western Ghats and ecological effects - Food Chain - Global market for alternative food resources - Modern agricultural practices and human health impacts.

UNIT II WATER AND WASTEWATER 9

Water budget - Fluoride in groundwater - Water disputes in India - Role of culture in water pollution - Ganga Action Plan - Interlinking of Rivers project and EIA – Advancements in urban water management – Industrial wastewater disposal - Zero liquid discharge – Wastewater reclamation, global scenario - Graphene in water technology.

UNIT III AIR AMBIENCE 9

Ambient air quality standards - PM, RSPM and Smog - Urban heat island - Air pollution and novel solutions in global scale - Urban transport and air quality - Paris climate change summit – CO_2 sequestration, Indian and global perspectives- Case studies.

UNIT IV SOLIDWASTE MANAGEMENT 9

Integrated municipal solid waste management – E-Waste management in India - Informal market for waste management in India - Nanowaste, scope, impact and research gaps – Plastic pollution in oceans, significances - Solid waste management in developed countries - Case studies on energy recovery from potential waste streams.

UNIT V ENERGY AND TECHNOLOGY 9

Renewable and non-renewable energy - Nuclear based energy generation and impacts, Indian perspective - Bloom box technology and background – Case studies on current trends in solar power technology, sustainable energy farms.

TOTAL: 45 PERIODS

H. Learning Resources:

a) Text Books:

1. Venugopal Rao.P., Textbook of "Environmental Engineering", Eastern Economy Edition. 2002.

2. Rajagopalan R., "Environmental Studies", Third Edition, Oxford Publishers. 2015.

3. Gilbert M. Masters, Wendell P. Ela., Introduction to Environmental Engineering and Science, Third Edition, Pearson Publishers. 2015.

b) References:

1. Gaur. R.C., Basic Environmental Engineering, New Age International Publishers. 2007.

1152CE150	E-WASTE MANAGEMENT	L	T	P	C
		3	0	0	3

Course Category / Type: Programme Elective / Theory

A. Preamble:

- This course deals about the generation and management aspects of electronic waste.

B. Prerequisite:

- Nil.

C. Link to other Courses:

- Solid waste Management

D. Course Educational Objectives:

Students undergoing this course are expected to:

- Gain knowledge on E-waste generation and impact scenario in global scale.
- Acquire knowledge on chemical-biological based metal recovery from E-waste.
- Impart knowledge on legislative provisions for E-waste handling and management in India.

E. 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 fundamentals of E-waste generation.	K2
CO2	Develop the public health risk assessment.	K2
CO3	Apply and to compare the conventional E-waste recycling methods.	K3
CO4	Apply and to examine the chemical and biological recovery from E-scrap.	K3
CO5	Outline the legislative norms for E-waste handling and management.	K2

F. Correlation of COs with POs:

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

G. Course Content:

UNIT 1 OVERVIEW ON E-WASTE 9

Introduction – Definition – Categories - Need for recycling - E-waste generation in India and global scenario - Estimation of waste electronic and electrical equipment (WEEE) - Quantification of health hazard due to informal recycling of E-waste - Extraction of precious and rare earth metals from End of life (EoL) electronic products - Social impacts of E-waste recycling.

UNIT II ENVIRONMENTAL AND PUBLIC HEALTH ISSUES 9

Characterization of WEEE - Global E-waste dumping scenario - Health exposure routes - CERCLA priority list - Toxic heavy metal exposure and impacts – PCBs, PBDEs and health impacts – Ghanaian Environment – Health risk assessment – Bioconcentration, hazardous index and hazardous quotient - Numerical problems.

UNIT III CONVENTIONAL MATERIAL RECOVERY 9

Process description – Disassembly, upgrading, refining – Existing E-waste recycling techniques – CRT recycling – Glass to glass recycling – Glass to Lead recycling - Pyro metallurgical process – Recovery of gold.

UNIT IV ADVANCED MATERIAL RECOVERY 9

Hydro metallurgical process – Cyanide leaching – Halide leaching – Thiourea leaching – Thiosulfate leaching – Extraction of precious metals – Cementation – Activated carbon – Ion exchange – Bio metallurgical processes – Hybrid technology.

UNIT V E-WASTE MANAGEMENT 9

Regulatory frameworks in India – Objectives of Hazardous and other wastes (Management and Transboundary Movement) rules, 2016 – Application of stakeholders - Responsibilities of producers, SPCBs and CPCB – Guidelines on implementation of E-waste rules 2011 – New additions in E-waste (Management & Handling) rules.

TOTAL: 45 PERIODS

H. Learning Resources:

a) Text Books:

1) Hester R.E. and Harrison R.M, "Electronic waste management", RSC Publishing. 2009.
2) Carlos P.Bergmann, "Electronic waste recycling techniques", Springer. 2015.

b) References:

1. E-Waste (Management and Handling) Rules, 2011.
2. Rakesh J, E-waste: Implications, Regulations and Management in India and Current Global best Practices, Third Edition, TERI Press, 2009.

c) Online Resources:

1.https://nptel.ac.in/courses/105105169/

1152CE151	TALL STRUCTURES	L	T	P	C
		3	0	0	3

Course Category / Type: Program Elective / Theory

A. Preamble:

- To understand the concept of analysis and design of tall structures, loading techniques in tall buildings.

B. Prerequisite:

- Nil

C. Link to other Courses:

- Basics of Dynamics and Aseismic Design of Structures (1151CE150)

D. Course Educational Objectives:

- Understand different design philosophies and materials
- Describe the types of loads and loading techniques used in tall buildings.
- Analyse for forces, drift and twist
- Buckling analysis of tall buildings

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

CO Nos.	Course Educational Objectives:	Bloom's Taxonomy level
CO1	Understand different design principles and materials	K2
CO2	Describe the different combination of loads and loading techniques.	K2
CO3	Study the Behaviour of various structural systems.	K3
CO4	Model and analyse the forces, drift and twist.	K3
CO5	Understand the overall buckling analysis of tall buildings with P-Delta analysis.	K3

F. Correlation of COs with POs:

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

G. Course Content:

UNIT I DESIGN CRITERIA AND MATERIALS 9

Development Of High Rise Structures – General Planning Considerations – Design Philosophies – Materials Used For Construction – High Strength Concrete – High Performance Concrete – Self Compacting Concrete – Glass – High Strength Steel

UNIT II LOADING 9

Gravity Loading – Dead Load – Live Load – Live Load Reduction Technique – Impact Load – Construction Load – Sequential Loading. Lateral Loading – Wind Load – Earthquake Load. Combination of Loads.

UNIT III BEHAVIOUR OF VARIOUS STRUCTURAL SYSTEMS 9

Factors Affecting Growth, Height and Structural Form. High Rise Behaviour of Various Structural Systems – Rigid Frames, Braced Frames, Infilled Frames, Shear Walls, Coupled Shear Walls, Wall frames, Tubular Structures, Cores, Outrigger – Braced and Hybrid Mega Systems.

UNIT IV ANALYSIS AND DESIGN 9

Modelling for Approximate Analysis, Accurate Analysis and Reduction Techniques, Analysis of Buildings as Total Structural System Considering Overall Integrity and Major Subsystem Interaction, Analysis for Member Forces, Drift and Twist, Computerised General Three Dimensional Analysis.

UNIT V STABILITY OF TALL BUILDINGS 9

Overall Buckling Analysis Of Frames, Wall-Frames, Approximate Methods, Second Order Effects of Gravity of Loading, P-Delta Analysis, Simultaneous First-Order And P-Delta Analysis, Translational, Torsional Instability, Out Of Plumb Effects, Stiffness Of Member In Stability, Effect of Foundation Rotation

TOTAL: 45 PERIODS

H. Learning Resources:

a) Text Books:

1. Beedle L. S., “Advances in Tall Buildings”, CBS Publishers and Distributors, Delhi, 1986.
2. Bryan Stafford Smith and Alexcoull, “Tall Building Structures - Analysis and Design”, John Wiley and Sons, Inc., 2005.

b) References:

1. Taranath B.S., “Structural Analysis and Design of Tall Buildings”, McGraw Hill. 1988.
2. Gupta.Y.P.,(Editor), Proceedings of National Seminar on High Rise Structures - Design and Construction Practices for Middle Level Cities, New Age International Limited, New Delhi,1995.
3. Lin T.Y and Stotes Burry D, “Structural Concepts and systems for Architects and Engineers”, John Wiley. 1988.

1152CE152	SUSTAINABLE ENGINEERING	L	T	P	C
		3	0	0	3

Course Category: Programme Elective

A. PREAMBLE

This course deals about the fundamental elements of sustainability concepts in Civil Engineering field.

B. PREREQUISITES

- Nil

C. LINKS TO OTHER COURSES

- Environmental Engineering
- Construction Materials and Techniques

D. COURSE EDUCATIONAL OBJECTIVES

Students undergoing this course are expected to:

- Gain preliminary aspects of sustainability concepts and their need.
- Acquire knowledge in circular economy and relevant importance.
- Impart knowledge on Life Cycle Assessment methodology.

E. 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 meaning and significance of sustainable development	K2
CO2	Illustrate the role of circular economy as sustainability measure	K2
CO3	Demonstrate the process of life cycle assessment of products	K2
CO4	Relate the results of system thinking in sustainable design	K2
CO5	Explain the sustainable options for man-made built environment	K2

F. CORRELATION OF COs WITH POs

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

G. COURSE CONTENT

UNIT 1 INTRODUCTION 9

Historic origins of sustainability – Sustainable development: Definition - Environment and ecology - Ecological footprint - Planet equivalent - Embodied Energy - Agenda 21 - Sustainable development goals (MDGs and SDGs)

UNIT II CIRCULAR ECONOMY 9

Definition of circular economy - Mining Vs Sustainable mining - Role of business in the circular economy - Circular economy business model strategies - Drivers for entrepreneurship in circular economy - Policies for product circularity - Eco-design - Extended producer responsibility.

UNIT III LIFE CYCLE ASSESSMENT 9

Risk and life cycle framework - Product life cycle - Eco cost - Life cycle assessment (LCA): Goal definition, Life cycle inventory, Life cycle impact assessment, Life cycle interpretation - Software tools for LCA.

UNIT IV DESIGN FOR SUSTAINABILITY 9

Product design - Sustainability thinking: Life cycle thinking, Circular thinking, Long-term thinking, System's thinking - Product-Service system - Types of product-service system - Methodology for system design for sustainability – Case studies.

UNIT V SUSTAINABILITY FOR BUILT ENVIRONMENT 9

Sustainability in: Sites, Construction materials, Construction techniques, Whole building performance - Sustainability in Water conservation.

TOTAL : 45 Periods

H. LEARNING RESOURCES

a) TEXT BOOKS:

1. Bhavik R. Bakshi., Sustainable Engineering: Principles and Practice, Cambridge University Press, 2019.
2. Peter Lacy and Jakob Rutqvist., Waste to Wealth: The Circular Economy advantage, Palgrave Macmillan - 1st Edition, 2015.

b) REFERENCES:

1. Robert Brinkmann., Introduction to Sustainability, Wiley, 2016.

c) ONLINE REFERENCE:

1. NPTEL Course on System design for sustainability
   https://nptel.ac.in/courses/107/103/107103081/
2. NPTEL Course on Sustainable Architecture

   https://nptel.ac.in/courses/124/107/124107011/

1152CE153	DISASTER MANAGEMENT AND MITIGATION	L	T	P	C
		3	0	0	3

Course Category / Type: Programme Elective

A. Preamble:

- This course is useful in distinguishing the different type of disasters and their effects. The student learns a coordinated approach to manage and mitigate in the event of a disaster with the assistance of stakeholders and other government agencies. This leads to familiarization with the Disaster Management Act of Government of India.

B. Prerequisite:

- Nil

C. Link to other Courses:

- Environmental Science

D. Course Educational Objectives:

Students undergoing this course are expected to:

- Understand the concepts of disaster, hazard and vulnerability
- Recognize the importance of disaster management
- Identify the appropriate agency organizing disaster mitigation.

E. 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 socio-economic impact due to disaster and hazard	K1
CO2	Classify the different type of disasters and their causes	K2
CO3	Describe the basic concepts of disaster management cycle, preparedness, response and recovery	K2
CO4	Recognize the stake holders, their jurisdiction and responsibilities in the disaster management system	K2
CO5	Prepare different case study reports using advanced techniques	K2

F. Correlation of COs with POs:

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

G. COURSE CONTENT

UNIT I BASIC CONCEPTS 9

Concepts and definition of Disaster, Hazard, Vulnerability, Risk analysis and Capacity Metrological factors – climatic change. Types of vulnerability - physical vulnerability and socio-economic vulnerability - Crisis Management - Disaster Management and Mitigation.

UNIT II TYPES OF DISASTER 9

Geological Disasters - earthquakes, landslides, tsunami, mining, volcanoes; Hydro-Meteorological Disasters: floods, cyclones, lightning, thunder-storms, hail storms, avalanches, droughts, cold and heat waves; Biological Disasters: pandemic, epidemics, pest attacks, cattle epidemic and food poisoning; Nuclear and Industrial Disaster: chemical and industrial disasters, nuclear accidents; Accidental Disasters: urban and forest fires, oil spill, mine flooding incidents, accidents (road, rail, air and sea), collapse of bridges, buildings and other facilities structures & dam failures; House-hold disasters: gas-cylinder leaks and explosion
Practical examples on all types of disaster.

UNIT III DISASTER MANAGEMENT FRAMEWORK 9

Disaster Management Cycle – Paradigm Shift in Disaster Management. Pre-Disaster – Risk Assessment and Analysis, Risk Mapping, Awareness During Disaster – Evacuation – Disaster Communication – Search and Rescue – Emergency Operation Centre – Incident Command System – Relief and Rehabilitation – Post-disaster – Damage and Needs Assessment– Early Recovery – Reconstruction and Redevelopment.

