Guru Nanak Dev Engineering College, Ludhiana
Department of Civil Engineering

Department Vision

To establish an outstanding centre of regional and national reputation for providing a quality engineering education to the students from the rural area of Punjab, excellent research and services to the professional and the community; to produce quality civil engineers; and to employ principles of continual quality improvement to enhance its programme and faculty.

Department Mission

a) To serve the people of Punjab and the country by providing a broad and high quality education to its student for a successful professional career.
b) To conduct strong basic and applied research for national needs.
c) To serve the construction industry; civil engineering profession and rural community through dissemination of knowledge and technical services.

Program Education Objectives (PEO)

1. To train the students so that they can work and contribute to the infrastructure development projects being undertaken by Govt. and private or any other sector companies.
2. To train students in such as a way that they can pursue higher studies so that they can contribute to the teaching profession/ research and development of civil engineering and other allied fields.
3. To train students in a manner that they should function effectively in the multicultural and multidisciplinary groups for the sustainable development and growth of civil engineering projects and profession.

Program Specific Outcomes (PSO)

1. **Understanding:** Graduates shall demonstrate sound knowledge in analysis, design, laboratory investigations and construction aspects of civil engineering infrastructure, along with good foundation in mathematics, basic sciences and technical communication.
2. **Broadness and Diversity:** Graduates will have a broad understanding of economical, environmental, societal, health and safety factors involved in infrastructural development, and shall demonstrate ability to function within multidisciplinary teams with competence in modern tool usage.
3. **Self-Learning and Service:** Graduates will be motivated for continuous self-learning in engineering practice and/or pursue research in advanced areas of civil engineering in order to offer engineering services to the society, ethically and responsibly.

Program Outcomes (PO)

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments**.**
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Study Scheme of Under Graduate (Batch 2014 & Onwards)

Year	Credits
First	54
Second	54
Third	52
Forth	45
Total Credits	**205**

Third Semester							**Contact Hours: 31 Hrs**	
Course Code	**Course Name**	**Load Allocation**			**Marks Distribution**		**Total Marks**	**Credits**
		L	**T**	**P**	**Internal**	**External**		
CE-14301*	Engineering Mathematics-III	3	1	-	40	60	100	4
CE-14302	Fluid Mechanics-I	3	1	-	40	60	100	4
CE-14303	Rock Mechanics & Engineering Geology	3	1	-	40	60	100	4
CE-14304	Strength of Materials	3	1	-	40	60	100	4
CE-14305	Surveying	3	1	-	40	60	100	4
CE-14306	Building Materials & Construction	3	0	-	40	60	100	3
CE-14307	Fluid Mechanics-I Lab	-	-	2	30	20	50	1
CE-14308	Strength of Materials Lab	-	-	2	30	20	50	1
CE-14309	Surveying Lab	-	-	3	30	20	50	2
TR-14301	Workshop Training	-	-	-	30	20	50	2
	Mentoring Class	-	1	-	-	-	-	-
	Total	**18**	**06**	**07**	**360**	**440**	**800**	**29**

* **This subject shall be taught by the faculty of Applied Science Department.**

Fourth Semester								**Contact Hours: 27 Hrs**
Course Code	**Course Name**	**Load Allocation**			**Marks Distribution**		**Total Marks**	**Credits**
		L	**T**	**P**	**Internal**	**External**		
CE-14401	Geomatics Engineering	3	-	-	40	60	100	3
CE-14402	Construction Machinery & Works Management	3	-	-	40	60	100	3
CE-14403	Design of Concrete Structures– I	3	1	-	40	60	100	4
CE-14404	Fluid Mechanics-II	3	1	-	40	60	100	4
CE-14405	Irrigation Engineering-I	3	1	-	40	60	100	4
CE-14406	Structural Analysis-I	3	1	-	40	60	100	4
CE-14407	Concrete Technology Lab	-	-	2	30	20	50	1
CE-14408	Structural Analysis Lab	-	-	2	30	20	50	1
GF-14401	General Fitness				100	-	100	1
	Mentoring Class	-	1	-	-	-	-	-
Total		**18**	**05**	**04**	**400**	**400**	**800**	**25**

Fifth Semester								**Contact Hours: 27 Hrs**
Course Code	**Course Name**	**L**	**T**	**P**	**Internal**	**External**	**Total**	**Credits**
CE-14501	Design of Steel Structures-I	3	1	-	40	60	100	4
CE-14502	Geotechnical Engineering	3	1	-	40	60	100	4
CE-14503	Structural Analysis - II	3	1	-	40	60	100	4
CE-14504	Transportation Engineering-I	3	1	-	40	60	100	4
CE-14505	Environmental Engineering-I	3	1	-	40	60	100	4
CE-14506	Transportation Engineering Lab	-	-	2	30	20	50	1
CE-14507	Environmental Engineering Lab	-	-	2	30	20	50	1
DECE-145XX	Departmental Elective – I	-	-	2	30	20	50	1
TRCE-14501	Industrial Training – I (Survey Camp)				60	40	100	2
	Mentoring Class	-	1	-	-	-	-	-
Total		**15**	**06**	**06**	**350**	**400**	**750**	**25**

Departmental Elective –I

S No	**Course Code**	**Course Name**
1	DECE-14508	Computer Aided Structural Drawing & Detailing
2	DECE-14509	Computer Aided Structural Analysis & Design
3	DECE-14510	Building Information Modeling

Sixth Semester								**Contact Hours: 29 Hrs**
Course Code	**Course Name**	**Load Allocation**			**Marks Distribution**		**Total Marks**	**Credits**
		L	**T**	**P**	**Internal**	**External**		
CE-14601	Design of Concrete Structures-II	3	1	-	40	60	100	4
CE-14602	Foundation Engineering	3	1	-	40	60	100	4
CE-14603	Professional Practice	3	1	-	40	60	100	4
CE-14604	Environmental Engineering – II	3	1	-	40	60	100	4
DECE-146XX	Departmental Elective –II	3	1	-	40	60	100	4
OEXX-146YY	Open Elective*	3	-	-	40	60	100	3
CE-14609	Geotechnical Engineering Lab	-	-	2	30	20	50	1
CE-14610	Computer Aided Analysis & Design	-	-	2	30	20	50	1
PRCE-14601	Minor Project	-	-	1	60	40	100	1
GF-14601	General Fitness	-	-	-	100	-	100	1
	Mentoring Class	-	1	-	-	-	-	-
	Total	**18**	**06**	**05**	**460**	**440**	**900**	**27**

List of Departmental Elective – II (6th Semester)		
S No	**Course Code**	**Course name**
1	DECE-14605	Numerical Methods in Civil Engineering
2	DECE-14606	Finite Elements Methods
3	DECE-14607	Reinforced Earth and Geotextiles
4	DECE-14608	Infrastructure Development and Management
List of Open Electives (6th Semester)*		
S No	**Course Code**	**Course Name**
1	OECE-14601	Building Maintenance & Safety
2	OECE-14602	Project Monitoring & Management

**(The students of Civil Engineering Department will select any one subject floated by the other department as their open elective subject other than their parent department.)*

Seventh/Eighth Semester					
Course Code	**Course Name**	**Mark Distribution**		**Total Marks**	**Credits**
		Internal	**External**		
TRCE-14701	Industrial Training – II	450	350	800	13
TRCE-14702	Industry Oriented Program	200	-	200	02
	Total	**650**	**350**	**1000**	**15**

Seventh/Eighth Semester							**Contact Hours: 30 Hrs**	
Course Code	**Course Name**	**Load Allocation**			**Marks Distribution**		**Total Marks**	**Credits**
		L	**T**	**P**	**Internal**	**External**		
CE-14801	Design of Steel Structures-II	3	1	-	40	60	100	4
CE-14802	Elements of Earthquake Engineering	3	1	-	40	60	100	4
CE-14803	Irrigation Engineering-II	3	1	-	40	60	100	4
CE-14804	Transportation Engineering-II	3	1	-	40	60	100	4
CE-14805	Seminar	-	-	2	50	-	50	2
DECE-148XX	Departmental Elective–III*	3	1	-	40	60	100	4
DECE-148YY	Departmental Elective- IV*	3	1	-	40	60	100	4
PRCE-14701	Major Project	-	-	3	120	80	200	3
GF-14701	General Fitness	-	-	-	100	-	100	1
	Mentoring Class	-	1	-	-	-	-	-
	Total	**18**	**07**	**05**	**510**	**440**	**950**	**30**

**** Departmental Elective III and IV should not be from the same group.***

Departmental Elective – III	• DECE-14806 Dynamics of Structures • DECE-14807 Advanced Reinforced Concrete Design • DECE-14808 Pre-stressed Concrete • DECE-14809 Pavement Design • DECE-14810 Traffic Engineering • DECE-14811 Bridge Engineering • DECE-14812 Matrix methods of Structural Analysis
Departmental Elective – IV	• DECE-14815 Ground Improvement Techniques • DECE-14816 Soil Dynamics and Machine Foundation • DECE-14817 Earth and Earth Retaining Structures • DECE-14818 Advanced Environmental Engineering • DECE-14819 Environmental Impact Assessment • DECE-14820 Flood Control and River Engineering • DECE-14821 Hydrology and Dams • DECE-14822 Disaster Management

CE-14301 Engineering Mathematics-III

Internal Marks: 40	L T P
External Marks: 60	3 1 0
Total Marks: 100	

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Analyze Fourier series to fit it into civil engineering problems.
2. Evaluate linear differential equations which are often the part of civil engineering problems using techniques of Laplace Transforms.
3. Evaluate the special functions which arise as a result of differential equations with variable coefficients.
4. Analyze different types of partial differential equations.
5. Apply the methods of partial differential equations to solve one dimensional equation.
6. Analyze the differential and integral calculus of complex functions.

