Appendix - I

COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY

SCHEME
AND
SYLLABUS

B.TECH CIVIL ENGINEERING
(2015 Admissions onwards)

COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY

B.TECH DEGREE COURSE IN CIVIL ENGINEERING

B.Tech - Scheme of Examinations (2015 admissions)

SEMESTER I

Code No.	Subject	L Hrs/Wk	T Hrs/Wk	P/D Hrs/ Wk	C	Marks		Total
						CA	ESE	
AS15-1101A	Engineering Mathematics –I	3	1	0	3	40	60	100
AS15-1102A	Engineering Physics	3	1	0	3	40	60	100
GE15-1103A	Engineering Mechanics	4	1	0	4	40	60	100
GE15-1104A	Basic Civil Engineering	3	0	0	3	40	60	100
GE15-1105A	Basic Mechanical Engineering	3	0	0	3	40	60	100
HS15-1106A	Technical Communication and Professional Ethics	2	1	0	2	40	60	100
GE15-11L1A	Civil Engineering Workshop	0	0	3	1	25	25	50
GE15-11L2A	Mechanical Engineering Workshop	0	0	3	1	25	25	50
HS15-11L3A	Language Lab	0	0	1	1	25	25	50
HS15-11L4A	NSS/Nature conservation	0	0	1	1	50	-	50
	TOTAL	**18**	**4**	**8**	**22**			

SEMESTER II

Code No.	Subject	L Hrs/Wk	T Hrs/Wk	P/D Hrs/ Wk	C	Marks		Total
						CA	ESE	
GE15-1201A	Computer Programming	3	1	0	3	40	60	100
AS15-1202A	Engineering Chemistry	3	1	0	3	40	60	100
GE15-1203A	Engineering Graphics	2	1	3	5	40	60	100
GE15-1204A	Basic Electrical Engineering	3	0	0	3	40	60	100
GE15-1205A	Basic Electronics Engineering	3	0	0	3	40	60	100
AS15-1206A	Environmental Studies	3	1	0	3	40	60	100
GE15-12L1A	Electrical Engineering Workshop	0	0	3	1	25	25	50
GE15-12L2A	Computer Programming Laboratory	0	0	3	1	25	25	50
	TOTAL	**15**	**6**	**9**	**22**			

SEMESTER III

Code No.	Subject	Hrs/week		C	Marks		Total
		L	T/D/P		CA	ESE	
AS15-1301*	Linear Algebra and Transform Techniques	3	1	3	40	60	100
CE15-1302	Surveying – I	3	1	3	40	60	100
CE15-1303	Strength of Materials	3	1	3	40	60	100
CE15-1304	Concrete Technology	3	1	3	40	60	100
CE15-1305	Fluid Mechanics -I	3	1	3	40	60	100
CE15-1306	Building Technology	4	-	3	40	60	100
CE15-13L1	Concrete Lab	-	3	2	25	25	50
CE15-13L2	Strength of Materials Lab	-	3	2	25	25	50
	TOTAL	**17**	**13**	**22**			

*Common to all branches

SEMESTER IV

Code No.	Subject	Hrs/week		C	Marks		Total
		L	T/D/P		CA	ESE	
AS15 -1401*	Complex Variables and Partial Differential Equations	3	1	3	40	60	100
CE15-1402	Surveying –II	3	1	3	40	60	100
CE15-1403	Analysis of Determinate Structures	3	1	3	40	60	100
CE15-1404	Engineering Geology and Seismology	4		3	40	60	100
CE15-1405	Fluid Mechanics II	3	1	3	40	60	100
CE15-1406	Building Planning and Drawing	1	3	3	40	60	100
CE15-14L1	Survey Practical	-	3	2	25	25	50
CE15-14L2	Fluid Mechanics Lab	-	3	2	25	25	50
	TOTAL	**17**	**13**	**22**			

*Common to all branches

SEMESTER V

Code No.	Subject	Hrs/week	C	Marks	Total

		L	T/D/P				
					CA	ESE	
AS15-1501*	Numerical and Statistical Methods	3	1	3	40	60	100
CE15-1502	Design of Concrete Structures-I	3	1	3	40	60	100
CE15-1503	Analysis of Indeterminate Structures	3	1	3	40	60	100
CE15-1504	Geotechnical Engineering –I	3	1	3	40	60	100
CE15-1505	Transportation Engineering –I	4		3	40	60	100
CE15-1506	Water Resources and Irrigation Engineering	4		3	40	60	100
CE15-15L1	Geotechnical Engineering Lab	-	3	2	25	25	50
CE15-15L2	Transportation Engineering Lab	-	3	2	25	25	50
	TOTAL	**20**	**10**	**22**			

*Common to all branches

SEMESTER VI

Code No	Subject	Hrs/week		C	Marks		Total
		L	T/D/P		CA	ESE	
CE15-1601	Environmental Engineering -I	3	1	3	40	60	100
CE15-1602	Design of Steel Structures	3	1	3	40	60	100
CE15-1603	Matrix Methods of Structural Analysis	3	1	3	40	60	100
CE15-1604	Geotechnical Engineering – II	3	1	3	40	60	100
CE15-1605	Transportation Engineering –II	4		3	40	60	100
CE15-1606	Elective- I	3	1	3	40	60	100
CE15-16L1	Environmental Engineering Lab	-	3	2	25	25	50
CE15-16L2	Computer Applications in Civil Engineering - I	-	3	2	25	25	50
	TOTAL	19	11	22			

CE15 – 1606 Elective – I	
Code	Name of Subject
E1	Retrofitting and Rehabilitation of Structures
E2	Disaster Management
E3	Traffic Engineering and Management
E4	Air Pollution Control and Management
E5	Ground Water Engineering
E6	Principles of Management

SEMESTER VII

Code No.	Subject	Hrs/week		C	Marks		Total
		L	T/D/P		CA	ESE	
CE15-1701	Environmental Engineering - II	3	1	3	40	60	100
CE15-1702	Design of Concrete Structures-II	3	1	3	40	60	100
CE15-1703	Construction Management	3	1	3	40	60	100
CE15-1704	Quantity Surveying and Valuation	3	1	3	40	60	100
CE15-1705	Elective -II	3	1	3	40	60	100
CE15-17L1	Computer Applications in Civil Engineering - II		3	2	25	25	50
CE15-17L2	Structural Engineering and NDT Lab	-	3	2	25	25	50
GE15-17L3	Entrepreneurship Development	-	1	1	50		50
CE15-17L4	Industrial Training		2	1	50		50
CE15-17L5	Project – Phase I		1	1	50		50
	TOTAL	**15**	**15**	**22**			

CE15 – 1705 Elective – II	
Code	Name of Subject
E1	Finite Element Method
E2	Ground Improvement Techniques
E3	Pavement Analysis and Design
E4	Solid Waste Management
E5	Remote Sensing and GIS
E6	Design of special Structures

SEMESTER VIII

Code No.	Subject	Hrs/week		C	Marks		Total
		L	T/D/P		CA	ESE	
CE15-1801	Architecture and Town Planning	4		3	40	60	100
CE15-1802	Earthquake Engineering	3	1	3	40	60	100
CE15-1803	Construction Safety and Fire Engineering	4		3	40	60	100
CE15-1804	Elective –III	3	1	3	40	60	100
CE15-18L1	Seminar	-	3	2	50		50
CE15-18L2	Project – Phase II		11	6	200		200
CE15-18L3	Comprehensive Viva Voce			2		50	50
	TOTAL	**14**	**16**	**22**			

CE15 – 1804 Elective – III	
Code	Name of Subject
E1	Bridge Engineering
E2	Environmental Geotechnics
E3	Construction Engineering and Materials Management
E4	Industrial Waste Engineering and Management
E5	Environmental Impact Assessment
E6	Sustainable Construction Techniques

LIST OF OPTIONAL SUBJECTS

Sl. No:	Subject	L	T	P	No: of Hours/Semester	CA Marks
1	Personality Enrichment	1	2		30	50
2	General Aptitude	1	2		30	50
3	Foreign Language	1	2		30	50
4	Advanced Computer Programming	1		2	30	50
5	Healthy Living	1		2	30	50
6	Theatre Arts	1		2	30	50
7	Imaging Devices	1		2	30	50
8	Disaster Management	1		2	30	50

One or more optional subjects may be offered in any semester outside regular teaching hours and the students may opt to study them if they wish. The course may be conducted by using experts from inside or outside the University on Self Supporting manner. The Fee may be fixed based on the expenses in a non-profit manner with the students of the department given a subsidised rate of fee and those from outside may also be allowed at a higher fee. The regular students may be issued the mark list with the optional subject included in current semester and the outsiders may be issued a certificate separately.

AS15-1301 LINEAR ALGEBRA AND TRANSFORM TECHNIQUES

Course Objectives: To acquire fundamental knowledge of linear algebra and transformation techniques and throw light on their application in engineering disciplines.

Course Outcomes: On completion of this course, a student will be able to

1. Solve linear system of equations and to determine Eigen values and vectors of a matrix.
2. Understand basic principles of vector space and its properties including linear transformation and their applications.
3. Determine Fourier series and transform.
4. Solve linear differential equation and integral equation using Laplace transform.

Module I

Linear Algebra 1: Rank of a matrix, solution of linear system of equations- existence, uniqueness, general form - Eigen values and Eigen vectors - properties of Eigen values - Diagonalization of a matrix - Cayley Hamilton theorem (without proof) Verification-Finding inverse and power of a matrix using it - Quadratic form-orthogonal reduction of quadratic form to Canonical form.

Module II

Linear Algebra 2: Vector space-subspace-Linear dependence and independence-Spanning of a subspace- Basis and Dimension. Inner product- Inner product spaces - Orthogonal and Orthonormal basis –Gram- Schmidt Orthogonalization process. Linear Transformation.

Module III

Fourier Analysis: Periodic function, Fourier series, Functions of arbitrary period, Even and odd functions, Half Range Expansion, Harmonic analysis, Complex fourier Series, Fourier Integrals, Fourier Cosine and Sine Transform, Fourier Transform.

Module IV

Laplace Transforms: Gamma functions and Beta function-Definition and properties, Laplace transforms. Inverse Laplace Transform, Shifting theorem, Transform of Derivative and Integrals, Solution of differential equation and integral equation using Laplce transform, Convolution, Unit step function, Second Shifting theorem, Laplace transform of periodic function.

References:

1. Kreyzig, E. (2011). *Advanced Engineering Mathematics* (10th edition). John Wiley & Sons, Hoboken, N.J.
2. Grewal, B. S. (2013). *Higher Engineering Mathematics* (43rd edition). Khanna Publishers, New Delhi.
3. Hsiung, C. Y. and Mao, G. Y. *Linear Algebra*. World Scientific, New Jersey.
4. Hoffman, K. and Kunze, R. (1971). *Linear Algebra*. Prentice Hall of India, New Delhi.
5. Venkataraman, M. K. *Linear Algebra*. (1999). The National Publishing Company, Chennai.

Type of Questions for End Semester Examination.

PART A: Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules ($10 \times 2 = 20$ marks).

PART B: ($4 \times 10 = 40$ marks)

Question nos. II and III [with sub sections (a), (b), …] (10 marks each with option to answer either II or III) from Module I.
Question nos. IV and V [with sub sections (a), (b), …] (10 marks each with option to answer either IV or V) from Module II.
Question nos. VI and VII [with sub sections (a), (b), …] (10 marks each with option to answer either VI or VII) from Module III.
Question nos. VIII and IX [with sub sections (a), (b), …] (10 marks each with option to answer either VIII or IX) from Module IV.

CE15–1302 SURVEYING – I

Course Objectives: To acquaint with basic principles and basic instruments related with surveying and levelling.

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

1. Carry out preliminary surveying in the field of civil engineering applications such as structural, highway and geotechnical engineering.
2. Plan a survey, taking accurate measurements, field booking, plotting and adjustment of traverse.
3. Use various conventional instruments involved in surveying with respect to utility and precision.
4. Plan a survey for applications such as road alignment and height of the building undertake measurement and plotting in civil engineering.

MODULE I

Introduction : Classification of surveys, primary division of Surveying-Principle of working from whole to part-conventional signs. **Chain Surveying**: Instruments - principles of chain surveying- Tie and check line-Chaining and Ranging-obstacles-chaining on sloping ground -Errors in chain Survey- uses of cross staff and optical square. **Compass survey** : Prismatic compass-surveyor's Compass, whole circle system and Quadrantal system-True and magnetic bearing-Dip and Declination-Local attraction-Traversing-Plotting a Traverse Survey -Graphical adjustment of closing error in a closed Traverse. **Plane Table Survey**: Instruments and accessories- Advantages and disadvantages of plane tabling - Different methods of plane Tabling-Two point problem-Three point problem - Errors in plane tabling.

MODULE II

Levelling: Definitions of Terms used in Leveling- levelling instruments-Temporary and permanent adjustments-principles of levelling-Simple levelling, Differential levelling-Reduction of levels-Classification of levelling-Profile levelling and cross sectioning -correction for curvature and refraction-Reciprocal levelling- Errors in levelling. **Contour Survey**: Definition-characteristics of Contour- uses of contours- Methods of contouring-Interpolation Contours-uses of Contour map.

MODULE III

Area and volumes: Areas along Boundaries- Mid ordinate rule-Average ordinate rule-Trapezoidal rule-Simpson's rule- Area by Meridian distance method- Area by Double meridian method. Departure and total latitude method-Coordinate method- Computation of volume by Trapezoidal and Prismoidal formule -Mass haul curve.

Introduction to advanced surveying Equipments – Total station – GPS – Electronic theodolite.

MODULE IV

Theodolite Surveying: Study of Theodolite - Temporary and permanent adjustments-measurement of horizontal angle- method of repetition and reiteration- measurement of vertical angle – Theodolite traversing by direct observation of Angles and by direct observation of Bearings- Adjustment of a closed Traverse (angular error, bearings and closing error) - Bowditch rule-Transit rule-Gale's traverse Table- Omitted measurements.

Tacheometric Surveying : Instruments used-Stadia System-fixed and movable hair methods-Tacheometric constants- Anallatic lens-Tangential System

References:

1. Punmia, B.C, Jain, A. K. and Jain, A. K. (2010). *Surveying*. Vol. I & II, Laxmi Publications.

2. Chandra, A. M. (2007). *Higher Surveying*. New Age International Publishers.
3. Ghilani, C. D, and Wolf, P. R. (2012), *Elementary Surveying*. Prentice Hall.
4. Arora, K.R. (2012). *Surveying*. Vol.I and II. Standard Book House.
5. Duggal, S. K. (2010), *Surveying*. Vol. I. Tata Mc Graw Hill Publishing Co Ltd.

Type of Questions for End Semester Examination.

PART A: Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules ($10 \times 2 = 20$ marks).

PART B: ($4 \times 10 = 40$ marks)

Question nos. II and III [with sub sections (a), (b), …] (10 marks each with option to answer either II or III) from Module I.
Question nos. IV and V [with sub sections (a), (b), …] (10 marks each with option to answer either IV or V) from Module II.
Question nos. VI and VII [with sub sections (a), (b), …] (10 marks each with option to answer either VI or VII) from Module III.
Question nos. VIII and IX [with sub sections (a), (b), …] (10 marks each with option to answer either VIII or IX) from Module IV.

CE15–1303 STRENGTH OF MATERIALS

Course Objectives: To smoothly drive the student's imagination and thought process from the realm of rigid body (Newtonian) mechanics into the wonderful world of elementary deformable body solid mechanics through the introduction of internal effects of forces on linearly elastic, homogeneous and isotropic materials, motivated by the application of the principles developed (in this course) in structural design.

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

1. Assimilate the fundamentals of stress and strain and their relationship, basic elastic and inelastic properties of materials and elastic response of bodies to axial force.
2. Thoroughly understand the importance of principal stresses and strains, physical measurement of strains and internal actions like shear force and bending moment due to transverse external forces.
3. Deep root ideas regarding the theory of simple bending, shear stresses due to shear force and simplified theory of torsion of bars with circular cross-sections (importance of geometry in torsion).
4. Conceive the concept of strain energy and its applications, elementary analysis of stability of slender columns and principal stresses and strains in thin pressure vessels distinguishing the role of "thickness" in structural action.

MODULE I

Material properties and Basic assumptions in strength of materials – elasticity, plasticity, ductility, brittleness, malleability, isotropy / anisotropy, linear / non-linear elasticity, Stress-strain curve of a mild steel bar in a tension test.

The concept of Stress and Strain: Definition of stress and strain, average stress and strain, stress and strain at a point, normal stress and shear stress, Complementary shear stress, shear strain, Hooke's law and Poisson' s ratio, Constitutive equations, Elastic moduli, Relationship between elastic moduli of an isotropic material, Factor of safety, Allowable stress.

Axially loaded Members: Changes in lengths of axially loaded members, Changes in lengths of non-uniform bars, Statically indeterminate problems, Thermal effects, misfits and pre strains.

MODULE II

Principal stresses and strains - Stress on inclined planes for axial and biaxial stress fields associated with shear stress, principal stresses, Mohr's circle of stress, principal strains, strain rosette.

Shear force and bending moment: Types of beams (determinate and indeterminate), loads and reactions in determinate beams, shear force and bending moment, relationships between intensity

of loading, shear forces and bending moment, Shear force and bending moment diagrams of statically determinate beams.

MODULE III

Stresses in beams : Pure bending and non uniform bending, Assumptions, Curvature of a beam, Longitudinal strains in a beam, Normal stresses in beams (linearly elastic and isotropic materials) due to bending, Design of beams for bending stresses, Non-prismatic beams, **Shear stresses** in beams of rectangular, circular, I and T cross sections.

Torsion: Circular bars of linearly elastic and isotropic materials, uniform torsion, assumptions, angle of twist, transmission of power by circular shafts, statically indeterminate problems, non-uniform torsion, Close and open coiled helical springs.

MODULE IV

Strain Energy: Definition of strain energy and complementary energy, strain energy due to axial load, bending moment, shear force and twisting moment, Introduction to applications of strain energy in solid mechanics.

Columns : Structural behavior of short and slender (long) columns, Buckling and stability, Euler's formula, Columns with pinned ends, and other support conditions, Slenderness ratio, Limitations of Euler's formula, Columns with eccentric axial loads, The secant formula for columns.

Thin Cylinders: Stresses and strains in thin cylinders and spherical shells.

References:

1. Gere, J. M. *Mechanics of Materials*. Brooks/Cole Thomson Learning.
2. Popov, E. P. *Engineering Mechanics of Solids*. Prentice-Hall of India Limited, New Delhi, India.
3. Timoshenko, S. P. and Young, D. H. *Elements of strength of materials*. East-West Press Private Limited, New Delhi, India.
4. Case, J., Chilver, L. and Ross, C. T. F. *Strength of Materials and Structures.* Elsevier, New Delhi.
5. Nash. *Strength of Materials*. Shaum's outline series, McGraw Hill publishers.
6. Subramanian, R. *Strength of Materials*. Oxford University Press.
7. Vazirani, V. N. and Ratwani, N. M. *Strength of Materials*. Vol I. Khanna Publishers.

Type of Questions for End Semester Examination.

PART A: Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules ($10 \times 2 = 20$ marks).

PART B: ($4 \times 10 = 40$ marks)

Question nos. II and III [with sub sections (a), (b), …] (10 marks each with option to answer either II or III) from Module I.

Question nos. IV and V [with sub sections (a), (b), …] (10 marks each with option to answer either IV or V) from Module II.

Question nos. VI and VII [with sub sections (a), (b), …] (10 marks each with option to answer either VI or VII) from Module III.

Question nos. VIII and IX [with sub sections (a), (b), …] (10 marks each with option to answer either VIII or IX) from Module IV.

CE15-1304 CONCRETE TECHNOLOGY

Course Objectives: To introduce the most versatile civil engineering construction material, concrete, its ingredients, properties, manufacture, tests and uses.

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

1. Understand the constituent materials of concrete, their properties and functions in concrete.

2. Design concrete mixes of specified grades via IS and ACI methods and generate an awareness regarding manufacturing process of concrete.
3. Clearly understand properties of concrete in its fresh and hardened state and tests for determination of them.
4. Generate awareness regarding special forms of concrete and some non-destructive testing methods of concrete.

MODULE I

Materials: Cement – Ingredients, Chemical composition, basic properties of cement compounds, Hydration of cement- heat of hydration, physical properties of Portland cements, Indian standard tests and specification, various types and grades of cement, storage of cement

Aggregates:- Classification of aggregates. Characteristics of aggregates – Strength of aggregate, particle shape and texture, specific gravity, bulk density, porosity, water absorption and moisture content of aggregate, bulking of fine aggregate, deleterious substance in aggregate, soundness of aggregate , alkali- aggregate reaction , sieve analysis:- grading curves, fineness modulus, grading requirements, grading of fine and coarse aggregates, zoning, IS tests and specification for aggregates for concrete.

Water: - Quality of mixing water, effect of impurities in water on properties of concrete. permissible impurities as per I.S

Admixtures:- Functions and classification of admixtures, factors influencing the dosage of different admixtures- IS specification for admixtures for concrete. accelerators - retarders - plastizers - water reducing agents - use of silica fumes.

MODULE II

Mix Design: Quality Control - Factors causing variations in the quality of concrete - mix design - nominal mixes - design mixes - factors influencing mix design - A.C.I method - I.S method - design for high strength mixes.

Process of manufacture of Concrete:- Mix proportion and grade of concrete - Various types of batching, mixing, transporting, placing, compacting, curing and finishing of concrete (in detail). Joints in concreting – construction and expansion.

MODULE III

Properties of fresh concrete: Water / Cement ratio and its significance in fresh concrete- workability- different methods for assessing workability according to IS Specification, factors affecting workability, requirements of workability for various work, segregation, bleeding, setting, hardening, strength development.

Properties of Hardened concrete: Strength of concrete- strength of concrete in compression, tension and flexure - stress- strain characteristics and elastic properties - shrinkage and creep. durability of concrete - permeability - chemical attack - sulphate attack - resistance to abrasion and cavitaion - resistance to freezing and thawing - resistance to fire - marine atmosphere - quality control - frequency of sampling - test specimens - statistical analysis of test results - standard deviation - acceptance criteria.

MODULE 1V

Special concrete: Lightweight concrete, High strength concrete, Polymer concrete, fiber reinforced concrete, Ferro-cement, Ready mixed concrete. vacuum concrete - shotcrete - steel fibre reinforced concrete- high performance concrete, reactive powder concrete, self-compacting concrete.

Non-destructive testing of concrete: Rebound hammer test, ultrasonic pulse velocity test, core cutter test.

References :

1. Neville, A. M. *Concrete Technology*. Pearson Education.

2. Neville, A. M. *Properties of Concrete* (4th edition). Pearson Education.
3. Santhakumar, A. R. (2013). *Concrete Technology*. Oxford University Press, India.
4. Orchard, D. F. *Concrete Technology*. Vol. I & II
5. Raju, K. N. *Design of Concrete Mixes*. CBS publishers.
6. Bungey, J. H. *The Testing of Concrete in Structures*. Urrey University of Press Hall.
7. Shetty, M. S. *Concrete Technology*. S I Chand & Company.
8. Gambhin, M. L. *Concrete Technology*. Tata McGraw Hill.
9. Thomas, J. (2015). *Concrete Technology*. Cengage Learning (India), 475p.

Type of Questions for End Semester Examination.

PART A: Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules ($10 \times 2 = 20$ marks).

PART B: ($4 \times 10 = 40$ marks)

Question nos. II and III [with sub sections (a), (b), …] (10 marks each with option to answer either II or III) from Module I.
Question nos. IV and V [with sub sections (a), (b), …] (10 marks each with option to answer either IV or V) from Module II.
Question nos. VI and VII [with sub sections (a), (b), …] (10 marks each with option to answer either VI or VII) from Module III.
Question nos. VIII and IX [with sub sections (a), (b), …] (10 marks each with option to answer either VIII or IX) from Module IV.