UNIT IV DISASTER MITIGATION 9

Disaster Profile of India – Mega Disasters of India and Lessons Learnt Disaster Management Act 2005 (GOI) – Institutional and Financial Mechanism National Policy on Disaster Management, National Guidelines and Plans on Disaster Management; Role of Government (local, state and national), NDMA, NDRF, NGOs, Inter-Governmental and other Agencies.

UNIT V RECENT ADVANCES IN DISASTER MITIGATION 9

Geo-informatics in Disaster Management (GIS, GPS and RS) Disaster Communication System (Early Warning and Its Dissemination) Case studies: Disaster risk assessment and preparedness for disasters with reference to disasters in: earthquake, building collapse, wild fire, floods, oil spill, pandemic, epidemic, house-hold disasters. **Total : 45 Periods**

H. LEARNING RESOURCES

(a) TEXT BOOKS:

1. Bryant E. (2005), Natural Hazards, Cambridge University Press, U.K.
2. Chakraborty, S.C. (2007), Natural Hazards and Disaster Management, Pragatishil Prokashak, Kolkata.
3. Coppola D P (2007), Introduction to International Disaster Management, Elsevier Science, London.
4. Khanna, B. K. (2005), Disasters: All You Wanted to Know About, New India Publishing Agency, New Delhi.

(b) REFERENCE BOOKS:

1. Angus M. Gunn (2008), Encyclopedia of Disasters – Environmental Catastrophes and Human Tragedies, Vol. 1 & 2, Greenwood Press, London.
2. Gupta, A.K., Niar S.S and Chatterjee S. (2013), Disaster management and Risk Reduction, Role of Environmental Knowledge, Narosa Publishing House, Delhi.
3. Srivastava, H. N. and Gupta, G. D.(2006), Management of Natural Disasters in developing countries, Daya Publishers, Delhi, 201 p.
4. Alexander, D. (1999), Natural Disasters, Kluwer Academic, London, 632 p.

(c) ONLINE SOURCES:

1. http://www.adpc.ait.ac.th
2. http://www.adrc.or.jp
3. http://www.cepredenac.org
4. http://www.disaster.info.desastres.net/crid
5. http://www.unige.ch/idndr
6. http://www.disaster.net
7. http://www.disaster.info.desastres.net/dipecho
8. http://www.disasterrelief.org
9. http://www.eri.u-tokyo.ac.jp
10. http://www.europa.eu.int/comm/echo
11. http://www.fao.org/giews/default.html
12. http://geoweb.fao.org
13. http://www.fao.org/fivims/default.html
14. http://www.fema.gov
15. http://www.haznet.org
16. http://www.ifrc.org
17. http://www.idrmhome.org
18. http://www.unisdr.org
19. http://www.osso.univalle.edu.co/tmp/lared/lared/html
20. http://www.desenredando.org
21. http://www.reliefweb.int/
22. http://www.promujer.org
23. http://www.sewa.org
24. http://www.wfp.org
25. http://www.who.int/eha
26. http://www.wmo.ch

1152CE301	SURVEYING PRACTICAL II	L	T	P	C
		0	0	2	1

Course Category / Type: Programme Elective / Laboratory

A. Preamble:

- This course will help the students to understand the methods, instruments used and applications of advanced surveying such as tacheometry, GPS and total station etc.

B. Prerequisite:

- Surveying Practical - I

C. Link to other Courses:

- Nil

D. Course Educational Objectives:

After undergoing the course

- The student will have complete field knowledge about survey field techniques and how and where they are used before and after construction.
- The student will possess knowledge about Survey field techniques.

E. 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 fundamental parts and handling of theodolite	K3
CO2	Find the horizontal angle, vertical angle, heights, distances and area of a field using theodolite surveying.	K3
CO3	Apply tacheometry concepts in finding horizontal angle, vertical angle, heights and distances between points in a field	K3
CO4	Perform marking and setting out work for building foundations.	K3
CO5	Understand the fundamental parts and handling of total station	K3

F. Correlation of COs with POs:

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

G. Course Content:

LIST OF EXPERIMENTS

1. Study of theodolite

2. Measurement of horizontal and vertical angles by reiteration and repetition methods.

3. Theodolite survey – Traversing

4. Theodolite survey -Triangulation

5. Heights and distances - Single plane method- Double plane method.

5. Tacheometry - Tangential system - Stadia system - Subtense system.

6. Setting out works - Foundation marking and Building.

7. Field work using Total Station.

TOTAL: 30 PERIODS

H. Learning Resources:

b) References:

1. James M. Anderson and Edward M. Mikhail, Surveying, Theory and Practice, 7thEdition, McGraw Hill, 2001.
2. Bannister and S. Raymond, "Surveying", 7th Edition, Longman, 2004.
3. Roy S.K., "Fundamentals of Surveying", 2nd Edition, Prentice Hall of India, 2004.
4. Arora K.R., Surveying Vol I & II, Standard Book house , 10th Edition, 2008.

1152CE302	MATERIAL TESTING LABORATORY	L	T	P	C
		0	0	2	1

Course Category / Type: Programme Elective / Laboratory

I. Preamble:

- This laboratory course will help the students to conduct test on engineering materials to identify and evaluate the properties.

J. Prerequisite:

b. Nil

K. Link to other Courses:

Strength of Materials

L. Course Educational Objectives:

- To understand the behavior of engineering materials.
- To know the properties of engineering materials.
- To examine the various strength of engineering materials.

M. 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 young's modulus, modulus of rigidity and double shear strength of engineering materials.	K3
CO2	Determine the fineness and soundness of the cement.	K3
CO3	Determine the hardness of the steel, brass and aluminum.	K3
CO4	Determine the compressive strength and water absorption of various materials.	K3
CO5	Determine the flexural strength of tiles.	K3

N. 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				
CO2	M	M			H					M				
CO3	M	M			H					M				
CO4	M	M			H					M				
CO5	M	M			H					M				

O. List of Experiments

11. Determination of Young's modulus for
    a. Wood
    b. Steel materials using beam deflection test.
12. Determination of modulus of rigidity for mild steel bar using torsion test.
13. Determination of the fineness of cement using Blains Permeability apparatus.
14. Soundness test on cement by Autoclave method.
15. Determination of Rockwell and Brinell hardness for
    a. Mild steel
    b. Brass
    c. Aluminum.
16. Determination of compressive strength of wood.
17. Determination of double shear strength of mild steel bar.
18. Determination compressive strength of bricks and solid blocks.
19. Water absorption test on Bricks and pressed tiles.
20. Flexure test on Tiles

P. Learning Resources:

a) Text Books:

4. Rangwala, S.C., "Engineering Materials", Charotar Publishing House, Anand, India, 28th edition. 2011.
5. Varghese.P.C, "Building Materials", PHI Learning Pvt. Ltd, New Delhi. 2012.
6. Rajput. R.K. "Engineering Materials", S. Chand and Company Ltd. New Delhi. 2008.

1152CE303	HIGHWAY ENGINEERING LABORATORY	L	T	P	C
		0	0	2	1

Course Category / Type: Programme Elective / Laboratory

A. Preamble:

- To learn the principles and procedures of testing Highway materials and to get hands on experience by conducting the test and evolving inferences.

B. Prerequisite:

- Nil

C. Link to other Courses:

- Nil

D. Course Educational Objectives:

- To make the students to identify the engineering properties of highway construction material.

E. 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 properties of aggregates used in various components of highway.	K3
CO2	Determine the various properties of bitumen.	K3

F. Correlation of Cos with POs

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

G. List of Experiments

I. TESTS ON AGGREGATES

1. Crushing Strength
2. Abrasion Value

3. Stripping value test
4. Impact Value
5. Flakiness and Elongation Index

II. TESTS ON BITUMEN

1. Penetration
2. Softening Point
3. Ductility
4. Flash and fire points
5. Viscosity

TOTAL: 30 PERIODS

H. Learning Resources:

a) Text Books:

1. Khanna.S. K., Justo.C.E.G and Veeraragavan A. "Highway Engineering", Nemchand Publishers, 2014.

2. Subramanian K.P., "Highways, Railways, Airport and Harbour Engineering", Scitech Publications (India), Chennai, 2010.

b) References:

1. Kadiyali.L.R. "Principles and Practice of Highway Engineering", Khanna Technical Publications, 8th edition Delhi, 2013.

2. Yang H. Huang, "Pavement Analysis and Design", Pearson Education Inc, Ninth Edition, South Asia, 2012.

3. Ian D. Walsh, "ICE manual of highway design and management", ICE Publishers, Ist Edition, USA, 2011.

4. Fred L. Mannering, Scott S. Washburn and Walter P.Kilareski, "Principles of Highway Engineering and Traffic Analysis", Wiley India Pvt. Ltd., New Delhi, 2011.

5. Garber and Hoel, "Principles of Traffic and Highway Engineering", CENGAGE Learning, New Delhi, 2010.

1152CE201	ADVANCED CONCRETE TECHNOLOGY	L	T	P	C
		1	0	4	3

Course Category / Type: Programme Elective / Integrated Course

A. Preamble:

- This course explain about the behavior of cement paste admixture and durability of concrete.

B. Prerequisite:

- Construction Materials
- Concrete Technology – 1151CE203

C. Link to other Courses:

- Repair and Rehabilitation of Structures – 1152CE119

D. Course Educational Objectives:

Students undergoing this course are expected to

- Gain knowledge about the chemical reaction of cement paste
- Acquire knowledge about admixtures
- Gain knowledge about the corrosion of steel in concrete
- Acquire knowledge about waste material uses to make concrete.

E. 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 importance of Bogue's compounds	K2
CO2	Explain the features of chemical and mineral admixtures	K2
CO3	Learn about the durability of concrete	K2
CO4	Learn about waste material used in concrete	K2
CO5	Explain about the advance concreting methods	K2

F. Correlation of COs with POs:

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

G. Course Content:

UNIT I IMPORTANCE OF BOGUE'S COMPOUNDS 3

Importance of Bogue's compounds, Structure of a Hydrated Cement Paste, Volume of hydrated product, porosity of paste and concrete, factors affecting strength and elasticity of concrete.

UNIT II CHEMICAL AND MINERAL ADMIXTURES 3

Chemical admixtures- Mechanism of chemical admixture, Air-entraining admixtures. Mineral admixture - effect on concrete property in fresh state and hardened state.

UNIT III DURABILITY OF CONCRETE 3

Introduction, permeability of concrete, chemical attack, acid attack, efflorescence, corrosion in concrete. Thermal conductivity, thermal diffusivity, specific heat. Alkali Aggregate Reaction, IS456-2000 requirement for durability

UNIT IV WASTE MATERIAL BASED CONCRETE 3

Influence of waste materials in concrete - Recycling & re-use of industrial waste material – Case Studies.

UNIT V ADVANCE CONCRETING METHODS 3

Methods of Concreting - Extreme weather concreting - Special concreting methods - Vacuum dewatering Concrete – Underwater Concrete.

LIST OF EXPERIMENTS:

1. Testing of Cement: Consistency, Fineness, setting time, Specific Gravity, Soundness.
2. Testing of Fine Aggregate: Specific Gravity, Sieve Analysis and Zoning, Bulking of Fine Aggregate, Bulk Density, Silt Content.
3. Testing of Coarse Aggregate: Specific Gravity, Sieve Analysis, Bulk Density, Flakiness Index, Elongation Index, Water Absorption & Moisture Content, Soundness of Aggregate.
4. Concrete Mix design: ACI 211.1-91 method, IS code method as per 10262- 2007 & 456-2000, DOE Method
5. Tests on Concrete: Workability tests – Slump Cone Test, Compaction Factor Test, Vee-Bee Consistometer Test, Flow Table Test, Strength Tests- Compressive Strength, Flexural Strength, Split Tensile Strength.
6. Effects of Admixture: Accelerator, Retarder, Super Plasticizer.

7. Nondestructive Testing: Rebound Hammer test, Ultrasonic Pulse Velocity test. Study on RCPT, SEM, Carbonation, Oxygen Diffusion

TOTAL: 15+60 = 75 PERIODS

H. Learning Resources:

a) Text Books:

1. Shetty M.S., Concrete Technology, S.Chand and Company Ltd. Delhi, 2012.
2. Santhakumar A.R. Concrete Technology, Oxford University Press, 2018.

b) References:

1. Gambhir.M.L. "Concrete Technology", 5th Edition, Tata McGraw Hill Education, New Delhi, 2013.
3. Gupta.B.L.,Amit Gupta, "Concrete Technology", Jain Book Agency, 2010.
4. Neville, A.M., "Properties of Concrete", Prentice Hall, 1995, London.
5. IS 10262:2009 "Guidelines for Concrete Mix Proportioning", Bureau of Indian Standards, New Delhi.1998.
6. Laboratory Manual on Concrete Technology 1st Edition, CBS Publishers & Distributors Pvt. Ltd, New Delhi, 2011

c) Online Resources:

1. http://nptel.ac.in/courses/105102012/

DEPARTMENT OF CIVIL ENGINEERING

CURRICULUM AND SYLLABI

ALLIED ELECTIVE AND INSTITUTE ELECTIVE COURSES

ALLIED ELECTIVES

Allied Electives					
Code	**Course**	**L**	**T**	**P**	**C**
1153CE101	Estimation of Civil Works	3	0	0	3
1153CE102	Maintenance and Rehabilitation of Structures	3	0	0	3
1153CE103	Energy Efficient Buildings	3	0	0	3
1153CE104	Fundamentals of Remote Sensing and GIS	3	0	0	3
1153CE105	Air pollution Management	3	0	0	3
1153CE106	Construction Project Management	3	0	0	3
1153CE107	Environmental Conservation	3	0	0	3
1153CE108	Smart Transportation System	3	0	0	3
1153CE109	Geographic Information System	3	0	0	3
1153CE110	Sustainable Cities	4	0	4	6
1153CE111	Disaster Management and Mitigation	3	0	0	3
				Total	**6**

1153CE101	ESTIMATION OF CIVIL WORKS	L	T	P	C
		3	0	0	3

Course Category: Allied Elective

A. Preamble:

- This course is designed to make the students to estimate the quantities of item of works involved in Civil Engineering works.