Course Content:

Fourier series: Periodic functions, Euler's formula. Even and odd functions, half range expansions, Fourier series of different wave forms.

Laplace Transforms: Laplace transforms of various standard functions, properties of Laplace transforms, inverse Laplace transforms, transform of derivatives and integrals, Laplace transform of unit step function, impulse function, periodic functions, applications to solution of ordinary linear differential equations with constant coefficients, and simultaneous differential equations.

Special Functions: Power series solutions of differential equations, Frobenius method, Legendre's equation, Legendre polynomial, Bessel's equation, Bessel functions of the first and second kind. Recurrence relations, equations reducible to Bessel's equation

Partial Differential Equations: Formation of partial differential equations, Linear partial differential equations, homogeneous partial differential equations with constant coefficients

Applications of PDEs: Wave equation and Heat conduction equation in one dimension. Two dimensional Laplace equation in Cartesian Coordinates, solution by the method of separation of variables

Functions of Complex Variable: Limits, continuity and derivative of the function of complex variable, Analytic function, Cauchy-Riemann equations, conjugate functions, harmonic functions; Conformal Mapping: Definition, standard transformations, translation, rotation, inversion, bilinear. Complex Integration: Line integrals in the complex plane, Cauchy's theorem, Cauchy's integral formula and derivatives of analytic function. Taylor's and Laurent's expansions (without proofs), singular points, poles, residue, Integration of function of complex variables using the method of residues

References:

- Kreyszing, E., Advanced Engineering Mathematics, Eighth edition, John Wiley, New Delhi.
- Grewal, B. S., Higher Engineering Mathematics, Khanna Publishers, New Delhi.
- Ian N. Sneedon, Elements of Partial Differential Equations, McGraw- Hill, Singapore,

1957.
- Peter. V. O' Nil, Advanced Engineering Mathematics, Wadsworth Publishing Company.
- Advanced Engineering Mathematics, O'Neil, Cengage Learning.
- Taneja, H. C., Engineering Mathematics, Volume-I & Volume-II, I. K. Publisher.

CE-14302 Fluid Mechanics-I

Internal Marks: 40 L T P
External Marks: 60 3 1 0
Total Marks: 100

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Understand the basic properties of Fluid.
2. Compute hydrostatic forces on submerged bodies.
3. Analyze flow rates, velocity, energy losses and momentum flux for fluid system.
4. Explain fluid flow phenomena.
5. Evaluate relationship among various parameters based on dimension analysis and model study.
6. To predict the resisting forces on moving submerged body.

Course Content:

Fluid and their properties: Concept of fluid, difference between solids, liquids and gases; ideal and real fluids; Continuum concept of fluid: density, specific weight and relative density; viscosity and its dependence on temperature; surface tension and capillarity, vapour pressure and cavitations, compressibility band bulk modulus; Newtonian and non-Newtonian fluids.

Fluid Statics: Concept of pressure, Pascal's law and its engineering hydrostatic paradox. Action of fluid pressure on plane (horizontal, vertical and inclined) submerged surface, resultant force and center of pressure, force on a curved surface due to hydrostatic pressure. Buoyancy and flotation, stability of floating and submerged bodies, Meta centric height and its determination

Fluid Kinematics: Classification of fluid flows, velocity and acceleration of fluid particle, local and convective acceleration, normal & tangential acceleration streamline, path line and streak line, flow rate and discharge mean velocity continuity equation in Cartesian co-ordinates. Rotational flows- Rotational velocity and circulation, stream & velocity potential functions.

Fluid Dynamics: - Euler's equation, Bernoulli's equation and steady flow energy equation, representation of energy changes in fluid system, impulse momentum equation, kinetic energy and momentum correction factors, flow along a curved streamline, free and forced vortex motions.

Dimensional Analysis and Similitude: Fundamental and derived units and dimensions, dimensional homogeneity, Rayleigh's and Buckingham's Pi method for dimensional analysis, dimension less number and their significance, geometric, kinematic and dynamic similarity, model studies.

Flow Past immersed bodies: Drag and lift deformation Drag and pressure drag. Drag on sphere, cylinder and Airfoil: Lift-Magnus Effect and circulation, lift on a circular cylinder.

Flow Measurement: - Manometers, Pitot tubes, venturimeter and orifice meters, orifices, mouthpieces, notches **(Rectangular and V-notches)** and weirs **(Sharp crested Weirs)**.

References:

- Fluid Mechanics & Hydraulic Machines : Dr. R.K. Bansal
- Hydraulic and Fluid Mechanic by P.N. Modi & S.M. Seth
- Engineering Fluid Mechanics by R.J. Garde & A.G. Mirajgaoker
- Fluid Mechanics by Douglas JF, Gasiorek JM, Swaffield JP; Pitman
- Fluid Mechanics: Streetes VL & Wylie EB; TATA Mcgraw Hill.
- Introduction to Fluid Mechanics by Robert W. Fox & Alan T. McDonald
- Fluid Mechanics by Potter, Cengage Learning

CE-14303 Rock Mechanics & Engineering Geology

Internal Marks: 40 L T P
External Marks: 60 3 1 0
Total Marks: 100

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Understand the geological considerations in civil engineering projects.
2. Predict the different properties of rocks.
3. Identify the geological problems associated with civil engineering structures and suggest remedies.
4. Analyze geological data for civil engineering projects.
5. Inter predict the engineering properties of rocks in laboratory and field.
6. Plan appropriate techniques for improvement the engineering properties of rocks.

Course Content:

General Geology: Importance of Engineering Geology applied to Civil Engineering Practices, Weathering, definition, types and effect, Geological works of rivers, wind, glaciers as agents of erosion, transportation and deposition.
Rocks & Minerals: Minerals, their identification, igneous, sedimentary & metamorphic rocks. Classification of rocks for engineering purposes, Rock quality designation (RQD)
Structural Geology: Brief idea about stratification, apparent dip, true dip, strike and in conformities. Folds, faults & joints: definition, classification relation to engineering operations.
Engineering Geology: Geological considerations in the Engineering, Projects like tunnels, highways, foundation, dams, and reservoirs. Earthquake- Definition, terminology, earthquake waves, intensity, recording of earthquake.
Engineering properties of rocks and laboratory measurement: Uniaxial compression test, tensile tests, permeability test, shear tests, size and shape of specimen rate of testing. Confining pressure, stress strain curves of typical rocks. Strength of intact and fissured rocks, effect of anisotropy, effect of saturation and temperature
In-situ determination of Engineering Properties of Rock masses: Necessity of in-situ tests, uniaxial load tests in tunnels and open excavations, cable tests, flat jack test, shear test, pressure tunnel test. Simple methods of determining in situ stresses, bore hole test
Improvement in properties of Rock masses: Pressure grouting for dams and tunnels, rock reinforcement rock bolting.

References:

- Introduction to Rock Mechanics: Richard E. Goodman.
- Engg. Behaviour of rocks: Farmar, I.W.
- Rock Mechanics and Engg.: Jaager C.
- Fundamentals of Rock Mechanics: Jaager and Cook
- Engineering Geology: D.S.Arora
- Engineering Geology : Parbin Singh
- Rock Mechanics for Engineering: B.P. Verma.

CE -14304 Strength of Material

Internal Marks: 40 L T P
External Marks: 60 3 1 0
Total Marks: 100

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Identify the concepts solid mechanics including static equilibrium, geometry of deformation, and material constitutive behavior.
2. Execute the fundamental concepts of stress, strain and elastic behaviour of materials to analyze structural members subjected to tension, compression, torsion
3. Analyse the bending stress on different types of sections.
4. Formulate appropriate theoretical basis for the analysis of combined axial and bending stresses.
5. Understand the behavior of columns and struts under axial loading.
6. Demonstrate the use of critical thinking and problem solving techniques as applied to structural systems.

Course Content:

Concept of Equilibrium: Load, reaction; General equilibrium equations; Equilibrium of a point in space; Equilibrium of a member; Concept of free body diagrams; Displacements; Concept of displacement-constraints/ supports; Statical-determinacy of a problem

Simple Stress and Strains: Introduction; Concept of stress and strain; Stress-strain curves for ductile, brittle materials; Generalized Hooke's law, Stress-strain diagram of ductile and brittle material, statically determinate and indeterminate problems, compound and composite bars, thermal stresses. Elastic constants, relations between various elastic constants and its use; Lateral strain, volumetric strain, poisons ratio; Stress and strains in thin cylinders, spherical shells; Thin vassals subjected to internal pressures.

Complex stress and strains: Introduction; Normal stress, tangential stress; Rectangular block subjected to normal stress along and across two planes, combination of normal and tangential stress; Concept of principal stress and its computation; Mohr circle; Principal strains, computation of principal stresses from the principal strains.

Shear force and Bending moment diagrams: Introduction to the concept of reaction diagrams—shear force and bending moment; Role of sign conventions; Types of load, beams, supports; Shear force and bending moment diagrams: simply supported, overhang and cantilever beams subjected to any combination of point loads, uniformly distributed and varying load, and moment; Relationship between load, shear force and bending moment; Different methods for plotting a bending moment and shear force diagrams.