CE15-1305 FLUID MECHANICS – I

Course Objectives: To introduce the students to the mechanics of fluids through a thorough discussion of the properties of the fluids, behavior of fluids under static conditions and to expose to the applications of the conservation laws to flow measurements and flow through pipes (both laminar and turbulent).

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

1. Appreciate the purpose of learning fluid mechanics, properties of fluids and pressure measurement devices.
2. Understand thoroughly how to compute hydrostatic forces and transport of mass, momentum and energy through introduction of the dynamics of fluids through the control volume approach.
3. Apply principles of dimensional analysis to design experiments.
4. Analyze and design simple pipe systems.

MODULE I

Introduction: Fundamental difference between a solid and a fluid, constituent relationships for solids and fluids, conservation principles applied in fluid mechanics.

Properties of fluids, concept of continuum, viscosity, compressibility, ideal and real fluids, surface tension, capillarity.

Stress at a point, pressure, Pascal's law, Variation of pressure with elevation in compressible and incompressible fluids, hydrostatic law, Pressure measurement, piezometers and manometers.

MODULE II

Hydrostatic forces exerted on submerged surfaces.

Description of fluid flow: with reference to translation, rotation and deformation, concept of continuum, control mass and control volume approach, Reynolds transport theorem. Steady flow and uniform flow.

Velocity field, one and two-dimensional flow analysis, circulation and vorticity, stream function and velocity potential function, potential flow, standard flow patterns, combination of flow patterns, flownet.

MODULE III

Forces exerted in a fluid flow, derivation of Continuity equation and Euler's equation. Bernoulli's equation and its applications. Momentum equation and its applications.
Dimensional Analysis as a tool in design of experiments, identification of non-dimensional numbers and their significance, dimensional analysis methods.
Measurement of flow in pipes and open channels.

MODULE IV
Head loss in flow through pipes, Darcy Weisbach equation, major and minor losses. Flow through pipes and pipe networks, equivalent pipe.
Laminar flow and its characteristics, Reynolds experiment. Laminar flow between parallel plates.
Laminar flow through pipes, Hagen-Poiseuille equation.
Turbulence, Reynolds turbulent stresses, Prandtl's mixing length theory.
Velocity distribution in turbulent flow.

References:

1. White, F. M. (2011). *Fluid Mechanics*. Tata McGraw Hill Publication.
2. Fox, R. W., Pritchard, P. J. and McDonald, A. T. (2011). *Introduction to Fluid Mechanics* (7th Student edition). Wiley India Edition.
3. Shames (1988). *Mechanics of Fluids*. McGraw Hill Book Co., New Delhi.
4. Streeter, V. L. and Wylie, B. (1999). *Fluid Mechanics*. McGraw Hill Book Co., New Delhi.
5. Modi, P. N. and Seth, S. M. *Hydraulics and Fluid Mechanics (including hydraulic machines)*. Standard Book House, Delhi, India.

Type of Questions for End Semester Examination.
PART A: Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules ($10 \times 2 = 20$ marks).
PART B: ($4 \times 10 = 40$ marks)
Question nos. II and III [with sub sections (a), (b), …] (10 marks each with option to answer either II or III) from Module I.
Question nos. IV and V [with sub sections (a), (b), …] (10 marks each with option to answer either IV or V) from Module II.
Question nos. VI and VII [with sub sections (a), (b), …] (10 marks each with option to answer either VI or VII) from Module III.
Question nos. VIII and IX [with sub sections (a), (b), …] (10 marks each with option to answer either VIII or IX) from Module IV.

CE15-1306 BUILDING TECHNOLOGY

Course Objectives: To motivate the students to learn and appreciate various components of a building, their functions, materials of construction and different stages of construction.

Course Outcomes: On completion of the course, a student will be able to
1. Assimilate properties of certain building materials, mortar, gypsum, etc. and their tests so as to assure precautions in building construction.
2. Make one aware of certain non-structural building materials and their uses in construction.
3. Thoroughly understand regarding certain components of building construction, like stairs, doors, windows, lintels, cavity walls, etc. and their appropriate uses.
4. Acquaint with finishing works in building construction.

MODULE I
Building stones -Requirement of good building stone- characteristics - testing. Common building stones. Preservation of stones. Clay products: Tiles- Manufacture-Properties-Types-Problems of efflorescence and lime bursting in tiles. Lime: Properties- Classifications -Manufacture -Testing of lime. Mortar: Types –Properties-Tests on mortar, selection and desirable properties of fine aggregate for good mortar. Gypsum: Forms of gypsum and gypsum plaster, properties of gypsum

plaster, building products of gypsum and their uses. Pozzolona: Natural and Artificial fly ash, Surkhi (burnt clay pozzolona), rice husk and ash pozzolona,

MODULE II

Timber - Defects - Seasoning - Decay - Preservation, Wood based products. Iron and steel - Structural sections - Properties and uses of structural steel – Corrosion- forms and preventive measures. Paints varnishes and distempers, Common constituents, types and desirable properties, Cement paints. Glass - Ingredients, properties types and use in construction. Plastics - classification, advantages of plastics, Mechanical properties and their use in construction. Miscellaneous materials – Asbestos, Insulating Materials - Thermal and sound insulating material desirable properties and type.

MODULE III

Cavity walls – Partition walls – Types and features.
Lintels – Classification and loading, Arches – Classification and construction details- Technical terms.
Stairs- Technical terms- Classification and Types of stairs.
Doors, Windows and Ventilations- Technical terms-Construction details of different types.

MODULE IV

Floors and flooring - Types of floors - Types of floor coverings; Roof - Types of roofs - Types and uses of roofing materials.
Finishing works - Plastering, pointing, painting, white washing, colour washing, distempering ; Damp proofing ant termite treatment.

References:

1. Singh, G. (1996). *Building materials*.
2. Rangwala, S. C. (1992). *Engineering Materials*. Charotar Publishing House, Anand.
3. Punmia, B. C. (1999). *Building Construction*. Laxmi Publications, New Delhi.
4. Rangwala, S. C. (1992). *Building Construction*. Charotar Publishing House, Anand.
5. Huntington, W. C. (1959). *Building Construction*. John Wiley, New York.

Type of Questions for End Semester Examination.

PART A: Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules ($10 \times 2 = 20$ marks).

PART B: ($4 \times 10 = 40$ marks)

Question nos. II and III [with sub sections (a), (b), …] (10 marks each with option to answer either II or III) from Module I.
Question nos. IV and V [with sub sections (a), (b), …] (10 marks each with option to answer either IV or V) from Module II.
Question nos. VI and VII [with sub sections (a), (b), …] (10 marks each with option to answer either VI or VII) from Module III.
Question nos. VIII and IX [with sub sections (a), (b), …] (10 marks each with option to answer either VIII or IX) from Module IV.

CE15–13L1 CONCRETE LAB

Course Objectives: To reinforce the concepts learned in concrete technology and to familiarize testing methods for the determination of certain properties of cement, mortar and concrete (fresh and hardened).

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

1. Feel the constituent materials of concrete and test their properties of engineering interest and assess the quality and suitability of such materials.
2. Clearly understand batching and mixing of concrete and the concept of workability and water-cement ratio.
3. Determine strength of concrete in compression and tension and hence appreciate grade of concrete and mix design.

4. Determine desirable properties of concrete of engineering interest.

LIST OF EXPERIMENTS

1. Determination of Standard consistency and Initial Setting time of Cement.
2. Determination of Soundness of cement (Le Chatelier's apparatus).
3. Particle size distribution of fine aggregate – sieve analysis
4. Bulking of sand.
5. Determination of compressive strength of cement mortar cube.
6. Mix Design of concrete.
7. Determination of workability of fresh concretes: slump and compaction factor tests.
8. Preparation of concrete cubes and cylinders.
9. Compression test on concrete cubes and split-tensile test on concrete cylinders.
10. Determination of Modulus of elasticity of concrete.
11. Flexure test on concrete.

Note : 50 % marks is earmarked for continuous evaluation, and 50% marks for end semester examination to be conducted by two examiners. A candidate shall secure a minimum of 50 % marks in the aggregate and 45 %minimum in the end semester examination for a pass. .

CE15-13L2 STRENGTH OF MATERIALS LAB

Course Objectives: To reinforce the concepts learned in strength of materials and to familiarize testing methods for the determination of certain material properties.

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

1. Conceive and reinforce the ideas of axial tension, compression, bending, torsion (circular bar), thoroughly through the respective experiments.
2. Understand the determination of certain material properties, like, hardness, toughness, Young's modulus, Rigidity modulus, ductility, flexural strength, etc.
3. Familiarize with testing equipment and machine in the laboratory.

LIST OF EXPERIMENTS

1. Tension test on mild steel bar.
2. Double shear test on mild steel bar
3. Torsion test on mild steel bar
4. Izode Impact test.
5. Charpy Impact test.
6. Rockwell Hardness test.
7. Brinell Hardness test.
8. Determination of modulus of rigidity of springs – close coiled and open coiled.
9. Fatigue strength test
10. Bending test of wooden / steel beam – determination of flexural strength and modulus of elasticity.
11. Compression test on wood and brick.
12. Verification of Clark-Maxwell's theorem.

Note : 50 % marks is earmarked for continuous evaluation, and 50% marks for end semester examination to be conducted by two examiners. A candidate shall secure a minimum of 50 % marks in the aggregate and* 45 %*minimum in the end semester examination for a pass.

AS15-1401 COMPLEX VARIABLES AND PARTIAL DIFFERENTIAL EQUATIONS

Course Objectives: To understand and use complex variables, function integrals, partial differential equation in engineering discipline.

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

1. Transform a region to another region using conformal mapping.
2. Evaluate real integrals using residue theorem.
3. Formation and solution of partial differential equation.
4. Determine solution of partial differential equation for vibrating string and heat conduction.

MODULE I

Analytic function- Cauchy-Riemann equation (Cartesian and polar)-Harmonic function-construction of analytic function given real or imaginary parts- Conformal mapping of standard elementary function and bilinear transformation.

MODULE II

Cauchy's integral theorem, Cauchy's integral formula and for derivatives-Taylor's and Laurent's expansion (without proof)-Singularities-Residues-Cauchy's Residues theorem- Contour integration involving unit circle.

MODULE III

Formation of partial differential equation eliminating arbitrary constants and function—Solution of first order equation-four standard types- Lagranges equation—Linear homogeneous partial differential equation with constant coefficient.

MODULE IV

One dimensional wave equation, D'Alembert's solution and one dimensional heat flow equation —solution by the method of separation of variables- application of Fourier series solution. Solution of Laplaces's equation over a rectangular region by the method of separation of variables.

References:

1. Kreyzig, E. (2011). *Advanced Engineering Mathematics* (10th edition). John Wiley & Sons, Hoboken, N.J.
2. Grewal, B. S. (2013). *Higher Engineering Mathematics* (43rd edition). Khanna Publishers, New Delhi.

Type of Questions for End Semester Examination.

PART A: Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules ($10 \times 2 = 20$ marks).

PART B: ($4 \times 10 = 40$ marks)

Question nos. II and III [with sub sections (a), (b), …] (10 marks each with option to answer either II or III) from Module I.

Question nos. IV and V [with sub sections (a), (b), …] (10 marks each with option to answer either IV or V) from Module II.

Question nos. VI and VII [with sub sections (a), (b), …] (10 marks each with option to answer either VI or VII) from Module III.

Question nos. VIII and IX [with sub sections (a), (b), …] (10 marks each with option to answer either VIII or IX) from Module IV.

CE15-1402 SURVEYING - II

Course Objectives: To understand advanced concepts of surveying by using basic instruments to study modern trends in surveying.

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

1. Set out horizontal curves.
2. Carry out a geodetic survey, taking accurate measurements using instruments and apply mathematical adjustment of errors involved in surveying measurements.
3. Plan a survey for applications such as road alignment and height of the building.
4. Invoke advanced surveying techniques over conventional methods in the field of civil engineering.

MODULE I

Curves: Types of curves - Basic definitions-Elements of a simple curve - Methods of setting out (Linear methods and Angular methods)-Compound Curves-Elements of a compound curve-Reverse Curve-Transition curves-advantages-super elevation- length of a transition curve - vertical curves-Types of vertical curves- length of the vertical curve.

MODULE II

Triangulation : Principles of Triangulation-classification triangulation-reconnaissance-Selection of Triangulation Stations-Intervisibility of Triangulation stations-Determination of elevations of stations (No obstruction due to intervening ground and obstruction due to intervening ground) -Signals-Elevated towers-selection of site for base line-Base line measurement-corrections-Satellite station.

Adjustments of observations: Laws of weight-Corrections to filed measurements with a closing error-Theory of least squares-Normal equation method-Most probable values of directly observed quantities and indirectly observed quantities-Method of differences - Triangulation adjustments -Station adjustments for 3 different. Cases (when the horizon is closed with angles of equal weight - unequal weight-when several angles are measured at a station individually and also in combinations)- Figure adjustment of a plane triangle adjustment of two connected triangles-adjustment of a closed traverse.

MODULE III

Field Astronomy: Definitions - solution of astronomical triangle-Co-ordinate systems-Time - Solar-Sidereal and Standard-Equation of time-sun dial-Determination of time, azimuth, latitude and longitude.

MODULE IV

Hydrographic Survey: Introduction - Shore Line Survey - River survey Soundings Methods of sounding - Method of locating soundings – plotting soundings-Three Point problem.

Photogrammetry: Phototheodolite -Principle of the method of Terrestrial photogrammetry - Field work - Stereo - Photogrammetry -aerial Surveying - Terminology - Scale and distortion of the vertical photograph - principle of Binocularvision and Stereoscopic fusion - Flight planning - plotting from Air Photographs - Heighting – Photo Interpretation Comparison between Air Photograph and Map -Application of Air photograph.

References:

1. Punmia, B.C, Jain, A. K. and Jain, A. K. (2010). *Surveying*. Vol. II. Laxmi Publications.
2. Arora, K. R. *Surveying*. Vol. II and III. Standard Book House.
3. Ghilani, C. D. and Wolf, P. R. *Elementary Surveying*. Prentice Hall.
4. Arora, K.R. *Surveying*. Vol. I and II. Standard Book House.
5. Duggal, S. K. *Surveying*. Vol. II. Tata McGraw Hill Publishing Co Ltd.

Type of Questions for End Semester Examination.

PART A: Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules ($10 \times 2 = 20$ marks).

PART B: ($4 \times 10 = 40$ marks)

Question nos. II and III [with sub sections (a), (b), …] (10 marks each with option to answer either II or III) from Module I.

Question nos. IV and V [with sub sections (a), (b), …] (10 marks each with option to answer either IV or V) from Module II.

Question nos. VI and VII [with sub sections (a), (b), …] (10 marks each with option to answer either VI or VII) from Module III.

Question nos. VIII and IX [with sub sections (a), (b), …] (10 marks each with option to answer either VIII or IX) from Module IV.

CE15–1403 ANALYSIS OF DETERMINATE STRUCTURES

Course Objectives: To motivate the students to enter the endless world of structures and their analysis as a smooth transition from the strength of materials, initiated through statically determinate structures and the concept of moving loads and influence lines.

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

1. Appreciate the effects of sudden loading and stress concentration on determinate structures and behavior of beams to asymmetric loading and geometry and initial curvature.
2. Cleary identify elastic deflection and slope in determinate structures motivated by the importance of serviceability part of analysis and design.
3. Develop basic concepts of built-up and composite beams, governing equations of two-dimensional linear elasticity and employing principal stresses in design through theories of failure in an elementary level through the introduction of plastic analysis.
4. Thoroughly assimilate the powerful concepts of moving loads and influence lines and their applications in determinate structural analysis.

MODULE I

Behavior of Structures to Impact and Stress concentration: Impact loading, Fatigue (progressive fracture), Stress concentration in axial loading, bending and torsion (elementary treatment only).

Asymmetry in Bending: Asymmetry in loading and geometry, Stresses in doubly symmetric beams with inclined loads, bending of determinate beams with initial curvature subjected to symmetrical loading.

Shear centre: The concept of shear centre introduced through singly symmetric and asymmetric cross-sections of beams.

MODULE II

Elastic Deflection of Determinate Beams: Basic concept of slope and deflection, Differential equation of elastic line of a beam, Relation between intensity of loading, shear force, bending moment, slope and deflection, Macaulay's method, Moment-area method, Strain energy method – Castigliano's theorems, Unit load method.

Deflection of Determinate Trusses: Deflection of joints of trusses through Castigliano's theorems, Unit load method, temperature effects.

MODULE III

Built-up and Composite Beams: Analysis of built-up and composite beams, shear flow, Combined stresses in Beams subjected to axial load, bending and torsion.

Plane stress and Plane strain problems: Introduction to plane stress and plane strain problems, equations of equilibrium, compatibility and constitutive equations in two-dimensions, examples of plane stress and plane strain problems.

Theories of failure: Maximum principal stress theory, maximum principal strain theory, maximum shear stress theory, maximum strain energy theory, maximum distortion energy theory, applications of each theory.

MODULE IV

Moving Loads and Influence Lines: Moving loads in structures introduced through examples of bridge girders, Definition and purpose (in analysis) of influence line, influence lines for reaction, shear force and bending moment at a given cross-section in statically determinate beams, criteria for maximum reaction, shear and bending moment at a section and absolute maximum of the same in determinate beams, Muller-Breslau influence theorem for statically determinate beams, influence lines for statically determinate trusses, criteria for maximum

bending moment at a panel point on the loaded chord, and unloaded chord of a truss, Muller Breslau influence theorem for statically determinate trusses.

References:

1. Timoshenko, S. P. and Young D.H. *Elements of strength of materials*. East-West Press Private Limited New Delhi, India.
2. Gere, J. M. *Mechanics of Materials*. Brooks/Cole Thomson Learning.
3. Wang, C. K. *Intermediate Structural Analysis*. McGraw Hill International Edition.
4. Popov, E. P. *Engineering Mechanics of Solids*. Prentice-Hall of India Limited, New Delhi, India.
5. Srinath, L. S. *Advanced Mechanics of Solids*. Tata McGraw Hill Education Pvt Ltd, New Delhi.
6. Punmia B. C., Jain A. K. and Jain A. K. *Strength of Materials and Theory of Structures*: Vol. II., Laxmi Publications (P) Ltd, New Delhi.
7. Menon, D. *Structural Analysis*. Narosa publishers.
8. Pytel, A. and Kiusalaas, J. *Mechanics of Materials*. Brooks/Cole Thomson Learning.
9. Reddy, C. S. *Basic Structural Analysis*. Tata McGraw Hill.

Type of Questions for End Semester Examination.

PART A: Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules ($10 \times 2 = 20$ marks).

PART B: ($4 \times 10 = 40$ marks)

Question nos. II and III [with sub sections (a), (b), …] (10 marks each with option to answer either II or III) from Module I.

Question nos. IV and V [with sub sections (a), (b), …] (10 marks each with option to answer either IV or V) from Module II.

Question nos. VI and VII [with sub sections (a), (b), …] (10 marks each with option to answer either VI or VII) from Module III.

Question nos. VIII and IX [with sub sections (a), (b), …] (10 marks each with option to answer either VIII or IX) from Module IV.

CE15-1404 ENGINEERING GEOLOGY AND SEISMOLOGY

Course Objectives: To make the students familiar with physical and structural geology as well as the basics of mineralogy and petrology which help them to plan accordingly for the construction of Civil engineering structures.

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

1. Understand weathering process and mass movement.
2. Distinguish geological formations.
3. Identify subsurface information and groundwater potential sites through geophysical investigations.
4. Apply geological principles for mitigation of natural hazards.

MODULE I

Introduction: Definition - branches of geology -scope of geology – geology in civil engineering- Geological time scale.

Physical Geology: Rock weathering and soils - physical weathering - chemical weathering - climate and soil formation - classification of soil - soil erosion and its control. *Wind* - Wind erosion - Wind transportation - Wind deposition

Rivers - erosion - transportation - deposition - river meandering - types of rivers - drainage patterns.-*Oceans* – sea erosion - transportation - deposition – coastal protection.

MODULE II

Mineralogy: Definition of minerals - physical properties – Study of physical properties of the following minerals - quartz, Telspar, Muscovite, Biotite, Kyanite, Serpentine.

Petrology : Classification, texture and structures of Igneous , Sedimentary and Metamorphic rocks- factors & kinds of metamorphism – Engineering properties of rocks- Description, engineering properties and uses of the following rocks – Granite , Gabbro, Basalt, Limestone, Shale, Laterite, Quartzite, Marble.
Structural Geology: Attitude of beds, study of structures –folds, faults, fractures and joints – classification, recognition in the field, relevance to civil engineering.

MODULE III
Geological Investigation : Objectives – Methods of investigation – Surface investigation – Sub - surface explorations –Geophysical Methods
Engineering Geology : Geological conditions necessary for design and construction of dam & reservoirs, tunnels, buildings & road cuttings – Landslides –definition, classification, causes and their corrections.

MODULE IV
Seismology : Internal structures of the earth – M-discontinuity – sources of seismic activity - Continental Draift - Plate tectonics –fault movement – Reservoir associated earthquakes – Elastic Rebound Theory - seismic waves – Terminology – Intensity and Magnitude of Earthquake – Energy Released during on earthquake – Locating Epicentre and Focus – Recording of an earthquake – Seismograph – working Principle and Sensitivity of a Seismographs – classification of earth quakes - based on depth of focus , magnitude, cause of origin –effects of earthquakes – Primary effects – Secondary effects - Distribution of earth quakes –Seismic History of India Seismic Zones of India – Tsunami – Introduction – Tsunami velocity – Velocity in deep ocean – Velocity in shallow water – wavelength of tsunami wave – Drawdown and Run up of a tsunami – inundates of Tsunami waves.

References:

1. Singh, P. *A text book of Engineering and General Geology*. Katson Publishers, Ludhiana.
2. Waltham,.T. *Foundations of Engineering Geology*. Spon Press, London.
3. Blyth, F. G. H. and de Frieitis, M. H. *Geology for Engineering*
4. Judo, W. R. *Principles of Engineering Geology and Geotechnics*. McGraw Hill.
5. Mukerjee, P. K. *A text book of geology*. World Press Ltd., Calcutta.

Type of Questions for End Semester Examination.
PART A: Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules ($10 \times 2 = 20$ marks).
PART B: ($4 \times 10 = 40$ marks)
Question nos. II and III [with sub sections (a), (b), …] (10 marks each with option to answer either II or III) from Module I.
Question nos. IV and V [with sub sections (a), (b), …] (10 marks each with option to answer either IV or V) from Module II.
Question nos. VI and VII [with sub sections (a), (b), …] (10 marks each with option to answer either VI or VII) from Module III.
Question nos. VIII and IX [with sub sections (a), (b), …] (10 marks each with option to answer either VIII or IX) from Module IV.

CE15-1405 FLUID MECHANICS – II

Course Objectives: To introduce the students to various hydraulic engineering problems like open channel flows and hydraulic machines.

Course Outcomes: On completion of the course, a student will be able to
1. Compute drag and lift coefficients and design channels.
2. Compute flow profiles in channel transitions and analyze hydraulic transients.
3. Design the working proportions of hydraulic machines.
4. Analyze compressible flows of liquids and gases.

MODULE I

Boundary Layer Theory: Concepts of boundary layer flows, Laminar and turbulent boundary layers, Integral momentum equation for boundary layer flows, Boundary layer separation and control, Drag and lift.

Uniform Flow in Open Channels: Specific energy, Critical flow, Channel transitions, Uniform flow formulae, best hydraulic sections.

MODULE II

Steady Gradually Varied Flow: Non uniform flow in open channels, gradually varied flow equation, Type of GVF profiles, Computation of GVF profiles.

Steady Rapidly Varied Flow: Hydraulic jump in a horizontal rectangular channel, Specific force, Computation of energy loss.

MODULE III

Unsteady Flow: Celerity of a gravity wave, Monoclonal rising wave, Positive and negative surges, St. Venant's equations, Method of characteristics, Hydraulic routing.