B. Prerequisite:

- Nil

C. Course Educational Objectives:

Students undergoing this course are expected to:

- Determine the various aspects of estimating of quantities of items of works involved in buildings, water supply and sanitary works, road works and irrigation
- Compute the rate analysis, valuation of properties and preparation of reports for estimation of various items
- Learn to estimate the material quantities, prepare a bill of quantities, make specifications and prepare tender documents the Problem solving technique

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 to convert measured items into construction operation method statements expressed in terms of labour, material and plant resources and generate durations for construction operations	K2
CO2	Assess to generate and communicate builder's quantities in various forms.	K3
CO3	Calculate the cost of the common facilities used in construction.	K3
CO4	Apply the market prices in their non-operational form.	K3
CO5	Explain the measurement and costing techniques within various construction areas	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											M
CO2	M		H											M
CO3	M		H											
CO4	L		L								M			
CO5						M				M	M			

F. Course Content:

UNIT I INTRODUCTION 9

Types of estimates – Units of measurements – Methods of estimates – Advantages

UNIT II ESTIMATION OF BUILDINGS 9

Load bearing and framed structures – Calculation of quantities of brick work, RCC, PCC, Plastering, white washing, colour washing and painting / varnishing for shops, rooms, residential building with flat and pitched roof

UNIT III ESTIMATION OF OTHER STRUCTURES 9

Estimating of septic tank, soak pit – sanitary and water supply installations – water supply pipe line – sewer line – tube well – open well

UNIT IV SPECIFICATIONS 9

Data – Schedule of rates – Analysis of rates – Specifications – sources – Detailed and general specifications.

UNIT V VALUATION 9

Necessity – Basics of value engineering – Capitalised value – Depreciation – Escalation – Value of building

TOTAL: 45 Periods

G. Learning Resources

a) Text Books:

1. Dutta, B.N, “Estimating and Costing in Civil Engineering” - UBS Publishers & Distributors Pvt. Ltd. 2016
2. Kohli, D.D and Kohli, R.C, “A Text Book of Estimating and Costing (Civil)” - S. Chand & Company Ltd. 2011

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, April 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).

1153CE102	MAINTENANCE AND REHABILITATION OF STRUCTURES	L	T	P	C
		3	0	0	3

Course Category: Allied Elective

A. Preamble:

- This course is designed to understand the principles of repair and rehabilitation of concrete structures.

B. Prerequisite:

- Nil

C. Course Educational Objectives:

Students undergoing this course are expected to:

- Understand the strength and durability aspects of concrete structures.
- Differentiate the various repair and protection methods for concrete structures.
- Outline the retrofitting of disaster affected structures.

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

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Contrast the maintenance and damage assessment for concrete structures.	K2
CO2	Outline the durability of concrete regarding repair and rehabilitation.	K2
CO3	Classify the different types of special concretes suitable for repair works.	K3
CO4	Illustrate the techniques of repairing concrete elements.	K3
CO5	Summarize the retrofitting methods for buildings subjected to disasters.	K3

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1						M								
CO2						M								
CO3					M									
CO4					M									
CO5					M	M								

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.

UNIT II STRENGTH AND DURABILITY OF CONCRETE 9

Quality assurance for concrete – Strength, Durability and Thermal properties, of concrete – Cracks- Different types, causes – Effects due to climate, temperature- Sustained, Elevated temperatures- Corrosion - Effects of cover thickness.

UNIT III SPECIAL CONCRETE 9

Polymer concrete- Sulphur infiltrated concrete- Fibre reinforced concrete- High strength concrete- High performance concrete- Vacuum concrete- Self-compacting concrete- Geopolymer concrete- Reactive powder concrete- Concrete made with industrial wastes.

UNIT IV TECHNIQUES FOR REPAIR AND PROTECTION METHODS 9

Non-destructive Testing Techniques- Epoxy injection- Shoring- Underpinning- Corrosion protection techniques – Corrosion inhibitors- Corrosion resistant steels- Coatings to reinforcement- Cathodic protection.

UNIT V REHABILITATION AND RETROFITTING OF STRUCTURES 9

Strengthening of Structural elements- Repair of structures distressed due to corrosion, fire, leakage and earthquake – Demolition techniques - Engineered demolition methods – Case studies.

TOTAL: 45 PERIODS

G. Learning Resources:

a) Text Books:

1. Denison Campbell, Allen and Harold Roper, "Concrete Structures, Materials, Maintenance and Repair" - Longman Scientific and Technical UK, 1991.
2. Allen R.T. & Edwards S.C,"Repair of Concrete Structures" - Blakie and Sons, UK, 1987.

b) References:

1. Shetty M.S, "Concrete Technology: Theory and Practice" - S.Chand and Company, 2018.

2. DovKominetzky.M.S, “Design and Construction Failures” -Galgotia Publications Pvt. Ltd. 2001.
3. Ravishankar.K and Krishnamoorthy.T.S, “Structural Health Monitoring, Repair and Rehabilitation of Concrete Structures” - Allied Publishers, 2004.
4. CPWD and Indian Buildings Congress, Hand book on Seismic Retrofit of Buildings - Narosa Publishers, 2008**.**
5. Gambhir.M.L, “Concrete Technology: 5th Edition” - Tata McGraw Hill, 2013.

1153CE103	ENERGY EFFICIENT BUILDINGS	L	T	P	C
		3	0	0	3

Course Category: Allied Elective

A. Preamble:

- This course provides the knowledge to plan and design a building which require less energy during construction and functioning.

B. Prerequisite:

Nil

C. Course Educational Objectives:

- Students undergoing this course are expected to learn the planning and design concepts to make a building which is sustainable in energy and consumes less energy.

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 natural factors like heat, light and other functions and their effects on buildings	K2
CO2	Understand how the natural energy can be utilized for heating and cooling purposes	K2
CO3	Decide how to plan the building such that natural lighting and electric lighting may be utilized effectively	K2
CO4	Helps to plan the building such that heat produced in the building by all factors can be reduced	K2
CO5	Helps to plan and design the buildings to suit for the specific climatic conditions	K2

E. Correlation of COs with POs:

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

F. Course Content:

UNIT I INTRODUCTION 9

Climate adapted and climate rejecting buildings – Heat Transfer – Measuring Conduction – Thermal Storage – The Greenhouse Effect – Site Planning and Development – Temperature – Humidity – Wind – Optimum Site Locations – Sun Path Diagrams – Sun Protection – Types of Shading Devices – Design responses to energy conservation strategies.

UNIT II PASSIVE SOLAR HEATING AND COOLING 9

General Principles of passive Solar Heating – Key Design Elements – Sunspace – Predicting ventilation in buildings – Window Ventilation Calculations – Room Organization Strategies for Cross and Stack Ventilation – Radiation – Evaporation and dehumidification – Wind Catchers – Mass Effect – Zoning – Load Control – Air Filtration and odor removal.

UNIT III DAYLIGHTING AND ELECTRICAL LIGHTING 9

Materials, components and details – Insulation – Optical materials – Radiant Barriers – Glazing materials – Glazing Spectral Response – Day lighting – Sources and concepts –– Day lighting design – Electric Lighting – Light Distribution – Electric Lighting control for day lighted buildings – Switching controls – Coefficient of utilization – Electric Task Lighting – Electric Light Zones – Power Adjustment Factors.

UNIT IV HEAT CONTROL AND VENTILATION 9

Hourly Solar radiation – Heat insulation – Terminology – Requirements – Heat transmission through building sections– Orientation of buildings – Building characteristics for various climates – Thermal Design of buildings – Influence of Design Parameters – Mechanical controls - Ventilation – Requirements – Minimum standards for ventilation.

UNIT V DESIGN FOR CLIMATIC ZONES 9

Energy efficiency – An Overview of Design Concepts and Architectural Interventions – Low Embodied Energy Materials –Design of Energy Efficient Buildings for Various Zones – Cold and cloudy – Cold and sunny – Composite – Hot and dry – Moderate – Warm and humid – Case studies of residences, office buildings and other buildings in each zones

TOTAL: 45 Periods

G. Learning Resources

a) Text Books:

1. Brown, G.Z. and DeKay, M, "Sun, Wind and Light: Architectural Design Strategies" - John Wiley and Sons Inc. 2001
2. Energy Conservation Building Code, Bureau of Energy Efficiency, New Delhi, 2007.
3. Handbook on Functional Requirements of Buildings Part 1 to 4 SP: 41 (S and T) 1995

b) References:

1. Majumdar, M (Ed), "Energy - Efficient Buildings in India" - Tata Energy Research Institute, Ministry of Non-Conventional Energy Sources, 2002.

2. Moore, F, “Environmental Control System” - McGraw Hill Inc. 2002.
3. Tyagi, A.K. (Ed), “Handbook on Energy Audits and Management” - Tata Energy Research Institute, 2000.

1153CE104	FUNDAMENTALS OF REMOTE SENSING AND GIS	L	T	P	C
		3	0	0	3

Course Category: Allied Elective

A. Preamble:

Students undergoing this course are expected to understand the basic concept of remote sensing and applications of Geographical Information System.

B. Prerequisite:

- NIL

C. Course Educational Objectives:

Students undergoing this course are expected to

- Understand the basic remote sensing concepts and its characteristics.
- Understand the satellite and sensor characteristics
- Analyze and interpret the projects using GIS software.

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 concept of Remote Sensing	**K2**
CO2	Understand the different types of sensors and satellites characteristics	**K2**
CO3	Understand the fundamentals of GIS and Data Base Management Systems in GIS.	**K2**
CO4	Understand the date types and DBMS in GIS.	**K2**
CO5	Understand the application of remote sensing and GIS in various engineering fields.	**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												
CO2	M	M												
CO3	L			M	M									
CO4	L													
CO5		M		M	L		M							

F. Course Content:

UNIT I FUNDAMENTALS OF REMOTE SENSING 9

Definition - components – Electromagnetic spectrum – wavelength regions important to remote sensing – Wave theory, Particle theory, Stefan-Boltzmann and Wein's Displacement Law – EMR interaction with atmospheric and earth surface – Atmospheric windows – spectral signature concepts – typical spectral reflective characteristics of water, vegetation and soil.

UNIT II PLATFORMS AND SENSORS 9

Types of platforms – orbit types, Sun-synchronous and Geosynchronous – Passive and Active sensors - scanning system**:** Across track and along track scanning – resolution concept – Pay load description of important Earth Resources and Meteorological satellites – Airborne and space borne - TIR and microwave sensors.

UNIT III FUNDAMENTALS OF GIS 9

Map – Definition – Types of Maps, Characteristics of Maps, Map Projections – GIS – Definition - History of GIS - Basic Components of GIS – Hardware, Software, Data, Methods, People – List of GIS Software: Popular software, Open Source software

UNIT IV DATA BASE STRUCTURE 9

Data: Spatial and Non-Spatial Data – Spatial Data: Points, Lines, Polygons/Area and Surface - Non-Spatial Data - Levels of Measurement: Nominal, Ordinal, Interval, Ratio – Data Base Management System: Definition, Functions, Merits and Demerits – Vector and Raster Data Base Structures.

UNIT V REMOTE SENSING AND GIS APPLICATIONS 9

Preparation of thematic layers – Integration of data for Surface and groundwater studies - Mineral exploration - Disaster Management: Floods, landslides and coastal zone management studies - highway alignment studies - power and telecommunication utilities - Case studies.

TOTAL: 45 PERIODS

G. Learning resources

a) Text Books:

1. Bhatta. B, "Remote Sensing and GIS" - Oxford University Press, 2008.
2. Anji Reddy.M, "Remote Sensing and Geographical information systems" – Oxford University Press, 2010.

b) References:

1. Lillesand, T.M. and Kiefer R.W, "Remote Sensing and image interpretation" - John Wiley & Sons (Asia), Newyork 2007
2. Burrough P.A, "Principle of Geographical Information Systems for land resources assessment" - Oxford University Press, 2004.
3. Clarke Parks and Crane, "Geographic Information Systems & Environmental Modelling" - Prentice-Hall of India, 2005.

1153CE105	AIR POLLUTION MANAGEMENT	L	T	P	C
		3	0	0	3

Course Category: Allied Elective

A. Preamble:

This course is to provide a basic understanding of air pollution and study the effect of air pollution and management. It also helps to impart knowledge on the principles and design of control of indoor/particulate/gaseous air pollutants and its emerging trends.

B. Prerequisite:

- NIL

C. Course Educational Objectives:

Students undergoing this course are expected to:

- To Learn sources and effects of air pollutants
- To know the meteorological processes and air quality modelling
- To learn the standards of air pollution in India

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

CO	STATEMENT	K LEVEL
CO1	Compare the various sources and respective effects of air pollutants.	K2
CO2	Apply modeling techniques and to determine the fate of air pollutant with respect to time and space	K2
CO3	Prevent and control air pollution by suitable air pollution control measures	K2
CO4	Relate the air quality standards and management policies.	K2
CO5	Summarize the causes and issues of air pollution in India.	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		
CO2	L					L	L							
CO3						M	M							
CO4						M	M							
CO5						M	M					M		

F. Course Content:

UNIT I SOURCES AND EFFECTS OFAIRPOLLUTANTS 9

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

UNIT II DISPERSION OF POLLUTANTS 9

Elements of atmosphere – Meteorological factors – Wind roses – Lapse rate - Atmospheric stability and turbulence – Plume rise – Dispersion of pollutants – Dispersion models – Applications.

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, condensation, combustion - Biological air pollution control technologies - bioscrubers, biofilters, and Indoor air quality.

UNIT IV AIR QUALITY MANAGEMENT 9

Air quality standards – Air quality monitoring - Air pollution control efforts – Zoning – Town planning regulation of new industries – Legislation and enforcement – Environmental Impact Assessment and Air quality – Air pollution measurement methods - Ambient air quality and emission standards - Air pollution indices - Air (Prevention and control of pollution) Act, 1981.

UNIT V AIR POLLUTION IN INDIA 9

Indian air pollution scenario – National air quality index – Role of the central pollution control board in controlling air pollution – Agricultural fires in India – Air quality in Delhi and other polluted cities in India.