Bending and Shear Stresses: Introduction; Assumptions and derivation of flexural formula for straight beams; Centroid of simple and built up section, second moment of area; Bending stress calculation for beams of simple and built up section, composite sections (flitched sections); Shear stress; Variation of bending and shear stress along the depth of section.

Columns and Struts: Stability of Columns; buckling load of axially loaded columns with various end conditions; Euler's and Rankine's formula; Columns under eccentric load, lateral load.

Torsion of Circular shafts: Torsion, basic assumptions, derivation of torsion equation; Power transmitted by shafts; analysis and design of solid and Hollow shafts based on strength

and stiffness; Sections under combined bending and torsion, equivalent bending and torsion.
Failure theories: Maximum principal stress theory, Maximum shear stress theory, Distortion Energy theory, Strain Energy theory, Constant Analysis of Thin Cylinder

References:

- Mechanics of Material : E .Popov
- Strength of Material: Rajput
- Strength of Materials: Sadhu Singh
- Strength of Materials by Gere, Cengage Learning

CE-14305 Surveying

Internal Marks: 40 L T P
External Marks: 60 3 1 0
Total Marks: 100

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Understand various methods and techniques of surveying and its applications (chain survey, compass survey, leveling and contouring).
2. Compute angles, distances and levels.
3. Apply the concept of tachometry survey in difficult and hilly terrain.
4. Discuss the working principle of ordinary and electronic survey instruments.
5. Select different instruments for data collection and apply corrections on collected data.
6. Analyze the survey data for different applications.

Course Content:

Introduction: Definition, principles of surveying, different types of surveys, topographical map, scale of map.
Chain and Compass Surveying: Measurement of distances with chain and tape, direct &indirect ranging, offsets, bearing and its measurement with prismatic compass, calculation of angles from bearings, Local Attraction.
Plane Table Surveying: Setting up the plane table and methods of plane tabling.
Levelling & Contouring: Setting up a dumpy level, booking and reducing the levels by rise &fall method and height of instrument method, correction due to curvature and refraction, characteristics of contours, methods of contouring, uses of contour maps.
Theodolite Traversing: Temporary and permanent adjustments, measurement of horizontal and vertical angles, adjustment of closing error by Bowditch & Transit rules.
Tachometry: Definition, determination of tachometer constants and reduced level from tachometric observations.
Triangulation: Selection of stations and base line, corrections for base line, satellite station and reduction to centre.
Curves: Elements of a simple curve, different methods of setting out of simple circular curve.

References:

- Duggal, S.K., Surveying Vol I & II, Tata McGraw Hill (2006)
- Punmia, B.C., Jain, Ashok Kumar and Jain, Arun Kumar, Surveying Vol. I and II, Laxmi Publications (2005)
- Agor, R., Surveying, Khanna Publishers (1982)
- Bhavikatti, S.S. Surveying & Levelling Volume I&II (2009)

CE-14306 Building Material & Construction

Internal Marks: 40 L T P
External Marks: 60 3 0 0
Total Marks: 100

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Identify and characterize building materials
2. Understand the manufacturing process of bricks, cement and concrete.
3. Select the appropriate methods for preservation of timber and metals
4. Evaluate the quality of building material through visual inspection or by laboratory testing.
5. Apply the knowledge to select suitable construction techniques for different building components.
6. Use the suitable techniques of damp proofing and fire resistance.

Course Content:

Building Stones & Bricks: General, Characteristics of a good building stone, Deterioration and preservation of stones, Artificial Stones, Composition of good brick earth, Qualities of good bricks, Classification of bricks, Tests on bricks and Varieties of fire bricks
Cement: Composition of cement, Raw Materials, Manufacturing process, Varieties of cement, Hydration of cement, Properties, testing of cement.
Concrete: Introduction, Constituents of concrete, batching of materials, manufacturing process of cement concrete, workability and factors affecting it, Methods to determine workability, segregation and bleeding of concrete, Strength of concrete and factors affecting it.
Timber: Structure of a tree, classification of trees, Defects in timber, Qualities of good a timber, Seasoning of timber, Decay of timber, Preservation of timber
Miscellaneous materials: Paints, Distempering, Glass, Plastics.
Foundation and Walls: Definition, types of foundations, causes of failures of foundation and remedial measures, Types of walls and thickness considerations.
Brick and stone masonry: Terms used, Types of bonds & their merits and demerits, rubble and ashlar joints in stone masonry, cement concrete hollow blocks and their advantages and disadvantage.
Damp Proofing: Sources, causes and bad effects of dampness, preventive measures for dampness in buildings.
Roofs: Terms used, Classification of roofs and roof trusses, Different roof covering materials**.**
Plastering and pointing: Objects, Methods of plastering, Materials and types, Defects in plastering, special material for plastered surface, Distempering white washing and colour washing**.**
Floors: General, Types of floors used in building & and their suitability, factors for selecting suitable floor for building**.**
Miscellaneous topics: Building Services–Plumbing service, Electrical services, Air conditioning, Acoustics and sound insulation, Fire protection measures, Lift

References:

- Rangwala – Building materials
- Bindra SP, Arora KR Building construction
- Shetty MS , Concrete Technology
- Punmia BC, Building construction

CE-14307 Fluid Mechanics Lab-I

Internal Marks: 30 L T P
External Marks: 20 0 0 2
Total Marks: 50

Course Outcome:

After completing this course the student must demonstrate the knowledge and ability to:

1. Predict the metacentric height of floating vessel and appreciate its utility in vessel design.
2. Calibrate various flow measuring devices (venturimeter, orifice meter and notches).
3. Authenticate the Bernoulli's theorem experimentally.
4. Assess the discharge of fluid over broad crested weir
5. Compute various losses and velocity in pipe flow in field
6. Compare good understanding of concepts and their applications in the laboratory.

Course Content:

1. To determine the meta-centric height of a floating vessel under loaded and unloaded conditions.
2. To study the flow through a variable area duct and verify Bernoulii's energy equation.
3. To determine the coefficient of discharge for an obstruction flow meter (venturimeter /orifice meter)
4. To determine the discharge coefficient for a Vee notch or rectangular notch.
5. To determine the coefficient of discharge for Broad crested weir**.**
6. To determine the hydraulic coefficients for flow through an orifice.
7. To determine the friction coefficient for pipes of different diameter.
8. To determine the head loss in a pipe line due to sudden expansion / sudden contraction/ bend.
9. To determine the velocity distribution for pipe line flow with a pitot static probe.

References:

- Practical Fluid Mechanics for Engineering Applications (Mechanical Engineering (Marcell Dekker) By John J. Bloomer
- Fluid Mechanics Practical Manual by Sarabjit Singh.

CE-14308 Strength of Material Lab

Internal Marks: 30 L T P
External Marks: 20 0 0 2
Total Marks: 50

Course Outcomes

After completing this course the student must demonstrate the knowledge and ability to:

1. Understand the importance of physical properties of steel.
2. Identify and comprehend code provisions for testing different properties of steel.
3. Develop stress –strain curve for axial compression, axial tension and shear.
4. Evaluate fatigue and impact strength of steel using suitable equipment.
5. Assess hardness of steel using Rockwell and Brinell apparatus.
6. Compute load carrying capacity of a leaf spring.

Course Content:

1. Draw Stress Strain curve for Ductile and Brittle material in tension.
2. Draw Stress Strain curve for Ductile and Brittle material in compression.
3. Draw shear stress, shear strain curve for ductile and brittle material in torsion strength testing
4. Draw load deflection curve for spring in loading and unloading conditions.
5. To determine the hardness of the given material by Rockwell and Brinell hardness testing machine.
6. To determine the fatigue strength of the material.
7. To determine the impact strength by Izod and Charpy test.
8. To determine the load carrying capacity of the leaf spring.
9. To test a mild steel and cast iron specimen in double shear.

CE-14309 Surveying Lab

Internal Marks: 30 L T P
External Marks: 20 0 0 3
Total Marks: 50

Course Outcomes:

After completing the course the students must demonstrate the knowledge and ability to:

1. Assess horizontal & vertical angles by Theodolite and various distances by Chaining along with ranging.
2. Survey the area using different methods of plane tabling and compass survey and to adjust the compass traverse graphically.
3. Compute the reduce levels using various methods of leveling.
4. Predict the location of any point horizontally and vertically using Tachometry.
5. Setting out curves in the field.
6. Analyze different types of survey data.

Course Content:

1. Measurement of distance, ranging a line.
2. Measurement of bearing and angles with compass, adjustment of traverse by graphical method.
3. Different methods of levelling, height of instrument, rise & fall methods.
4. Measurement of horizontal and vertical angle by theodolite.
5. Determination of tachometric constants and determination of reduced levels by tachometric observations.
6. Plane table survey, different methods of plotting, two point & three point problem.
7. Determination of height of an inaccessible object.
8. Setting out a transition curve. Setting out of circular curves in the field using different methods.

CE-14401 Geomatics Engineering

Internal Marks: 40	L T P
External Marks: 60	3 0 0
Total Marks: 100	

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Demonstrate the use of remote sensing in resolving the location related problems.
2. Explain and apply the concept of photogrammetry in the survey.
3. Retrieve the information from remotely sensed data and interpret the data for survey.
4. Analyze and representation of the geographical data.
5. Understand the basic concepts related to GIS and GPS.
6. Apply the electronic technology for surveying works.