Hydraulic Similitude: Similarity laws, and Model studies.

Compressible Flows: Celerity of an elasticity wave, Area velocity relationships, Flow through nozzles, Constant area flow, Normal shocks, Water Hammer.

MODULE IV

Hydraulic Machinery: Impact of jets, Classification of hydraulic machines, one dimensional flow analysis and velocity triangles, Design of Pelton turbine, Design of Francis turbine, Design of a Kaplan turbine Design of centrifugal pump, Design of axial flow pump, Selection of hydraulic machines.

References:

1. Chow, V.T. (2009). *Open Channel Hydraulics*. Blackburn Press.
2. White, F. M. (2011). *Fluid Mechanics*. Tata McGraw Hill Publications.
3. Fox, R. W., Orutcgardm, O. H. and McDonald, A. T. (2011). *Introduction to Fluid Mechanics* (7th student edition). Wiley India.
4. Subramnaya, K. (2008). *Flow In Open Channel*. Tata McGraw Hill Publications, New Delhi.

Type of Questions for End Semester Examination.

PART A: Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules ($10 \times 2 = 20$ marks).

PART B: ($4 \times 10 = 40$ marks)

Question nos. II and III [with sub sections (a), (b), …] (10 marks each with option to answer either II or III) from Module I.

Question nos. IV and V [with sub sections (a), (b), …] (10 marks each with option to answer either IV or V) from Module II.

Question nos. VI and VII [with sub sections (a), (b), …] (10 marks each with option to answer either VI or VII) from Module III.

Question nos. VIII and IX [with sub sections (a), (b), …] (10 marks each with option to answer either VIII or IX) from Module IV.

CE15-1406 BUILDING PLANNING AND DRAWING

Course Objectives: To train the students in drawing to scale some components of buildings and plan and design residential and other buildings introducing various views necessary in a building sketch.

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

1. Conceive the idea of different parts of doors, windows, stairs and roof trusses and prepare detailed working drawings of such building components.

2. Prepare working drawings including plan, elevation, section, site plan, location plan, etc. of various types of buildings from requirements.

MODULE I

Doors and Windows (Panelled and Glazed)-Sectional plan, sectional elevation and Front View.
Roof Trusses-Elevation and joint details of wooden King post truss, Queen post truss and a steel roof truss.
Stairs-Plan & Section of RCC dog legged stair.

MODULE II

Buildings –Preparation of working drawings (from line sketches or from specifications) of different types of buildings - Single storeyed (R.C.C flat roof & Tiled roof) and double storeyed residential buildings (R.C.C roof).
A twin house with combination roof, Factory building. Preperation of site plan.

References:

1. National Building Code of India.
2. Kerala Municipal Building Rules.
3. Shaw and Kale. *Building Drawing*.
4. Prabhu, B. T. S. *Building Drawing and Detailing*. Spades, Calicut.
5. Malik, R. S. and Meo, G. S. *Civil Engineering Drawing*.
6. Verma, B. P. *Civil Engineering Drawing and House Planning*. Khanna Publishers, Delhi.

Type of Questions for End Semester Examination.

Module I – One question should be answered out of two questions – 20 Marks
Module II –Building plan – section - elevation – site plan from line sketch / Specefications – 40 Marks.

CE15- 14L1 SURVEY PRACTICALS

Course Objectives: To train the students to acquire skills in making precise measurements and obtaining accurate result.

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

1. Conduct survey and field data, prepare field notes from survey data, interpret survey data and compute areas and volumes.

Plane Table survey:

1. Method of Radiation.
2. Method of Intersection.
3. Solving three point problem - Bessel's method.
4. Solving three point problem - trial and error method & tracing paper method.
5. Solving two point problem.

Leveling:

6. Study of leveling instruments.
7. Fly leveling.
8. Longitudinal sectioning.
9. Cross sectioning.
10. Contour surveying.
11. Permanent adjustments.

Theodolite

12. Study of Theodolite.

13. Permanent adjustments of Theodolite.
14. Determination of Tacheometric Constants.
15. Heights and distances by stadia tacheometry.
16. Heights and distances by tangential tacheometry.
17. Heights and distances by solution of triangles.
18. Setting out simple curve-angular methods.
19. Demonstration of Total Station.

Note : 50 % marks is earmarked for continuous evaluation, and 50% marks for end semester examination to be conducted by two examiners. A candidate shall secure a minimum of 50 % marks in the aggregate and* 45 %*minimum in the end semester examination for a pass.

CE15-14L2 FLUID MECHANICS LAB

Course Objectives: To reinforce the theory learned in the fluid mechanics courses and familiarize various pipe fittings and tools to have a feel of them.

Course Outcomes: On completion of the course, a student will be able to
1. Identify the behavior of various fluid flows and use this information in practical applications.
2. Conceive the idea of metacentric height, losses due to friction, purpose of notches, etc. and their practical use.

LIST OF EXPERIMENTS

1. Study of pipe fittings and plumbing tools
2. Experiment on notches
3. Pipe friction apparatus
4. Determination of minor losses
5. Metacentric height
6. Venturimeter
7. Orifice meter
8. Flow through orifice
9. Heleshaw experiment
10. Reynolds experiment
11. Free & forced vortex apparatus
12. Verification of Bernoullis equation

Note : 50 % marks is earmarked for continuous evaluation, and 50% marks for end semester examination to be conducted by two examiners. A candidate shall secure a minimum of 50 % marks in the aggregate and* 45 %*minimum in the end semester examination for a pass.

AS15 -1501 NUMERICAL AND STATISTICAL METHODS

Course Objectives: To understand the concept of Probability, Statistics and Numerical methods which arise in engineering applications.

Course Outcomes: On completion of the course, a student will be able to
1. Study the defects arising in any of the Engineering product.
2. Study Quality of the components purchased for project.
3. Apply the principles and techniques learnt in this course for solving practical problems which arise in the industry.

Module I
Numerical solution of algebraic and transcendental equation by -Regula-falsi method, Newton Raphson's method, Gauss Seidal iteration method to solve a system of equations and convergence (without proof)Newton's forward and backward interpolation formula, Lagrange interpolation, Newton's divided difference and central differences.

Module II
Numerical differentiation at the tabulated points with forward, backward and central differences, Numerical integration with trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule. Taylor series method, Euler method, Modified Euler method, Runge – Kutta method of second and fourth order for solving 1st order ordinary differential equation.

Module III
Random variable(discrete and continuos) Expectation-mean and variance of probability distribution, Binomial, Poisson and Normal distribution and Fitting of this Distribution to the given data, Curve fitting-fitting of straight line, parabola, exponential.

Module IV
Population and Sample-Sampling Distribution (of mean and variance)Testing of Hypothesis-level of significance, Z-test statistic, Chi square test for variance, for goodness of fit and F-test.

References:

1. Kreyzig, E. (2011). *Advanced Engineering Mathematics* (10th edition). John Wiley & Sons, N. J.
2. Grewal, B. S. (2013). *Higher Engineering Mathematics* (43rd edition). Khanna Publishers, New Delhi.
3. Kandaswamy, P., Thilagavathy, K. and Gunavathy, K. (2007). *Numerical methods*. S Chand & Co., New Delhi.
4. Johnson, R. A., Miller, I. and Freund, J. E. (2010). *Probability and statistic for Engineers*. (eighth edition). Pearson, New Delhi.

Type of Questions for End Semester Examination.
PART A: Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules ($10 \times 2 = 20$ marks).
PART B: ($4 \times 10 = 40$ marks)
Question nos. II and III [with sub sections (a), (b), …] (10 marks each with option to answer either II or III) from Module I.
Question nos. IV and V [with sub sections (a), (b), …] (10 marks each with option to answer either IV or V) from Module II.
Question nos. VI and VII [with sub sections (a), (b), …] (10 marks each with option to answer either VI or VII) from Module III.
Question nos. VIII and IX [with sub sections (a), (b), …] (10 marks each with option to answer either VIII or IX) from Module IV.

CE15–1502 DESIGN OF CONCRETE STRUCTURES – I

Course Objectives: To introduce the structural design concepts to students through design philosophy, usage of the IS codes and structural detailing.

Course Outcomes: On completion of the course, a student will be able to
1. Identify and calculate different types of loads on structures.
2. Design Reinforced Concrete beams and slabs using limit state method.
3. Design structures for serviceability.
4. Design Reinforced Concrete Columns and staircase.

MODULE I

Introduction to different design philosophies, Principles of Working Stress and Limit State methods (Limit State method in detail), Analysis of singly and doubly reinforced beams of rectangular and flanged sections, Design for bending, compression, shear and torsion – Design of singly and doubly reinforced beams of rectangular and flanged sections.

MODULE II

Types of **slabs** – design of one-way slabs – temperature and shrinkage reinforcement – behavior of two way edge supported slab – analysis by coefficient method – Design of two way edge supported slab.

Analysis and design for torsion: Torsion in plain concrete members – torsion in reinforced concrete members – combined torsion and shear – Limit state design of beams – Code provision for torsion design.

MODULE III

Bond, anchorage and development length: Fundamentals of flexural bond – ultimate bond strength and development length – Code provisions for development of tension reinforcement – anchorage of tension bars by hooks – anchorage requirements for web reinforcement – development of bars in compression – bundled bars – bar cutoff and bend points in beams.

Serviceability: Cracking in flexural members – Code provisions for crack control – control of deflection – immediate deflection – deflection due to long term loads – Code provisions for control of deflection – deflection due to shrinkage and temperature changes.

MODULE IV

Staircases- types of staircase-design of straight flight stair cases.

Columns: Design of short columns – axial compression – lateral ties and spirals – compression plus bending in rectangular columns – strain compatibility analysis and interaction diagrams – balanced failure – distributed reinforcement –unsymmetrical reinforcement – circular columns – Code provisions for design of short columns – biaxial bending – Design of slender columns – concentrically loaded columns – compression plus bending – Code provisions for design of slender columns.

References:

1. Nilson, A. H. *Design of Concrete Structures*. McGraw Hill Companies Inc.
2. Pillai, S. U. and Menon, D. *Reinforced Concrete Design*. Tata McGraw Hill Publishing Company Limited, New Delhi, India.
3. Varghese, P. C. *Limit State Design of Reinforced Concrete*. Prentice Hall of India Pvt Ltd, New Delhi, India.
4. Syal and Goel. *Reinforced concrete structures*, S Chand.

Type of Questions for End Semester Examination.

Question nos. I and II [with sub sections (a), (b), …] (15 marks each with option to answer either I or II) from Module I.

Question nos. III and IV [with sub sections (a), (b), …] (15 marks each with option to answer either III or IV) from Module II.

Question nos. V and VI [with sub sections (a), (b), …] (15 marks each with option to answer either V or VI) from Module III.

Question nos. VII and VIII [with sub sections (a), (b), …] (15 marks each with option to answer either VII or VIII) from Module IV.

Use of IS. Codes: 456-2000, 875-1987 and Interaction charts for column design are permitted in the Examination Hall.

CE15–1503 ANALYSIS OF INDETERMINATE STRUCTURES

Course Objectives: To sail through to indeterminate structures smoothly from determinate ones motivating the students via the advantages possessed by the former and to introduce the conventional methods of their elastic analysis.

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

1. Distinguish clearly static and kinematic indeterminacy of structures and force and displacement methods of analysis of indeterminate structures and master a few force methods of analysis of pin-jointed and rigid-jointed structures.
2. Analyze rigid-jointed structures by the well known displacement based method, the slope-deflection technique motivated by matrix formulation of equilibrium equations of the method and its computer implementation.
3. Familiarize the iterative procedure of analysis of rigid-jointed structures illustrated via the moment distribution method.
4. Identify the advantage of certain geometrical features in structures and supports through the analysis of arches and cable stayed suspension bridges.

MODULE I

Indeterminacy of structures: Degree of static and kinematic indeterminacy of pin-jointed and rigid-jointed structures (sufficient examples should be included to reinforce the concept), redundant and degree of freedom, brief introduction to force and displacement methods based on the degree of static and kinematic indeterminacy.

Force method of Analysis of indeterminate trusses: Force method in which reactions as redundant, axial forces in members as redundant, both reactions and axial forces in members as redundant, induced reactions due to yielding of support, pre-strains.

Force method of Analysis of indeterminate beams and frames: Method of consistent deformation, strain energy method (Castigliano's theorems), unit load method, induced reactions due to yielding of supports, Three moment equation method – application of three moment equation to continuous beams, analysis of continuous beams subjected to uneven support settlement.

MODULE II

Displacement Method of Analysis – The Slope Deflection method: Derivation of the slope-deflection equation for a one-span beam, analysis of continuous beams, beams subjected to uneven support settlement, analysis of rigid jointed frames with and without unknown joint translation, rigid frames subjected to support settlement, analysis of gable frames.

MODULE III

Displacement Method of Analysis – The Moment Distribution method: Stiffness and carry over factors, distribution factors, analysis of continuous beams, check on moment distribution, modified stiffness factors at the near end when far end is hinged, beams subjected to uneven support settlement, analysis of rigid jointed frames with and without joint translation, rigid frames subjected to support settlement.

MODULE IV

Arches and frames: Theory of arches, Eddy's theorem, Three hinged arches, two hinged arches, fixed arches, Influence lines for bending moment, shear force and axial thrust.

Cable Suspension bridges: Equilibrium of un-stiffened cable, tension in the cable, length of the cable, anchor cable, roller support, saddle support, effect on cable length due to change in temperature.

References:

1. Wang, C. K. *Intermediate Structural Analysis*. McGraw Hill International Edition.

2. Menon, D. *Structural Analysis*. Narosa publishers.
3. Pandit, G. S. and Gupta, S. P. *Theory of structures*, Tata McGraw Hill.
4. Roy and Chakrabarty. *Fundamentals of Structural Analysis*. S Chand.
5. Norris, C. H. and Wilbur J. B. *Elementary Structural Analysis*. McGraw Hill, New York.
6. Punmia, B. C. and Jain, A. K. *Theory of Structures*, Laxmi Publications (P) Ltd.

Type of Questions for End Semester Examination.

PART A: Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules ($10 \times 2 = 20$ marks).

PART B: ($4 \times 10 = 40$ marks)

Question nos. II and III [with sub sections (a), (b), …] (10 marks each with option to answer either II or III) from Module I.
Question nos. IV and V [with sub sections (a), (b), …] (10 marks each with option to answer either IV or V) from Module II.
Question nos. VI and VII [with sub sections (a), (b), …] (10 marks each with option to answer either VI or VII) from Module III.
Question nos. VIII and IX [with sub sections (a), (b), …] (10 marks each with option to answer either VIII or IX) from Module IV.

CE15-1504 GEOTECHNICAL ENGINEERING – I

Course Objectives: To equip the student to understand the properties and behavior of soil for the design of foundations, earth and earth retaining structures.

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

1. Understand the properties of soils and to classify them through laboratory investigation.
2. Compute the effect of water and stress due to external load.
3. Understand the principles of compaction and its control.
4. Understand the volume change behavior under static loading; compute consolidation settlement in soft soil and time rate of settlement.
5. Gain knowledge of shear strength parameters, its determination and its applications in slopes.

MODULE I

Nature of soil and functional relationships: Soil types – residual soil and transported soil. Three phase system – void ratio –specific gravity-– porosity-water content-dry,saturated and submerged unit weight-– degree of saturation –relative density -Relationship between Basic Soil properties. Concepts of single grained, honey combed and flocculent structure - Basic Structural units of clay minerals- common clay minerals.

Laboratory and field identification of soils: Determination of water content by oven drying – specific gravity using Pyenometer and specific gravity bottle – grain size analysis by sieve analysis, hydrometer analysis and pipette analysis – Atterberg limit and indices
field density by core cutter, sand replacement and wax coating methods. Classification of Soils: Necessity – Principles of classification – I.S. classification – plasticity chart.

MODULE II

Soil water: Classification- effective stress - total stress - pore pressure - pressure diagrams for different conditions.

Permeability: definition - Darcy's law - factors affecting permeability - laboratory determination – permeability of stratified soils.

Stress distribution: Boussinesque's and Westergaard's equations for vertical pressure due to point loads and uniformly distributed loads - assumptions and limitations - pressure bulb – Newmarks` charts and their use.

MODULE III

Compaction: definition and objectives of compaction - proctor test and modified proctor test - concept of OMC and maximum dry density - zero air voids line - factors influencing compaction - field compaction methods - Proctor needle for field control.
Consolidation: definition - concepts of coefficient of compressibility - coefficient of volume change and compression index - e-log p curves - pre-consolidation pressure - Terzaghi's theory of one dimensional consolidation - determination of coefficient of consolidation - difference between consolidation and compaction.

MODULE IV
Shear Strength: definition - Mohr's strength and stress circles - Mohr's envelope - Mohr-Coulomb strength theory - direct, triaxial and UCC tests - drainage conditions-UU, CU and CD tests - vane shear tests - total and effective stress - strength parameters – sensitivity and thixotropy.
Stability of slopes: Slope failure, base failure and toe failure - Swedish circle method - friction circle method - Taylor's stability number - stability charts.

References:

1. Ranjan, G. and Rao, A. S. R. *Basic and Applied Soil Mechanics*. Wiley Eastern Ltd.
2. Das, B. M. *Principles of Geotechnical Engineering*. Thomas Brooks Cole, Singapore.
3. Punmia, B. C. *Soil Mechanics and Foundations*. Laxmi Publications.
4. Terzaghi, K. and Peck, R. B. *Soil Mechanics in Engineering Practice*. John Wiley.
5. Venkataramaiah, C. *Geotechnical Engineering*. New Age International Publishers.
6. Arora, K. R. *Soil Mechanics and Foundation Engineering*. Standard Publishers and Distributors.

Type of Questions for End Semester Examination.
PART A: Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules ($10 \times 2 = 20$ marks).
PART B: ($4 \times 10 = 40$ marks)
Question nos. II and III [with sub sections (a), (b), …] (10 marks each with option to answer either II or III) from Module I.
Question nos. IV and V [with sub sections (a), (b), …] (10 marks each with option to answer either IV or V) from Module II.
Question nos. VI and VII [with sub sections (a), (b), …] (10 marks each with option to answer either VI or VII) from Module III.
Question nos. VIII and IX [with sub sections (a), (b), …] (10 marks each with option to answer either VIII or IX) from Module IV.

. CE15-1505 TRANSPORTATION ENGINEERING – I

Course Objectives: To build a strong, stable and deep concept on highway and air transportation and to equip the students to plan, and design various structures and traffic control devices coming under these two modes of transportation.

Course Outcomes: On completion of the course, a student will be able to:
1. Carry out surveys involved in planning and highway alignment.
2. Design cross section elements, sight distance, horizontal and vertical alignment.
3. Implement traffic studies, traffic regulations and control, and intersection design.
4. Determine the characteristics of pavement materials.
5. Carry out the surveys, perform geometric design for airports.

MODULE I
Classification, Alignment and surveys: Classification of highways – typical cross section of roads in embankment and in cutting, definition of various cross sectional elements – requirements and factors controlling alignment of roads, Engineering surveys.
Geometrical Design of Highways: Camber – sight distances – Stopping, passing and overtaking Sight distances, Overtaking zone requirements, worked out problems – design of horizontal

alignments, design speed – horizontal curves – Super elevation – Super elevation design – radius of horizontal Curve – extra widening of pavement – transition curves and methods of provision of super elevation and design of horizontal alignment – design of vertical alignment – gradient and grade Compensation Vertical curves – summit curves – length of summit curve - valley curves – length of valley curve.

MODULE II

Traffic Engineering: Introduction - road user, vehicle and traffic characteristics - traffic engineering studies – speed – speed and delay - volume - origin and destination - parking and accident studies.

Road intersections- principles of design of at grade intersection - simple layouts.

Traffic operation-Traffic control devices- classifications and uses of traffic signs and markings – traffic signals.

MODULE III

Highway Materials, Testing and Design: Road aggregates – Desirable props & tests – Bituminous materials – Types of bituminous materials used in highway construction – requirements – desirable properties and tests.

Highway construction and Maintenance: Construction of bituminous concrete and cement concrete pavements . Joints in Concrete pavements – types and causes of failures in flexible and rigid pavements, Pavement Design –Basic difference between flexible and rigid pavements – factors to be considered in Design of pavements.

MODULE IV

Airport planning and design

Introduction - aircraft characteristics and their influence on planning of airports –classification of airports- airport obstructions and zoning - component parts of airports and site selection – runway design - orientation - basic runway length - corrections to basic runway length - worked out problems- geometric design of runways; design of taxiways and aprons – Controlling of air traffic-Operation of instrument landing system-terminal area planning concepts and its facilities - aircraft parking configurations.

References:

1. Khanna, S. K., Justo and Veeraraghavan. *Highway Engineering*. NemChand and Bros, Roorkee, India.
2. Khadiyali, L. R. *Traffic Engineering and Transport Planning*. Khanna Publishers.
3. Ministry of Road Transport and Highways Specifications for Road and Bridge Works. Fourth Edition. Indian Roads Congress, New Delhi, India.
4. Khanna, S. K., Arora, M. G., and Jain, S. S. *Airport planning and Design*, Sixth Edition. Nem Chand and Bros, Roorkee, India.
5. Rangwala, S. C. *Airport Engineering*. Charoter Publishing House.
6. Horonjeff, R., McKelvey, F. X., Sproule, W. J., and Young, S. B. *Planning and Design of Airports*. Fifth Edition. McGraw-Hill, New York.

Type of Questions for End Semester Examination.

PART A: Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules ($10 \times 2 = 20$ marks).

PART B: ($4 \times 10 = 40$ marks)

Question nos. II and III [with sub sections (a), (b), …] (10 marks each with option to answer either II or III) from Module I.

Question nos. IV and V [with sub sections (a), (b), …] (10 marks each with option to answer either IV or V) from Module II.

Question nos. VI and VII [with sub sections (a), (b), …] (10 marks each with option to answer either VI or VII) from Module III.

Question nos. VIII and IX [with sub sections (a), (b), …] (10 marks each with option to answer either VIII or IX) from Module IV.

CE15-1506 WATER RESOURCES AND IRRIGATION ENGINEERING

Course Objectives: To introduce the students to the concept of soil-plant characteristics and their water requirements, understand the necessity of planning an irrigation system to provide water at the right time and right place and introduce the student to the concept of hydrological aspects of water availability and requirements and should be able to quantify, control and regulate the water resources.

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

1. Analyze hydro-meteorological data.
2. Estimate abstractions from precipitation.
3. Compute yield from surface and subsurface basin.
4. Develop rainfall-runoff models.
5. Analyze and design gravity dams and earth and rock-fill dams.
6. Design spillways and energy dissipation structures.

MODULE I

Hydrologic cycle, scope, application of hydrology, Precipitation: Formation of precipitation – forms of precipitation – type of precipitation - measurement of precipitation –recording and non recording gauges – gauge network - adjustments of precipitation data - average depth of precipitation over an area - Arithmetic mean, Theissen polygon and isohyetal method – Hyetograph – Mass curve - Depth area duration curves. Water Loses: Evaporation, transpiration and infiltration – Factors affecting evaporation-measurement of evaporation - Evaporation formulas – Infiltration, factors affecting infiltration, Determination of infiltration rate - Effect of infiltration on run–off - Recharge of ground water.

Run off : Factors affecting run–off – Empirical formulae-runoff – hydrograph - Components of hydrograph - Separation of base flow - Hydrograph for isolated storm and complex storm - unit hydrograph - derivation of unit hydrograph for isolated and complex storm – Unit hydrograph for different duration – S hydrograph.

MODULE II

Ground water Hydrology : Occurrence, distribution of ground water – Darcy' s law – Permeability, safe yield - Location and development of ground water supplies - Hydrology of well – Steady flow in confined and unconfined aquifers - open well – yield of an open well – Effect of partial penetration - Interference of wells - Boundary effect - Specific capacity of well – Tube wells –Yield from a tube well - Strainers – Site for a tube well Flow and lift Irrigation –Perennial and Inundation irrigation - Important Crops and crop seasons –Duty and delta – Method of Cultivation - Water requirement – Irrigation efficiency – Multipurpose projects. Reservoirs : Investigation and planning – Selection of site – Engineering, Geological, and hydrological Investigations - Fixation of storage capacity - Contours- Mass curve - operation of reservoirs - reservoirs sedimentation.