TOTAL: 45 Periods

G. Learning Resources:

a) Text Books:

1. Anjaneyulu, D, "Air Pollution and Control Technologies" - Allied Publishers, Mumbai,2002.
2. Rao, C.S. "Environmental Pollution Control Engineering" - Wiley Eastern Ltd. New Delhi, 1996.
3. Rao M.N., and Rao H. V. N, "Air Pollution Control" - Tata McGraw Hill, New Delhi,1996.

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,1991.
3. Peavy S.W, Rowe D.R, and Tchobanoglous G, "Environmental Engineering" - McGraw Hill, New Delhi,1985.
4. Garg S.K, "Environmental Engineering Vol. II" - Khanna Publishers, New Delhi,1998
5. Mahajan, S.P, "Pollution Control in Process Industries" - Tata McGraw Hill, New Delhi, 1991.

1153CE106	CONSTRUCTION PROJECT MANAGEMENT	L	T	P	C
		3	0	0	3

Course Category: Allied Elective

A. Preamble:

- This course provides the knowledge to understand the various steps involved in the planning, cost and safety management of a project.

B. Prerequisite:

- Nil

C. Course Educational Objectives:

- Students undergoing this course are expected
  - To study how the owner view a project in consideration with project life cycle, construction agencies legal requirements etc
  - To study the various types of organization and their impact on and suitability to construction projects
  - To study the design and construction procedures along with labour material and equipment utilization
  - To study the elements of cost of a project

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 roles of various personnel in project	K2
CO2	Understand the concept of organizing a project	K2
CO3	Understand the design and construction process of a project	K2
CO4	Demonstrate effective utilization of labour, material and equipment	K2
CO5	Predict cost control and financial accounting	K2

E. Correlation of COs with POs:

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

F. Course Content:

UNIT I THE OWNERS' PERSPECTIVE 9

Introduction - Project Life Cycle - Types of Construction - Selection of Professional Services - Construction Contractors - Financing of Constructed Facilities - Legal and Regulatory Requirements - Changing Environment of the Construction Industry - Role of Project Managers.

UNIT II ORGANIZING FOR PROJECT MANAGEMENT 9

Project Management – modern trends - Strategic Planning - Effects of Project Risks on Organization - Organization of Project Participants -Traditional Designer-Constructor Sequence - Professional Construction Management - Owner-Builder Operation - Turnkey Operation - Leadership and Motivation for the Project Team.

UNIT III DESIGN AND CONSTRUCTION PROCESS 9

Design and Construction as an Integrated System - Innovation and Technological Feasibility - Innovation and Economic Feasibility - Design Methodology - Functional Design - Construction Site Environment.

UNIT IV LABOUR, MATERIAL AND EQUIPMENT UTILIZATION 9

Historical Perspective - Labour Productivity - Factors Affecting Job-Site Productivity - Labour Relations in Construction - Problems in Collective Bargaining - Materials Management - Material Procurement and Delivery - Inventory Control - Tradeoffs of Costs in Materials Management. - Construction Equipment - Choice of Equipment and Standard Production Rates - Construction Processes Queues and Resource Bottlenecks.

UNIT V COST ESTIMATION 9

Costs Associated with Constructed Facilities - Approaches to Cost Estimation - Type of Construction Cost Estimates - Effects of Scale on Construction Cost - Unit Cost Method of Estimation - Methods for Allocation of Joint Costs - Historical Cost Data - Cost Indices - Applications of Cost Indices to Estimating - Estimate Based on Engineer's List of Quantities - Estimation of Operating Costs.

TOTAL: 45 Periods

H. Learning Resources:

a) Text Books:

1. Chitkara, K.K, “Construction Project Management: Planning, Scheduling and Control” - Tata McGraw-Hill Publishing Company, New Delhi, 2005.
2. Choudhury S, “Project Management” - McGraw-Hill Publishing Company, New Delhi, 1988.
3. Prasanna Chandra, “Project Planning, Analysis, Selection, Implementation and review” - Tata Mcgraw Hill, 1999.
4. Senguntha,B and Guha,H., “Construction Management and Planning” – Tata Mc Graw Hill, 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. Frederick E and Gould, "Construction Project Management", Wentworth Institute of Technology - Massachusetts Institute of Technology Press, 2000.
3. George J. Ritz , "Total Construction Project Management" - McGraw-Hill, 1994.

1153CE107	ENVIRONMENTAL CONSERVATION	L	T	P	C
		3	0	0	3

Course Category: Allied Elective

A. Preamble:

To provide a basic understanding of the occupancy of the ecosystem in line with Biodiversity. Its conservative measures are taken by the agencies as well as the federal Government.

B. Prerequisite:

- NIL

C. Course Educational Objectives:

Students undergoing this course are expected to:

- Understand the basics of ecosystems and Biodiversity
- Understand and visualize the conservative measures as well as sustainable development strategies laid by the federal agencies and Government bodies

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

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Illustrate the elements and types of biodiversity.	K2
CO2	Contrast the threats and damages to biodiversity.	K2
CO3	Classify the bio diversity conservation and protection measures.	K2
CO4	Outline the sustainable management of biodiversity.	K2
CO5	Summarize the legal aspects of environmental conservation.	K2

E. Correlation of COs with POs:

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

F. Course Content:

UNIT I TYPES, FUNCTIONS AND BENEFITS OF BIODIVERSITY 9

Types of Biodiversity: Species, Genetic and Ecosystem diversity – Alpha, beta, and gamma diversity – Biodiversity and ecosystem function – Mega diversity zones and Biodiversity Hot Spots in India – Ecologically Sensitive Areas (ESA) in India - Use of Biodiversity: Source of food, medicine, raw material, aesthetic and cultural uses – Biodiversity Prospecting: Significance of Indigenous Knowledge Systems

UNIT II THREATS TO BIODIVERSITY 9

Natural and anthropogenic threats to biodiversity – Human-Animal conflict with special reference to elephants and tigers - IUCN Threat Categories – Red Data Book – Wildlife exploitation - Species extinctions – Endangered and endemic species of flora and fauna in India - Over-harvesting and Climate change on biodiversity - Causes and Impacts of Invasive species to biodiversity

UNIT III CONSERVATION STRATEGIES 9

Current practices in conservation: Habitat or Ecosystem Approaches - Species-based Approaches - Social Approaches: Chipko Movement – In-situ conservation: Afforestation, Social Forestry, Agroforestry, Botanical gardens, Zoos, Biosphere Reserves, National Parks, Sanctuaries, Protected Area Network, Sacred Groves and Sthalavrikshas – Ex-situ conservation: Cryopreservation, Gene Banks, Seed Banks, Pollen Banks, Sperm Banks, DNA Banks, Tissue Culture and Biotechnological Strategies

UNIT IV SUSTAINABLE MANAGEMENT OF BIO RESOURCES 9

National Biodiversity Authority (NBA) – Functions of State Biodiversity Board (SBB) and Biodiversity Management Committee's (BMC) – The role of WWF, FAO, UNESCO, UNDP and UNEP for biodiversity conservation – An elementary account on WTO, GAAT and TRIPS – Biopiracy rights of farmers, breeders and indigenous people –Biodiversity informatics with special reference to plant genetic resources

UNIT V POLICIES, PROGRAMMES AND ACTS FOR CONSERVATION 9

Status and protection of species in National and International levels – Role of CITES and IUCN – Convention on Biological Diversity (CBD) – Nagoya Protocol – Man and Biosphere Programme (MAB) – Policies implemented by MoEF for biodiversity conservation – Salient features of Biological Diversity Act 2002.

TOTAL: 45 Periods

G. Learning Resources:

a) Text Books:

1. Chaudhuri AB and Sarkar DD, "Mega diversity Conservation: Flora, Fauna and Medicinal Plants of India's Hot Spots" - Daya Publishing House, New Delhi, 2003.
2. Dadhich LK and Sharma AP, "Biodiversity: Strategies for Conservation" - APH Publishing Corporation, New Delhi, 2002.

b) References:

1. Gary K Meffe and Ronald Carroll C, “Principles of Conservation Biology” - Sinauer Associates Inc. Massachusetts, 1994.
2. Groombridge B (Ed.)“Global Biodiversity Status of the Earths Living Resources” - Chapman & Hall, London, 1992.
3. Khan TI,Dhari N and Al Ajmi, “Global Biodiversity: Conservation Measure” - Pointer Publishers, Jaipur 1999.

1153CE108	SMART TRANSPORTATION SYSTEM	L	T	P	C
		3	0	0	3

Course Category: Allied Elective

A. Preamble:

This course is to provide the exposure of latest technologies and its effect on transportation system

B. Prerequisite:

- NIL

C. Course Educational Objectives:

Students undergoing this course are expected to understand the advancements in transportation system with the help of latest technologies.

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 what is an intelligent transport system	K2
CO2	Get the helps of ITS in the field of transport system	K2
CO3	Enhance the intersection design and management	K2
CO4	Understand the advanced concepts of transport management system	K2
CO5	Apply traveler information system	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								
CO2					M	M								
CO3					M	M								
CO4					M	M								
CO5					M	M								

F. Course Content:

UNIT I INTRODUCTION TO INTELLIGENT TRANSPORT SYSTEM 9

Definition – Role and Responsibilities – Advanced Traveller Information System – Fleet Oriented ITS Services – Electronic Toll Collection – Critical issues – Security – Safety

UNIT II ITS ARCHITECTURE AND HARDWARE 9

Architecture – ITS Architecture Framework – Hardware Sensors – Vehicle Detection – Techniques – Dynamic Message Sign – GPRS – GPS – Toll Collection

UNIT III INTERSECTION MANAGEMENT 9

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 – Data Collection – Process – Dissemination to Travelers – Evaluation of Information – Value of Information – Business Opportunities

TOTAL: 45 Periods

G. Learning Resources:

a) Text Books:

1. Henry F.Korth and Abraham Siberschatz, "Data Base System Concepts" - McGraw Hill, 1992.
2. Turban E, "Decision Support and Export Systems Management Support Systems" - Maxwell Macmillan, 1998.

b) References:

1. Sitausu S.Mittra, "Decision Support Systems: Tools and Techniques" - John Wiley, New York, 1986.
2. Cycle W. Halsapple and Andrew B.Winston, "Decision Support Systems: Theory and Application" - Springer Verlog, New York, 1987

1153CE109	GEOGRAPHIC INFORMATION SYSTEM	L	T	P	C
		3	0	0	3

Course Category: Allied Elective

A. Preamble:

Students undergoing this course are expected gain the knowledge of physical concepts and underlying various engineering and technological applications in remote sensing.

B. Prerequisite:

- NIL

C. Course Educational Objectives:

Students undergoing this course are expected to
- Understand the basic concepts of Geographic Information System
- Understand the spatial data structures and input, management and output processes.

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

CO	STATEMENT	K LEVEL
CO1	Understand the GIS, background, development and components of GIS	K2
CO2	Understand the various data types in GIS	K2
CO3	Understand the projection, coordination systems and errors in GIS.	K2
CO4	Understand the data quality and standards	K2
CO5	Understand the vector and raster data base management system and GIS layout.	K2

E. Correlation of COs with POs:

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

F. Course Content:

UNIT I FUNDAMENTALS OF GIS 9

Introduction to GIS - Basic spatial concepts - Coordinate Systems - GIS and Information Systems – Definitions – History of GIS - Components of a GIS – Hardware, Software, Data, People, Methods – Proprietary and open source Software - Types of data – Spatial, Attribute data- types of attributes – scales/ levels of measurements.

UNIT II SPATIAL DATA MODELS 9

Database Structures – Relational, Object Oriented – Entities – ER (entity relationship) diagram - data models - conceptual, logical and physical models - spatial data models – Raster Data Structures – Raster Data Compression - Vector Data Structures - Raster vs Vector Models- TIN and GRID data models.

UNIT III DATA INPUT AND TOPOLOGY 9

Scanner - Raster Data Input – Raster Data File Formats – Geo-referencing – Vector Data Input – Digitizer – Datum Projection and reprojection -Coordinate Transformation – Topology - Adjacency, connectivity and containment – Topological Consistency – Non topological file formats - Attribute Data linking – Linking External Databases – GPS Data Integration

UNIT IV DATA QUALITY AND STANDARDS 9

Data quality - Basic aspects - completeness, logical consistency, positional accuracy, temporal accuracy, thematic accuracy and lineage – Metadata – GIS Standards –Interoperability - OGC (open geospatial consortium) - Spatial Data Infrastructure

UNIT V DATA MANAGEMENT AND OUTPUT 9

Import/Export – Data Management functions- Raster to Vector and Vector to Raster Conversion - Data Output - Map Compilation – Chart/Graphs – Multimedia – Enterprise vs. Desktop GIS distributed GIS.

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.

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/105102015/

1153CE110	SUSTAINABLE CITIES	L	T	P	C
		4	0	4	6

COURSE CATEGORY: Allied Elective

A. PREAMBLE

This course deals about the smart city development with emphasize on urban forest concept.

B. PREREQUISITES:

- Nil.

C. COURSE EDUCATIONAL OBJECTIVES:

Students undergoing this course are expected to:

- Gain knowledge on current trends in smart city development.
- Acquire knowledge on futuristic urban forest systems and concepts.
- Demonstrate knowledge on smart city and urban forest elements.

D. COURSE OUTCOME:

After the completion of the course the students will be able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's)
CO1	Contrast the smart city and features.	K2
CO2	Elaborate the smart solutions in urban scale.	K2
CO3	Explain the local and global need of urban forests.	K2
CO4	Illustrate the executing paths of urban forest infrastructures	K2
CO5	Outline the comparisons between a smart city and urban forest.	K2
CO6	Communicate effectively through a presentation.	S3
CO7	Work in small groups and fabricate models based on smart city and urban forest concepts.	S4

K2-Understand; K3-Apply; S3-Skill Level-Precision; S4-Skill Level-Articulation.