Course Content:

Photogrammetry: Introduction, Basic Principles, Photo-Theodolite, Elevation of a Point by Photographic Measurement, Aerial Camera, Vertical Photograph, Tilted Photograph, Scale, Crab and Drift, Flight Planning for Aerial Photography, Ground Control for Photogrammetry, Photomaps and Mosaics, Stereoscopic Vision, Stereoscopic parallax, Stereoscopic Plotting Instruments, Introduction of Electronic Total Station & their Applications

Remote Sensing: Introduction, Basic Principles, Electromagnetic (EM) Energy Spectrum, EM Radiations and the Atmosphere, Interaction of EM radiations with Earth's Surface, Types of remote sensing systems, Remote Sensing Observation Platforms, Satellites and their characteristics – Geo-stationary and sun-synchronous, Earth Resources Satellites, Meteorological satellites, Sensors, Types and their characteristics, Across track and Along track scanning, Applications of Remote Sensing.

Geographical Information System (GIS): Definition, GIS Objectives, Hardware and software requirements for GIS, Components of GIS, Coordinate System and Projections in GIS, Data structure and formats, Spatial data models – Raster and Vector, Data inputting in GIS, Data base design - editing and topology creation in GIS, Linkage between spatial and non spatial data, Spatial data analysis – significance and type, Attribute Query, Spatial Query, Vector based spatial data analysis, Raster based spatial data analysis, Errors in GIS, Integration of RS and GIS data, Digital Elevation Model, Network Analysis in GIS, GIS Software Packages.

Global Positioning System (GPS): Introduction, Fundamental concepts, GPS system elements and signals, GPS measurements and accuracy of GPS, Satellite Movement, GPS Satellites, Co-ordinate systems - Geoids, Ellipsoid and Datum, Spheroid, Customized Local Reference Ellipsoids, National Reference Systems, Worldwide Reference Ellipsoid, WGS 84, Differential-GPS, Classification of GPS receivers, GPS Applications.

References:

- Arora, K.R., 2007: Surveying Vol-III, Standard Book House.
- Campbell, J.B.2002: Introduction to Remote Sensing. Taylor Publications.
- Chang.T.K. 2002: Geographic Information Systems, Tata McGrawHill.
- Heywood.I, Cornelius S, CrverSteve. 2003: An Introduction to Geographical Information Systems, Pearson Education.

- Joseph George, 2003: Fundamentals of Remote Sensing. Universities Press.
- Punmia, B.C., Jain A.K., 2005: Higher Surveying, Luxmi Publications
- Sabbins, F.F., 1985: Remote Sensing Principles and Interpretation. W.H.Freeman and company.
- Kaplan, E.D., Understanding GPS : Principles and Application; Artec House; 2 Edition

CE-14402 Construction Machinery & Works Management

Internal Marks: 40 L T P
External Marks: 60 3 0 0
Total Marks: 100

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Understand the concept, and need of project planning and the related concepts.
2. Utilize various management tools and techniques, such as PERT, CPM, etc. in the project planning.
3. Develop a network and perform time estimates to find the critical path.
4. Assess the minimum total cost and do the project scheduling.
5. Perform cost analysis for a given activity and formulate a project contract.
6. Select appropriate construction equipment and machinery for a given construction activity.

Course Content:

Introduction: Need for project planning & management, time, activity & event, bar chart, Milestone chart, uses & draw backs.

PERT : Construction of PERT network, time estimates, network analysis, forward pass & backward pass, slack, critical path, data reduction, suitability of PERT for research project, numerical problems, probability of achieving scheduled project.

CPM: Definitions, network construction, critical path, fundamental rules, determination of project schedule, activity time estimates, float types, their significance, numerical problems.

Cost Analysis and Contract: Type of costs, cost time relationships, cost slopes, conducting a crash programme, determining the minimum total cost of project, numerical problems, updating a project, when to update, time grid diagram, resource scheduling, planning of different components of civil engineering projects such as a house, workshop, dam, tunnel.

Introduction of Modern Civil Engineering Equipments and Plants: Dragline, Hoes. Line diagram of each, sizes, output, uses, factors affecting selection of each equipment, economic life of equipment, maintenance and repair cost, Hoisting &Transporting Equipments- Hosts, Winches, Cranes, Belt conveyors, Ropeways, trucks & Wagons, Construction Equipments, concrete pumps, Working flow diagram of RMC Plant, Bituminous Plant , Paver Plant.

Introduction of relevant software

References:

- Construction Planning and Equipment - R.L. Peurifoy - Tata McGraw Hill, New Delhi PERT and CPM - L.S. Srinath, East West Press
- Management Guide to PERT & CPM - Wiest & levy; Prentice Hall
- Construction Equipment & Planning and Application. - Mahesh Verma, Artec Publication.
- Construction Planning and Management by U. K. Shrivastava; Galgotia Publications Pvt. Ltd.

CE-14403 Design of Concrete Structures-I

Internal Marks: 40 L T P
External Marks: 60 3 1 0
Total Marks: 100

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Identify the quality control tests on concrete making materials.
2. Understand the behavior and the durability aspects of the concrete under different loading and exposure conditions.
3. Design the concrete mixes as per various mix techniques.
4. Apply the stress-strain response of steel and concrete in the design of various RC elements.
5. Compare the fundamental concepts of different design philosophies available for RC elements.
6. Execute the solution using a logic and structured approach based on Limit State Method and IS code provisions for various RC elements, such as beams, slabs and stairs.

Course Content:

Note*: Relevant Codes of Practice are permitted in Examination*.

Concrete Technology
Cement and Aggregates, properties and testing, Water, Admixtures, Fresh concrete, workability, Compaction, Curing, Strength of Concrete, Elasticity, Shrinkage and Creep, Durability of Concrete, Testing of hardened concrete, Concrete Mix Design, Quality Control and acceptance Criteria.

Design of Reinforced Concrete Elements*
- Concept and Methods of Structural Design, Objectives, Properties of Concrete and Steel, Stress-Strain behavior of Steel and Concrete
- Design Philosophies: Working Stress Method, Limit State Method
- Analysis & Design of Simply Supported Beams – (Rectangular and Flanged Sections)
- Analysis & Design for Shear, Bond, Anchorage, Development Length and Torsion
- Analysis & Design of One and Two way Slabs, Stairs

**All design and analysis should be based on Limit State Methods.*

References:

- Properties of Concrete by A.M. Neville – Prentice Hall
- Concrete Technology by M.S.Shetty. – S.Chand & Co.
- Concrete Technology by M.L. Gambhir. – Tata Mc. Graw Hill Publishers, New Delhi
- Concrete Technology by A.R. Santha Kumar, Oxford university Press, New Delhi
- Advanced Design of Structures N. Krishna Raju
- Advanced RCC Design Pillai & Mennon, Tata MacGraw Hill
- Limit State Design by A.K. Jain

- Limit State Design of Reinforced Concrete P.C. Vergese
- IS 456:2000, “Plain and Reinforced Concrete- Code of Paractice”, Bureau of Indian Standards, New Delhi.
- IS 10262:2009 “Guidelines for concrete mix design proportioning”, Bureau of Indian Standards, New Delhi.

CE- 14404 Fluid Mechanics-II

Internal Marks: 40 L T P
External Marks: 60 3 1 0
Total Marks: 100

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Distinguish and identify different types of fluid flow.
2. Formulate equation of flow through different media/obstructions for a laminar and turbulent flow.
3. Apply the principles of conservation of energy and momentum in the flow studies in open channels and simple pipe network.
4. Design pipe network and open channels for passing a given discharge.
5. Evaluate the effect of channel shapes on the discharge parameters.
6. Understand and apply the theory of hydraulic jumps and surges.

Course Content:

Laminar Flow: Navier-stokes equations in Cartesian coordinates (no derivation), meaning of terms, Flow through circular section pipe, flow between parallel plates, stokes law. Flow through porous media,. Transition from laminar to turbulent, Critical velocity and critical Reynolds Number

Turbulent Flow: Turbulent flows and flow losses in pipes, Darcy equation minor**,** head losses in pipe fittings, hydraulic and energy gradient lines, Definition of turbulence, scale And intensity, Effects of turbulent flow in pipes, Equation for velocity distribution in smooth and rough pipes (no derivation), Resistance diagram

Boundary Layer Analysis: Assumption and concept of boundary layer theory. Boundary-layer thickness, displacement, momentum & energy thickness, laminar and turbulent boundary layers on a flat plate; Laminar sub-layer, smooth and rough boundaries. Local and average friction coefficients, Separation and Control

Uniform flow in open Channels: Flow classifications, basic resistance Equation for open channel flow, Chezy, Manning, Bazin and Kutter formulae, Variation of roughness coefficient, conveyance and normal depth, Velocity Distribution, Most efficient flow sections; rectangular, trapezoidal and circular

Energy and Momentum principles and critical flow: Energy and specific Energy in an open channel;critical depth for rectangular and trapezoidal channels. Alternate depths, applications of specific energy to transitions and Broad crested weirs. Momentum and specific force in open channel flow, sequent depths.

Gradually varied Flow: Different Equation of water surface profile; limitation, properties and classification of water and surface profiles with examples, computation of water surface profile

Hydraulic Jump and Surges: Theory of Jump, Elements of jump in a rectangular Channel, length and height of jump, location of jump, Energy dissipation and other uses, Positive and negative surges

References:

- Hydraulics & Fluid Mechanics by P.N. Modi and S.M. Seth; Standard Publication
- Flow in Open Channels by S. Subraminayam; Tata MacGraw Hill
- Introduction to Fluid Mechanics by Robert N.Fox & Alan T. Macnold

- Fluid Mechanics : Dr. R.K. Bansal; Laxmi Publications
- Fluid Mechanics: Dr. Jagdish Lal; Metropolitan Book Co. (p) Ltd.