MODULE III

Head works : Storage and diversion works- Layout of head works - Selection of site – Weirs- Types of weirs – Weirs on permeable foundation – Uplift and piping – Bligh' s creep theory - Lane' s weighted creep theory – Khosla' s theory of independent variables - Design of aprons- Body wall – vertical drop weir - design of sloping glacis weir. River regulators - Silt excluder -Silt vane, Surplussing Arrangements: Spillways – Type and Functions – design of Ogee Spillway and Siphon Spillway - energy dissipation below spillways – stilling basin – spillway crest gates. Distribution works : Classification of canals – design of canals – erodible canals - canals in alluvial soils – regime theory – Kennedy, Lacey traction theories – Manning' s formula - Design.

Non–erodible canals - Friction formula—Chezy,Manning's formula, Silting in canal and prevention – Scour-protection against scour.

MODULE IV

Storage works: Type of dams-Gravity dams –Forces acting on a gravity dam-Elementary profile-Single step method of design –Method of stability analysis-Zonal method of design safety criteria-Galleries in dams. Arch dams – Types-Thin cylinder theory. Earth and rockfill dams -Types of earthern dams.

References:

1. Subramanya, K. Engineering *Hydrology*, Tata McGraw-Hill.
2. Punmia, B. C. and Lal. *Irrigation and Water Power*. Laxmi Publications Pvt Ltd.
3. Modi, P. N. *Irrigation Water Resources and Water Power*, Standard Book House.
4. Sahasrabudhe, S. F. *Irrigation Engineering and Hydraulic Structures*. Kataria Publications.

Type of Questions for End Semester Examination.

PART A: Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules ($10 \times 2 = 20$ marks).

PART B: ($4 \times 10 = 40$ marks)

Question nos. II and III [with sub sections (a), (b), …] (10 marks each with option to answer either II or III) from Module I.

Question nos. IV and V [with sub sections (a), (b), …] (10 marks each with option to answer either IV or V) from Module II.

Question nos. VI and VII [with sub sections (a), (b), …] (10 marks each with option to answer either VI or VII) from Module III.

Question nos. VIII and IX [with sub sections (a), (b), …] (10 marks each with option to answer either VIII or IX) from Module IV.

CE15-15L1 GEOTECHNICAL ENGINEERING LABORATORY

Course Objectives: To Attain Knowledge In Assessing Both Physical And Engineering Properties Of Soils Through Laboratory Testing Procedures.

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

1. Determine the index properties of soils.
2. Classify soils as per I.S.
3. Determine the engineering properties of soils.

LIST OF EXPERIMENTS

1. Determination of Specific gravity, water content and particle size distribution by hydrometer method.
2. Determination of field density by core cutter and sand replacement method.
3. Determination of Atterberg Limits.
4. Compaction tests – I.S. light and heavy compaction.
5. California Bearing Ratio Test
6. Permeability tests – constant head and variable head methods.
7. Consolidation test.
8. Shear strength tests – Direct shear, Triaxial, UCC & Vane Shear Test
9. Demonstration of field tests like Standard Penetration Test, Dynamic Cone Penetration Test, Static Cone Penetration Test, Electrical Resistivity method, Pressure meter test, Plate load test.

Note : 50 % marks is earmarked for continuous evaluation, and 50% marks for end semester examination to be conducted by two examiners. A candidate shall secure a minimum of 50 % marks in the aggregate and* 45 %*minimum in the end semester examination for a pass.

CE15-15L2 TRANSPORTATION ENGINEERING LABORATORY

Course Objectives: To learn the characteristics, properties and testing procedures of aggregate, bitumen and bituminous mixtures.

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

1. Characterize the aggregates and bitumen used for road construction.
2. Design a bituminous mixture.

1. Tests on Aggregates

Crushing Value
Los-Angeles Abrasion Value
Impact Value
Specific Gravity
Water Absorption
Shape Test – Flakiness Index, Elongation Index & Angularity Number

2. Tests on Bitumen

Viscosity Test
Ductility Test
Softening Point Test
Specific Gravity
Penetration Test
Flash Point Test

3. Tests on Soil

CBR Test

4. Test on Bituminous mixes

Marshall Test

Note: 50 % marks is earmarked for continuous evaluation, and 50% marks for end semester examination to be conducted by two examiners. A candidate shall secure a minimum of 50 % marks in the aggregate and* 45 %*minimum in the end semester examination for a pass.

CE15-1601 ENVIRONMENTAL ENGINEERING –I

Course Objectives: To understand the basic principles and develop knowledge in unit operations, design and execution of water treatment system as well as the elements of environmental pollution.

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

1. Recognize the important professional and ethical responsibilities as an environmental engineer so as to estimate or analyze the quantity and quality of water required for a community water supply scheme.
2. Attain perfect knowledge on water supply sources, its collection, transport, transmission and maintenance.

3. Getting knowledge about sanitary plumbing systems, systems of sewerage and distribution systems in water supply engineering
4. Generate an ability to provide engineering solutions for the environmental problems related with air pollution, solid wastes disposal and noise pollution.

MODULE I

Scope of Environmental Engineering, Global environmental problems, Water supply Engineering: Rural and Urban water supply systems - Water demand – per-capita demand, factors affecting per capita demand, variations in the rate of consumption, fire demand, design period, forecasting population. Quality of water – impurities in water and their importance - water borne diseases - analysis of water - physical, chemical and bacteriological tests. WHO and Indian standards for drinking water.

MODULEII

Sources of water: Surface water sources-groundwater sources. Collection of water: intakes - location, types, pipe materials- design of gravity and pumping main. Pumps: classification - selection of pumps - location of pumping stations. Distribution systems-different layout of pipe networks - appurtenances in the distribution system - meters, valves, fire hydrants etc. pipe laying, testing & disinfections of mains- detection and prevention of leaks in distribution system-maintenance of distribution system. Storage of water - effect of storage on quality of water.

MODULE III

Sanitary plumbing: Sanitary fixtures-Systems of piping-House drainage-Connection of house drains and street sewers. Systems of sewerage-Quantity of storm sewage-Quantity of sanitary sewage-Sewers, types, materials, shape, construction, appurtenances, hydraulic design of sewers, sewage pumping, ejectors, sewer junctions-maintenance, inspection and ventilation of sewers.

MODULE IV

Natural methods of wastewater disposal: land disposal-Sewage farming-disposal by dilution-self-purification of streams-oxygen sag curve-dilution into sea, comparison of disposal methods. Air pollution: type of pollutants, sources, health effects, meteorological aspects, , monitoring and air pollution control. Solid waste management: type, sources, characteristics, collection, vehicles for transportation and processing – Disposal: composting, sanitary land fill, incineration. Noise pollution: Sources, effects, control, noise survey.

References:

1. Garg, S. K. (2001). *Environmental Engineering.* Vol I & II. Khanna publications, New Delhi**.**
2. Birdic, G. S. and Birdic, J. S. (1998). *Water supply and Sanitary Engineering*. DhanputRai & Sons, New Delhi.
3. Rowe, P. and Tchobanoglous. *Environmental Engineering*. McGraw Hill International Editions.
4. Veslind and Morgan. *Introduction to Environmental Engineering*. Thomson Learning.
5. Rao, M. N. and Rao, H. V. N. *Air Pollution*. Tata McGraw Hill Pvt. Ltd, New Delhi.
6. Hammer, M. J. and Hammer, M. J. (Jr). (1998). *Water and Wastewater Technology*, Prentice Hall of India, Pvt Ltd, New Delhi.
7. CPHEEO, *Manual on Water Supply and Treatment*. Third edition. Ministry of Urban Development, Gov. of India.

Type of Questions for End Semester Examination.

PART A: Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules ($10 \times 2 = 20$ marks).

PART B: ($4 \times 10 = 40$ marks)

Question nos. II and III [with sub sections (a), (b), …] (10 marks each with option to answer either II or III) from Module I.
Question nos. IV and V [with sub sections (a), (b), …] (10 marks each with option to answer either IV or V) from Module II.
Question nos. VI and VII [with sub sections (a), (b), …] (10 marks each with option to answer either VI or VII) from Module III.
Question nos. VIII and IX [with sub sections (a), (b), …] (10 marks each with option to answer either VIII or IX) from Module IV.

CE15-1602 DESIGN OF STEEL STRUCTURES

Course Objectives: To understand the concepts of steel design, know the analysis and design of plate girder and gantry girder and understand the concepts of plastic design.

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

1. Design bolt and weld connections.
2. Design tension and compression members.
3. Design beams and plate girders.
4. Design light gauge steel structures.

MODULE I

Materials and specifications: rolled steel sections- types of structural steels – specifications- Limit state and working stress design concepts, **Types of connections** – *Bolted joints*-Types of bolted joints-load transfer mechanism-failure of bolted joints-efficiency of the joint-*welded joints*-advantages and disadvantages of welded joints – types of welds and their symbols -Design of welded and bolted connections.

MODULE II

Tension member: Net sectional area – permissible stresses – design of axially loaded tension member. **Compression member**: strength of an axially loaded compression member – effective length – maximum slenderness ratio – compression member with two rolled sections back to back – design of compression members – lacing and battening for built-up compression member – column base – slab base – gussetted base.

MODULE III

Beams: design procedure for laterally supported and unsupported beams – built up beams
Plate girders- design of section, curtailment of flange plate, bearing and intermediate stiffeners, connections, flange and web splices, Gantry girders (only design concept).

MODULE IV

Light gauge steel structures – Types of sections, Flat width ratio, Buckling of thin elements, Effective design width, Form factor, Design of tension, compression members and beams.
Plastic design- basic assumptions - shape factor, load factor- Redistribution of moments - upper bound lower bound and uniqueness theorems- analysis of simple and continuous beams, two span continuous beams and simple frames by plastic theory - static and kinematic methods, Plastic design- Design of section for Continuous beams and simple frames.

References:

1. Subramanian, N. *Design of steel structures*. Oxford University Press.
2. Arya, A. S. and Ajmani, J. L. *Design of Steel Structures*. Nemchand & Bros.
3. Dayaratnam, P. *Design of Steel Structures.* Wheeler.
4. Ramachandra. *Design of Steel Structures*. Standard books.
5. Duggal, S. K. *Design of Steel Structures*. T.M.H. Publications.

Use of IS:800 – 2007, IS:801 – 1975, IS:811 – 1987 and structural steel table are permitted in the examination hall.

Type of Questions for End Semester Examination.

Question nos. I and II [with sub sections (a), (b), …] (15 marks each with option to answer either I or II) from Module I.
Question nos. III and IV [with sub sections (a), (b), …] (15 marks each with option to answer either III or IV) from Module II.
Question nos. V and VI [with sub sections (a), (b), …] (15 marks each with option to answer either V or VI) from Module III.
Question nos. VII and VIII [with sub sections (a), (b), …] (15 marks each with option to answer either VII or VIII) from Module IV.

CE15-1603 MATRIX METHODS OF STRUCTURAL ANALYSIS

Course Objectives: To motivate the students to computer implementation of structural analysis through the flexibility and stiffness matrix approaches evolved from the methods of consistent deformation and slope deflection, respectively and validation of computer outputs aided by approximate analysis.

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

1. Assimilate the concepts of element-based and structure-based flexibility matrix approaches to analyze rigid-jointed and pin-jointed structures initiated from the compatibility equations in the method of consistent deformation.
2. Formulate stiffness matrices of basic beam and truss elements and analyze rigid and pin-jointed structures (statically determinate and indeterminate) via element-based and structure-based stiffness methods, initiated from the equilibrium equations of the slope-deflection method.
3. Appreciate the direct stiffness method as a generalized approach which would in turn seed the concept of the finite element analysis of structures.
4. Quickly analyze multi-storied rigid-jointed frames by approximate methods so as to check the output given by any structural analysis software.

MODULE I

Introduction to the Flexibility and Stiffness Matrix Methods: Concept of flexibility and stiffness coefficients, Development of flexibility matrix, Concept of element approach, Development of equilibrium matrix, Element flexibility matrices for truss and beam elements, Development of structure flexibility matrix, Determination of displacements in statically determinate beams, rigid jointed and pin-jointed plane frames by flexibility matrix approach, Analysis of statically indeterminate beams and rigid jointed plane frames by flexibility method.

MODULE II

Analysis by Stiffness Matrix Method: Development of stiffness matrix, Element approach, Development of compatibility matrix, Element stiffness matrices for truss and beam elements, Equivalent joint loads, Development of structure stiffness matrix by element approach, Analysis of statically indeterminate beams, rigid jointed and pin-jointed plane frames by stiffness matrix approach, effect of fabrication errors or temperature changes, effect of support settlement.

MODULE III

Analysis by Direct stiffness Method: Local and global coordinate systems, Transformation of element stiffness matrices from local to global co-ordinates, Equivalent nodal forces and load vector, Global stiffness matrix, Application of direct stiffness method to two span continuous beams, plane frames, Advantages of direct stiffness method, Concept of finite element method introduced through the procedure of the direct stiffness method, Comparison of flexibility matrix and stiffness matrix methods.

MODULE IV

Approximate methods of multi-storey frame analysis: Vertical and lateral load analysis of multi-storey frames, assumptions for vertical load analysis, The Substitute frame method,

assumptions for lateral load analysis, Portal method, Cantilever method, Kani's method, comparison of the methods.

References:

1. Weaver, W. J. and Gere, J. M. *Matrix analysis of framed structures*, CBS Publishers, New Delhi.
2. Pandit, G. S. and Gupta, S. P. *Structural analysis – A Matrix Approach*. Tata McGraw Hill, New Delhi.
3. Krishnamoorthy, C. S. *Finite Element Analysis – Theory and Programming*. Tata McGraw Hill Publishing Company Limited, New Delhi, India.
4. Mukhopadhyay, M. and Sheik, A. H. *Matrix and Finite Element Analysis of Structures*, Ane Books Pvt. Ltd.
5. Wang, C. K. *Intermediate Structural Analysis*. McGraw Hill International Edition.
6. Punmia, B. C. and Jain, A. K. *Theory of Structures*. Laxmi Publications (P) ltd.

Type of Questions for End Semester Examination.

PART A: Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules ($10 \times 2 = 20$ marks).

PART B: ($4 \times 10 = 40$ marks)

Question nos. II and III [with sub sections (a), (b), …] (10 marks each with option to answer either II or III) from Module I.

Question nos. IV and V [with sub sections (a), (b), …] (10 marks each with option to answer either IV or V) from Module II.

Question nos. VI and VII [with sub sections (a), (b), …] (10 marks each with option to answer either VI or VII) from Module III.

Question nos. VIII and IX [with sub sections (a), (b), …] (10 marks each with option to answer either VIII or IX) from Module IV.

CE15-1604 GEOTECHNICAL ENGINEERING – II

Course Objectives: To impart knowledge on common methods on subsoil investigation and design of foundation.

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

1. Determine the earth pressure on retaining structures.
2. Gain knowledge on soil exploration methods.
3. Understand various foundations.
4. Assess the bearing capacity of soils and foundation settlements.

MODULE I

Earth Pressure-General and local states of plastic equilibrium – Rankines and coulomb's theories for active and passive conditions- influence of surcharge – Rebhann's and Culmann's graphical methods for active earth pressure

Sheet pile walls: Types and uses of sheet piles – Design of cantilever and anchored sheet pile walls (Free earth support only).

MODULE II

Site investigation and soil exploration: objectives - planning - reconnaissance - methods of subsurface exploration - test pits - Auger borings - rotary drilling - depth of boring - boring log - soil profile- location of water table - S.P.T, Cone Penetration Tests, Plate load test, field vane shear test - geophysical methods (in brief) - sampling - disturbed and undisturbed samples – soil investigation report.

MODULE III

Foundation -Functions of foundations - requisites of satisfactory foundations - definition of shallow and deep foundation - different types of foundations -selection of type of foundation.
Bearing capacity: ultimate bearing capacity and allowable soil pressure - Terzaghi's equation for bearing capacity for continuous , circular and square footings - bearing capacity factors and charts - Skempton's formulae - effect of water table on bearing capacity – IS recommendation.
Settlement analysis: distribution of contact pressure – estimation of immediate and consolidation settlement – effects, causes and remedial measures of total and differential settlement – permissible total and differential settlements as per IS recommendation -
Design considerations – Proportioning of shallow foundations.
Raft foundations: bearing capacity equations - design considerations - floating foundations.

MODULE IV
Pile foundations: uses of piles - classification of piles based on purpose and material –selection of type of piles - determination of capacity of axially loaded single vertical pile - (static and dynamic formulae) - determination of capacity by penetration tests and pile load tests (IS methods) - negative skin friction - group action and pile spacing – settlement analysis of pile groups.
Caissons and cofferdams: different types – different shapes of well foundations- component parts of well and forces- construction details and design considerations of well foundations - sinking of wells and remedial measures for tilts and shifts – types and uses of cofferdams.

References:

1. Arora, K. R. *Soil Mechanics and Foundation Engineering*. Standard Publishers, Distributors.
2. Ranjan, G. and Rao, A. S. R. *Basic and Applied Soil Mechanics*. Wiley Eastern Ltd.
3. Bowles, J. E. *Foundation Analysis and Design*. Mc Graw Hill.
4. Tomlinson. *Foundations Design and Construction*.
5. Teng, W. C. *Foundation Design*. Prentice Hall of India.
6. Kurian, N. P. *Design of foundation system*. Narosa Publication.
7. Das, B. M. *Principles of Foundation Engineering*. Thomson Learning.
8. Varghese, P. C. *Foundation Engineering*. Prentice Hall of India.

Note: *Structural designs of foundations are not contemplated in this course.*

Type of Questions for End Semester Examination.

PART A: Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules ($10 \times 2 = 20$ marks).

PART B: ($4 \times 10 = 40$ marks)

Question nos. II and III [with sub sections (a), (b), …] (10 marks each with option to answer either II or III) from Module I.
Question nos. IV and V [with sub sections (a), (b), …] (10 marks each with option to answer either IV or V) from Module II.
Question nos. VI and VII [with sub sections (a), (b), …] (10 marks each with option to answer either VI or VII) from Module III.
Question nos. VIII and IX [with sub sections (a), (b), …] (10 marks each with option to answer either VIII or IX) from Module IV.

CE15-1605 TRANSPORTATION ENGINEERING – II

Course Objective: To provide a strong base in planning, designing, construction and maintenance of structures coming under railways, waterways and tunnelling.

Course Outcomes: On completion of the course, a student will be able to:
1. Understand the basics and design of various components of railway track.
2. Study the railway operation control.
3. Learn the tunnel driving procedures, its lighting, ventilation and drainage.

4. Know the types of harbour and construction of break waters.
5. Acquire knowledge about the types of docks and dredgers.

MODULE I

Railway Engineering: Permanent way – main requirements – Component parts. Rails –functions of rails –requirements of a good rail, weight and length., defects in rails, rail joint and other fastenings, check and guard rails, coning of wheels, creep of rail. Sleeper - its functions and requirements, sleeper density, Ballast- functions and requirements, different types used.

Geometric Design: Design of horizontal curves-Super elevation, negative super elevation in branches, length of transition curves –grade compensation on curves, widening of gauge on curves.

MODULE II

Railway Operation control: Points and Crossings-Design features of a turn out-Types of railway track points –Details of station yards and Marshalling yards-Signaling and interlocking – Principles of track circuiting-Control of train movement by absolute block system-automatic block system-Centralized traffic control systems.

Tunnel Engineering: Tunnel sections-types size and shapes-tunnel surveying-Alignment, transferring center grade in to tunnel-tunnel driving procedure-tunneling through hard and soft soils(Only Full face Method and Compressed air method) –Tunnel lining ventilation lighting and drainage of tunnels.

MODULE III

Harbor Engineering: Classification of harbors Breakwaters-necessity and functions-different types-forces acting on breakwater-design principles-construction of breakwaters-general study of pier heads, quays, landing stages-wharves, jetties, transit sheds and warehouses-channel demarcation-signal characteristics Beacons, buoys, channel- lighting, light houses).

MODULE IV

Dock Engineering: Function and types of docks, dry docks, floating docks slipways, dock gates and caissons-s Dredging-Mechanical and hydraulic dredgers-general study of bucket ladder-Dredger, grab dredger and dipper dredgers.

References:

1. Chandra, S. and Agarwal, M. M. *Railway Engineering*. Oxford University Press, New Delhi, India.
2. Saxena, S.C, and Arora S. P. *Railway Engineering*. Dhanpat Rai and Sons, New Delhi, India.
3. Agarwal, M. M. *Indian Railway Track*. Prabha and Co., New Delhi, India.
4. Rangwala, S. C. *Principles of Railway Engineering*. Charotar Publishing House, Anand, India.
5. Bindra, S. P. *A Course in Docks and Harbour Engineering*. Dhanpat Rai and Sons, New Delhi, India.
6. Seetharaman, S. *Dock and Harbour Engineering*. Umesh Publications, New Delhi, India.
7. Srinivasan, R. *Harbour, Dock and Tunnel Engineering*. Charotar Publishing House, Anand, India.

Type of Questions for End Semester Examination.

PART A: Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules ($10 \times 2 = 20$ marks).

PART B: ($4 \times 10 = 40$ marks)

Question nos. II and III [with sub sections (a), (b), …] (10 marks each with option to answer either II or III) from Module I.

Question nos. IV and V [with sub sections (a), (b), …] (10 marks each with option to answer either IV or V) from Module II.

Question nos. VI and VII [with sub sections (a), (b), …] (10 marks each with option to answer either VI or VII) from Module III.
Question nos. VIII and IX [with sub sections (a), (b), …] (10 marks each with option to answer either VIII or IX) from Module IV.

CE15-16L1 ENVIRONMENTAL ENGINEERING LAB

Course Objectives: To characterize and quantify the water and wastewater quality parameters and identify the ill effects of environmental pollution.

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

1. Determine physical, chemical and biological characteristics of water and wastewater.
2. Determine optimum dosage of coagulant.
3. Determine available chlorine content in bleaching powder.
4. Assess the quality of water and wastewater.

LIST OF EXPERIMENTS

1. Determination of solids (total, dissolved, organic, inorganic and settleable) in water.
2. Determination of turbidity and optimum coagulant dose.
3. Determination of acidity, alkalinity and pH of water.
4. Determination of hardness and chlorides in water.
5. Determination of iron in water.
6. Determination of sulphates and sulphides in water.
7. Determination of D.O and BOD of waste water.
8. Determination of COD of waste water
9. Determination of available chlorine in bleaching powder and the chlorine dose required to treat the given water sample.
10. Determination of manganese in water.
11. Determination of coliforms in water.

Reference:

1. Standard methods for the examination of water and wastewater. (2012). 21st Edition. Washington: APHA.

2. Sawyer, C. N., McCarty, P. L. and Perkin, G. F. (2002). *Chemistry for Environmental Engineering and Science*. 5th edition. McGraw-Hill Inc.

3. Kotaiah, B. and Swamy, N. K. (2007). *Environmental Engineering Laboratory Manual*. First edition. Charotar Publishing House Pvt. Ltd.

Note : 50 % marks is earmarked for continuous evaluation, and 50% marks for end semester examination to be conducted by two examiners. A candidate shall secure a minimum of 50 % marks in the aggregate and* 45 % *minimum in the end semester examination for a pass.

CE15-16L2 COMPUTER APPLICATIONS IN CIVIL ENGINEERING - I

Course Objectives: To practice the students in a computer package for building drawing and train the students to use the total station.

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

1. Familiarize with a civil engineering drawing software.
2. Draw all the relevant views of buildings using CAD software.
3. Acquaint one with the existing rules and regulations of buildings, stipulated by the National Building code and state building rules.
4. Plan a survey appropriately using Total station, take accurate measurements, field booking and plotting with the skill to understand the surroundings.