E. CORRELATION OF COs WITH POs

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1									M			H
CO2					M				M			H
CO3									M			H
CO4					M				M			H
CO5									M			H
CO6									M	M	M	
CO7									M	M	M	

H- High**; M-**Medium**; L-**Low

F. COURSE CONTENT:

UNIT 1 SMART CITY 9

Definition of smart city – Objectives – Mission strategy – Basic infrastructure – Features of smart city - Smart solutions – Smart city selection process: stage I and stage II – State of urbanisation in India - India's 100 smart city mission – Proposed reference framework for smart city mission in India - Major issues and challenges in smart city development.

UNIT II SMART SOLUTIONS 9

Strategy for developing as a smart city – Urban street design – Street typology: principles of street design – Street elements: foot path, cycle tracks, carriage way, shoulders, on-street parking, bus stops – Safety elements: pedestrian crossings, traffic calming measures, speed breakers, traffic signals, central medians, railings and bollards, street lights, street furniture, signage, road markings, advertisements – Multi utility zones: street plantation, utility services, storm water, garbage bins, public toilets.

UNIT III URBAN FORESTS 9

What is vertical forest? – Green infrastructure glossary – Urban forests revolution – The necessity – Living facades – Evolution of high rise forest buildings – Technical drawings and tools. Benefits and issues in urban forests - Case studies: Nanjing towers, Shijiazhuang Forest city.

UNIT IV SYSTEMS AND TECHNOLOGY 9

Greenery in the context of tall buildings - Building structural systems – Planting restraint safety systems – Building envelope and vegetation layers – Irrigation systems – Energy performances – Monitoring: selection of testing areas and trees, determining the success of plantings, tree health-field and laboratory tests – Use of digital photography in determining vegetal cover in urban settings – Maintenance.

UNIT V SMART CITY Vs URBAN FORESTS **9**

Forest Vs City – Benefits of urban trees – Trees and climate change – Trees as public health infrastructure – Cost, time span comparisons between smart city and urban forest development - Incorporation of smart solutions in urban forests – Major sustainability challenges.

MODEL MAKING **15**

Students need to formulate into groups (of maximum 3) to identify, conceptualize, fabricate and demonstrate the working models based on smart city and urban forest concepts, under following themes:

1. Smart solutions in Environmental monitoring (Air, Water and Waste management)
2. Smart solutions in Traffic management.
3. Smart solutions in Building automation.
4. Buildings with green facades.
5. Buildings with vertical farming.

SEMINAR **15**

Students need to present a seminar individually on a specific topic followed by a guided study.

FIELD VISIT **15**

Students need to formulate into groups (of maximum 3) to undergo field visits regarding smart city construction and urban forest and to submit a report.

TOTAL: 90 PERIODS

G. LEARNING RESOURCES:

a) TEXTBOOKS

1. Mani N, "Smart Cities and Urban development in India", 2016.
2. Satyam A, Calzada I, "The smart city transformations: The revolution of the 21st century", 2017.
3. GRIHA Manuals (Volume 1 – 5), TERI Publications, 2015.

b) REFERENCES

1. Reconceptualising Smart Cities: A Reference Framework for India - Center for Study of Science, Technology and Policy (CSTEP), 2015.
2. Stefeno Boeri, A vertical forest, 2016.

c) ONLINE RESOURCES

www.smartcities.gov.in

https://www.youtube.com/watch?v=Yc1nWwB86Wo

https://www.youtube.com/watch?v=k9RGdbxzsBY

https://www.youtube.com/watch?v=jAcdg9g1tv0

1153CE111	DISASTER MANAGEMENT AND MITIGATION	L	T	P	C
		3	0	0	3

Course Category / Type: Allied Elective

A. Preamble:

- This course is useful in distinguishing the different type of disasters and their effects. The student learns a coordinated approach to manage and mitigate in the event of a disaster with the assistance of stakeholders and other government agencies. This leads to familiarization with the Disaster Management Act of Government of India.

B. Prerequisite:

- Nil

C. Link to other Courses:

- Environmental Science

D. Course Educational Objectives:

Students undergoing this course are expected to:

- Understand the concepts of disaster, hazard and vulnerability
- Recognize the importance of disaster management
- Identify the appropriate agency organizing disaster mitigation.

E. 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 socio-economic impact due to disaster and hazard	K1
CO2	Classify the different type of disasters and their causes	K2
CO3	Describe the basic concepts of disaster management cycle, preparedness, response and recovery	K2
CO4	Recognize the stake holders, their jurisdiction and responsibilities in the disaster management system	K2
CO5	Prepare different case study reports using advanced techniques	K2

F. Correlation of COs with POs:

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

G. COURSE CONTENT

UNIT I BASIC CONCEPTS 9

Concepts and definition of Disaster, Hazard, Vulnerability, Risk analysis and Capacity Metrological factors – climatic change. Types of vulnerability - physical vulnerability and socio-economic vulnerability - Crisis Management - Disaster Management and Mitigation.

UNIT II TYPES OF DISASTER 9

Geological Disasters - earthquakes, landslides, tsunami, mining, volcanoes; Hydro-Meteorological Disasters: floods, cyclones, lightning, thunder-storms, hail storms, avalanches, droughts, cold and heat waves; Biological Disasters: pandemic, epidemics, pest attacks, cattle epidemic and food poisoning; Nuclear and Industrial Disaster: chemical and industrial disasters, nuclear accidents; Accidental Disasters: urban and forest fires, oil spill, mine flooding incidents, accidents (road, rail, air and sea), collapse of bridges, buildings and other facilities structures & dam failures; House-hold disasters: gas-cylinder leaks and explosion
Practical examples on all types of disaster.

UNIT III DISASTER MANAGEMENT FRAMEWORK 9

Disaster Management Cycle – Paradigm Shift in Disaster Management. Pre-Disaster – Risk Assessment and Analysis, Risk Mapping, Awareness During Disaster – Evacuation – Disaster Communication – Search and Rescue – Emergency Operation Centre – Incident Command System – Relief and Rehabilitation – Post-disaster – Damage and Needs Assessment– Early Recovery – Reconstruction and Redevelopment.

UNIT IV DISASTER MITIGATION 9

Disaster Profile of India – Mega Disasters of India and Lessons Learnt Disaster Management Act 2005 (GOI) – Institutional and Financial Mechanism National Policy on Disaster Management, National Guidelines and Plans on Disaster Management; Role of Government (local, state and national), NDMA, NDRF, NGOs, Inter-Governmental and other Agencies.

UNIT V RECENT ADVANCES IN DISASTER MITIGATION 9

Geo-informatics in Disaster Management (GIS, GPS and RS) Disaster Communication System (Early Warning and Its Dissemination) Case studies: Disaster risk assessment and preparedness for disasters with reference to disasters in: earthquake, building collapse, wild fire, floods, oil spill, pandemic, epidemic, house-hold disasters. **Total : 45 Periods**

H. LEARNING RESOURCES

(a) TEXT BOOKS:

1. Bryant E. (2005), Natural Hazards, Cambridge University Press, U.K.
2. Chakraborty, S.C. (2007), Natural Hazards and Disaster Management, Pragatishil Prokashak, Kolkata.
3. Coppola D P (2007), Introduction to International Disaster Management, Elsevier Science, London.
4. Khanna, B. K. (2005), Disasters: All You Wanted to Know About, New India Publishing Agency, New Delhi.

(b) REFERENCE BOOKS:

1. Angus M. Gunn (2008), Encyclopedia of Disasters – Environmental Catastrophes and Human Tragedies, Vol. 1 & 2, Greenwood Press, London.
2. Gupta, A.K., Niar S.S and Chatterjee S. (2013), Disaster management and Risk Reduction, Role of Environmental Knowledge, Narosa Publishing House, Delhi.
3. Srivastava, H. N. and Gupta, G. D.(2006), Management of Natural Disasters in developing countries, Daya Publishers, Delhi, 201 p.
4. Alexander, D. (1999), Natural Disasters, Kluwer Academic, London, 632 p.

(c) ONLINE SOURCES:

1. http://www.adpc.ait.ac.th
2. http://www.adrc.or.jp
3. http://www.cepredenac.org
4. http://www.disaster.info.desastres.net/crid
5. http://www.unige.ch/idndr
6. http://www.disaster.net
7. http://www.disaster.info.desastres.net/dipecho
8. http://www.disasterrelief.org
9. http://www.eri.u-tokyo.ac.jp
10. http://www.europa.eu.int/comm/echo
11. http://www.fao.org/giews/default.html
12. http://geoweb.fao.org
13. http://www.fao.org/fivims/default.html
14. http://www.fema.gov
15. http://www.haznet.org
16. http://www.ifrc.org
17. http://www.idrmhome.org
18. http://www.unisdr.org
19. http://www.osso.univalle.edu.co/tmp/lared/lared/html
20. http://www.desenredando.org
21. http://www.reliefweb.int/
22. http://www.promujer.org
23. http://www.sewa.org
24. http://www.wfp.org
25. http://www.who.int/eha
26. http://www.wmo.ch

INSTITUTE ELECTIVES

Institute Electives					
Code	**Course**	**L**	**T**	**P**	**C**
1154CE101	Resource and Energy Recovery from Waste	3	0	0	3
1154CE102	Electronic Distance Measuring Methods	3	0	0	3
1154CE103	Construction Contracts	3	0	0	3
1154CE104	Building Materials	3	0	0	3
1154CE105	Construction Engineering	3	0	0	3
1154CE106	Green Technology and Smart Buildings	3	0	0	3
1154CE107	Startup Essentials	3	0	0	3
1154CE108	Application of Remote Sensing and GIS in Disaster Management	3	0	0	3
1154CE109	Intellectual Property and Innovation	3	0	0	3
1154CE110	Disaster Management and Mitigation	3	0	0	3
1154CE301	Surveying Laboratory	0	0	2	1
1154CE302	Environmental Engineering Laboratory	0	0	2	1
1154CE303	Concrete Technology Laboratory	0	0	2	1
1154CE304	Soil Mechanics Laboratory	0	0	2	1
1154CE305	CADD Laboratory	0	0	2	1
1154CE306	Building Drawing Laboratory	0	0	2	1
				Total	**10**

1154CE101	RESOURCE AND ENERGY RECOVERY FROM WASTE	L	T	P	C
		3	0	0	3

COURSE CATEGORY: Institute Elective

A. PREAMBLE :

To understand the principles and design of recovering materials and energy from wastes through mechanical, biological and thermal methods and learn to manage the undesirable by-products.

B. PRE-REQUISITES:

- NIL

C. COURSE EDUCATIONAL OBJECTIVES:

Students undergoing this course are expected to:

- Understand the different methodologies to recover certain resources and energy from waste.
- Differentiate the mechanical, biological and thermos-chemical methods of energy recovery from waste.
- Outline the waste management hierarchy and recycling possibilities for a given waste stream.

D. COURSE OUTCOMES:

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

CO	STATEMENT	K LEVEL
CO1	Explain the mechanical methods for material recycling.	K2
CO2	Illustrate the biological processes for resource recovery from waste streams.	K2
CO3	Compare the bio-chemical conversion processes for waste to energy.	K2
CO4	Outline the thermos-chemical conversion processes for waste to energy.	K2
CO5	Summarize the best possible waste recycling methods for a given waste stream.	K2

E. CORRELATION OF COS WITH POS:

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

F. COURSE CONTENT:

UNIT I MECHANICAL PROCESSING FOR MATERIAL RECYCLING 9

Resource recovery for a sustainable development - Material and energy flow management and analysis - Systems and processes for reduction, reuse and recycling - Objectives of waste processing - Source segregation and hand sorting - Waste storage and conveyance – Shredding – Pulping - Size separation by screens.

UNIT II BIOLOGICAL PROCESSING FOR RESOURCE RECOVERY 9

Mechanisms of biological processing – Aerobic processing of organic fraction - Composting methods and processes - Factors affecting - Design of windrow composting systems – In-vessel composting - Compost quality control - Vermiculture: definition, scope and importance - Environmental requirements - Culture methods - Applications of vermiculture.

UNIT III BIO-CHEMICAL CONVERSION OF WASTE TO ENERGY 9

Principles and Design of Anaerobic Digesters – Process characterization and control - The biochemistry and microbiology of anaerobic treatment - Toxic substances in anaerobic treatment - Methane generation by Anaerobic Digestion - Single stage and multistage digesters - Digester design and performance -Gas collection systems.

UNIT IV THERMO-CHEMICAL CONVERSION OF WASTE TO ENERGY 9

Principles and Design of Energy Recovery Facilities - Types and principles of energy conversion processes - Incinerator design - Mass Burn and RDF Systems - Composition and calorific value of fuels and waste, Determination of the stoichiometric air consumption, Calculation of the flue gas composition - Grate firing designs, boiler design, removal of bottom ash, heat recovery - Emission Controls – Flue gas cleaning, de-dusting, flue gas scrubbers, DeNOx processes, dioxins and furans – Pyrolysis process - Alterative processes.

UNIT V CASE STUDIES ON WASTE RECYCLING 9

Recycling technologies for paper, glass, metal, plastic – Used lead acid battery recycling - Electronic waste recycling – Waste oil recycling – Solvent recovery - Environmental impacts of waste recycling - DFE.

TOTAL: 45 PERIODS

G. LEARNING RESOURCES:

a) REFERENCES:

1. Aarne Veslind and Alan E Rimer, "Unit operations in Resource Recovery Engineering" - Prentice Hall Inc. London, 1981.

2. Manser A G R and Keeling A, "Practical handbook of processing and recycling on municipal waste" - Pub CRC Lewis London, 1996.

3. Chiumenti, Diaz, Savage, Eggerth, and Goldstein, "Modern Composting Technologies" - JG Press October, 2005

4. Charles R Rhyner, "Waste Management and Resource Recovery" - Lewis Publishers, 2005.

5. Gary C. Young, "Municipal Solid Waste to Energy Conversion Processes: Economic, Technical, and Renewable Comparisons", John Wiley & Sons, 2010.

b) ONLINE RESOURCES:

1. https://onlinecourses-archive.nptel.ac.in/noc19_ch13/course

1154CE102	ELECTRONIC DISTANCE MEASURING METHODS	L	T	P	C
		3	0	0	3

COURSE CATEGORY: Institute Elective

A. PREAMBLE:

To provide a basic understanding of distance measurement and use the advanced equipment's in the distance measurement.