CE-14405 Irrigation Engineering –I

Internal Marks: 40 L T P
External Marks: 60 3 1 0
Total Marks: 100

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Identify the basic understanding of soil water plant relationship.
2. Understand different irrigation techniques and the related theories.
3. Apply different theories/methods to design lined and unlined canals.
4. Estimate the yield of tube-well using different formulae.
5. Design different hydraulic structures required for effective river training works.
6. Demonstrate the knowledge related to the water logging, losses, economics of lining, etc.

Course Content:

Introduction: Importance of Irrigation Engineering, purposes of Irrigation, objectives of Irrigation, Benefits of Irrigation, Advantages & Disadvantages of various techniques of irrigation, water requirements of crops, factors affecting water requirement, consumptive use of water, water depth or delta , Duty of water, Base Period, relation between delta, duty and base period, Soil crop relation-ship and soil fertility

Canal Irrigation: Classifications of canals, canal alignment, Inundation canals, Bandhara irrigation, advantages and disadvantages, Silt theories-Kennedy's theory, Lacey's theory, Drawbacks in Kennedy's & Lacey's theories, comparison of Lacey's and Kennedy's theories, Design of unlined canals based on Kennedy & Lacey's theories, Types of lining, selection of type of lining, Economics of lining, maintenance of lined canals, silt removal, strengthening of channel banks, measurement of discharge in channels, design of lined canals, methods of providing drainage behind lining, Losses in canals-Evaporation and seepage, water logging, causes and ill effects of water logging anti water logging measures. Drainage of land, classification of drains - surface and subsurface drains Design considerations for surface drains, Advantages and maintenance of tile drains

Tube-Well Irrigation: Types of tube wells - strainer type, cavity type and slotted type. Type of strainers, Aquifer, porosity, uniformity coefficient, specific yield & specific retention, coefficients of permeability, transmissibility and storage, Yield or discharge of a tube well, Assumptions, Theim's & Dupuit's formulae, Limitations of Theim's and Dupuit's formulae. Interference of tube wells with canal or adjoining tube-wells, causes of failure of tubewells, optimum capacity, Duty and delta of a tube well. Rehabilitation of tubewell

River Training Works: Objectives, classification of river-training works, Design of Guide Banks. Groynes or spurs - Their design and classification ISI, Recommendations of Approach embankments and afflux embankments, pitched Islands, Natural cut-offs and Artificial cut-offs and design Considerations

References:

- Principles & practice of Irrigation Engg. S.K.Sharma; S. Chand, Limited.
- Irrigation & Water Power Engg. B.C. Punmia, Pande B.B.Lal; Laxmi Publications (p) Ltd Fundamentals of Irrigation Engg. Dr. Bharat Singh; Nem Chand & Bros
- Irrigation Engg. & Hydraulic Structure S.R.Sahasrabudhe; S. K. Kataria & Sons
- Irrigation Engg. & Hydraulic Structure Varshney, Gupta & Gupta; Nem Chand and

Brothers Irrigation Engg. & Hydraulic Structure Santosh Kumar Garg; Khanna Publishers

CE- 14406 Structural Analysis- I

Internal Marks: 40 L T P
External Marks: 60 3 1 0
Total Marks: 100

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Understand the concept of structural systems, loads, supports and displacements
2. Analyze different types of statically determinate structures including cables, beams, arches, frames and trusses.
3. Identify and apply a suitable analysis technique for statically determinate structures.
4. Assess the effect of rolling loads, support displacements and temperatures on response of statically determinate structures.
5. Develop and use the concept of influence line diagram for calculating maximum values of different structural quantities in a statically determinate structure, like BM, SF and displacement.
6. Evaluate the forces acting over dams, chimneys and retaining walls.

Course Content:

Determinate Structures: Concept of determinacy; Analysis of determinate structural elements—truss, arch, beam, frame, cables; Internal forces in determinate structures; Reaction diagram-- Bending moment, shear force, radial shear, normal thrust diagrams for the determinant structures.

- Analysis of plane trusses, compound and complex trusses using method of joints, method of joints, tension coefficients including lack of fit , temperature difference
- Analysis of three-hinged arch of various shapes under different loading conditions.
- Analysis of simple portal frame, cables under different loading conditions.
- Analysis of cables under point load and UDL with ends at same or different levels

Displacements: Concept; Governing differential equation for deflection of straight beams; Following methods for determination of structural displacements:

- Geometric Methods: Double integration; Macaulay's method; Moment area method; Conjugate beam method.
- Energy Methods: Strain energy in members, Betti's and Maxwell's Laws of reciprocal deflections, Concept of Virtual work and its applications, Castigliano's theorems, unit load method, deflections of trusses and 2D-frames.

Moving Loads and Influence Line Diagrams: Concept of influence line diagram, rolling loads; Bending moment and shear force diagrams due to single and multiple concentrated rolling loads, uniformly distributed moving loads; Equivalent UDL; Muller Breslau principle; Influence lines for beams, girders with floor beams and frames; calculation of the maximum and absolute maximum shear force and bending moment; Concept of envelopes; Influence line for displacements; Influence line for bar force in trusses.

Analysis of Cables and Suspension Bridges: General cable theorem, shape, elastic stretch of cable, maximum tension in cable and back-stays, pressure on supporting towers, suspension bridges, three hinged stiffening girders

Analysis of Dams, Chimneys and Retaining Walls: Introduction, loadings for the dames, chimneys, and retaining walls; limit of eccentricity for no-tension criteria; Concept of core; Middle-third rule; maximum/minimum base pressures.

References:

- Basic structural Analysis C.S.Reddy; Tata McGraw-Hill Education
- Analysis of Structures Vol- I and Vol.-II Vazirani & Ratwani; Khanna Publishers
- Intermediate structural Analysis C.K.Wang; McGraw-Hill
- Advanced Structural Analysis, A.K. Jain, Nem Chand & Bros., Roorkee.
- Theory of Structures, Vol.- I, S.P. Gupta & G.S.Pandit, Tata McGraw Hill, New Delhi.

CE-14407 Concrete Technology Lab

Internal Marks: 30 L T P
External Marks: 20 0 0 2
Total Marks: 50

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Evaluate properties of various building materials, such as cement, aggregates, bricks and tiles.
2. Conduct experiments and check the acceptance criteria (if any).
3. Design concrete mixes by relevant code provisions.
4. Analyze the properties of concrete in fresh and hardened state.
5. Create a well organized document and present the results appropriately.
6. Understand and apply non destructive testing (NDT) for evaluating concrete quality.

Course Content:

1. To determine the Specific Gravity and Soundness of cement
2. To determine the Standard Consistency, Initial and Final Setting Times of Cement and Compressive Strength of Cement.
3. To determine the Fineness Modulus, Bulk Density, Water Absorption and Specific gravity of Fine and Coarse Aggregates.
4. Mix Design of Concrete as per BIS method.
5. To determine the Slump, Compaction Factor and Vee-Bee Time of Concrete.
6. To determine the Compressive Strength of Concrete by Cube and Cylinder.
7. To carry out the Split Tensile and Flexural Strength of Concrete.
8. To determine the Compressive Strength of Brick and Tile.
9. Experiment on concrete using Non-Destructive Techniques.

Books/Manuals:-

- Concrete Manual by Dr. M.L. Gambhir, Dhanpat Rai & Sons Delhi.
- Concrete Lab Manual by TTTI Chandigarh
- Concrete Technology, Theory and Practice by M. S. Shetty, S. Chand & Company.

CE-14408 Structural Analysis Lab

Internal Marks: 30	L T P
External Marks: 20	0 0 2
Total Marks: 50	

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Verify theoretical formulas by conducting experiments.
2. Predict the behavior of statically determinate beams and trusses.
3. Understand two hinged arch and three hinged arch structures.
4. Demonstrate the influence lines for statically determinate and indeterminate beams.
5. Observe and compute deflections of simply supported beams, curved beams and frames using classical methods.
6. Outline the deflected shapes of columns and struts with different end conditions.

Course Content:

1. Deflection of a simply supported beam and verification of Clark-Maxwell's theorem.
2. To determine the Flexural Rigidity of a given beam.
3. To verify the Moment- area theorem for slope and deflection of a given beam.
4. Deflection of a fixed beam and influence line for reactions.
5. Deflection studies for a continuous beam and influence line for reactions.
6. Study of behaviour of columns and struts with different end conditions.
7. Experiment on three-hinged arch.
8. Experiment on two-hinged arch.
9. Deflection of a statically determinate pin jointed truss.
10. Forces in members of redundant frames.
11. Experiment on curved beams.
12. Unsymmetrical bending of a cantilever beam.

References:

- Laboratory Manual on Structural Mechanics by Dr. Harvinder Singh; New Academic Publishing Comp. Ltd

CE-14501 Design of Steel Structures – I

Internal Marks: 40 L T P
External Marks: 60 3 1 0
Total Marks: 100

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Understand different types of steel sections; their specifications and properties and its use as a structural material.
2. Analyze and design various types of steel connections using bolts and weld.
3. Understand the design of built up sections and column bases.
4. Determine the design loads for roof truss.
5. Design various components like purlins, web members, top chord members etc.
6. Prepare detailed working structural drawings of steel.