MODULE I

Introduction of a Popular Drafting Package: Basic Commands and simple drawings.
From the given line sketch and specification, develop working drawings (plan, elevation and section) of the following buildings using CAD.

- Single storied residential building with flat and tiled roof (2drawings).
- Public buildings like office, dispensary, post office, bank etc. (1drawing).
- Factory building with trusses supported on Brick walls and pillars (1drawing).

Planning of Buildings (2 drawings)
Technical terms in building planning, Building rules, preparation of site plans and service plans as per building Rules. Planning and designing of residential buildings from given requirements of areas and specifications and preparation of working drawing.

MODULE II

Total station and Survey camp
Survey camp is conducted at the end of the semester. The use of total station is compulsory for survey work.

References:

1. National Building Code of India
2. Kerala Municipal Building Rules
3. Shaw and Kale.*Building Drawing*.
4. Prabhu, B. T. S. *Building Drawing and Detailing*, Spades, Calicut.
5. Malik, R. S. and Meo, G. S. *Civil Engineering Drawing*.
6. Verma, B. P. *Civil Engineering Drawing and House Planning*. Khanna Publishers, Delhi.

Note : 50 % marks is earmarked for continuous evaluation, and 50% marks for end semester examination to be conducted by two examiners. A candidate shall secure a minimum of 50 % marks in the aggregate and* 45 % *minimum in the end semester examination for a pass.

ELECTIVES

CE15-1606 E1 RETROFITTING AND REHABILITATION OF STRUCTURES

Course Objectives: To inculcate the importance of assessment of defects and retrofitting and rehabilitation of structures.

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

1. Assess strength and materials deficiency in concrete structures.
2. Suggest methods and techniques used in repairing / strengthening existing masonry structures.
3. Suggest methods and techniques used in repairing / strengthening existing concrete structures.
4. Apply cost effective retrofitting strategies for repairs of floors and steel structures.

MODULE I

Concept of Repairing – retrofitting – strengthening – rehabilitation – restoration – remoulding Repair materials/ methods: – Repair methodology, issues related to material Technology - Desired properties of repair materials – materials for repair – new repair systems / products. Distresses in concrete structures – Deterioration of structures – causes and prevention – crack repair techniques – Repair techniques/ materials for structures – repair of structural components.

MODULE II

Retrofitting of Masonry buildings: Failure mode of masonry buildings – out-of-plane failure – in-plane failure – diaphragm failure – failure of connection – methods of retrofitting – cement or epoxy injection– using wire mesh and cement mortar – re construction of bulged portion of masonry wall – grouting with cement – pointing with mortar – shotcreting – using FRP fabric – using RC and steel frames – adding reinforcements to masonry – stitching of wall corners – use of tie rods – Prestressing of masonry – external binding or jacketing – Splint and bandage technique – Inserting new walls – exterior supplemental elements – strengthening of parapets.

MODULE III

Retrofitting of RC structure: Global retrofitting methods – adding new shear walls – adding steel bracing – adding infill walls – non-conventional methods – seismic base isolation – Supplemental damping devices; Member or local retrofit methods – jacketing/confinements –jacketing of columns using steel sections – reinforced concrete jacketing – FRP jacketing – beam jacketing – beam column joint jacketing – slab column connection – foundation – cost comparison of different methods.

MODULE IV

Repair of Concrete Floors: Surface preparation – thin bonded toppings – reinstating joint sealants – Crack repair – crack cleaning and resin injection – crack cutting and mortar filling – application of cement/sand screed – use of toppings Retrofitting of Steel Structure: Rain water protection – drainage in structural members – preparation of surface by sand blasting – protective coatings – Cathodic protection – Sacrificial metal – adding additional plates strengthening the joints – concrete jacketing .

References:

1. Agarwal, P. and Shrikhande, M. *Earthquake Resistant Design of Structures*. Prentice Hall of India Pvt Ltd, New Delhi.
2. Balachandran and Margrab. *Vibrations*. Thomason Books Cole.
3. Santhakumar, A. R. *Concrete Technology*. Oxford University Press, New Delhi.

Type of Questions for End Semester Examination.

PART A: Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules ($10 \times 2 = 20$ marks).

PART B: ($4 \times 10 = 40$ marks)

Question nos. II and III [with sub sections (a), (b), …] (10 marks each with option to answer either II or III) from Module I.
Question nos. IV and V [with sub sections (a), (b), …] (10 marks each with option to answer either IV or V) from Module II.
Question nos. VI and VII [with sub sections (a), (b), …] (10 marks each with option to answer either VI or VII) from Module III.
Question nos. VIII and IX [with sub sections (a), (b), …] (10 marks each with option to answer either VIII or IX) from Module IV.

CE15-1606 E2 DISASTER MANAGEMENT

Course Objectives: To impart the concepts of different types of natural and industrial disasters and develop skills in various stages of disaster preparedness, mitigation and management as well as the methodologies for disaster risk assessment.

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

1. Learn the importance of disaster management in industry, identification and mitigation of industrial hazards.
2. Learn about offsite and onsite emergency planning, awareness and preparedness for managing disasters.

3. To attain knowledge in legal aspects of hazardous chemicals handling and storage in view of Indian factories act and international standards.
4. Learn about the engineering and non-engineering controls of mitigating various natural disasters incorporating latest tools.

MODULE I

Importance of disaster management for chemical industry - Types of emergencies – major industrial disasters – causes and consequences of major industrial disasters like Flixborough, Seveso and Bhopal. Components of a major hazard control system – identification of major hazard control installations – purpose and procedures – safe operation of major hazard installations – mitigation of consequences – reporting to authorities. Implementation of major hazard control systems – group of experts – training – checklists – inspection – evaluation of major hazards – information to the public – manpower requirements – sources of Information.

MODULE II

Emergency planning – on-site and off-site emergency plan – need of plan – possible approach – objectives of emergency plan.

On-site emergency planning – formulation of the plan and emergency services – Identification of resources – actions and duties – emergency procedure – mock drills. Off-site emergency planning – objectives and elements of off-site plan – role of administrative machinery – role of major hazard works management – role of the local authority. Emergency preparedness at local level – Awareness and preparedness for emergencies at local level (APELL) – The process and its partners.

MODULE III

Requirements of emergency plan as per Indian legislations like Factories Act, Manufacture, Storage and Import of Hazardous Chemicals Rules, Chemical Accidents (Emergency planning, Preparedness and Response) Rules.

Emergency planning and preparedness in international standards like ISO 14001, OHSAS 18001 and OSHA's Process Safety Management System, Emergency Planning in Seveso II directive – elements of emergency planning in IS : 18001 – Hazardous Materials / Spills Emergencies – contingency plans for road transportation of hazardous chemicals – contingency plans for oil spills in marine environment.

MODULE IV

Natural Hazards – potentially hazardous natural phenomena – earthquakes – landslides – flooding – cyclones – hazards in arid and semi-arid areas – nature of the hazard – hazard management activities – disaster mitigation – natural hazard prediction – emergency preparedness – disaster, rescue and relief – post disaster rehabilitation and reconstruction – education and training activities – vulnerable elements to be considered in the development planning for natural hazard management – applications of remote sensing and GIS in disaster management.

References:

1. ILO, Geneva. *Major Hazard Control – a Practical Manual.*
2. UNEP, Paris. (1998). *APELL - A Process for responding to technological accidents, A Handbook,* Industry and Environment Office.
3. *Accident Prevention Manual for Business and Industry, Vol. I* – National Safety Council, USA.
4. *Oil spill Response: The National Contingency Plan* - Institute of Petroleum, London.
5. Petak, W. J. and Atkisson, A. A. *Natural Hazard Risk Assessment and Public Policy: Anticipating the Unexpected*.
6. Rao, U. R. *Space Technology for Sustainable Development*.

Type of Questions for End Semester Examination.

PART A: Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules ($10 \times 2 = 20$ marks).

PART B: ($4 \times 10 = 40$ marks)

Question nos. II and III [with sub sections (a), (b), …] (10 marks each with option to answer either II or III) from Module I.
Question nos. IV and V [with sub sections (a), (b), …] (10 marks each with option to answer either IV or V) from Module II.
Question nos. VI and VII [with sub sections (a), (b), …] (10 marks each with option to answer either VI or VII) from Module III.
Question nos. VIII and IX [with sub sections (a), (b), …] (10 marks each with option to answer either VIII or IX) from Module IV.

CE15-1606 E3 TRAFFIC ENGINEERING AND MANAGEMENT

Course Objectives: To appreciate the traffic engineering as application of engineering techniques to achieve the safe and efficient movement of people and goods.

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

1. Acquire comprehensive knowledge of traffic surveys.
2. Achieve knowledge on design of road intersections and signals.
3. Become familiar with various traffic control and traffic management measures.
4. To use an appropriate traffic flow theory for traffic characteristics and to determine the capacity of highways.
5. Practice methods of economic evaluation.

MODULE I

Traffic Engineering: Definition, Functions.

Road User and the Vehicle: Human factors governing road user behavior - Vehicular characteristics.

Traffic Surveys: Speed, Journey time and delay study – Methods-Moving observer method, Presentation of data- grouping of speed data, cumulative frequency curve, problems. Vehicle volume counts and classifications - methods Parking surveys. Uses of photographic techniques in traffic survey.

Origin - Destination Surveys: methods, zoning and presentation of results.

MODULE II

Traffic Controls: Different types of traffic signs and markings. Traffic signals - design, coordinated signals-time-distance diagram -area traffic control-Other traffic control aids and street furniture.

Intersections And Interchanges –Types-Planning and layout

Traffic Safety: Accidents-causes and prevention.

Parking: Parking problems – desirable parking space standards for different land use -common methods of on-street parking, off-street parking facilities, parking surveys

Traffic Management: Travel demand management, scope of traffic management measures-restrictions on turning movements and one-way streets.

Highway Lighting: Importance of highway lighting, design factors, spacing between lighting units.

MODULE III

Highway Capacity And Level Of Service: Definitions - PCU-LOS concept, Factors affecting capacity and LOS. Capacity of highways, urban streets, rotary, weaving sections and signalized intersections.

Theory Of Traffic Flow: Fundamental diagram of traffic flow-Relationship between speed and concentration.

MODULE IV

Transportation Economics: Cost and benefits of transport project, basic principles and methods of economic evaluation, rate of return method s and discounting cash flow methods– worked out problems. Road user cost-Motor Vehicle operation cost.

References:

1. Khadiyali, L. R. *Traffic Engineering and Transport Planning*. Khanna Publishers.
2. Roess, R. P., Prassas, E. S. and McShane, W. R. *Traffic Engineering*. 4th edition. Prentice Hall.
3. May, A. D. *Traffic Flow Fundamentals*. First edition. Prentice Hall.
4. Mannering,F. L., Washburn, S. S. and Walter P. K. *Principles Of Highway Engineering And Traffic Analysis*. 4th edition. Wiley India Pvt Ltd.
5. Slinn, M., Matthews, P. and Guest, P. *Traffic Engineering Design: Principles and Practice*.
6. Chakroborty, P. and Das, A. *Principles of Transportation Engineering*. Prentice Hall of India Pvt. Ltd.
7. Recommended Practice for Traffic Rotaries - IRC 65-1976
8. Guidelines for capacity of roads in rural areas -IRC 64-1990
9. Guidelines for design and installation of Road Traffic Signals -IRC 93- 1985

Type of Questions for End Semester Examination.

PART A: Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules ($10 \times 2 = 20$ marks).

PART B: ($4 \times 10 = 40$ marks)

Question nos. II and III [with sub sections (a), (b), …] (10 marks each with option to answer either II or III) from Module I.
Question nos. IV and V [with sub sections (a), (b), …] (10 marks each with option to answer either IV or V) from Module II.
Question nos. VI and VII [with sub sections (a), (b), …] (10 marks each with option to answer either VI or VII) from Module III.
Question nos. VIII and IX [with sub sections (a), (b), …] (10 marks each with option to answer either VIII or IX) from Module IV.

CE15-1606 E4 AIR POLLUTION CONTROL AND MANAGEMENT

Course Objectives: To understand the basic concept and develop knowledge about various sources, effects and control techniques for air pollution and air quality management.

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

1. Identify sampling and analysis techniques for air quality assessment.
2. Attain perfect knowledge about the plume behavior for atmospheric stability conditions.
3. Attain ability to design air pollution controlling devices.
4. Gain knowledge about air quality management.

MODULE I

Sources and effects of Air pollution : 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.

MODULE II

Dispersion of Pollutants: Elements of atmosphere – Meteorological factors – Wind roses – Lapse rate – Atmospheric stability and turbulence – Plume rise – Dispersion of pollutants – Dispersion models - Applications.

MODULE III

Air Pollution Control : 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.

MODULE IV

Air Quality Management**:** 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. Noise Pollution**:** Sources of noise pollution – Effects – Assessment - Standards – Control methods – Prevention.

References:

1. Heumann, W. L.(1997). *Industrial Air Pollution Control Systems*. McGraw-Hill, New York.
2. Mahajan, S. P. (1991). *Pollution Control in Process Industries*. Tata McGraw-Hill Publishing Company, New Delhi.
3. Peavy, S. W., Rowe, D. R. and Tchobanoglous, G. (1985). *Environmental Engineering*. McGraw Hill, New Delhi.
4. Garg, S.K. *Environmental Engineering*, Vol. II, Khanna Publishers, New Delhi.
5. Anjaneyulu, D. (2002). *Air Pollution and Control Technologies*. Allied Publishers, Mumbai.
6. Rao, C.S. (1996). *Environmental Pollution Control Engineering*. Wiley Eastern Ltd., New Delhi.
7. Rao, M. N. and Rao, H. V. N. (1996). *Air Pollution Control*. Tata-McGraw-Hill, New Delhi.
8. Noel, D. N. (1999). *Air Pollution Control Engineering*. Tata McGraw Hill Publishers.
9. Stern, A. C. (1984). *Fundamentals of Air Pollution*. Academic Press.

Type of Questions for End Semester Examination.

PART A: Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules ($10 \times 2 = 20$ marks).

PART B: ($4 \times 10 = 40$ marks)

Question nos. II and III [with sub sections (a), (b), …] (10 marks each with option to answer either II or III) from Module I.
Question nos. IV and V [with sub sections (a), (b), …] (10 marks each with option to answer either IV or V) from Module II.
Question nos. VI and VII [with sub sections (a), (b), …] (10 marks each with option to answer either VI or VII) from Module III.
Question nos. VIII and IX [with sub sections (a), (b), …] (10 marks each with option to answer either VIII or IX) from Module IV.

CE15-1606 E5 GROUND WATER ENGINEERING

Course Objectives: To introduce the student to the principles of Groundwater governing equations and characteristics of different aquifers and to understand the techniques of development and management of groundwater.

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

1. Evaluate groundwater resources using geophysical methods
2. Estimate aquifer parameters

3. Model regional groundwater flow
4. Design water wells

MODULE I: HYDRAULICS OF GROUND WATER FLOW

Characteristic of Ground water -Ground water column – Permeability - Darcy's Law - Types of aquifers -Storage coefficient - Specific field - Transmissivity - Governing equations of ground water flow - Steady state flow - Dupuit Forchheimer assumptions - Velocity potential - Flow nets

MODULE II: ESTIMATION OF AQUIFER PROPERTIES

Pumping test - Unsteady state flow – Theis' method – Jacob's method – Chow's method - Theis' recovery method Image well theory – Effect of partial penetrations of wells - Collector wells.

MODULE III: GROUND WATER EXPLORATION AND ARTIFICIAL RECHARGE

Surface Investigations of Ground water: Geologic methods, Remote Sensing, Geophysical exploration, Electric Resistivity method, Seismic Refraction Method;
Artificial Recharge of Groundwater : Concept of Artificial Recharge methods, Recharge mounds, Induced Recharge, water spreading, flooding, basins, ditching, modification of natural channels, irrigation, recharge pits, shafts and recharge wells.

MODULE IV: GROUND WATER DEVELOPMENT AND MANAGEMENT

Infiltration gallery –Water logging- Conjunctive use , Rainwater harvesting - Safe yield -Yield test – Geophysical methods –Saline intrusion , Sources of Salinity, Desalination, Remediation of Saline intrusion
Groundwater Modeling Techniques: Porous media models, Viscous fluid models, Membrane models, Thermal models, Electric Analog Models, Digital Computer Models

References:

1. Todd, D. K. (2000). *Ground Water Hydrology*. John Wiley and Sons.
2. Rastogi, A. K. (2007). *Numerical Ground Water Hydrology*. Penram International Publishing (India) Pvt. Ltd.
3. Karanth. (2000). *Ground Water Assessment, Development and Management.* Tata McGraw Hill Ltd.
4. Raghunath, H. M. (2000). *Ground Water Hydrology*. Wiley Eastern Ltd.

Type of Questions for End Semester Examination.

PART A: Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules ($10 \times 2 = 20$ marks).

PART B: ($4 \times 10 = 40$ marks)

Question nos. II and III [with sub sections (a), (b), …] (10 marks each with option to answer either II or III) from Module I.
Question nos. IV and V [with sub sections (a), (b), …] (10 marks each with option to answer either IV or V) from Module II.
Question nos. VI and VII [with sub sections (a), (b), …] (10 marks each with option to answer either VI or VII) from Module III.
Question nos. VIII and IX [with sub sections (a), (b), …] (10 marks each with option to answer either VIII or IX) from Module IV.

GE15-1606 E6 PRINCIPLES OF MANAGEMENT

Course Objectives: To identify and analyze problems by applying the principles of management.

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

1. Inculcate the ability of formulating, analysing, and solving management problems through the application of scientific management.
2. Introduce the importance of Productivity and Project Management.
3. Get exposed to personnel, marketing and financial management.
4. Understand the principles of economics and IPR aspects.

MODULE I

Basic concept of Management: Introduction, definitions of managements, characteristics of management, levels of management, management skills, scientific management - Contributions of Gilbreth and Gantt.

Functions of Management: Planning, forecasting, organizing, staffing, directing, motivating, controlling, co-coordinating, communicating, decision making.

Organization: Introduction, definition of organization, system approach applied to organization, necessity of organization, elements of organization, process of organization, principles of organization, formal and informal organization, organization structure, types of organization structure.

Forms of Business Organization: Concept of ownership organization, types of ownership, Individual ownership, partnership, joint stock company, private and limited company, co-operative organizations, state ownership, public corporation.

MODULE II

Productivity and Production: Measurement of productivity, productivity index productivity improvement procedure, Organization by product function.

Inventory control: Classification, Functions, inventory models, inventory costs, EOQ, Materials Requirement Planning – Objectives, Functions and methods.

Project Management: Functions, Characteristics and feasibility studies.

MODULE III

Personnel Management: Introduction, definition, objectives, characteristics, functions, principles and organization of personnel management, Recruitment and training methods.

Markets and Marketing: Introduction, the market, marketing information, market segmentation, consumer and industrial markets, pricing, sales, physical distribution, consumer behaviour and advertisement.

Financial Management: the basic concepts of financial accounts, inflation, profitability, budgets and controls, cost accounting, valuation of stock, allocation of overheads, standard costing, marginal costing, Break even point.

MODULE IV

Economics: Principles of economics, problem of scarcity, demand, supply, utility, time value of money, inflation and deflation, determination of price, Consumer Optimization, Consumer Response, Consumer Demand Curve.

IPR Aspects: General introduction to IPR, eligibility for patent, patent information and prior art search, procedure for filing patent application, rights of patent owner and duration, ownership of patent and commercialization, assignment, licensing and technology transfer, designs and Utility models.

References:

1. Mazda, F. *Engineering Management*. Addison-Wesley.
2. Koontz and O'Donnell. *Essentials of Management*. Mc Graw Hill.
3. Kotlar, P. *Marketing Management*. Prentice Hall India.
4. Chandra, P. *Finance Management*. 5th edition. TMH.
5. Monks, J. G. *Operations Management*. MGH.

6. Cornish, W. R. and Llewellyn, (2007). *Intellectual Property.* 6th edition. Sweet & Maxwell, London.
7. WIPO, *Intellectual Property – A powerful tool for economic growth*.
8. Hunt, D., Nguyan, L. and Rodgers, M. (2007). *Patent Searching: Tool and Techniques*. John Wiley and Sons.
9. Sulivan, N. F. *Transfer of Technology*. Cambridge University Press.
10. Lipsey, R. and Chrystal, A. *Economics*. Oxford University Press.
11. Karl, C. E. and Fair, R. C. (2009). *Principles of Economics*. 8th edition. Pearson Education.
12. Mankiw, N. G. (2005). *Principles of Economics*. 3rd edition. Thomson South-Western.

Type of Questions for End Semester Examination.

PART A: Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules ($10 \times 2 = 20$ marks).

PART B: ($4 \times 10 = 40$ marks)

Question nos. II and III [with sub sections (a), (b), …] (10 marks each with option to answer either II or III) from Module I.
Question nos. IV and V [with sub sections (a), (b), …] (10 marks each with option to answer either IV or V) from Module II.
Question nos. VI and VII [with sub sections (a), (b), …] (10 marks each with option to answer either VI or VII) from Module III.
Question nos. VIII and IX [with sub sections (a), (b), …] (10 marks each with option to answer either VIII or IX) from Module IV.

CE15-1701 ENVIRONMENTAL ENGINEERING – II

Course Objectives: To understand the basic principles and concepts of unit operations and processes involved in water and wastewater treatment thereby developing student's skill in the basic design of unit operations and processes with a sound knowledge in evaluating the performance of water and wastewater treatment plants.

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

1. Recognize the type of unit operations and processes involved in water treatment plants.
2. Design individual unit operation or process appropriate to the situation by applying physio- chemical engineering principles to treat the waste water.
3. Design individual unit process for biological waste water treatment.
4. Design anaerobic systems and appropriate methods for disposal and treatment of wastewater and sludge in a cost effective and sustainable way.

MODULE I

General layout of water treatment plant. Sedimentation – plain sedimentation, theory of sedimentation, continuous flow sedimentation tanks. Theory of coagulation and flocculation, design of flash mixers, clarifiers and clarifloculators. Filtration - Theory of filtration, Classification of filters, design, construction, control, operation and maintenance of these units. Disinfection, methods of disinfection, chlorination. Miscellaneous treatment methods: color, odour and taste removal, iron and manganese removal, deflouridation, removal of hardness. Aeration, purpose of aeration.

MODULE II

Objectives of wastewater treatment - Effluent standards, KSPCB Standards, BIS Standards. Layout of conventional treatment plant - preliminary, primary, secondary and tertiary treatments in general. Preliminary process: screens - types of screens, design, disposal of screenings, grit chamber - function, design, construction and operation, disposal of grit , detritus tank, skimming tank -function, design and operation, disposal, Sedimentation: Design ,construction and operation, rectangular and circular tanks, disposal of sludge.

MODULE III

Biological process: principle and theory of biological treatment. Sewage filtration; Trickling filters - design, construction and operation. Activated sludge process: Design, construction and operation of conventional and extended aeration, aeration methods. Miscellaneous methods- Stabilization ponds, Oxidation ditch, Aerated lagoons, rotating biological contactors.

MODULE IV

Sludge treatment and disposal: quantity of sludge, characteristics of sludge, sludge thickening, digestion, conditioning and disposal, design of sludge digesters only. Septic Tanks: Design (as per Ministry of urban development) construction, disposal of effluents, cleaning of tanks, Imhoff tanks.

Sewage treatment by high rate anaerobic methods: Anaerobic digestion suspended growth, contact process, UASB, attached growth, filters, expanded bed- only basics.