B. PRE-REQUISITE:

- Basic Civil Engineering

C. LINKS TO OTHER COURSES:

- Surveying

D. COURSE EDUCATIONAL OBJECTIVE:

Students undergoing this course are expected to:

- Learn how to measure the distance by using EDM.
- Learn the working principle and the measuring concept of Total Station.

E. COURSE OUTCOMES:

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

CO	Course Outcomes	Level of learning domain (Based on revised Bloom's)
CO 1	Understand the fundamentals of EDM	K2
CO 2	Illustrate basic the knowledge on electronics	K2
CO 3	Apply the knowledge of propagation of electromagnetic waves and their correction	K2
CO 4	Understand the working principle, functions and operations of Total station and EDM.	K2
CO 5	Apply and use the total station and EDM concepts.	K2

F. CORRELATION OF COs WITH POs:

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

G. COURSE CONTENT:

UNIT I FUNDAMENTALS 9

Methods of measuring distance, historical development, basic principles of EDM, classifications, applications and comparison with conventional surveying.

UNIT II BASIC ELECTRONICS 9

Fundamentals of electronics, resonant circuits, semiconductors, Lasers, Cathode ray tube, photo multiplier tube, transducers, oscillators, frequency mixing, modulation and demodulation, Kerrcell modulator, measurement of phase difference, reflectors and power sources.

UNIT III PROPAGATION OF ELECTROMAGNETIC WAVES 9

Definition, classification, applications, propagation properties, wave propagation at lower and higher frequencies. Refractive index, factors affecting, computation of group refractive index for light and near infrared waves at standard conditions and ambient conditions, reference refractive index, first velocity correction, computation of refractive index for microwaves, measurement of atmospheric parameters, mean refractive index, real time application of first velocity correction, second velocity correction and total atmospheric correction.

UNIT IV ELECTROMAGNETIC DISTANCE MEASURING SYSTEM 9

Electro-optical system, measuring principle, working principle, sources of error, infrared EDM instruments, Laser EDM instruments and total station. Microwave system, measuring principle, working principle, sources of error, microwave EDM instruments, comparison with Electro optical system, care and maintenance of EDM instruments, Modern Positioning Systems. EDM traversing, trilateration and base line measurement using EDM.

UNIT V FIELD STUDIES 9

Study different EDM instruments and Total Station. EDM traversing, trilateration and base line measurement using EDM.

TOTAL: 45 PERIODS

H. LEARNING RESOURCES:

a) TEXT BOOK:

1. Rueger, J.M, "Electronic Distance Measurement" - Springer, Berlin, 1990.

b) REFERENCES

1. Burnside, C.D, "Electromagnetic distance measurement Crosby Lock wood staples" - U.K Press. 1971.
2. Laurila, S.H, "Electronic Surveying in Practice" - John Wiley and Sons, 1983.
3. Soastamoinen J.J, "Surveyor's guide to electro-magnetic Distance Measurement" - Adam Hilger Ltd. 1967.

1154CE103	CONSTRUCTION CONTRACTS	L	T	P	C
		3	0	0	3

COURSE CATEGORY: Institute Elective

PREAMBLE:

Students should be conversant with contract procedures, legal requirements and labour regulations.

A. PRE-REQUISITE:

Nil

B. LINKS TO OTHER COURSES:

- Safety in Construction

C. COURSE EDUCATIONAL OBJECTIVE:

Students undergoing this course are expected to:

- To study the various types of construction contracts and their legal aspects and provisions.
- To study contract laws and regulations so that adequate knowledge on formulating and managing construction contracts is gained.
- To know about tendering and legal requirements

D. COURSE OUTCOMES:

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

CO	COURSE OUTCOMES	Level of learning domain (Based on revised Bloom's)
CO1	Classify the construction contracts.	K2
CO2	Contrast the basics of tenders in project acquisition.	K2
CO3	Infer the significances of arbitration.	K2
CO4	Explain the legal requirements for construction projects.	K2
CO5	Summarize the important aspects of labour regulations.	K2

E. CORRELATION OF COURSE OUTCOMES WITH PROGRAMME OUTCOMES:

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

H- High; M-Medium; L-Low

F. COURSE CONTENT

UNIT I CONSTRUCTION CONTRACTS 9

Indian Contracts Act – Elements of Contracts – Types of Contracts – Features – Suitability – Design of Contract Documents – International Contract Document – Standard Contract Document – Law of Torts.

UNIT II TENDERS 9

Prequalification – Bidding – Accepting – Evaluation of Tender from Technical, Contractual and Commercial Points of View – Contract Formation and Interpretation – Potential Contractual Problems – World Bank Procedures and Guidelines – Tamil Nadu Transparency in Tenders Act.

UNIT III ARBITRATION 9

Comparison of Actions and Laws – Agreements – Subject Matter – Violations – Appointment of Arbitrators – Conditions of Arbitration – Powers and Duties of Arbitrator – Rules of Evidence – Enforcement of Award – Costs.

UNIT IV LEGAL REQUIREMENTS 9

Insurance and Bonding – Laws Governing Sale, Purchase and Use of Urban and Rural Land – Land Revenue Codes – Tax Laws – Income Tax, Sales Tax, Excise and Custom Duties and their Influence on Construction Costs – Legal Requirements for Planning – Property Law – Agency Law – Local Government Laws for Approval – Statutory Regulations.

UNIT V LABOUR REGULATIONS 9

Social Security – Welfare Legislation – Laws relating to Wages, Bonus and Industrial Disputes, Labour Administration – Insurance and Safety Regulations – Workmen's Compensation Act – Indian Factory Act – Tamil Nadu Factory Act – Child Labour Act - Other Labour Laws.

TOTAL: 45 PERIODS

G. LEARNING RESOURCES:

a) TEXT BOOKS:

1. Kwaku, A., Tenah, P.E. and Jose M.Guevara, P.E, "Fundamentals of Construction Management and Organisation" - Printice Hall, 1982.
2. Patil. B.S, "Civil Engineering Contracts and Estimates" - Universities Press, 2006.

b) REFERENCES

1. Gajaria G.T., "Laws Relating to Building and Engineering Contracts in India", 2000.
2. Jimmie Hinze, "Construction Contracts" - McGraw Hill, 3rd edition, 2013.
3. Joseph T. Bockrath, "Contracts and the Legal Environment for Engineers and Architects" - McGraw Hill, 7th edition 2010.

1154CE104	BUILDING MATERIALS	L	T	P	C
		3	0	0	3

Course Category : Institute Elective

A. Preamble:

To provide a general overview of basic construction related materials, properties, manufacturing / fabricating processes, and uses.

B. Prerequisite:

- 1150CE101 Basic Civil Engineering

C. Course Educational Objectives:

Students undergoing this course are expected:

- To examine the properties of common construction materials and their behaviour
- To assess material properties, mechanical tests and quality control tests.
- To appraise appropriateness and sustainability of materials for construction projects.

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

CO	STATEMENT	K LEVEL
CO1	Classify the different types of stones and their properties for construction.	K2
CO2	Explain the constituents of bricks and various types of cements and properties	K2
CO3	Outline the ingredients, properties and types of concrete.	K2
CO4	Explain role of timber and aluminium as materials in constructions.	K2
CO5	Demonstrate the advancements in construction materials.	K2

E. Correlation of COs with POs:

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

F. Course Content:

UNIT I STONES 9

Classification - Selection – Use of stones in buildings - Requirement and testing of stones – Deterioration and preservation of stone work - Artificial stones.

UNIT II BRICKS AND CEMENT 9

Manufacture of bricks - Classification - Qualities - Tests on Brick - Uses of brick - Cement – Types of cement – Tests on cement – Application of cement.

UNIT III CONCRETE 9

Concrete – Ingredients – Manufacturing Process - Properties of fresh concrete - Properties of hardened concrete – Tests on fresh and hardened concrete – Application of concrete – RMC – Types of Concrete - Admixtures. .

UNITS IV TIMBER AND OTHER MATERIALS 9

Timber – Market forms – Plywood – Veneer – Thermocol – Steel – Aluminium and Other Metallic Materials – Composition – Aluminium composite panel – Uses – Market forms – Paints – Varnishes.

UNIT V MODERN MATERIALS 9

Glass – Ceramics – Sealants for joints - Glass fibre reinforced polymers – Carbon Fibre reinforced polymers – Clay products – Composite materials – Types – Applications of laminar composites – Fibre textiles – Geo-membrane and Geo-textiles.

TOTAL: 45 PERIODS

G. Learning Resources:

a) **a) Text Books:**

1. Rangwala, S.C, “Engineering Materials” - Charotar Publishing House, 43rd edition 2017.
2. Varghese.P.C, “Building Materials” - PHI Learning Pvt. Ltd, New Delhi, 2015.
3. Rajput. R.K, “Engineering Materials” - S. Chand and Company Ltd. New Delhi, 2008.

b) **b) References:**

1. Jagadish.K.S, “Alternative Building Materials Technology” - New Age International Publishers, New Delhi, 2008.
2. Gambhir. M.L and Neha Jamwal, “Building Materials: Products, Properties and Systems” - Tata McGraw Hill Educations Pvt. Ltd, New Delhi, 2017.
3. Santhakumar A R “Concrete Technolgy” Oxford University Press ” India, 2016
4. Shetty.M.S, “Concrete Technology: Theory and Practice” - S. Chand and Company Ltd., New Delhi, 8th edition, 2018.

1154CE105	CONSTRUCTION ENGINEERING	L	T	P	C
		3	0	0	3

COURSE CATEGORY: Institute Elective

H. PREAMBLE :

To understand the planning and execution of construction activities and construction materials and equipment.

I. PRE-REQUISITES:

- 1150CE101 Basic Civil Engineering

J. COURSE EDUCATIONAL OBJECTIVES:

Students undergoing this course are expected to:

- Understand the different methodologies for site selection and investigation.
- Differentiate the various materials available for construction activities.
- Outline the construction planning and equipment.

K. COURSE OUTCOMES:

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

CO	STATEMENT	K LEVEL
CO1	Demonstrate the site selection and site investigation processes.	K2
CO2	Classify the various construction materials and their properties.	K2
CO3	Illustrate the ingredients and methods of concreting.	K2
CO4	Compare the equipment used in various construction activities.	K2
CO5	Outline the planning and execution of a building’s construction.	K2

L. CORRELATION OF COs WITH POs:

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

M. COURSE CONTENT

UNIT I SITE SELECTION RECONNAISSANCE 9

Site visit – Reconnaissance – Type of soil – Ground water conditions – Site exploration – Local topography – Escarpments, excavations, cuttings, fillings, quarries. Water levels in wells, streams. Flood marks – Drainage pattern. Evidence of erosion on land slides. Soil sampling – Typical bore log. Bearing capacity based on field tests and laboratory tests. Concept of smart cities. Remote Sensing, GIS, GPS.

UNIT II CONSTRUCTION MATERIALS 9

Bricks – Ingredients – Composition – Classification. Steel – Uses – Classification – Composition – Raw materials. Water quality assurance. Wood – Uses – Classification – Types – Bamboo as a construction material. Glass – Types – Uses. Aluminum – Composition – Classification. Varnish – Paints – Sealants – Admixtures – Uses. Masonry - Types – Uses. Composites – Uses. Alternate materials used in construction. Smart materials – Types – Eco friendly materials used in construction.

UNIT III CONCRETING METHODS 9

Concrete – Ingredients – Preparation of concrete – Ready mix concrete – Admixtures. Preparation and testing of cubes. Concrete – Placing – Curing – Minimum required duration. Types of concrete – Special concreting methods – Under water concreting. Pre-cast and prefabricated elements. Pre-stressed concrete structures. Ready mix concrete and transportation methods.

UNIT IV CONSTRUCTION EQUIPMENTS 9

Earthwork – Earth moving operations. Types of earthwork equipment – Tractors, motor grades, scrapers, front end waders – Earth movers. Compactors – Sheep foot rollers – Vibro-flotation. Pile driving equipment – Hammers. Concreting – Batching, mixing, hauling. Material handling equipment. Erection of structures. Equipments for dredging, trenching, tunneling, etc.

UNIT V PLANNING AND EXECUTION 9

Types of building foundation. Basic concepts in developing plan, elevation, isometric view. Assessing the loads – Live load – Dead load – Earthquake load – Wind forces. Estimation and costing – Application of software packages. Construction scheduling – Contracting – Agreement. Planning for energy saving arrangements.

TOTAL: 45 PERIODS

N. LEARNING RESOURCES:

a) TEXT BOOKS

1. Shetty M.S, “Concrete Technology” - S. Chand and Company Ltd. Delhi, 2008.
2. Santhakumar. A.R, “Concrete Technology” - Oxford University Press, 2016.
3. Denison Campbell, Allen and Harold Roper, “Concrete Structures: Materials, Maintenance and Repair” - Longman Scientific and Technical UK, 1991.
4. Chitkara, K.K, “Construction Project Management: Planning, Scheduling and Control” - Mc Graw-Hill Publishing Company, New Delhi, 2005.

b) REFERENCES

1. IS 456:2000, Plain and Reinforced Concrete, Code of Practice, Bureau of Indian Standards, Manak Bhawan, No.9, Bhadur Shah Zafar Marg, New Delhi 110 002.
2. IS 2212:1991, Brick Works, Code of Practice, Bureau of Indian Standards, Manak Bhawan, No.9, Bhadur Shah Zafar Marg, New Delhi 110 002.

1154CE106	GREEN TECHNOLOGY AND SMART BUILDINGS	L	T	P	C
		3	0	0	3

Course Category: Institute Elective

A. Preamble:

To understand the principles and mechanisms of green and smart building concepts.

B. Prerequisite:

- NIL

C. Course Educational Objectives:

Students undergoing this course are expected to:

- Understand the different methodologies to recover certain resources and energy from waste.
- Differentiate the mechanical, biological and thermo-chemical methods of energy recovery from waste.
- Outline the waste management hierarchy and recycling possibilities for a given waste stream.