Course Content:

Note: *Relevant Indian Codes of Practice and Steel Table/SP: 6(1) is permitted in Examination.*

Introduction: Properties of structural steel, I.S. rolled sections, I.S. specifications.
Connections: Riveted, bolted and welded connections for axial and eccentric loads.
Tension members: Design of members subjected to axial tension.
Compression members: Design of axially loaded members, built-up columns, laced and battened columns including the design of lacing and battens.
Flexural members: Design of laterally restrained and un-restrained rolled and built-up sections, encased beams.
Column bases: Design of slab base, gusseted base and grillage foundation.
Roof truss: Design loads, combination of loads, design of members (including purlins) and joints, detailed working drawings.

References:

- Limit state design of steel structures: S K Duggal, Mc Graw Hill
- Design of steel structures: N Subramanian Oxford Higher Education
- Design of steel structures (Vol. 1): Ram Chandra Standard Book House - Rajsons
- Design of steel structures (by limit state method as per IS: 800-2007): S S Bhavikatti *IK I*nternational *Publishing* House
- IS 800: 2007 (General construction in steel-Code of practice)
- SP: 6(1) (Handbook for structural engineers-Structural steel sections)

CE-14502 Geotechnical Engineering

Internal Marks: 40 L T P
External Marks: 60 3 1 0
Total Marks: 100

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Understand the origin and identification of different soils.
2. Determination of different physical and engineering characteristics of soils.
3. Analyze the slopes for their stability by different methods.
4. Evaluate shear strength and permeability parameters of different soils.
5. Compute consolidation settlements.
6. Apply the principles of compaction to field problems.

Course Content:

Basic Concepts: Definition of soil and soil mechanics, common soil mechanics problems in Civil Engineering, Principal types of soils, Important properties of very fine soil, Characteristics of main Clay mineral groups, Weight volume relationship and determination of specific gravity from pycnometer test, Field density from sand replacement method and other methods.
Index Properties: Grain size analysis, Stokes's law and Hydrometer analysis, Consistency and sensitivity of Clay, Atterbeg Limits, Flow Index and Toughness Index, Underlying theory of shrinkage limit determination, Classification of coarse and fine grained soils as per Indian Standard.
Compaction: Definition and object of compaction and concept of O.M.C. and zero Air Void Line, Modified proctor Test, Factors affecting compaction Effect of compaction on soil properties and their discussion, Field compaction methods- their comparison of performance and Relative suitability, Field compacative effort, Field control of compaction by proctor.
Consolidation: Definition and object of consolidation, Difference between compaction and Consolidation, Concept of various consolidation characteristics i.e. av, mv and cv, primary and secondary consolidation, Terzaghi's Differential equation and its derivation. Boundary conditions for Terzaghi's solution for one dimensional consolidation concept of cv, tv & U, consolidation test determination of cv from curve fitting methods, consolidation pressure determination, Normally consolidated and over consolidated clays, Causes of over-consolidation, Effect of disturbance on e-Logσ curves of normally consolidated clays, importance of consolidation settlement in the design of structures.
Permeability and Seepage: Concept of effective stress principal, seepage pressure, critical hydraulic gradient and quick sand condition. Capillary phenomenon in soil, Darcy's Law and its validity, seepage velocity, co-efficient of permeability (k) and its determination in the laboratory Average permeability of stratified soil mass, factors affecting 'k' and brief discussion.
Shear Strength: Stress analysis of a two dimensional stress system by Mohr circle. Concept of pole, Coulomb's law of shear strength coulomb - Mohr strength theory, Relation between principal stesses at failure, Direct, triaxial and unconfined shear strength tests. Triaxial shear tests based on drainage conditions typical strength envelopes for clay obtained from these

tests, Derivation of skempton's pore pressure parameters. Stress strain and volume change characteristics of sands.

Stability of Slopes: slope failure, base failure and toe failure - Swedish circle method - $\varphi=0$ analysis and $c=0$ analysis - friction circle method - Taylor's stability number - stability charts - sliding block analysis

References:-

- Soil Mech. & Foundation Engg, by K.R.Arora Standard *Publishers* Distributors
- Geotechnical Engineering, by P. Purshotama Raj *Tata Mcgraw Hill*
- Soil Mech. & Foundation Engg., by V.N.S.Murthy CBS *Publishers* & Distributors.
- Principle of Geotechnical Engineering by B.M.Das Cengage Publisher
- Basic and applied Soil Mechanics by Gopal Ranjan and A.S. Rao New Age InternationalPublishers
- Geotechnical Engineering by Gulati and Datta, Tata McGraw Hill
- Problems in Soil mechanics and Foundation Engineering by B.P.Verma, Khanna Publishers.

CE-14503 Structural Analysis-II

Internal Marks: 40 L T P
External Marks: 60 3 1 0
Total Marks: 100

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Distinguish statically determinate and indeterminate structural systems.
2. Analyze the beams and trusses using the Classical Methods of analysis.
3. Compute reactive forces in the beams, pin-jointed and rigid jointed frames using Conventional Methods of analysis.
4. Develop and apply the approximate methods of analysis for framed structures.
5. Predict the structural response under different types of loading, support displacements and temperature changes.
6. Apply the concept of influence lines for deciding the critical forces and sections while designing.

Course Content:

Pre-requisite: Structural Analysis-1
Indeterminate Structures: Concept of indeterminate /redundant structures; Static and kinematic indeterminacies; stability of structures; internal forces; Conditions of stress-strain relationships, equilibrium and compatibility of displacements; Solution of simultaneous algebraic equations.
Indeterminate Structural Systems: Pin-jointed and rigid-jointed structural systems; Deformation of redundant structures-sway and non-sway frames, elastic curve; Static equilibrium and deformation compatibility checks; Effects of support settlement and lack of fit; Fixed-end moments—member loading, sinking of supports, temperature; Analysis of redundant beams, frames, trusses, arches.
Classical Methods of Analysis: Methods of consistent deformation; Theorem of three moments
Conventional Methods of Analysis: Slope deflection method; Moment distribution method; Rotation contribution method (Kani's Method**).**
Approximate Methods of Analysis: Portal method; Cantilever method; Substitute frame method.
Influence Line Diagrams: Concept and application in the analysis of statically indeterminate structures; Influence line for bar forces in the statically indeterminate trusses, beams and frames.

References:-

- Basic structural analysis - C.S. Reddy Tata McGraw-Hill
- Intermediate structural analysis - C . K. Wang. McGraw Hill
- Indeterminate structural analysis - J. Sterling Kinney Addison-Wesley Educational Publishers
- Theory of structures - B.C. Punima, Laxmi Publications

- Structural Analysis, Devdas Menon, Narosa Publishers.

CE-14504 Transportation Engineering – I

Internal Marks: 40 L T P
External Marks: 60 3 1 0
Total Marks: 100

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Appreciate the importance of different modes of transportation and characterize the road transportation.
2. Align and design the geometry of pavement as per Indian Standards according to topography.
3. Assess the properties of highway materials in laboratory.
4. Understand the importance of drainage, construction methods for various roads, pavement failure and its maintenance.
5. Compute the transportation cost of highway project and outline the sources of highway financing.
6. Interpret the traffic data after conducting traffic survey and describe the traffic characteristics, traffic safety and traffic environment interaction.

Course Content:

Highway Engineering

Introduction: Importance of Transportation, Different Modes of Transportation, Characteristics of Road Transport.

Highway Development & Planning: Principles of Highway Planning, Road Development in India, Classification of Roads, Road Patterns, Planning Surveys.

Highway Alignment: Requirements, Alignment of Hill Roads, Engineering Surveys.

Highway Geometric Design: Cross Section Elements, Carriageway, Camber, Sight Distances, Horizontal Curves, Extra-widening, Super-elevation, Vertical Curves.

Highway Materials: Properties of Sub-grade and Pavement Component Materials, Tests on Sub-grade Soil, Aggregates and Bituminous Materials.

Highway Construction: Earthen/Gravel Road, Water Bound Macadam, Wet Mix Macadam, Bituminous Pavements, Cement Concrete Pavements.

Highway Drainage and Maintenance: Importance of drainage and maintenance, Surface Drainage and Subsoil Drainage, Construction in Water-logged areas, Pavement Failures, Pavement Evaluation, Maintenance and Strengthening Measures.

Highway Economics & Financing: Total Transportation Cost, Economic Analysis, Sources of Highway Financing.

Traffic Engineering

Traffic Characteristics: Road User Characteristics, Driver Characteristics, Vehicular Characteristics.

Traffic Studies: Volume Studies, Speed Studies, O-D Survey, Parking Study.

Traffic Safety and Control Measures: Traffic Signs, Markings, Islands, Signals, Cause and Type of Accidents, Use of Intelligent Transport System.

Traffic Environment Interaction: Noise Pollution, Vehicular Emission, Pollution Mitigation Measures.

References:-

- Khanna S.K., and Justo, C.E.G. “Highway Engineering”, Nem Chand and Brothers, Roorkee,1998.
- Kadiyali, L.R. “Principles and Practice of Highway Engineering”, Khanna Publishers, New Delhi, 1997.
- Flaherty, C.A.O. “Highway Engineering”, Volume 2, Edward Arnold, London, 1986.
- Sharma, S.K. “Principles, Practice & Design of Highway Engineering”, S. Chand & Company Ltd., New Delhi, 1985.
- Mannering, “Principles of Highway Engineering & Traffic Analysis”, Wiley Publishers, NewDelhi.