References:

1. Garg, S. K. (1999). *Sewage Disposal and Air Pollution Engineering – Environmental Engineering*, Vol. II. Khanna Publishers, New Delhi.
2. Metcalf & Eddy, Inc. (2003), *Waste water Engineering Treatment and Reuse*. McGraw Hill International Editions, New Delhi.
3. Sawyer and mc Carthe, *Chemistry for Environmental Engineering*. McGraw Hill.
4. Fair, Geyer and Okun. *Water and Waste water Engineering*.
5. Hammer, M. J. *Water and waste water technology*. John Wiley and Sons,Inc.
6. Vesilind and Worrell, W. A. *Solid waste Engineering*. Thomson Learning.
7. Punmia, B. C. *Water supply Engineering*. Arihant Publications, Jodpur.
8. Peavy, H. S., Rowe, D. R. and Tchobanoglous, G. (1985). *Environmental Engineering*. McGraw Hill Inc., New York.
9. Modi, P. N. (2008). *Sewage treatment and Disposal and waste water Engineering – Environmental Engineering*. Vol. II. Standard Book House.

Type of Questions for End Semester Examination.

PART A: Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules ($10 \times 2 = 20$ marks).

PART B: ($4 \times 10 = 40$ marks)

Question nos. II and III [with sub sections (a), (b), …] (10 marks each with option to answer either II or III) from Module I.

Question nos. IV and V [with sub sections (a), (b), …] (10 marks each with option to answer either IV or V) from Module II.

Question nos. VI and VII [with sub sections (a), (b), …] (10 marks each with option to answer either VI or VII) from Module III.

Question nos. VIII and IX [with sub sections (a), (b), …] (10 marks each with option to answer either VIII or IX) from Module IV.

CE15-1702 DESIGN OF CONCRETE STRUCTURES – II

Course Objectives: To give an introduction to pre-stressed concrete, special structural forms and detailing of RCC structural members.

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

1. Design footings and retaining walls.
2. Understand the concepts of pre-stressing in concrete structures and identify the materials for pre-stressing.
3. Analyze a Pre-stressed Concrete section and Estimate losses of pre-stressing.
4. Design water retaining structures.

MODULE I

Footings- Design of Isolated footings- axial and eccentric loading- Design of Combined footings- rectangular and trapezoidal footings.

Retaining walls – Design of cantilever retaining walls with horizontal and inclined surcharge-counterfort retaining walls.

MODULE II

Pre-stressed Concrete – General principles- systems of prestressing- materials for prestressing - **Loss of prestress**: Significance – Lump sum estimate – elastic shortening of concrete – time dependent losses – loss due to creep of concrete – loss due to shrinkage of concrete – loss due to steel relaxation – loss due to anchorage take up – loss or gain due to bending of members – practical considerations for frictional loss – theoretical considerations for frictional loss – total amount of losses elongation of tendons.

MODULE III

Analysis of sections for flexure: Stresses in concrete due to prestress – stresses in concrete due to loads – stresses in steel due to loads – discussion on moment curvature relationship of a prestressed concrete beam **Design of sections for flexure**: Preliminary design – general concepts of elastic design – elastic design with no tension in concrete – elastic design allowing tension – elastic design allowing and considering tension – ultimate design – arrangement of steel and prestressing in stages.

MODULE IV

Water tanks – design of circular, square and rectangular water tanks at ground level- design of overhead water tank (excluding supporting structure).

References:

1. Varghese, P. C. *Limit State Design of Reinforced Concrete*. PrenticeHall of India Ltd.
2. Ashok K Jain, A. K. *Reinforced Concrete Limit State Design*. Nem Chand Brothers, Roorkee.
3. Pillai, U. and Menon, D. *Reinforced Concrete Design*. Tata McGraw- Hill.
4. Krishnaraju, N. *Prestressed Concrete*. Tata McGraw- Hill.
5. Lin, T. Y. and Burns, N. H. *Design of prestressed concrete structures*. John Wiley & Sons, New York.

Type of Questions for End Semester Examination.

Question nos. I and II [with sub sections (a), (b), …] (15 marks each with option to answer either I or II) from Module I.
Question nos. III and IV [with sub sections (a), (b), …] (15 marks each with option to answer either III or IV) from Module II.
Question nos. V and VI [with sub sections (a), (b), …] (15 marks each with option to answer either V or VI) from Module III.
Question nos. VII and VIII [with sub sections (a), (b), …] (15 marks each with option to answer either VII or VIII) from Module IV.

CE15-1703 CONSTRUCTION MANAGEMENT

Course Objectives: To enable the students to develop an ability to influence project planning and to manage pre-construction activities and to inculcate how to control project schedule, cost, quality and risk.

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

1. Understand principles of effective leadership.
2. Read and interpret construction documents and specifications.
3. Create schedules; bar charts, critical path networks.
4. Identify types of float and the use of float to manage projects.
5. Correlate manpower and cost loading to schedule.
6. Understand the uses and working of various equipments involved in construction.

7. Identify all activities and issues related to planning, financing, procuring, constructing, and managing the built environment.

MODULE I

Organization and Management: Concept of organization, characteristics of organization, elements of organization, organizational structures, organization charts, Types of organization formal line, military or scalar organization, functional organization, line and staff organization, project organization, matrix organization, management by objectives.

Organizational conflict, group Dynamics, Organizational change, motivation and leadership, Authority and responsibility, span of control, Delegation of authority. – Centralization and decentralization.

MODULE II

Construction Planning: Objects of planning – stages of construction – Construction team – resources of construction industry – planning and scheduling – scheduling using bar charts - limitations of bar chart – Material, Labour, Equipment, Financial schedules.

Construction Contracts- Contracting procedure-Types of contracts-tenders – prequalification procedure - earnest money deposit – security deposit - contract document

MODULE III

Network Techniques– Difference between CPM and PERT – development of a network – representation of various activities and events in a CPM network – Network logic – network calculation-Float- Slack –Critical path– Crashing the programme – Time cost trade off – Resource Smoothing-leveling.

MODULE IV

Construction Equipments : Earth Moving and Excavating– Bull dozer, Scraper, power shovel, dragline, Clam shells, – Hauling and Conveying equipments – Trucks , Cranes, Pile driving Equipment, Aggregate crushers.

Introduction to Equipment Economics: Owning and Operating Costs, Factors for selection of equipment.

References:

1. Srinath, L. S. (1995). *An Introduction to Project Management*. Tata McGraw Hill publications.
2. Arora and Bindra. *Building construction Planning Techniques and methods of construction*. Dhanpat rai & Sons.
3. Peurifoy and Schexnayder. *Construction Planning, Equipment and Methods*. Tata McGraw Hill.
4. Gahlot and Dhir. *Construction Planning and Management*. New Age International.
5. Khanna, O. P. *Industrial Engineering and Management*. Dhanapat Rai Publications.
6. Mazda, F. (1998). *Engineering management*. Addison Wesley, Longman Ltd.

Type of Questions for End Semester Examination.

PART A: Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules ($10 \times 2 = 20$ marks).

PART B: ($4 \times 10 = 40$ marks)

Question nos. II and III [with sub sections (a), (b), …] (10 marks each with option to answer either II or III) from Module I.

Question nos. IV and V [with sub sections (a), (b), …] (10 marks each with option to answer either IV or V) from Module II.

Question nos. VI and VII [with sub sections (a), (b), …] (10 marks each with option to answer either VI or VII) from Module III.

Question nos. VIII and IX [with sub sections (a), (b), …] (10 marks each with option to answer either VIII or IX) from Module IV.

CE15-1704 QUANTITY SURVEYING AND VALUATION

Course Objectives: To impart the basics of calculation of quantities and rates of works, labor and properties so as to enable students to prepare an estimate of a project and as well as valuation of a property.

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

1. Calculate the exact quantities of items of work done for affecting payment especially when direct measurements are difficult and also to determine the quantities of different materials required for various items of work.
2. Assimilate a thorough idea regarding the quality and quantity of materials, required for a project with given specifications.
3. Prepare valuation report of real and landed property.
4. Mould oneself as an entry level graduate engineer competent to manage any civil engineering project confidently.

MODULE I

Estimate-Types of estimate - Revised estimate, supplementary estimate, maintenance estimate, detailed estimate, approximate estimate - plinth area method, cubic rate method, unit rate method, bay method, approximate quantity from bill method, comparison method, Preparation of detailed estimates and abstracts for RCC single storey buildings - centre line method and long wall - short wall method, Detailed specifications for common building materials and items of work as per I.S specifications.

MODULE II

Estimation of earth work for road works - Preparation of bar bending schedule and estimation of quantities for R C.C footings -Columns – Beams and slabs, Calculation of quantities of materials and analysis of rates for various items of work in building construction-rubble work, brick work, PCC, RCC, plastering, pointing etc., Introduction to data book and schedule of rates, Preparation of abstract of estimate of buildings.

MODULE III

Valuation –purpose – principle, Explanation of different technical terms, Types of values. Gross income – net income – Outgoings, Depreciation – methods of calculating depreciation – straight line method – constant percentage method, sinking fund method – and quantity survey method.

MODULE IV

Methods of valuation of property – rental method – direct comparison with capital cost – valuation based on profit – valuation based on cost – development method – depreciation method valuation of land – comparative method – abstractive method- belting method- valuation of based on hypothetical building schemes..Valuation of agricultural land, Free hold and leasehold properties – gilt edged securities. Different forms of rent and rent fixation.

References:

1. Dutta, B. N. *Estimating and Costing in Civil Engineering*.
2. Chakrabarthi. *Estimating Costing and Specifications in Civil Engineering*.
3. Shah, N. A. *Quantity Surveying and Valuation*.
4. Ranagawala. *Valuation of Real Properties*.

Type of Questions for End Semester Examination.

PART A: Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules ($10 \times 2 = 20$ marks).

PART B: ($4 \times 10 = 40$ marks)

Question nos. II and III [with sub sections (a), (b), …] (10 marks each with option to answer either II or III) from Module I.

Question nos. IV and V [with sub sections (a), (b), …] (10 marks each with option to answer either IV or V) from Module II.

Question nos. VI and VII [with sub sections (a), (b), …] (10 marks each with option to answer either VI or VII) from Module III.
Question nos. VIII and IX [with sub sections (a), (b), …] (10 marks each with option to answer either VIII or IX) from Module IV.

CE15-17L1 COMPUTER APPLICATIONS IN CIVIL ENGINEERING - II

Course Objectives: To introduce certain commonly used software in civil engineering, especially for structural design and construction management so as to motivate the students to use them judiciously after thorough comparison of typical results with manual calculations and develop independent computer programs for civil engineering applications.

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

1. Identify the available open source software tools used for specific problems in Civil Engineering.
2. Familiarize with a structural design software and develop capabilities to undertake analysis and design works with the help of such software.
3. Familiarize with a construction management software and develop capabilities to plan and schedule construction activities with the help of such software.
4. Interpret the results available through computer output with the theory learnt in classrooms.

Using STAAD of Equivalent package

1) Analysis & Design of truss system
2) Analysis & Design of steel frames
3) Analysis & Design of RC frame
4) Analysis & Design of combined steel truss and RC frame (Auditorium)
5) Design of footings

Using Primavera or MS project or equivalent package

Identification of activities and preparation of bar chart and
Network diagram of following projects

1) Construction of multi-storey building
2) Installation of new water supply scheme
3) Construction of high way

References:

1) STAAD Reference Manual / Equivalent package reference manual.

Note: 50 % marks is earmarked for continuous evaluation, and 50% marks for end semester examination to be conducted by two examiners. A candidate shall secure a minimum of 50 % marks in the aggregate and* 45 % *minimum in the end semester examination for a pass.

CE15-17L2 BUILDING TECHNOLOGY AND STRUCTURAL ENGINEERING LAB

Course Objectives: To reinforce the theories learnt in building technology and structural design through certain experiments on beams, NDT on concrete structures, comfort level and demonstration of dynamic excitation of scaled building models.

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

1. Visualize the failure patterns of balanced, under-reinforced and over-reinforced beams the information of which could be employed in building construction.
2. Practice certain non-destructive methods of testing strength of concrete structures.
3. Conceive the idea of comfort level in a room due to various factors, like temperature, humidity, radiation and ventilation.
4. Visualize at least three modes of oscillation of building frames subjected to base movement and hence study their dynamic characteristics.

LIST OF EXPERIMENTS

1) Testing of under reinforced and over reinforced flexural reinforced concrete beams.
2) Non Destructive testing of Concrete – rebound hammer test.
3) Non Destructive testing of Concrete – ultrasonic pulse velocity test.
4) Determination of relative humidity using wet and dry bulb thermometer.
5) Determination of effective temperature in a room.
6) Determination of air circulation in a room
   (a) Rate of Ventilation due to stack effect
   (b) Rate of Ventilation due to wind effect
7) Determination of Intensity of Light.
8) Measurement of solar radiation using Pyranometer.
9) Measurements of sound levels in a hall.
10) Dynamics of scaled building frame model subjected to harmonic base motion.
11) Dynamics of single storied building frame model having planar asymmetry subjected to harmonic base motion.

Note : 50 % marks is earmarked for continuous evaluation, and 50% marks for end semester examination to be conducted by two examiners. A candidate shall secure a minimum of 50 % marks in the aggregate and 45 %***minimum in the end semester examination for a pass.***

GE15 - 17L3 ENTREPRENEURSHIP DEVELOPMENT

Course Objectives: Study of this subject provides an understanding of the scope of an entrepreneur, key areas of development, financial assistance by the institutions, methods of taxation and tax benefits, etc.

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

1. Develop awareness about the importance of entrepreneurship opportunities available in the society.
2. Get acquainted with the challenges faced by the entrepreneur.

Exercises:

1. To study the types of entrepreneurs and the factors affecting entrepreneurial growth.
2. To make an assessment of the major motives influencing an entrepreneur.
3. To make an overview of the various stress management techniques.
4. How to identify and select a good business opportunity?
5. Preparation of a techno economic feasibility report for a given project.
6. Preparation of a preliminary project report for a given project.
7. To identify the various sources of finance and management of working capital.
8. Carry out the costing and break even analysis of a proposed project.
9. Preparation of a PERT / CPM chart for the various activities involved in a project.

10. To make a study of the various causes and consequences of sickness in small business and identify corrective measures.

References:

1. Rajeev, R. (2011). *Entrepreneurship*. Second edition. Oxford Latest Edition.
2. Gordon, E. and Natarajan, K. (2007). *Entrepreneurship Development*. Fourth edition, Himalaya.
3. Coulter. (2008). *Entrepreneurship in Action*. Second edition, PHI.
4. Jain, P. C. (2003). *Handbook for New Entrepreneur*. Oxford University Press.
5. Khanka, S. S. (2013). *Entrepreneurial Development*. Fifth edition, S. Chand and Co.

Note: There will only be continuous evaluation for this course. The evaluation will be based on the performance of the student in the exercises given above. A minimum of 50% marks is required for a pass.

CE15-17L4 INDUSTRIAL TRAINING

Course Objectives: To pave the idea of industry-institute collaboration and a mapping between the classroom learning and what is practiced in an industry through motivating students to visit construction sites (or related industry) and involve in certain ongoing civil engineering projects.

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

1. Connect the theory learnt from the syllabus to the work in the project undergone.
2. Appreciate the importance of field experience in addition to classroom learning.
3. Collaborate with experienced engineers in the industry and work with them.

Students have to visit at least one industry relevant to civil engineering as part of industrial training and spend a minimum of 15 days during semester break between VI and VII semester. A report of the same should be submitted at the beginning of the VII semester and evaluation shall be conducted based on the report, presentation and viva.

CE15-17L5 PROJECT- PHASE I

Course Objectives: To identify a research / industry related problem for the undergraduate project work with the guidance of the respective faculty and prepare a design and work plan.

Course Outcomes: On completion of this course a student will be able to

1. Conduct literature survey in a relevant area of one's course of study and finally identify and concentrate on a particular problem.
2. Formulate a project proposal through extensive study of literature and / or discussion with learned resource persons in industry and around.
3. Generate a proper execution plan of the project work to be carried out in Phase II through thorough deliberations and improve presentation skills.

Each batch comprising of around 5 students shall identify a project related to the curriculum of study. At the end of the semester, each student shall submit a project synopsis comprising of the application and feasibility of the project.

Guidelines for evaluation:

1.	Attendance and Regularity	10
2.	Theoretical knowledge and individual involvement	15
3.	Quality and contents of project synopsis	15
4.	Presentation	10
	Total	50 Marks

***Note**: Evaluation will be done by the respective project guide and project coordinator.*

ELECTIVES

CE15 – 1705 E1 FINITE ELEMENT METHOD

Course Objectives: To introduce the students in to the realm of the most versatile, highly practiced and thoroughly researched numerical method in engineering and mathematics, the finite element method systematically, in the domain of solid mechanics.

Course Outcomes: On completion of this course a student will be able to

1. Conceive the requirement of approximate solution in engineering and the concepts of one-dimensional finite element formulation.
2. Understand clearly two-dimensional finite element formulation in the domain of linearly elastic and isotropic solid mechanics and convergence requirements.
3. Practice various numerical integration procedures which are essential part of the FEM and convince about the assembly and imposition of boundary conditions in the FEM.
4. Extend the basics of the FEM to three-dimensional problems and to higher order elements and their employment in the method.

MODULE I

Fundamental Concepts: Mathematical model of an engineering problem – boundary value and initial value problems, Requirement of approximate solution, the basic procedure of the finite element method explained through the problem of total elongation of a tapering bar, the idea of approximation and interpolation, concept of finite elements.

One-dimensional finite element procedure: Weighted residual problem with special mention to Galerkin method, Strong and weak formulation of the governing equations, Essential and natural boundary conditions, One-dimensional elements – two-noded and three-noded Lagrangian bar elements, Beam element (Hermitian element), development of shape functions, application to cable problem, column buckling problem, General truss element, solution of a truss problem.

MODULE II

Two-dimensional finite element procedure through elastic solid mechanics: Revisiting the equilibrium equations, compatibility equations, strain-displacement equations and constitutive equations (assuming isotropy) for plane stress and plane strain problems, Displacement function,

Convergence and compatibility requirements, Finite element formulation through the principle of stationary potential energy.

Element properties: Three-noded triangular elements, area co-ordinates, development of shape functions, 4-noded square element in the natural coordinate system, shape functions, iso-parametric, sub-parametric and super-parametric elements, the concept of mapping in FEM, Serendipity elements, computation of nodal load vector.

MODULE III

Numerical integration: Importance of numerical integration in the FEM, Trapezoidal rule, Simpson's rule, Error term, Newton-Cotes rule, Gauss-Legendre rule, Changing limits of integration, Multiple integrals (integration in two and three dimensions), Numerical integration over quadrilateral elements, Numerical integration over triangular elements.

The concept of Assembly in the FEM: Degrees of freedom in element level and global level, Element stiffness matrices, global stiffness matrices, algebraic equations involving the matrices, assembly procedure explained through with one and two-dimensional examples.

Imposition of boundary conditions and solution: The method of imposing boundary conditions in an FE formulation, Solution of equations – Gauss elimination and Gauss-Siedel methods, Newton-Raphson method.

MODULE IV

Three-dimensional finite element formulation: Galerkin formulation of linearly elastic problems, basic three-dimensional elasticity equations, three-dimensional linear finite elements – rectangular prism, triangular prism, tetrahedron, element properties.

Higher order 2D and 3D elements in the FEM: Six-noded triangle, nine and eight-noded quadrilateral, static condensation, twenty-noded brick element, applicability of the elements.

Reference:

1. Reddy, J. N. (2005). *An Introduction to the Finite Element Method*, Tata McGraw-Hill.
2. Cook, R. D., Malkus, D. S., Plesha, M. E. and Witt, R. J. *Concepts and Applications of Finite Element Analysis*, John Wiley & Sons, Inc.
3. Zienkiwicz, O. C., Taylor, R. L. and Zhu, J. Z., (2006). *The finite element method: Its basis and fundamentals*. Elsevier.
4. Krishnamoorthy, C. S. (1994), *Finite Element Analysis – Theory and Programming*. Tata McGraw-Hill, New Delhi.

Type of Questions for End Semester Examination.

PART A: Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules ($10 \times 2 = 20$ marks).

PART B: ($4 \times 10 = 40$ marks)

Question nos. II and III [with sub sections (a), (b), …] (10 marks each with option to answer either II or III) from Module I.

Question nos. IV and V [with sub sections (a), (b), …] (10 marks each with option to answer either IV or V) from Module II.

Question nos. VI and VII [with sub sections (a), (b), …] (10 marks each with option to answer either VI or VII) from Module III.

Question nos. VIII and IX [with sub sections (a), (b), …] (10 marks each with option to answer either VIII or IX) from Module IV.

CE15-1705 E2 GROUND IMPROVEMENT TECHNIQUES

Course Objectives: To impart knowledge regarding the various ground improvement techniques that an engineer has when encountered with problematic soils at a site.

Course Outcomes: On completion of this course a student will be able to

1. Understand the ground conditions and suggest ground improvement techniques.
2. Design sand drain as per field requirements.

3. Understand and suggest different grouts / grouting techniques for various field conditions.
4. Gain knowledge regarding reinforced earth and its application areas including geo-synthetics.

MODULE I

Introduction to Ground improvement techniques: Role of ground improvement in foundation engineering- Factors affecting choice of ground improvement techniques- Geotechnical problems in alluvial, lateritic and black cotton soils

Drainage and Dewatering: well point system, shallow & deep well system, vacuum dewatering, electro osmosis

Chemical and Thermal Methods of stabilization: cement stabilization-types of soil cement-factors affecting soil cement mixing

Lime stabilization-effect of lime on soil properties – Brief description of Electrical and Thermal methods.

MODULE II

In-situ densification methods in granular soils: Introduction-mechanical stabilization-deep dynamic compaction-vibro compaction- blasting

In-situ densification methods in cohesive soils: Preloading- Concept of three dimensional consolidation –preloading with sand drains- sand drain design and methods of their installation – prefabricated vertical drains- stone columns & lime piles (installation techniques only).

MODULE III

Introduction to grouts and grouting- basic functions -Classification of grouts -Grout ability Ratio.

Properties of grouts: viscosity, fluidity, stability, rigidity, thixotropy, permeance.

Methods of grouting – Permeation grouting, Compaction grouting, jet grouting, Hydro fracturing.

Grouting technology – ascending and descending stages.

Grouting applications: seepage control in soil and rock under dams- seepage control in soil for cut off walls –stabilization grouting for underpinning.

MODULE IV

Earth Reinforcement- Concept of reinforced earth –Reinforcing materials- Backfill – construction of reinforced earth wall- Stability analysis of reinforced earth retaining walls-external stability analysis, internal stability analysis (brief mention about the methods only) - application areas of reinforced earth structures.

Geosynthetics: Classification- Functions of geotextiles as separators, reinforcement, filters and in drainage- damage and durability of geotextiles- Natural Geotextiles and its application.

Reference:

1. Tomlinson, M.J. *Foundation design and construction*.
2. Koerner, R. M. *Construction and Geotechnical Methods in Foundation Engineering*. Mc Graw Hill.
3. Jones, C. J. F. P. *Earth Reinforcement and soil structures*. Butterworths.
4. Bell, F. G. (1983). *Foundation Engineering in Difficult Ground*. Butterworth, London.
5. Purushothamaraj, P. *Ground Improvement techniques*. Laxmi Publications(P) Ltd., New Delhi.
6. Gulhati, S. K. and Datta, M. *Geotechnical Engineering*. Tata McGraw Hill.
7. Babu, G. L. S. *An Introduction to Soil Reinforcement and Geosynthetics*.
8. Beena, K. S. *Soil improvement and Coir Geotextiles*. Cochin University Publications.

Type of Questions for End Semester Examination.

PART A: Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules ($10 \times 2 = 20$ marks).

PART B: ($4 \times 10 = 40$ marks)

Question nos. II and III [with sub sections (a), (b), …] (10 marks each with option to answer either II or III) from Module I.
Question nos. IV and V [with sub sections (a), (b), …] (10 marks each with option to answer either IV or V) from Module II.
Question nos. VI and VII [with sub sections (a), (b), …] (10 marks each with option to answer either VI or VII) from Module III.
Question nos. VIII and IX [with sub sections (a), (b), …] (10 marks each with option to answer either VIII or IX) from Module IV.