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 concepts of smart buildings.	K2
CO2	Outline the functions of sensors and actuators.	K2
CO3	Classify and compare the advanced building materials.	K3
CO4	Illustrate the different types of smart building systems.	K3
CO5	Summarize the uses of nano technology in green building materials.	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									
CO2	L				L									
CO3	L				L									
CO4	L				L									
CO5	L				L									

G. Course Content:

UNIT I INTRODUCTION TO SMART MATERIALS AND STRUCTURES 9

Introduction to smart buildings - Basic concepts - Cost analysis of buildings – Introduction to smart building - Green buildings – Techniques - Merits.

UNIT II ACTUATOR TECHNIQUES 9

Actuator and actuator materials – Piezoelectric and Electrostrictive Materials – Magneto structure Material – Shape Memory Alloys – Electrorheological Fluids – Electromagnetic actuation – Role of actuators and Actuator Materials.

UNIT III ADVANCED BUILDING MATERIALS 9

Aluminum, glass, fabric, various types of finishes and surface treatments-Construction chemicals – Sealants-Engineering grouts, mortars, admixtures and additives- Green concrete.

UNIT IV BUILDING SYSTEMS 9

Lighting – Day lighting- Ventilation – Natural ventilation- Indoor air quality- Heating/cooling – Geothermal- Passive and Active systems for energy production and conservation-Water conservation – Grey water reuse-Water saving plumbing fixtures.

UNIT V NANOMATERIALS FOR GREEN SYSTEMS 9

Green materials, bio materials, bio polymers, bio plastics, and composites- Nanotech Materials for truly sustainable construction- Windows- Skylights and Lighting- Paints- Roofs- Walls and Cooling- Multifunctional Gas Sensors- Biomimetic Sensors- Optical Interference Sensors- Thermo-sensors- Light sensors, and Stimulus-responsive smart materials- Nanomaterials.

TOTAL: 45 PERIODS

H. Learning Resources:

a) Text Books:

1. Brain Culshaw, "Smart Structure and Materials" - Artech House, Borton, London, 1996.

b) References:

1. Srinivasan, A.V and Michael McFarland. D, "Smart Structures: Analysis and Design"- Cambridge University Press, 2001.

1154CE107	STARTUP ESSENTIALS	L	T	P	C
		3	0	0	3

Course Category: Institute Elective

A. Preamble:

This course deals about the fundamentals of startups and its initial requirements.

B. Prerequisite:

- Nil

C. Course Educational Objectives:

Students undergoing this course are expected to:

- Gain knowledge on entrepreneurship and qualities of an entrepreneur.
- Acquire knowledge on creativity and its importance for startup companies.
- Impart knowledge on step by step procedure for developing a startup in India.

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

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Contrast the fundamentals of entrepreneurship.	K2
CO2	Relate the concepts of creativity with the context of entrepreneurship.	K2
CO3	Outline the structure of a startup from definition to registration.	K2
CO4	Illustrate the fund generation ways for a startup.	K2
CO5	Compare the various Indian and foreign startups as case studies.	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	H	H		
CO2									M	L		H		
CO3									M	M	H	H		
CO4									M	M	H	H		
CO5									M	M	H	H		

F. Course Content:

UNIT 1 ENTERPRENEURSHIP 9

Definition - Innovation and entrepreneurship, Contributions of entrepreneurs to the society, risk- Corporate entrepreneurship or intrapreneurship - Learning entrepreneurship - Profile of an entrepreneur (entrepreneurial qualities) - New venture: decision to start a startup - Risk in entrepreneurship, mitigation, market survey - 10 success lessons from giants for entrepreneurs.

UNIT II CREATIVITY 9

Lucid dreaming – Mental blocks – Relationship in-between happiness and stress – How to be creative? – Creativity: vertical and lateral thinking – Stenberg's theory of creativity – The 10000 hours rule – Motivation – Traits of a creative engineer – Ways to improve creativity.

UNIT III ELEMENTS OF A START-UP 9

Definition - How to start a startup? - Mastering in fundamentals – Questions to be answered – Organization structure of a startup – Company registration in India: a step by step procedure – One Person Company (OPC) - Significances of intellectual property in startups.

UNIT IV FINANCE 9

Funding options – Government & private schemes (Carbon Zero Challenge Initiative, IIT Madras) – Startup India Standup India – Startup financial pyramid: foundation, processes, model, budgeting and monitoring – Mistakes to avoid.

UNIT V CASE STUDIES 9

Success and failure case studies of domestic and international startups.

TOTAL: 45 PERIODS

G. Learning Resources:

c) a) Text Books:

1. Robert D. Hisrich and Veland Ramadani, "Effective Entrepreneurial Management: Strategy, Planning, Risk Management, and Organization" - Springer, 2017.
2. Kuratko & Hodgetts, "Entrepreneurship - Theory, Process and Practice" - Thomson South-Western Publication 2015.

d) b) References:

1. Robert D. Hisrich, "Entrepreneurship" - Tata McGraw Hill Publications, Edition-10, 2017.
2. NPTEL Lecture material: https://onlinecourses.nptel.ac.in/noc19_ge08/course

1154CE108	APPLICATION OF REMOTE SENSING AND GIS IN DISASTER MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE CATEGORY: Institute Elective

A. PREAMBLE:

To understand the basics of remote sensing and GIS for applications of disaster mitigation studies

B. PREREQUISITES:

Nil

C. COURSE EDUCATIONAL OBJECTIVES:

Students undergoing this course are expected to:

- Understand the GIS, background, development and components of GIS
- Study the sensor parameters.
- Analysis and demonstrate the various spatial and non-spatial data in GIS
- Enumerate the application of GIS in disaster mitigation

D. COURSE OUTCOMES:

After the completion of the course the students will be able to

CO	Course Outcomes	Level of learning domain (Based on revised Bloom's)
CO1	Explain the remote sensing principles and the characteristics of spectral reflectance of water, vegetation and soil.	K2
CO2	Compare the resolution concepts and payload characteristics of different sensors.	K2
CO3	Outline the fundamental concepts of spatial and non-spatial data in GIS.	K2
CO4	Relate the spatial communication system and mitigation system during disaster.	K2
CO5	Summarize the application of GIS in various fields.	K2

E. CORRELATION OF COs WITH POs:

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

F. COURSE CONTENT:

UNIT I INTRODUCTION TO REMOTE SENSING 9

Definition of remote sensing and its components – Electromagnetic spectrum – Wavelength regions important to remote sensing – Wave theory, Particle theory, Stefan-Boltzmann and Wein's Displacement Law – Atmospheric scattering, absorption – Atmospheric windows –Typical spectral reflective characteristics of water, vegetation and soil.

UNIT II PLATFORMS AND SENSORS 9

Types of platforms – Orbit types, Sun-synchronous and geosynchronous – Passive and active sensors – Resolution concept – Pay load description of important earth resources and meteorological satellites

UNIT III FUNDAMENTALS OF GIS 9

Introduction to GIS - Components of a GIS – Hardware, software, data and methods – Standard GIS software – Open source software – Data type – Spatial and non-spatial data – Measurement scales – Data base management systems – Raster and vector data base management system (DBMS).

UNIT IV DISASTER MITIGATION SYSTEM 9

Needs and approach towards prevention – Principles and components of mitigation - Satellite communications during disasters: networks, use of Internets, warning system - Post disaster review – Case studies.

UNIT V APPLICATION OF GIS 9

Use of GIS in Resource mapping - Groundwater, flood monitoring, forest management - urban planning, agriculture and soil. Potential of GIS application in disaster mapping – Disaster management plan – Case studies

TOTAL: 45 PERIODS

G. LEARNING RESOURCES

a) TEXT BOOKS

1. Lo.C.P and Albert K.W. Yeung, "Concepts and Techniques of Geographic Information Systems" - Prentice-Hall India Publishers, 2006.
2. Anji Reddy M, "Remote sensing and Geographical information system" - B.S Publications, 2011.

b) REFERENCES

1. Chestern, "Geo Informational Systems - Application of GIS and Related Spatial Information Technologies" - ASTER Publication Co., 1992.
2. Jeffrey Star and John Estes, "Geographical Information System: An Introduction" - Prentice Hall, 1990.
3. Burrough P.A, "Principles of GIS for Land Resources Assessment" - Oxford Publication, 1980.
4. Mohamed Gad, "Large scale disasters: Prediction, Control and Mitigation" - Cambridge University Press, 2008.
5. NDM – National Disaster Management Guidelines. Includes SDM plans.

1154CE109	INTELLECTUAL PROPERTY AND INNOVATION	L	T	P	C
		3	0	0	3

COURSE CATEGORY: Institute Elective

A. PREAMBLE

This course deals about the fundamentals of intellectual property and their role in engineering domain.

B. PREREQUISITES:

- Nil

C. COURSE EDUCATIONAL OBJECTIVES:

Students undergoing this course are expected to:

- Understand the basics of intellectual property and their classifications.
- Outline the role of innovation and intellectual property in engineering career.

D. COURSE OUTCOMES:

After the completion of the course the students will be able to:

CO	Course Outcomes	Level of learning domain (Based on revised Bloom's)
CO1	Outline the overview of intellectual property and creativity theories.	K2
CO2	Extend the definition and types of patents.	K2
CO3	Explain the fundamentals of copyright, trademarks and design.	K2
CO4	Demonstrate the role of IP in engineering career.	K2
CO5	Apply the knowledge of intellectual property with case studies.	K3

E. CORRELATION OF COs WITH POs

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

F. COURSE CONTENT:

UNIT 1 INTRODUCTION 9

Intellectual property – Characteristics of IP – Intellectual property rights: Types, IP Acts – Creativity - Lucid dreaming – Mental blocks - Vertical and lateral thinking – Stenberg's theory of creativity – The 10000 hours rule – Theories of motivation – Traits of a creative engineer – Ways to improve creativity - Role of IP in global economy.

UNIT II PATENT 9

Definition – Patentability tool – Indicators for patentability - Procedure for patent filing: Indian and international application – Opposition - Forms – Inventions not patentable in India – Role of patents in entrepreneurship.

UNIT III COPYRIGHT, TRADEMARK AND DESIGN 9

Copyright: Origin and evolution, International arrangements, History in India, Criteria for protection and registration – Trademark: History and origin, International arrangements, History in India, types of trademarks, Criteria for protection and registration – Design: Meaning, Criteria for protection – Geographical Indication: Meaning, Characteristics – Geographical Indication in India.

UNIT IV ROLE OF INTELLECTUAL PROPERTY IN ENGINEERING CAREER 9

Edison's 15 lessons for innovation - Engineering projects - Problem based Vs people based projects – Projects to patent creation. Case studies.

UNIT V CASE STUDIES 9

Low cost sanitary pad making machine – Environment-friendly paper – Plastic road construction – Implantable biosensors for diabetes monitoring – Location tracking without GPS – Offline internet - Pharmaceutical case studies – Case studies from digital market.

TOTAL: 45 PERIODS

G. LEARNING RESOURCES:

a) TEXT BOOKS

3. Stephen Johnson, Guide to Intellectual Property: What it is, how to protect it, how to exploit it? Economist Books, 2015.
4. Deborah E. Bouchoux, Intellectual Property: The Law of Trademarks, Copyrights, Patents, and Trade Secrets, Cengage Learning, 2014.

b) REFERENCES

3. NPTEL Lecture material (Intellectual property): https://nptel.ac.in/courses/109106137/

4. NPTEL Lecture material (Roadmap to Patent Creation): https://nptel.ac.in/courses/127105008/

1154CE110	DISASTER MANAGEMENT AND MITIGATION	L	T	P	C
		3	0	0	3

Course Category / Type: Institute Elective

A. Preamble:

- This course is useful in distinguishing the different type of disasters and their effects. The student learns a coordinated approach to manage and mitigate in the event of a disaster with the assistance of stakeholders and other government agencies. This leads to familiarization with the Disaster Management Act of Government of India.

B. Prerequisite:

- Nil

C. Link to other Courses:

- Environmental Science

D. Course Educational Objectives:

Students undergoing this course are expected to:

- Understand the concepts of disaster, hazard and vulnerability
- Recognize the importance of disaster management
- Identify the appropriate agency organizing disaster mitigation.

E. 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 socio-economic impact due to disaster and hazard	K1
CO2	Classify the different type of disasters and their causes	K2
CO3	Describe the basic concepts of disaster management cycle, preparedness, response and recovery	K2
CO4	Recognize the stake holders, their jurisdiction and responsibilities in the disaster management system	K2
CO5	Prepare different case study reports using advanced techniques	K2

F. Correlation of COs with POs:

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

G. COURSE CONTENT

UNIT I BASIC CONCEPTS 9

Concepts and definition of Disaster, Hazard, Vulnerability, Risk analysis and Capacity Metrological factors – climatic change. Types of vulnerability - physical vulnerability and socio-economic vulnerability - Crisis Management - Disaster Management and Mitigation.

UNIT II TYPES OF DISASTER 9

Geological Disasters - earthquakes, landslides, tsunami, mining, volcanoes; Hydro-Meteorological Disasters: floods, cyclones, lightning, thunder-storms, hail storms, avalanches, droughts, cold and heat waves; Biological Disasters: pandemic, epidemics, pest attacks, cattle epidemic and food poisoning; Nuclear and Industrial Disaster: chemical and industrial disasters, nuclear accidents; Accidental Disasters: urban and forest fires, oil spill, mine flooding incidents, accidents (road, rail, air and sea), collapse of bridges, buildings and other facilities structures & dam failures; House-hold disasters: gas-cylinder leaks and explosion
Practical examples on all types of disaster.

UNIT III DISASTER MANAGEMENT FRAMEWORK 9

Disaster Management Cycle – Paradigm Shift in Disaster Management. Pre-Disaster – Risk Assessment and Analysis, Risk Mapping, Awareness During Disaster – Evacuation – Disaster Communication – Search and Rescue – Emergency Operation Centre – Incident Command System – Relief and Rehabilitation – Post-disaster – Damage and Needs Assessment– Early Recovery – Reconstruction and Redevelopment.