CE-14505 Environmental Engineering - I

Internal Marks: 40 L T P
External Marks: 60 3 1 0
Total Marks: 100

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Identify different types of water demands and select suitable source of water.
2. Predict future population and estimate future water demands
3. Demonstrate a firm understanding of various water quality parameters.
4. Design different water treatment units to meet the drinking water quality standards and criteria.
5. Plan and design the water transportation, pumping stations and pipe network
6. Design low cost water treatment techniques in the rural areas.

Course Content:

Introduction: Beneficial uses of water, water demand, per capita demand, variations in demand, water demand for fire fighting, population forecasting and water demand estimation.
Water sources and development: Surface and ground water sources; Selection and development of sources; Assessment of potential; Flow measurement in closed pipes, intakes and transmission systems.
Pumps and pumping stations: Types of pumps and their characteristics and efficiencies; Pump operating curves and selection of pumps; pumping stations.
Quality and Examination of Water: Impurities in water, sampling of water, physical, chemical and bacteriological water quality parameters, drinking water quality standards and criteria.
Water treatment: Water treatment schemes; Basic principles of water treatment; Design of plain sedimentation, coagulation and flocculation, filtration – slow, rapid and pressure; Disinfection units; Fundamentals of water softening, fluoridation and deflouridation, and water desalination and demineralization, taste and odour removal.
Transportation of Water: Pipes for transporting water and their design, water distribution systems and appurtenances; Water supply network design and design of balancing and service reservoirs; operation and maintenance of water supply systems.
Rural water supply: Principles, selection of source, rain water harvesting, quantitative requirements, low cost treatment techniques.
References:-

- Water Supply Engineering- Environmental Engg. (Vol. – I) by B.C. Punmia, Ashok Jain, Arun Jain, Laxmi Publications, New Delhi.
- Environmental Engg. - A design Approach by Arcadio P. Sincero and Gregoria P. Sincero, Prentice Hall of India, New Delhi.
- "Environmental Engg." By Howard S. Peavy, Donald R. Rowe & George Tchobanoglous, McGraw Hill, International Edition
- Water Supply Engineering- Environmental Engg. (Vol. – I) by S.K. Garg, Khanna Publishers, Delhi.
- Water Supply and Sewerage by Steel EW and McGhee, Terence J.; McGraw Hill.

CE-14506 Transportation Engineering Lab

Internal Marks: 30 L T P
External Marks: 20 0 0 2
Total Marks: 50

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Characterize the pavement materials as per the Indian Standard guidelines.
2. Evaluate the strength of subgrade soil by CBR test.
3. Conduct experiments to evaluate aggregate properties.
4. Determine properties of bitumen material and mixes
5. Evaluate the pavement condition by rough meter and Benkelman beam test.
6. Create a well organized report and present the results appropriately

Course Content:

I Tests on Sub-grade Soil
1. California Bearing Ratio Test
II Tests on Road Aggregates
2. Crushing Value Test
3. Los Angles Abrasion Value Test
4. Impact Value Test
5. Shape Test (Flakiness and Elongation Index)
III Tests on Bituminous Materials and Mixes
6. Penetration Test
7. Ductility Test
8. Softening Point Test
9. Flash & Fire Point Test
10. Bitumen Extraction Test
IV Field Tests
11. Roughness Measurements Test by Roughometer
12. Benkelman Beam Pavement Deflection Test

References:-

- Khanna S.K., and Justo, C.E.G. "Highway Material & Pavement Testing", Nem Chand andBrothers, Roorkee.

CE -14507 Environmental Engineering Laboratory

Internal Marks: 30 L T P
External Marks: 20 0 0 2
Total Marks: 50

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Conduct experiments as per standard methods of sampling and analysis.
2. Demonstrate the expertise to characterize water and wastewater samples.
3. Understand the importance of laboratory analysis as a controlling factor in the treatment of water and wastewater.
4. Record the experimental observations and interpret the analysis results.
5. Use the analysis results for making informed decisions about the drinkability of water and disposal of wastewater.
6. Evaluate and compare different techniques of experimental analysis.

Course Content:

1. To measure the pH value of a water/waste water sample.
2. To determine optimum Alum dose for Coagulation.
3. To find MPN for the bacteriological examination of water.
4. To find the turbidity of a given waste water/water sample
5. To find B.O.D. of a given waste water sample.
6. To measure D.O. of a given sample of water.
7. To determine of Hardness of a given water sample
8. To determine of total solids, dissolved solids, suspended solids of a given water sample.
9. To determine the concentration of sulphates in water/wastewater sample.
10. To find chlorides in a given sample of water/waste water.
11. To find acidity/alkalinity of a given water sample
12. To determine the COD of a wastewater sample.

References:

- Chemistry for Enviromental Engg. and Science by Sawyer & McCarty, TMH, New Delhi
- Standard Methods for the examination of water & wastewater, APHA, AWWA, WE

DECE-14508 Computer Aided Structural Drawing & Detailing

Internal Marks: 30	L T P
External Marks: 20	0 0 2
Total Marks: 50	

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Create, dimension and sketch a plot/plan for representation/expression of civil engineering designs.
2. Draft construction/design drawings including structural drawings for civil engineering projects.
3. Produce structural drawing of reinforced concrete elements such as beams, slabs and staircases.
4. Develop structural drawing of steel elements such as connections, tension members, compression members, beams, column base and roof trusses.
5. Understand various connection details.
6. Gain proficiency in CAD software.

Course Content:

- Structural Drawings of Reinforced Concrete Elements such as Beams, Slabs and Staircases as per Indian Standard Guidelines
- Structural Drawings of Steel Elements such as Connections, Tension Members, Compression Members, Beams, Column Base, and Roof Trusses.

DECE-14509 Computer Aided Structural Analysis & Design

Internal Marks: 30	L T P
External Marks: 20	0 0 2
Total Marks: 50	

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Demonstrate the knowledge regarding the design of beams, slabs and staircase.
2. Prepare flow charts for the analysis and design of beams, staircases and slabs.
3. Create computer code for the analysis of beams, staircase and slab using spread sheets.
4. Predict flexural and shear capacity of rectangular RC beams for a given value of the tensile and the compression steel as per the provisions of IS 456.
5. Use modern engineering tools for the automation of analysis and design.
6. Use appropriate format and grammatical structure to create a well organized document.

Course Content:

1. To draw flow chart for the analysis of beams.
2. To develop computer code for the analysis of beams using spread sheets.
3. To predict flexural and shear capacity of rectangular RC beams for a given value of the tensile and the compression steel as per the provisions of IS 456.
4. To draw flow charts for the design of following structural elements:
    - Beams
    - Staircases
    - Slabs
5. To develop spread sheets for the design of following structural elements:
    - Beams
    - Staircases
    - Slabs

TR-14501 Industrial Training – I

Internal Marks: 60
External Marks: 40
Total Marks: 100

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Conduct reconnaissance and survey of areas independently.
2. Apply basic and advanced surveying techniques for measuring distances and angles.
3. Interpret and plot topographical map using the data taken using different survey instruments.
4. Share responsibilities and duties in group assignments.
5. Create a well organized document and present the results appropriately.
6. Use modern equipment, tools and instrumentation in the survey.

Course Content:

Survey Camp of 4 weeks duration will be held immediately after 4^{th} semester at a Hilly Terrain. The students are required to prepare the Topographical Map of the area by traditional method. Students should also be exposed to modern Survey Equipment and practices, like Total Station, Automatic Level, GPS etc.

CE-14601 Design of Concrete Structures – II

Internal Marks: 40 L T P
External Marks: 60 3 1 0
Total Marks: 100

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Demonstrate basic knowledge of structural analysis for beams and slabs in calculating BM and SF.
2. Understand the principles involved in analysis and design of reinforced concrete structures.
3. Employ the code of practice for design of reinforced concrete structural members and elementary structural systems.
4. Design various sub – structure components like foundations, retaining walls.
5. Design various super – structure components like columns, continuous beams.
6. Apply the concepts of structure design to special structural elements like curved beams, domes, water retaining structures.

Course Content:

Note: *Relevant Indian Codes of Practice and Design handbooks are permitted (as per note mentioned below) in Examination.*

1. Foundations - Theory and Design: Isolated Footing (Square, Rectangular), Combined Footing (Rectangular, Trapezoidal, Strap), Raft Footing

2. Compression Members: Definitions, Classifications, Guidelines and Assumptions, Design of Short Axially Loaded Compression Members, Design of Short Compression Members under Axial Load with uniaxial and biaxial Bending, Preparation of Design Charts, Design of Slender Columns

3. Design of Continuous beams and curved beam.

4. Design of Domes.

5. Design of Retaining walls: Cantilever type retaining wall, Counter-fort type retaining wall.

6. Introduction to water retaining structures, Design of circular and rectangular water tanks resting on ground

References:

1. Reinforced Concrete Design; Pillai & Menon; Tata McGraw-Hill Education
2. Limit state Design of Reinforced Concrete; Varghese P C; Prentice-Hall of India Pvt. Ltd".
3. Reinforced Cement Concrete, Mallick and Rangasamy; Oxford-IBH.