CE15-1705 E3 PAVEMENT ANALYSIS AND DESIGN

Course Objective: To equip the students to carry out design and evaluation of flexible and rigid pavements in varied field conditions.

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

1. Identify the pavement components and compare highway and airport pavements.
2. Calculate stresses and ESWL in flexible pavements and design the flexible pavement.
3. Calculate the combined stresses due to temperature and wheel load stress and design rigid pavements by IRC method.
4. Evaluate pavements.

MODULE I

Introduction: types and component parts of pavements - Functions of various layers of pavements-prime coat, tack coat, seal coat- factors affecting design and performance of pavements - comparison between highway and airport pavements – functions and significance of sub grade properties – various methods of assessment of sub grade soil strength for pavement design - cause and effects of variations in moisture content and temperature - depth of frost penetration - design of bituminous mixes by Marshall method.

MODULE II

Stress analyses and methods of flexible pavement design: stresses and deflections in homogeneous masses - Burmister theory - wheel load stresses - ESWL of multiple wheels - repeated loads and EWL factors - empirical, semi - empirical and theoretical approaches for flexible pavement design - group index, CBR, -IRC method ,triaxial, Mcleod and Burmister layered system methods.

MODULE III

Rigid Pavements: Westergaard's approach-Bradbury's stress coefficients-IRC method of design. Temperature Stresses in Concrete pavements-Warping stress-Frictional Stress-Combination of stresses. Joints in Concrete pavements-Necessity-requirements-Types-Expansion joints-Contraction Joints-Construction joints, Design of joints-dowel bars and tie bars.

MODULE IV

Pavement evaluation: structural and functional evaluation of flexible and rigid pavements - pavement distress - evaluation of pavement structural condition by Benkelman beam rebound deflection, design of flexible pavement overlay using BBD data.

References:

1. Huang, Y.H. *Pavement Analysis and Design*. Second Edition. Dorling Kindersley (India) Pvt. Ltd., New Delhi, India.
2. Khanna, S.K., Justo and Raghavan, V. *Highway Engineering*. Nem Chand and Bros.
3. IRC: 37-2012 Guidelines for the Design of Flexible Pavements, The Indian Roads Congress, New Delhi.
4. IRC: 58-2011 *Guidelines for the Design of Plain Jointed Rigid Pavements for Highways*, The Indian Roads Congress, New Delhi.

5. IRC 81-1981 *Tentative Guidelines for Strengthening of Flexible Pavements by Benklman Beam Deflections Techniques*.
6. Mallick, R.B. and T. El-Korchi. *Pavement Engineering – Principles and Practice*. CRC Press, Taylor and Francis Group, Florida, USA.
7. Ministry of Road Transport and Highways. *Specifications for Road and Bridge Works*, Fifth Edition, Indian Roads Congress, New Delhi, India.
8. Papagiannakis, A.T. and Masad, E. A. *Pavement Design and Materials*. John Wiley and Sons, New Jersey, USA.
9. Yoder, E .J. and Witczak, M. W. *Principles of Pavement Design*. Second Edition, John Wiley and Sons, New York.

Type of Questions for End Semester Examination.

PART A: Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules ($10 \times 2 = 20$ marks).

PART B: ($4 \times 10 = 40$ marks)

Question nos. II and III [with sub sections (a), (b), …] (10 marks each with option to answer either II or III) from Module I.
Question nos. IV and V [with sub sections (a), (b), …] (10 marks each with option to answer either IV or V) from Module II.
Question nos. VI and VII [with sub sections (a), (b), …] (10 marks each with option to answer either VI or VII) from Module III.
Question nos. VIII and IX [with sub sections (a), (b), …] (10 marks each with option to answer either VIII or IX) from Module IV.

CE15-1705 E4 SOLID WASTE MANAGEMENT

Course Objectives: To gain insight into sustainable technologies for collection, transfer and transport of municipal solid waste and hazardous waste management, and develop ability to design and operate municipal solid waste landfill with an emphasis in cost effective engineering systems for resource and energy recovery.

Course Outcomes: On completion of this course a student will be able to

1. Identify the sources and composition of solid waste and integrated waste management approach which is beneficial for society.
2. Demonstrate an ability to choose sustainable technologies for storage, transport and processing of solid wastes.
3. Identify the types and design of cost effective technologies for landfill disposal and its operation
4. To develop a student's skill in hazardous waste management.

MODULE I

Solid wastes: Types and sources – need for solid waste management – Elements of integrated waste management – Salient features of Indian legislations on management and handling of municipal solid wastes, Solid Waste generation rates and variation: Composition, physical, chemical and biological properties of solid wastes –waste sampling and characterization plan – Source reduction of wastes – Recycling and reuse – waste exchange

MODULE II

Storage, Collection and Transport of wastes: Handling and segregation of wastes at source – storage and collection of municipal solid wastes – analysis of collection systems – need for transfer and transport – transfer stations - Optimizing waste allocation.

Waste Processing Technologies : Objectives of waste processing – material separation and processing technologies – biological and chemical conversion technologies – methods and controls of composting – thermal conversion technologies and energy recovery – incineration.

MODULE III

Municipal Solid Waste Disposal : Waste disposal options – Disposal in landfills – Landfill Classification, types and methods – site selection – design and operation of sanitary landfills, secure landfills and landfill bioreactors – leachate and landfill gas management – landfill closure and environmental monitoring – closure of landfills- landfill remediation

MODULE IV

Household hazardous waste management: Definition and identification of hazardous wastes, sources and characteristics-hazardous wastes in municipal waste-minimization of hazardous waste-compatibility, handling and storage of hazardous waste-collection and transport, Regulatory requirement for identification, characterization and disposal of hazardous, nonhazardous and domestic wastes.

References:

1. Tchobanoglous, G., Theisen, H. and Vigil, S. A. (1993). *Integrated Solid Waste Management*. McGraw-Hill International edition, New York.
2. CPHEEO (2000). *Manual on Municipal solid waste management*. Central public Health and Environmental Engineering Organization, Government of India, New Delhi.
3. Michael, D. LaGrega, Buckingham, P. L. and Jeffrey, C. E. (2011). *Environmental resources Management, Hazardous waste Management*. McGraw-Hill International edition, New York.
4. Peavy, H. S., Rowe, D. R. and Tchobanoglous, G. (1985). *Environmental Engineering*. McGraw Hill, New York.
5. Vesilind, P. A., Worrell, W. and Reinhart, D. (2002). *Solid Waste Engineering*. Brooks/Cole Thomson Learning Inc.
6. Wentz, C. A. *Hazardous waste Management*. MCGraw-Hill Publication.

Type of Questions for End Semester Examination.

PART A: Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules ($10 \times 2 = 20$ marks).

PART B: ($4 \times 10 = 40$ marks)

Question nos. II and III [with sub sections (a), (b), …] (10 marks each with option to answer either II or III) from Module I.

Question nos. IV and V [with sub sections (a), (b), …] (10 marks each with option to answer either IV or V) from Module II.

Question nos. VI and VII [with sub sections (a), (b), …] (10 marks each with option to answer either VI or VII) from Module III.

Question nos. VIII and IX [with sub sections (a), (b), …] (10 marks each with option to answer either VIII or IX) from Module IV.

CE15-1705 E5 REMOTE SENSING AND GIS

Course Objectives: To retrieve the information content of remotely sensed data, analyze the energy interactions in the atmosphere and earth surface features, interpret the images for preparation of thematic maps, apply problem specific remote sensing data for civil engineering applications, introduce the fundamentals and components of Geographic Information System, provide details of spatial data structures and input, management and output processes.

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

1. Understand the concepts and foundations of remote sensing.
2. Learn visual image interpretation.
3. Understand spatial data modeling and analytical modeling
4. Obtain output from new maps.

MODULE I

Remote sensing: Definition-Components of Remote sensing - Energy, Sensor, Interacting Body - Active and passive Remote Sensing – Platforms - Aerial and Space Platforms-Balloons,

Helicopters, Aircraft and Satellites - Synoptivity and Repetivity – Electro Magnetic Radiation (EMR) - EMR spectrum-visible, Infra Red (IR), near IR, Middle IR, Thermal IR and Microwave - Black Body Radiation – Planck's law - Stefan-Boltzman law.
EMR Interaction with Atmosphere and Earth Materials : Atmospheric characteristics- Scattering of EMR - Raleigh, Mie, Non–selective and Raman Scattering - EMR Interaction with Water vapour and ozone – Atmospheric Windows – Significance of Atmospheric windows - EMR interaction with Earth Surface Materials, Radiance, Irradiance, Incident, Reflected, Absorbed and transmitted energy - Reflectance – Specular and diffuse reflection surfaces - Spectral Signature – Spectral Signature curves EMR interaction with water, soil and earth surface.

MODULE II
Optical and Microwave Remote Sensing : Satellites – Classification based on orbits - Sun Synchronous and Geo Synchronous - based on purpose - Earth Resources Satellites, communication satellites, weather satellites, spy satellites – Satellite sensors - Resolution- Spectral, Spatial Radiometric and Temporal Resolution, description of Multispectral Scanning, Along and Across Track Scanners - Description of sensors in Landsat , SPOT, IRS series- Current Satellites – Radar-Speckle-Back Scattering – Side Looking Airborne Radar - Synthetic Aperture Radar – Radiometer - Geometrical characteristics.

MODULE III
Geographic Information system (GIS) : GIS – Components of GIS – Hardware, Software and Organizational Context - Data-Spatial and Non – Spatial, Maps - Types of Maps, Projection - Types of Projection - Data Input – Digitizer, Scanner – Editing – Raster and Vector data structure, Analysis using Raster and Vector data-retrieval, Reclassification, Overlaying , Buffering – Data Output – Printers and Plotters.

MODULE IV
Visual Interpretation of Satellite Images – Elements of Interpretation - Interpretation Keys Characteristics of Digital Satellite Images, Image enhancement, Filtering , Classification – Integration of GIS and Remote Sensing – Application of Remote Sensing and GIS, Urban Applications – Water resources – Urban Analysis - Watershed Management - Resources Information systems.

References:

1. Lillesand, T. M., Kiefer, R. W. and Chipman, J. W. *Remote Sensing and Image Interpretation*. John Wiley & Sons.
2. Sabinne. *Remote Sensing Principles and Interpretation*. W.H.Freeman & Co.
3. Burrough and McDonnel. *Principles of GIS*. Oxford University Press.
4. Heywood, J., Cornelius, S. and Carver, S. *An Introduction to GIS*. Pearson Education.

Type of Questions for End Semester Examination.
PART A: Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules ($10 \times 2 = 20$ marks).
PART B: ($4 \times 10 = 40$ marks)
Question nos. II and III [with sub sections (a), (b), …] (10 marks each with option to answer either II or III) from Module I.
Question nos. IV and V [with sub sections (a), (b), …] (10 marks each with option to answer either IV or V) from Module II.
Question nos. VI and VII [with sub sections (a), (b), …] (10 marks each with option to answer either VI or VII) from Module III.
Question nos. VIII and IX [with sub sections (a), (b), …] (10 marks each with option to answer either VIII or IX) from Module IV.

CE15-1705 E6 DESIGN OF SPECIAL STRUCTURES

Course Objectives: To introduce special concrete and steel structures like, shear walls, folded plates, shells, deep beams, bunkers, silos, space trusses, power transmission towers, etc. so that

students can appreciate the effort behind design and construction of such structures and to motivate students to take up such designs, confidently.

Course Outcomes: On completion of this course a student will be able to

1. Assimilate the basics of design of special RC structures, flat slabs and folded plates and appropriate use of them in building construction.
2. Conceive the importance of shell geometry and associated theory and design certain spatial structures.
3. Enter in to the world of design of power plant and power transmission structures.
4. Design concrete members reinforced with non corrosive FRP bars in place of steel as conventional bars.

MODULE I

Design of Special RC Elements

Design of RC walls - Ordinary walls and shear walls - Design of Corbels - Deep beams and grid floors.

Design of Flat Slabs and Folded Plates

Design of flat slabs. Design of folded plates- Folded Plate structures - structural behaviour - Types - Design by ACI - ASCE Task Committee method

MODULE II

Design of Shell Structures

Membrane theory of shells-Classification of shells - Types of shells - Structural action-Membrane theory - Shells of revolution and shells of translation - Examples - Limitations of membrane theory.

Design of Spatial Structures

Space frame - design philosophy-Space frames - configuration - types of nodes – general principles of design Philosophy – Behavior. Analysis of space frames - Formex Algebra, FORMIAN - Detailed design of Space frames.

MODULE III

Design of Power Plant Structures

Bunkers and Silos - Chimneys and Cooling Towers - High Pressure boilers and piping design – Nuclear containment structures.

Analysis and Design of Power Transmission Structures

Analysis and design of Transmission Line Towers, Types of bracing patterns - Sag and Tension calculations. Substation Structures, Tower foundations-Design of foundations for towers - Structural design of supports for foundation excavation design of ground anchors

MODULE IV

Structural design with FRP bars

Fibre Reinforced Polymer (FRP) bars-Introduction- Materials and manufacturing-Properties of FRP reinforcing bars-Design basis for FRP reinforced concrete, under reinforced section, over reinforced section, Design of FRP reinforced flexural members, Design procedure for Serviceability, design for shear and FRP reinforcement detailing.

References:

1. Purushothaman, P. (1986). *Reinforced Concrete Structure Structural Elements: Behavior Analysis and Design*.Tata Mc Graw Hill.
2. Krishnaraju, N. (1986). *Advanced Reinforced Concrete Design*. CBS Publishers and Distributors.
3. Ramasamy, G. S. (1986). *Design and Construction of Concrete Shells Roofs*. CBS Publishers.
4. Subramanian, N. (1999). *Principles of Space Structures*. Wheeler Publishing Co.

5. Santhakumar, A. R. and Murthy, S. S. (1992). *Transmission Line Structures*. Tata McGraw Hill.
6. Raina, V. K. (1991). *Concrete Bridge Practice.* Tata McGraw Hill Publishing Company, New Delhi.
7. Krishnaraju, N. (1988). *Design of Bridges*. Oxford and IBH Publishing Co., New Delhi.
8. Ponnuswamy, S. (1989). *Bridge Engineering*. Tata McGraw Hill.
9. Thomlinson, M. J. and Boorman, R. (1995). *Foundation design and construction*. 4th edition, ELBS Longman.

Note: *Relevant IS codes are permitted during the Examination.*

Type of Questions for End Semester Examination.

PART A: Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules ($10 \times 2 = 20$ marks).

PART B: ($4 \times 10 = 40$ marks)

Question nos. II and III [with sub sections (a), (b), …] (10 marks each with option to answer either II or III) from Module I.
Question nos. IV and V [with sub sections (a), (b), …] (10 marks each with option to answer either IV or V) from Module II.
Question nos. VI and VII [with sub sections (a), (b), …] (10 marks each with option to answer either VI or VII) from Module III.
Question nos. VIII and IX [with sub sections (a), (b), …] (10 marks each with option to answer either VIII or IX) from Module IV.

CE15-1801 ARCHITECTURE AND TOWN PLANNING

Course Objective: Student will be able to design and to do functional planning of buildings with respect to the town planning rules and regulation

Course Outcomes: On completion of this course a student will be able to gain knowledge

1. In traditional and modern architecture.
2. In doing functional planning of buildings.
3. About evolution of towns, surveys, zoning, and planning town/city leading towards the development of a modern town.
4. In land use planning and prepare master plan with respect to planning regulations.

MODULE I

Principles of Architectural Design: Definition of Architecture – factors influencing architectural development, Qualities of Architecture, Creative and Design Principles in architecture Characteristic features of a style –historical examples from Neolithic, Egyptian, Roman and Gothic architecture.

MODULE II

Functional Planning of Buildings: Occupancy classification of buildings – general requirements of sites and building- building codes and rules – licensing of building works.
Functional planning of buildings such as institutional, public, commercial and industrial buildings.
Consideration of comfort factors such as acoustics, lighting, ventilation and thermal aspects.

MODULE III

Town Planning Theory: Evolution of towns – problems of urban growth-beginning of town planning acts – ideal towns –garden city movement – concept of new towns -comprehensive planning of towns. Re- planning of existing towns.
Survey –Necessity- Collection of data- types-uses-Methods-drawings-reports.
Zoning-Objects- principles-importance-advantage-transition zone-economy of zoning-zoning powers.

MODULE IV

Housing- classification of residential buildings- Agencies for housing- Housing finance agencies- problems of housing in India

Slums – causes- Characteristics- Effects-slum clearance schemes –Re-housing

Master Plan – Objects- –Necessity- Collection of data- drawings- features- Planning standards- Report

Neighborhood planning- Principles- importance- features, Public utility services, Green belt

Town Planning Legislations: Laws relating to land acquisition; urban land ceiling,UDPFI guidelines, disaster mitigation management; Environmental and Pollution Control Acts.

References:

1. Fletcher, B. *A History of world Architecture*.
2. Pickering, E. *Architecture Design*.
3. Hiraskar, G. K. *Great Ages of World Architecture.*
4. Rangwala, S. C. *Town Planning*. Charotar Publishing House.
5. Agarwala, S. C. *Architecture & Town Planning*. Dhanpat Rai & Co (P) Ltd.

Type of Questions for End Semester Examination.

PART A: Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules ($10 \times 2 = 20$ marks).

PART B: ($4 \times 10 = 40$ marks)

Question nos. II and III [with sub sections (a), (b), …] (10 marks each with option to answer either II or III) from Module I.

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Question nos. VI and VII [with sub sections (a), (b), …] (10 marks each with option to answer either VI or VII) from Module III.

Question nos. VIII and IX [with sub sections (a), (b), …] (10 marks each with option to answer either VIII or IX) from Module IV.

CE15-1802 EARTHQUAKE ENGINEERING

Course Objectives: To introduce the response of structures to the most vulnerable hazard to them, earthquakes and the principles of seismology and design of structures to lessen the ill-effects of earthquakes.

Course Outcomes: On completion of this course a student will be able to

1. Develop an insight into the causes for the occurrence of earth quakes, characteristics of earth quake ground motion and how the strong motion data help generating design earth quake motions.
2. Assimilate the importance of the structural configuration of buildings to make it earth quake resistant and thereby mitigate the damages caused.
3. Analyze the response of a structure due to earth quake ground motion.
4. Practice guidelines for an efficient seismic resistant design and construction.

MODULE I

Earthquake Ground Motion: Causes of earthquake- Seismic waves-Intensity and Magnitude of earthquake-Energy released in an earthquake-earthquake frequency- seismic zones in India-**strong motion**-source effect-path effect-site effect-use of strong motion data; strong motion characteristics-**Response spectrum**-types of response spectra-design spectrum.

MODULE II

Seismic Resistant Building Architecture: Seismic effects on structures-Inertia forces-deformations-horizontal and vertical shaking-Importance of architectural features-effects of irregularity-Lateral load resisting systems-**Building Characteristics**-Mode shapes and fundamental period, Building frequency and ground period, Damping, Ductility, Seismic weight,

Hyperstaticity, Non structural elements, foundation soil/Liquefaction, foundations-Quality of construction and materials.

MODULE III

Structural Dynamics: Dynamic analysis, Types of dynamic loading, Structural vibrations, Free vibrations and forced vibrations- Response of the system towards loading, Degrees of freedom, SDOF and MDOF systems-Vibration analysis of SDOF systems- Free vibration of un-damped SDOF system- free vibration of viscously damped SDOF systems - Forced vibration of SDOF systems-harmonic excitation-base motion-principles of vibration isolation-determination of damping coefficient, Vibration measuring instruments, Response of a system to support motion.

MODULE IV

Lateral Loads: IS 1893 based determination of design lateral forces in multi-storey RC buildings.

Soil structure interaction effects: direct approach-sub structure approach (description only).

Ductility requirements of RC buildings: displacement ductility-rotational ductility-considerations based on IS13920 in flexural members, columns, joints of frames (description only).

References:

1. Agarwal, P. and Shrikhande, M. *Earthquake Resistant Design of Structures*. Prentice Hall of India Pvt Ltd, New Delhi.
2. Duggal. *Earthquake Resistant Design of Structures*. Oxford University Press.
3. Park, R. and Paulay, T. *Reinforced Concrete Structures*. John Wiley.
4. Chopra, A. K. *Dynamics of Structures*. Pearson Education Pvt. Ltd.
5. Paz, M. *Structural Dynamics: Theory and Computation*. CBS Publishers & Distributors, New Delhi.

Type of Questions for End Semester Examination.

PART A: Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules ($10 \times 2 = 20$ marks).

PART B: ($4 \times 10 = 40$ marks)

Question nos. II and III [with sub sections (a), (b), …] (10 marks each with option to answer either II or III) from Module I.

Question nos. IV and V [with sub sections (a), (b), …] (10 marks each with option to answer either IV or V) from Module II.

Question nos. VI and VII [with sub sections (a), (b), …] (10 marks each with option to answer either VI or VII) from Module III.

Question nos. VIII and IX [with sub sections (a), (b), …] (10 marks each with option to answer either VIII or IX) from Module IV.

CE15-1803 CONSTRUCTION SAFETY AND FIRE ENGINEERING

Course Objectives: To have a broad understanding of cause of accidents during construction due to improper work methods and prevention and codal provisions for fire protection of buildings.

Course Outcomes: On completion of this course, a student will be able to:

1. Recognize the importance of managing safety and health in construction and key legislation.
2. Report workplace accidents.
3. Understand correct working procedures and employee welfare provisions.
4. Identify types of hazards and ways to prevent accidents in different types of construction.
5. Understand the chemistry of fire and fire prevention methods.
6. Understand various standards to protect building and human life from fire hazards.

MODULE I

Introduction to Construction Industry and Safety: Basic concepts – accident – injury –lost time accidents, reportable accident, frequency rate, severity rate, incidence rate.
Technological, Organization and Behavioral Aspects of safety in construction, Human factors that are Impediments to safety in construction, Roles of different groups in ensuring safety, health, welfare and social security, Steps to be taken in construction sites in case of accidents, Introduction to ergonomics and its relevance to construction.

MODULE II
Safety in various construction operations such as soil excavation, rock blasting, dewatering, piling, demolition, working at heights-ladders and scaffolds, working in confined spaces, Safety in electrical works at construction site.
Safety in storage, stacking and handling of construction materials-cement, lime, aggregates, bricks and blocks, steel, glass, paint and varnish, flammable and hazardous materials used at sites.
Safety in the operation of construction equipments- excavators, trucks, tower cranes, mobile cranes, lifting tackles, chain and pulley, Personal protective equipment's for construction.

MODULE III
Classification of fire. Effect of high temperature on the properties of concrete, steel, masonry, wood, Fire damage to concrete, steel, masonry and timber, Repair techniques to the fire damaged reinforced concrete columns, beams, slabs and to the steel structural members.

MODULE IV
Design principles of fire resistant walls.
Classification of buildings based on occupancy, types of construction as per National Building code of India; Fire zones; General Requirements of fire protection for all individual occupancies.
Life safety aspects of building fires – Exit Requirements as per NBC of India. Requirements other than general requirements for buildings of different occupancy classification.

References:

1. Vaid, K. N. *Construction Safety Management*.
2. Smith and Harmathy. *Design of Buildings for Fire Safety*.
3. National Building Code of India, Part – IV and VII
4. Linger, L. *Modern Methods of Material Hand ling*.
5. Merchant, E. W. *A Complete Guide to Fire and Buildings*.
6. Jain, V. K. *Fire Safety in Buildings*. New Age International (p) Ltd., New Delhi.

Type of Questions for End Semester Examination.
PART A: Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules ($10 \times 2 = 20$ marks).
PART B: ($4 \times 10 = 40$ marks)
Question nos. II and III [with sub sections (a), (b), …] (10 marks each with option to answer either II or III) from Module I.
Question nos. IV and V [with sub sections (a), (b), …] (10 marks each with option to answer either IV or V) from Module II.
Question nos. VI and VII [with sub sections (a), (b), …] (10 marks each with option to answer either VI or VII) from Module III.
Question nos. VIII and IX [with sub sections (a), (b), …] (10 marks each with option to answer either VIII or IX) from Module IV.