UNIT IV DISASTER MITIGATION 9

Disaster Profile of India – Mega Disasters of India and Lessons Learnt Disaster Management Act 2005 (GOI) – Institutional and Financial Mechanism National Policy on Disaster Management, National Guidelines and Plans on Disaster Management; Role of Government (local, state and national), NDMA, NDRF, NGOs, Inter-Governmental and other Agencies.

UNIT V RECENT ADVANCES IN DISASTER MITIGATION 9

Geo-informatics in Disaster Management (GIS, GPS and RS) Disaster Communication System (Early Warning and Its Dissemination) Case studies: Disaster risk assessment and preparedness for disasters with reference to disasters in: earthquake, building collapse, wild fire, floods, oil spill, pandemic, epidemic, house-hold disasters. **Total : 45 Periods**

H. LEARNING RESOURCES

(d) TEXT BOOKS:

5. Bryant E. (2005), Natural Hazards, Cambridge University Press, U.K.
6. Chakraborty, S.C. (2007), Natural Hazards and Disaster Management, Pragatishil Prokashak, Kolkata.
7. Coppola D P (2007), Introduction to International Disaster Management, Elsevier Science, London.
8. Khanna, B. K. (2005), Disasters: All You Wanted to Know About, New India Publishing Agency, New Delhi.

(e) REFERENCE BOOKS:

5. Angus M. Gunn (2008), Encyclopedia of Disasters – Environmental Catastrophes and Human Tragedies, Vol. 1 & 2, Greenwood Press, London.
6. Gupta, A.K., Niar S.S and Chatterjee S. (2013), Disaster management and Risk Reduction, Role of Environmental Knowledge, Narosa Publishing House, Delhi.
7. Srivastava, H. N. and Gupta, G. D.(2006), Management of Natural Disasters in developing countries, Daya Publishers, Delhi, 201 p.
8. Alexander, D. (1999), Natural Disasters, Kluwer Academic, London, 632 p.

(f) ONLINE SOURCES:

27. http://www.adpc.ait.ac.th
28. http://www.adrc.or.jp
29. http://www.cepredenac.org
30. http://www.disaster.info.desastres.net/crid
31. http://www.unige.ch/idndr
32. http://www.disaster.net
33. http://www.disaster.info.desastres.net/dipecho
34. http://www.disasterrelief.org
35. http://www.eri.u-tokyo.ac.jp
36. http://www.europa.eu.int/comm/echo
37. http://www.fao.org/giews/default.html
38. http://geoweb.fao.org
39. http://www.fao.org/fivims/default.html
40. http://www.fema.gov
41. http://www.haznet.org
42. http://www.ifrc.org
43. http://www.idrmhome.org
44. http://www.unisdr.org
45. http://www.osso.univalle.edu.co/tmp/lared/lared/html
46. http://www.desenredando.org
47. http://www.reliefweb.int/
48. http://www.promujer.org
49. http://www.sewa.org
50. http://www.wfp.org
51. http://www.who.int/eha
52. http://www.wmo.ch

1154CE301	SURVEYING LABORATORY	L	T	P	C
		0	0	2	1

Course Category: Institute Elective

A. Preamble:

To provide a basic understanding of provide a practical knowledge of surveying.

B. Prerequisite:

- 1150CE101 Basic Civil Engineering

C. Course Educational Objectives:

Students undergoing this course are expected to:

- Get practical exposure on fundamental surveying such as chain surveying, levelling and compass surveying.

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

CO	COURSE OUTCOMES	Bloom's Taxonomy level
CO1	Understand the Study of chains and its accessories	K2
CO2	Understand the Study of bearing using prismatic and surveyors compass	K2
CO3	Understand the Plane table surveying: Radiation, Intersection and Resection	K3
CO4	Understand the Fly levelling , Check levelling using Dumpy level and Tilting level	K3

E. Correlation of COs with POs:

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

F. Course Content:

LIST OF EXPERIMENTS

1. Study of chains and its accessories
2. Ranging and Chaining of a line
3. Study of bearing using prismatic and surveyors compass
4. Compass Traversing
5. Plane table surveying: Radiation, Intersection
6. Fly leveling , Check levelling using Dumpy level and Tilting level

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” - Vidyarthi Griha Prakashan, 24^{th} 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.

1154CE302	ENVIRONMENTAL ENGINEERING LABORATORY	L	T	P	C
		0	0	2	1

Course Category: Institute Elective

A. Preamble:

The objective of this laboratory course is to give practical knowledge in fixing the water, wastewater and air quality in order to identify the pollution status and arriving at the appropriate treatment techniques and control measures required to keep up their quality standards.

B. Prerequisite:

- 1150CH102 Environmental Studies

C. Course Educational Objectives:

Students undergoing this course are expected to:

- The students will have a complete practical knowledge quality estimation of a given water sample.
- The students will be able to measure the pollutant concentration in wastewater samples.

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

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Examine and evaluate the water samples for quality standard parameters.	K4, K5
CO2	Examine and evaluate the pollutant concentration in wastewater samples.	K4, K5

E. Correlation of COs with POs:

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

F. Course Content:

LIST OF EXPERIMENTS

1. Determination of a) pH b) Alkalinity c) Sulphates
2. Determination of a) Chlorides b) Chlorine c) Turbidity
3. Coagulation and precipitation process for treating wastewater
4. Determination of Total Solids in water
5. Determination of Sodium, Potassium, and Calcium in water.

TOTAL: 30 periods

G. Learning Resources:

a) Text Books:

1. Garg, S.K, “Environmental Engineering, Vol.I” - Khanna Publishers, New Delhi, 2005.
2. Garg, S.K, “Environmental Engineering Vol. II” - Khanna Publishers, New Delhi, 2003.
3. Modi, P.N, “Water Supply Engineering, Vol. I” - Standard Book House, New Delhi, 2005.
4. Punmia, B.C, Ashok K Jain and Arun K Jain, “Water Supply Engineering”- Laxmi Publications Pvt. Ltd., New Delhi, 2005

b) References:

1. Government of India, Manual on Water Supply and Treatment, CPHEEO, Ministry of Urban Development, New Delhi, 2003

1154CE303	CONCRETE TECHNOLOGY LABORATORY	L	T	P	C
		0	0	2	1

Course Category: Institute Elective

A. Preamble:

This laboratory course aims to provide the understanding of determination of fresh state and hardened state properties of concrete.

B. Prerequisite:

- Nil

C. Course Educational Objectives:

Students undergoing this course are expected to:

- Determine the various engineering properties of concrete in both fresh and hardened state.
- Execute non-destructive testing on concrete cubes.

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

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Examine and evaluate the fresh and hardened concrete for its characteristics.	K4, K5
CO2	Examine the concrete cubes with non-destructive tests.	K4, K5

E. Correlation of COs with POs:

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

F. Course Content:

LIST OF EXPERIMENTS

1. Determination of Properties of fresh concrete
   a) Slump Cone Test
   b) Vee Bee Consistometer
   c) Flow Table Test
   d) Compaction Factor

2. Determination of Properties of Hardened Concrete
   a) Compression Test
   b) Tension Test
   c) Flexural Test

3. Determination of NDT Test on Concrete
    a) Rebound Hammer Test
    b) Ultra-Sonic Pulse Velocity Meter.
    c) Profometer.

TOTAL: 30 PERIODS

G. LEARNING RESOURCES

a) Text Books:

1. Shetty M.S, "Concrete Technology" - S. Chand and Company Ltd. Delhi, 2008.
2. Santhakumar.A.R, "Concrete Technology" - Oxford University Press, 2016.

b) References:

1. Gambhir.M.L, "Concrete Technology" - McGraw Hill Education, 2013.
2. Gupta.B.L and Amit Gupta, "Concrete Technology" - Jain Book Agency, 2010.
3. Neville, A.M, "Properties of Concrete" - Prentice Hall, 1995, London.
4. IS 10262:2009 Guidelines for Concrete Mix Proportioning, Bureau of Indian Standards, New Delhi.
5. IS 383:1970 – Specification for coarse and fine aggregates from natural sources for concrete, Bureau of Indian Standards, New Delhi.

1154CE304	SOIL MECHANICS LABORATORY	L	T	P	C
		0	0	2	1

Course Category: Institute Elective

A. Preamble:

The students will learn the various laboratory experiments to determine the properties and classification of soils.

B. Prerequisite:

- Nil

C. Course Educational Objectives:

Students undergoing this course are expected to:

- Complete practical knowledge on accessing the index and engineering properties of soil samples.

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

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Examine and evaluate the index properties of soil.	K4, K5
CO2	Examine and evaluate the engineering properties of soil.	K4, K5

E. Correlation of COs with POs:

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

F. Course Content:

LIST OF EXPERIMENTS:

1. (a) Grain size distribution (Sieve analysis)
(b) Moisture content determination and Specific gravity of soil grains

2. (a) Hydrometer analysis
(b) Atterberg limits test

3. (a) Permeability determination (constant head and falling head methods)
(b) Field density test
(i) Core cutter method
(ii) Sand replacement method

4. One dimensional consolidation test (Determination of co-efficient of consolidation only)

5. Determination of shear strength parameters.
(a) Relative density

(b) Direct shear test on cohesionless soil

TOTAL: 30 PERIODS

G. Learning Resources:

a) Text Books:

1. Gopal Ranjan and Rao A.S.R, "Basic and Applied Soil Mechanics" - Wiley Eastern Ltd., New Delhi (India), 2000.
2. Punmia B.C, "Soil Mechanics and Foundations" - Laxmi Publications Pvt. Ltd., New Delhi, 2005.
3. Geotechnical Lab Manual Prepared by Vel Tech Staff.

b) References:

1. IS Code of Practice (2720) Relevant Parts, as amended from time to time, Bureau of Indian Standards, New Delhi.
2. Arora K.R, "Soil Mechanics and Foundation Engineering" - Standard Publishers and Distributors, New Delhi, 2011.
3. Sutten B.H.C, "Solving Problems in Soil Mechanics" - Longman Group Scientific and Technical, U.K. England, 1994.

1154CE305	CADD LABORATORY	L	T	P	C
		0	0	2	1

Course Category: Institute Elective

H. PREAMBLE:

This laboratory course aims to provide the understanding and using the CADD tool for making computer based building plans and sectional drawings.

I. PREREQUISITES:

- Nil

J. LINKS TO OTHER COURSES:

- Nil

K. COURSE OUTCOME:

Students undergoing this course are expected to:

- Draw the plan and sectional sketches for a given area of a building (residential, industrial)
- Draw the perspective views of a given structures.

L. COURSE OUTCOME:

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)
CO1	Illustrate the different types of roofs of a building.	K3
CO2	Illustrate perspective drawings of a given structures.	K3

M. CORRELATION OF COs WITH POs:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					H							
CO2					H							

G. COURSE CONTENT:

LIST OF EXPERIMENTS:

1. Principles of planning, orientation and complete joinery details (Paneled and Glazed Doors and Windows)
2. Buildings with load bearing walls
3. Buildings with sloping roof
4. R.C.C. framed structures.
5. Perspective view of 3D framed Structures
6. Industrial buildings – North light roof structures

TOTAL: 30 PERIODS

H. LEARNING RESOURCES:

a) TEXTBOOKS

1. Sikka V. B, ”A Course in Civil Engineering Drawing” - 4th Edition, S.K. Kataria and Sons, 2015.
2. George Omura, “Mastering in Autocad 2005 and Autocad LT 2005” – BPB Publications, 2008.

b) REFERENCES

1. Shah.M.G., Kale. C.M. and Patki. S.Y., "Building Drawing with an Integrated Approach to Built Environment"- Tata McGraw Hill Publishers Limited, 2007.
2. Verma.B.P, "Civil Engineering Drawing and House Planning" - Khanna Publishers, 2010.
3. Marimuthu V.M., Murugesan R. and Padmini S, "Civil Engineering Drawing-I" - Pratheeba Publishers, 2008.

1154CE306	BUILDING DRAWING LABORATORY	L	T	P	C
		0	0	2	1

Course Category: Institute Elective

A. Preamble:

This laboratory course helps to provide knowledge of the CADD tool for making computer based building plans and sectional drawings.

B. Prerequisite:

- Nil

C. Course Educational Objectives:

- To explore the fundamental concepts and workflows for creating various models using AutoCAD.
- To provide knowledge on various global symbols and sign conventions used in building drawing.
- To create plan, section and elevation of residential buildings and take the print out.

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 fundamentals of different views of components of a building	K3
CO2	Use the precision drafting tools to develop accurate technical drawings.	K6
CO3	Familiarize with the standard symbols and sign conventions suitably.	K6
CO4	Create plan, section and elevation of residential building using drafting software.	K6
CO5	Understand and create the perspective view of single storied residential building.	K6

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				
CO2					H	M		M		H				
CO3					H	M		M		H				
CO4					H	M		M		H				
CO5					H	M		M		H				

F. Course Content:

LIST OF EXPERIMENTS:

1. Building components.
2. Markings of building components
3. Conventional signs.
4. Residential building: Plan, Elevation and Section.
5. Isometric Projection of a single storied residential building.

G. Learning Resources:

a) Text Books:

1. Sikka V. B, "A Course in Civil Engineering Drawing" - 4th Edition, S.K. Kataria and Sons, 2015.
2. George Omura, Brian C. Benton, "Mastering AutoCAD 2014 and AutoCAD LT2014", Wiley – An Autodesk Official Press, 2013.

b) References:

1. Bhatt N. D, "Engineering Drawing" - Charotar Publishing House Pvt. Ltd., 53rd Edition, 2019.
2. A.K. Purwar, "Civil Engineering Drawing" - Vayu Education of India, 2013 edition.
3. S. Kaleem A. Zaidi, Suhail Siddiqui, "Drawing & Design of Residential and Commercial Building" - Standard Publisher Distributors.
4. Kumaraswamy N, Kameswara Rao A, "Building planning & Drawing", Charotar Publishing, 2013.