CE15-18L1 SEMINAR

Course Objectives: To encourage and motivate the students to read and collect recent and relevant information from their area of interest confined to the relevant discipline from technical publications including peer reviewed journals, conferences, books, project reports, etc., prepare a report based on a central theme and present it before a peer audience.

Course Outcomes: On completion of this course a student will be able to:

1. Identify and familiarize with some of the good publications and journals in their field of study.
2. Acquaint oneself with preparation of independent reports, name them based on a central theme and write abstracts, main body, conclusions and reference identifying their intended meaning and style.
3. Understand effective use of tools of presentation, generate confidence in presenting a report before an audience and improve their skills in the same.
4. Develop skills like time management, leadership quality and rapport with an audience.

Students shall individually prepare and submit a seminar report on a topic of current relevance related to the field of Civil Engineering. The reference shall include standard journals, conference proceedings, reputed magazines and text books, technical reports and URLs. Each students shall evaluated by a team of internal experts comprising of 3 teachers based on style of presentation, technical content, adequacy of references, depth of knowledge and overall quality of the seminar report.

CE15-18L2 PROJECT PHASE II

Course Objectives: To enable students to apply any piece of theory and experiments which they have learned to a specific problem related to industry / research which is identified with the help of a guide in Phase I and solve it.

Course Outcomes: On completion of this course a student will be able to

1. Realize various steps involved in conducting a project work, like literature survey, methodology adopted – field study / survey / experiments / numerical work, analysis of the data to arrive at final results and conclusions, etc.
2. Initiate a habit of proper report writing with all of its major components, proper style of writing and preparation of a distinct abstract and carved out conclusions.
3. Conceive the pros and cons of working in a team and the wonderful results which could evolve through team-work.
4. Present and defend self-prepared and corrected report (with the help of project guide) of a self-created work to a peer audience.

Each batch of students shall develop the project started during the VII semester.

- A detailed project report in the prescribed formal shall be submitted at the end of the semester. All test results and relevant design and engineering documentation shall be included in the report.
- The work shall be reviewed and evaluated periodically.

The final evaluation of the project shall be done by a team of minimum 3 internal examiners including the project guide and shall include the following.

- Presentation of the work
- Oral examination
- Quality and content of the project report

Guidelines for evaluation:

i. Regularity and progress of work	50
ii. Work knowledge and involvement	50
iii. End semester presentation and oral examination	50
iv. Project Report – Presentation style and content	50

Total 200 marks

Note: Points (i) and (ii) to be evaluated by the respective project guide and the project coordinator based on continuous evaluation. (iii)-(iv) to be evaluated by the final evaluation team comprising of 3 internal examiners including the project guide.

CE15-18L3 COMPREHENSIVE VIVA - VOCE

Course Objectives:

To test the student's learning and understanding of the theory and applications of the various concepts taught during the entire course of their programme and to prepare the students to face interviews in both the academic and industrial sectors.

Course Outcomes: On completion of this course a student will be able to

1. Refresh all the subjects covered during the programme.
2. Gain good knowledge of theory and practice.
3. Develop oral communication skills and positive attitude.
4. Face technical interviews with confidence.

Each student is required to appear for a viva-voce examination at the end of the complete course work. The examination panel shall comprise of two internal examiners and one external examiner appointed by the University. The examiners shall evaluate the students in terms of their conceptual grasp of the course of study and practical/analysis skills in the field. The students shall produce the seminar report and project reports duly attested by the institutional authorities, before the examiners

ELECTIVES

CE15 – 1804 E1 BRIDGE ENGINEERING

Course Objectives: To motivate the students to apply the techniques of geotechnical engineering, structural analysis with the knowledge of moving loads and influence lines, reinforced concrete design and steel structural design for the design of various bridge components including the design of appropriate foundation of bridges.

Course Outcomes: On completion of this course a student will be able to

1. Design slab culverts, T-beam bridges and steel bridges for railways.
2. Design substructures for all types of bridges.
3. Gather information regarding inspection and maintenance of bridges.

MODULE I

Investigation for Bridges: Investigation stages – classification of bridges – investigations – estimates – Major bridges – coverage – topographic details – catchments area map – hydrologic particulars – geotechnical details – seismology of the area - navigation requirements – construction resources – particulars of nearest bridges – traffic forecast – Major bridges – factors for choice of ideal site –techno economic feasibility – project report preparation – preparation of drawings.

MODULE II

Loading standards: components of bridge structure – need for loading standard – loading requirement – railway loading standards – road bridge loadings.
Construction of bridges: Setting out of pier and abutments – setting out of single span bridge – setting out of multi span bridge – Open excavation in dry condition – foundation below water table – pile foundations – precast driven piles – cast in situ piles – load test on piles – well foundation – sinking of wells – construction of super structure.

MODULE III
Concrete Bridges for Road Transport: Design of simply supported solid slab bridge – Dispersion of load along the span – design of slab – Design of Girder Bridge – Design of deck slabs – design of longitudinal girders – Courbon's method – Design of bearings.
Steel Bridge for Railways: Steel girder design.

MODULE IV
Inspection of Bridges: Necessity for inspection of bridges – inspection procedures – aspects of inspection – testing of bridges – assessment of safe load bearing capacity
Maintenance of Bridges: Substructure maintenance – super structure maintenance – bearings – girders.

References:

1. Ponnuswamy, S. *Bridge Engineering*. Tata McGraw Hill Publishing Company Ltd.
2. Aswani, M. G., Vazirani, V. N. and Ratwani, M. M. *Design of Concrete Bridges*. Khanna Publishers.

Type of Questions for End Semester Examination.
Question nos. I and II [with sub sections (a), (b), …] (15 marks each with option to answer either I or II) from Module I.
Question nos. III and IV [with sub sections (a), (b), …] (15 marks each with option to answer either III or IV) from Module II.
Question nos. V and VI [with sub sections (a), (b), …] (15 marks each with option to answer either V or VI) from Module III.
Question nos. VII and VIII [with sub sections (a), (b), …] (15 marks each with option to answer either VII or VIII) from Module IV.

CE15-1804 E2 CONSTRUCTION ENGINEERING AND MATERIALS MANAGEMENT

Course Outcomes: On completion of this course a student will be able to
1. Have a detailed understanding of temporary structures in construction.
2. Identify the quality standards in highway and general construction.
3. Demonstrate their abilities in key areas such as Purchase Management, Inventory Control, Logistics, Warehousing and Human Resource Management.
4. Demonstrate their abilities to organize Stores and warehouses, Monitor, indentify and control inventory.

MODULE I
Formwork: Requirements of a good formwork – Loads on form work – guiding points in the design of form work – column form work –formwork for beams and floors – form work for deck slabs in bridges.
Scaffolding/ Falsework, Shoring and Underpinning: Scaffolding – parts of scaffolding – types of scaffolding – points to be kept in view of scaffolding – shoring – types of shoring – underpinning – methods of underpinning.
Construction dewatering - Coffer dams- Temporary sheeting and bracings.

MODULE II

Quality control: Introduction to IRC and MOST standards – General system Requirements, Field Laboratory, Material specifications, Introduction to ISO 9000/IS 14000 Series – Relevance to Construction, Overview, Interpretation of important clauses, Elements / System Requirements of ISO 9001 – Quality Policy, Quality System, Contract Review Process, Design control Control of documents, Purchasing Standards, Product Identification and Traceability, Process Control Standards to prevent nonconformities, Inspection and Testing Standards, Standards for personnel training. Building the ISO System – Quality Manual, Procedure Manual, Quality Documentation. Implementation – Quality System Management, Auditing, follow up audits.

MODULE III

Materials Management Introduction: Scope, Objectives and functions, phases in materials management, requisition, procurement and distribution, Procurement: Purchase procedure, tender, earnest money, security deposit, purchase order, Vendor rating. Receipt: Invoice, cash memo, inspection. Storage: Methods of storage, bin, rack, piling and special arrangements, stock verification Issue: issue vouchers, FIFO & LIFO systems, imprest stores, consumable stores, custody stores.

MODULEIV

Materials Management and Inventory Control:

Selective control techniques of inventory- Inventory, Inventory control, Inventory classification & Management, Inventory control, its objectives and how to achieve them, Functions of inventories, Economics order Quantity, Inventory models- Simple EOQ model EOQ model with stock out, Inventory model under risk ABC analysis.

References:

1. Peurifoy, R. L., Ledbetter, W. B. and Schexnayder, C. J. *Construction planning equipment and method*. McGraw Hill Publishing company.
2. Singh, G. *Building construction Engineering*. Standard book house.
3. Gopalakrishnan, P. and Sunderesan, M. *Materials Management- an Integrated Approach*.
4. Starr and Miller. *Inventory Control- theory and practice*.
5. MOST Standards Hand Book , RDSO Standards , CPWD Standards.
6. O'Brein. *Construction Inspection Hand Book*.
7. Deb, A. *Materials Management*. Academic Publishers.
8. Khanna, O. P. *Industrial Engineering and Management*. Dhampat Rai Publications.

Type of Questions for End Semester Examination.

PART A: Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules ($10 \times 2 = 20$ marks).

PART B: ($4 \times 10 = 40$ marks)

Question nos. II and III [with sub sections (a), (b), …] (10 marks each with option to answer either II or III) from Module I.
Question nos. IV and V [with sub sections (a), (b), …] (10 marks each with option to answer either IV or V) from Module II.
Question nos. VI and VII [with sub sections (a), (b), …] (10 marks each with option to answer either VI or VII) from Module III.
Question nos. VIII and IX [with sub sections (a), (b), …] (10 marks each with option to answer either VIII or IX) from Module IV.

CE15-1804 E2 ENVIRONMENTAL GEOTECHNICS

Course Objectives: To gain knowledge in the geotechnical engineering problems associated with soil contamination, safe disposal of waste and remediate the contaminated soils by different techniques thereby protecting the environment.

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

1. Understand the importance of clay mineralogy on soil behavior.
2. Understand the change in engineering properties of soil due to varying environment.
3. Gain knowledge of contaminant transport mechanisms in soils.
4. Understand the various site remediation techniques.

MODULE I

Scope and importance of environmental geotechniques- Clay mineralogy- Basic structural units of clay minerals- kaolinite mineral - montmorillonite mineral- illite mineral - isomorphous substitution - inter sheet and inter layer bonding in the clay minerals- specific surface area- surface charges and adsorption-exchangeable cations and cation exchange capacity- attractive forces and repulsive forces- adsorbed properties of adsorbed water- diffused double layer- adsorbed water- soil structure- dispersion and flocculation- methods for the identification of minerals (introduction only).

MODULE II

Effect of environment on Geotechnical properties of soils: Basic mechanisms controlling Atterberg limits and compressibility behavior of saturated Kaolinitic and Montmorillonitic clays with different pore fluids- Effect of drying on Atterberg limits.-Volume change behaviour- factors controlling resistance to volume change- shear strength behavior of kaolinitic and montmorillonitic clays with different pore fluids- Permeability and its mechanisms- Activity-sensitivity-causes of sensitivity-influence of exchangeable cations, pH and organic matter on properties of soils.

MODULE III

Wastes and Contaminants (introduction only): sources of wastes-types of wastes- composition of different wastes- characteristics and classification of hazardous wastes- generation rates-

Sources of contamination - Nature and mobility of ground contamination- Ground water contamination- sources of ground water contamination- potential problems in soils due to contaminants.

Soil waste interaction; contaminant transport - advective, diffusive, dispersive and combined process - attenuation capacity-

Contaminated Land : -Site investigation- Site assessment and treatment selection.

Ex situ treatment – General aspects of treatment technologies- Excavation and disposal- Soil washing- Thermal treatment- Biological treatment- Physical treatment –Fixation.

Containment- General aspects of containment- displacement barriers- trench barriers- horizontal barriers.

In situ treatment- Extraction- Biological and fungal treatment- Fixation- Electrokinesis- Hydraulic measures.

MODULE IV

Disposal and containment techniques: Overview on landfills Criteria for selection of sites for waste disposal-hydrological aspects of selection of waste disposal sites—Current MoEF rules for municipal solid wastes(management and handling)- Current CPCB guidelines for hazardous waste landfills- typical cross sections- components of landfills and functions of each component-siting considerations and geometry- construction of landfills.

Containment control systems- liners and covers for waste disposal- rigid liners- flexible liners-types of clay liners.

Disposal facilities- subsurface disposal techniques -disposal systems for typical wastes (sketches only).

References

1. Mitchell, J (1976), *Fundamentals of soil behavior*. John Wiley and sons, New York.

2. Ranjan, G. and Rao, A. S. R. (1991). *Basic and Applied Soil Mechanics*. Wiley Eastern Ltd., New Delhi.
3. Koerner, R. M. (1984). *Construction and Geotechnical methods in Foundation Engineering*. McGraw Hill Book Co., New York.
4. Yong, R. N. (1992). *Principles of contaminant Transport in Soils*. Elsevier, New York.
5. RamanathaIyer, T. S. (2000). *Soil Engineering Related to Environment*. LBS centre.
6. Datta, M. (1997). *Waste disposal in engineered landfills*. Narosha publication, New Delhi.
7. Gulathi, S. and Datta, M. *Geotechnical Engineering*. Tata McGraw-Hill Publishing Company Ltd. New Delhi.
8. Sharby, R. (2000). *Environmental Geotechnology*. Chapman and Hall London.
9. Daniel, D. E. (1993). *Geotechnical Practice of waste disposal*. Chapman and Hall London.
10. Bachi. *Design Construction and monitoring of landfills*. John Wiley and Sons, New York.

Type of Questions for End Semester Examination.

PART A: Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules ($10 \times 2 = 20$ marks).

PART B: ($4 \times 10 = 40$ marks)

Question nos. II and III [with sub sections (a), (b), …] (10 marks each with option to answer either II or III) from Module I.
Question nos. IV and V [with sub sections (a), (b), …] (10 marks each with option to answer either IV or V) from Module II.
Question nos. VI and VII [with sub sections (a), (b), …] (10 marks each with option to answer either VI or VII) from Module III.
Question nos. VIII and IX [with sub sections (a), (b), …] (10 marks each with option to answer either VIII or IX) from Module IV.

CE15-1804 E4 INDUSTRIAL WASTE ENGINEERING & MANAGEMENT

Course Objectives: To understand the various processes of industrial wastewater treatment and its management and the engineering requirements for the treatment and disposal facilities associated with various types of industries.

Course Outcomes:

1. Identify the effects of industrial wastewaters and stream quality criteria for public water supply and effluent standards.
2. Recognize the importance on the effect of wastewater discharge on stream.
3. Identify and design treatment options for industrial wastewater.
4. Identify the characteristics of industrial wastewaters and formulate environmental management plan.

MODULE I

Effect of industrial waste on stream, land and air, Stream quality criteria for public water supply and effluent standards, characterization studies, Variation in wastewater flow rates and constituents, Objective of wastewater treatment, Plant analysis and design, General layout of an effluent treatment plant, Volume reduction, Strength reduction, Neutralization, Equalization and Proportioning.

MODULE II

Disposal of treated waste into rivers, lake, reservoirs and estuaries, De-oxygenation and Re-oxygenationin river and Streams, Development of Oxygen sag model, Application of Streeter Phelp's equation, Estimation of assimilation capacity of stream, Ocean disposal, Water reclamation and reuse.

MODULE III

Physico–chemical treatment methods: Application of sedimentation, coagulation, flocculation, adsorption, chemical precipitation, ion exchange, reverse osmosis and electro-dialysis process. Biological treatment methods: Principle, Attached and suspended culture systems, modification of activated sludge process, rotating biological contactors, bio-tower, stabilization pond, oxidation ditch, aerated lagoon, sequencing batch reactors, Conventional and high rate anaerobic treatment concept of anaerobic contact process, anaerobic rotating biological contractors, Anaerobic Expanded/Fluidized bed reactors, Upflow anaerobic sludge blanket reactors and modifications.

MODULE IV

Sources & their Characteristics, waste treatment flow sheets for selected industries such as textiles, tanneries, dairy, sugar, paper, distilleries, refineries, fertilizer, thermal power plants.
Removal and control of particulate matter and gaseous pollutants, Waste management techniques, Control of Volatile organic compounds by absorption, adsorption, combustion and bio-filtration, Environmental management through ISO 14000, Environmental Auditing procedures, Auditing for waste minimization, Eco-labeling and Life Cycle Assessment.

References:

1. Metcalf and Eddy. *Wastewater Engineering, Treatment, Disposal and Reuse*. Tata McGraw Hill Publications.
2. Nemerow, H. N. *Liquid Waste from Industry – Theory, Practice and Treatment* . McGraw Hill Publications.
3. Rao, M. N. and Datta, A. K. *Waste Water Treatment*. Oxford IBH Publication.
4. Wark and Warner. *Air Pollution*. Harper and Row Publication.
5. Eckenfelder, W. W. *Industrial Water Pollution Control*. McGraw Hill Publication.
6. Vesilind, Worrell and Reinhart. *Solid Waste Engineering*. Tomson Brook Cole.
7. Arcevala and Asolekar. *Waste water Treatment for pollution control and Reuse*. Tata McGraw Hill Publications.
8. Nemerow, N. L. (2007). *Industrial Waste Treatment*. Butterworth-Heinemann.

Type of Questions for End Semester Examination.

PART A: Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules ($10 \times 2 = 20$ marks).

PART B: ($4 \times 10 = 40$ marks)

Question nos. II and III [with sub sections (a), (b), …] (10 marks each with option to answer either II or III) from Module I.
Question nos. IV and V [with sub sections (a), (b), …] (10 marks each with option to answer either IV or V) from Module II.
Question nos. VI and VII [with sub sections (a), (b), …] (10 marks each with option to answer either VI or VII) from Module III.
Question nos. VIII and IX [with sub sections (a), (b), …] (10 marks each with option to answer either VIII or IX) from Module IV.

CE15–1804 E5 ENVIRONMENTAL IMPACT ASSESSMENT

Course Objective: To understand the basic principles of Environmental Impact Assessment and develop knowledge in various processes involved in EIA with case studies.

Course Outcomes:

1. Identify the environmental attributes to be considered for the EIA study.
2. Formulate objectives of the EIA studies.
3. Identify the methodology to prepare rapid EIA.
4. Prepare EIA reports and environmental management plans.

MODULE I

Introduction: Concepts of environmental impact analysis, key features of National environmental policy act, Environmental protection acts, EIA methodologies – Screening and scoping - matrix

and network methodologies for impact identification, description of the affected environment – environmental indices, Rapid EIA and Comprehensive EIA.

MODULE II

Prediction and Assessment of Impact on Air and Water Environment: Basic information on air quality, sources and effects of air pollutants, key legislations and regulations, impact prediction approaches, assessment of significance of impacts, identification and incorporation of mitigation measures Assessment of impact on water quality (surface and ground water), Vegetation and wildlife.

MODULE III

Prediction and Assessment of Impact on Noise & Social Environment: Basic information on noise, key legislation and guidelines, impact prediction methods, assessment of significance of impacts, identification and incorporation of mitigation measures, Environmental Risk Analysis, Definition of Risk, Consequence Analysis.

MODULE IV

Decision Methods for Evaluation of Alternative: Development of decision matrix.
Public participation in environmental decision making, techniques for conflict management and dispute resolution, verbal communication in EIA studies.

References:

1. Canter, L.W. (1997). *Environmental impact assessment*. McGraw-Hill.
2. Marriott, B. B. (1997). *Environmental Impact Assessment: A Practical Guide*. McGraw-Hill Professional.
3. Peter Morris, P. and Therivel, R. (2001). *Methods of Environmental Impact Assessment*. Routledge.
4. Denver Tolliver, D. (1993). *Highway Impact Assessment*. Greenwood Publishing Group.
5. Jain, R. K., Urban, L. V., Stacey, G. S. and Balbach, H. E. (2001). *Environmental Assessment*. McGraw-Hill Professional.
6. Relevant IRC and CPCB codes.
7. Anjaneyalu,Y. (2002). *Environmental Impact Assessment Methodologies*. B.S. Publications, Hyderabad.
8. Canter, R. L. (1991). *Environmental Impact Assessment*. McGraw Hill Inc., New Delhi.
9. *Environmental Assessment Source book* (1991), Vol.I, II & III., The World Bank, Washington, D.C.
10. Judith Petts, J. (1999). *Hand book of Environmental Impact Assessment*. Vol.I& II, Blackwell Science.

Type of Questions for End Semester Examination.

PART A: Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules ($10 \times 2 = 20$ marks).

PART B: ($4 \times 10 = 40$ marks)

Question nos. II and III [with sub sections (a), (b), …] (10 marks each with option to answer either II or III) from Module I.
Question nos. IV and V [with sub sections (a), (b), …] (10 marks each with option to answer either IV or V) from Module II.
Question nos. VI and VII [with sub sections (a), (b), …] (10 marks each with option to answer either VI or VII) from Module III.
Question nos. VIII and IX [with sub sections (a), (b), …] (10 marks each with option to answer either VIII or IX) from Module IV.

CE15-1804 E6 SUSTAINABLE CONSTRUCTION TECHNIQUES

Course Objectives: To implement the concept of green buildings and sustainable construction through cost effective and environmental friendly techniques in civil engineering project.

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

1. Make one aware about the concepts of green buildings and rating systems.
2. Improve one's knowhow on the usability of locally available materials in building construction.
3. Introduce one on the innovations in building constructions and equip them with practical knowledge to cost effectiveness in building projects.
4. Make the younger generation aware about their social commitment towards a sustainable future.

MODULE I

Sustainable development – sustainable construction - Green buildings – Various rating systems for the assessment of sustainability- LEED, GRIHA, Life cycle Analysis.

MODULE II

Cost Reduction Techniques – Planning aspects – Construction aspects.

Innovative techniques for foundation- ground improvement by rope drains-bamboo reinforcement-sand piles- Brick arch foundation- stub foundation.

Locally available building materials and their usability, Applications of bamboo in building construction-flooring-roofing-ceiling-Trusses.

MODULE III

Innovative techniques for walls- Lato blocks-cellular concrete blocks-hollow concrete blocks-hollow clay blocks- Stabilized Soil blocks-Stone masonry blocks- Sand lime bricks. Straw-bale technology- Rat trap bond masonry.

Innovative techniques for roofing- Filler slabs -Funicular shells-Precast reinforced concrete channel units- Precast reinforced concrete cored units- Prestressed concrete hollow cored units-Precast RCC joists flooring/roofing systems- Reinforced brick panel roofing system-Two-way spanning flooring system using precast units.

MODULE IV

Mud Construction – Mud as building and building material – Field tests for identification of suitable soil for mud construction- Techniques for mud stabilization.

Techniques of mud construction- finishes and protective treatments.

Prefabricated building components – advantages of prefabrication, Ferro-cement products, Applications of industrial wastes in building process – Fly ash-Lime sludge.

References:

1. Rao, M. A. G. and Murthy, R. D. S. *Appropriate Technologies for Low cost housing*.
2. Rai, M. and Jaisingh, M. P. *Advances in building materials and construction*. CBRI Rookie Publications.
3. Merrit, F. S. *Building Construction Hand book*.
4. Perry, D. J. and Brandew, P. S. *Cost planning of buildings*.

Type of Questions for End Semester Examination.

PART A: Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules ($10 \times 2 = 20$ marks).

PART B: ($4 \times 10 = 40$ marks)

Question nos. II and III [with sub sections (a), (b), …] (10 marks each with option to answer either II or III) from Module I.

Question nos. IV and V [with sub sections (a), (b), …] (10 marks each with option to answer either IV or V) from Module II.

Question nos. VI and VII [with sub sections (a), (b), …] (10 marks each with option to answer either VI or VII) from Module III.

Question nos. VIII and IX [with sub sections (a), (b), …] (10 marks each with option to answer either VIII or IX) from Module IV.