BIS Codes of practice and Design Hand References:

1. *IS 456-2000*- Indian Standard. Plain and Reinforced concrete -Code of practice
2. *IS 3370- Code of practice for concrete structures for storage of liquids
3. *Design Aid SP 16
4. Explanatory hand book SP24.
5. Detailing of Reinforcement SP 34

CE-14602 Foundation Engineering

Internal Marks: 40 L T P
External Marks: 60 3 1 0
Total Marks: 100

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Evaluate relative merits and demerits of various soil investigation techniques to understand the characteristics of subsoil for the design of foundations.
2. Analyze the settlement of substructures for cohesive and non-cohesive soils.
3. Predict the soil failure by understanding its criteria.
4. Apply the knowledge of soil bearing capacity for the design of shallow foundation.
5. Demonstrate the knowledge of earth pressure for the lateral stability of retaining wall and well foundations.
6. Understand the concept of deep foundation (pile foundation and well foundation).

Course Content:

Soil Investigation: Object of soil investigation for new and existing structures. Depth of exploration for different structures, Spacing of bore Holes. Methods of soil exploration and relative merits and demerits, Types of soil sample. Design features of sampler affecting sample disturbance, Essential features and application of the following types of samples- Open Drive samples, Stationery piston sampler, Rotary sampler, Geophysical exploration by seismic and resistivity methods, Bore hole log for S.P.T.

Earth Pressure Terms and symbols used for a retaining wall. Movement of all and the lateral earth pressure. Earth pressure at rest, Rankine states of plastic equilibrium, Ka and Kp for horizontal backfills. Rankine's theory both for active and passive earth pressure for Cohesion-less backfill with surcharge and fully submerged case. Cohesive backfill condition, Coulomb's method for cohesion less backfill, Merits and demerits of Ranking and Coulomb's theories, Culmann's graphical construction (without surcharge load)

Shallow Foundation: Type of shallow foundations, Depth and factors affecting it, Definition of ultimate bearing capacity, safe bearing capacity and allowable bearing capacity. Rankine's analysis and Terzaghi's analysis, types of failures, Factors affecting bearing capacity, Skemptons Equation, B.I.S recommendations for shape, depth and inclination factors. Plate Load test and standard penetration Test Bosussinesq equation for a point load, uniformly loaded circular and rectangular area, pressure distribution diagrams, Newmarks chart and its construction, 2:1 method of load distribution, Comparison of Bosussinesq and Westerguard analysis for a point load, Causes of settlement of structures, Comparison of immediate and consolidation settlement, calculation of settlement by plate load Test and Static Cone penetration test data, Allowable settlement of various structures according to I.S. Code, Situation most suitable for provision of rafts, Proportioning of rafts, Methods of designing raft, Floating foundation

Pile Foundations: Necessity and uses of piles, Classification of piles, Merits and demerits of different types based on composition, Types of pile driving hammers & their comparison, Effect of pile driving on adjacent ground, Use of Engineering News Formula and Hiley's Formula for determination of allowable load, Limitations of pile driving formulae, Cyclic Pile Load Test, Separation of skin friction and point resistance using cyclic pile load test, Determination of point resistance and frictional resistance of a single pile by Static formulas Piles in Clay, Safe load on a Friction and point Bearing pile, Pile in sand, Spacing of piles in a group, Factors affecting capacity of a pile group, Efficiency of pile group by converse – Labare formula and feeds formula, Bearing capacity of a pile group in clay by block failure and individual action approach, Calculation of settlement of friction pile group in clay, Related Numerical problems, Settlement of pile groups in sand, Negative skin friction, Related numerical problem

Caissons and Wells: Major areas of use of caissons, advantages and disadvantages of open box and pneumatic caissons, Essential part of a pneumatic caisson, Components of a well foundation, Calculation of allowable bearing pressure. Conditions for stability of a well, Forces acting on a well foundation, Computation of scour depth

References-

1. Soil Mech. & Foundation Engg, by K.R. Arora, Standard Publishers Distributors
2. Geotechnical Engineering, by P. Purshotama Raj
3. Soil Mech. & Foundation Engg., by V.N.S. Murthy
4. Principle of Foundation Engineering by B.M.Das, CL Engineering
5. Basic and applied Soil Mechanics by Gopal Ranjan and A.S.R.Rao, New Age International
6. Soil Mech. & Foundations by Muni Budhu Wiley, John Wiley & Sons
7. Geotechnical Engineering by Gulhati and Datta, Tata McGraw - Hill Education
8. Foundation Engineering by Varghese P.C, PHI Learning.
9. Soil mechanics and Foundation Engineering by B.P.Verma, Khanna Publication.
10. Foundation Analysis and Design by Bowles J.E, Tata McGraw - Hill Education

CE-14603 Professional Practice

Internal Marks: 40	L T P
External Marks: 60	3 1 0
Total Marks: 100	

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Prepare general and detailed specifications of different civil engineering works.
2. Formulate rough and detailed building estimates
3. Compute the quantity of materials required for civil engineering works as per the specifications
4. Evaluate contracts and tenders pertaining to construction practices
5. Analyze rates for the items not covered in CSR.
6. Demonstrate the knowledge related to various rules and regulation applicable to construction industry.

Course Content:

Estimates-Method of building estimates, types, site plan index plan, layout plan, plinth area, floor area, Technical sanction, administrative approval, estimate of buildings, roads, earthwork, R.C.C. works, sloped roof, roof truss, masonry platform, complete set of estimate.
Schedule of Rates, analysis of rates- For earthwork, concrete work, D.P.C., stone masonry, plastering, pointing, and road work
Specifications- For different classes of building and Civil engineering works, Rules and measurements for different types of Civil engineering works
Types of contracts- Tenders, tender form, submission and opening of tenders, measurement book, muster roll, piecework agreement and work order
Accounts-Division of accounts, cash, receipt of money, cash book, temporary advance, imprest, accounting procedure
Arbitration: Acts and legal decision making process.

References:

1. Estimating and Costing by B.N. Datta, UBSPD, New Delhi
2. Estimating and Costing by G.S. Birdie, Dhanpat Rai Publication New Delhi .
3. Estimating and Costing by V.N. Chakravorty, Calcutta
4. Civil Engg. Contracts & Estimates by B.S. Patil, Orient-Longman Ltd., New Delhi.

CE-14604 Environmental Engineering - II

Internal Marks: 40 L T P
External Marks: 60 3 1 0
Total Marks: 100

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Demonstrate a firm understanding of various sewerage systems and their suitability.
2. Design sewer and drainage systems layout for communities.
3. Evaluate the waste water characteristics to determine the degree of treatment required.
4. Explain the physical, chemical and biological techniques of wastewater treatment.
5. Compare the applicability of treatment technologies under different conditions
6. Design the treatment units and assess the efficacy of an entire treatment system
7. Ability to make decisions regarding the treatment plant site selection, operation and maintenance and the need of advanced treatment.

Course Content:

Introduction: Terms & definitions, systems of sanitation and their merits and demerits, system of sewerage, choice of sewerage system and suitability to Indian conditions.
Sewerage System: Generation and estimation of community Sewage, flow variations, storm water flow, types of sewers, Design of sewers and storm water sewers, construction & maintenance of sewers, sewer appurtenances, sewage pumping and pumping stations
House Drainage: Principles of house drainage, traps, sanitary fittings, systems of plumbing, drainage lay out for residences.
Characteristics of Sewage: Composition of domestic and industrial sewage, sampling, physical, chemical and microbiological analysis of sewage, biological decomposition of sewage, BOD and BOD kinetics, effluent disposal limits.
Treatment of Sewage: Introduction to unit operations and processes - Primary treatment; screening (theory), grit chamber (theory and design), floatation units, sedimentation tanks (theory and design), Secondary treatment units; ASP (theory and design), Sequencing batch reactors (theory and design), Trickling filters (theory and design) Anaerobic systems; Anaerobic filters (theory), UASB (theory), Anaerobic lagoons, Sludge Handling and disposal; thickening, stabilization, dewatering, drying and disposal.
Low Cost Sanitation Systems: Imhoff tanks (theory and design), septic tank (theory and design), soakage pit/soil absorption systems; stabilization ponds (theory and design); macrophyte ponds; oxidation ponds (theory and design); and constructed wetland systems.

Wastewater Treatment Plants and Advanced Wastewater Treatment: Treatment Plants; site selection, plant design, Hydraulic Profiles, operation and maintenance aspects. Advanced wastewater treatment for nutrient removal, disinfection and polishing.

References:

1. Waste Water Engg. (Environmental Engg.-II) by B.C.Punmia, Ashok Jain, Laxmi Publications, New Delhi
2. Environmental Engg. - A design Approach by Arcadio P. Sincero and Gregoria P. Sincero, Prentice Hall of India, New Delhi.
3. "Waste Water Engineering - Treatment and Reuse" by Metcalf & Eddy, TMH, New Delhi.
4. "Environmental Engg." By Howard S. Peavy, Donald R. Rowe & George Tchobanoglous, McGraw Hill, International Edition
5. Environmental Engineering (Vol. II) by S.K. Garg, Khanna Publishers, Delhi.

DECE-14605 Numerical Methods in Civil Engineering

Internal Marks: 40	L T P
External Marks: 60	3 1 0
Total Marks: 100	

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Demonstrate the concept of approximations and errors in the implementation and development of numerical methods.
2. Select an appropriate solution to an engineering problems dealing with the roots of equations through numerical methods.
3. Execute the solution using of problems involving linear algebraic equations and appreciate the application of these problems in fields of engineering.
4. Apply the techniques to fit curves to data and be capable of choosing the preferred method for any particular problem.
5. Evaluate the solution of the problems through the numerical integration and differentiation and solve ordinary and partial differential equations and eigen value problems through various techniques.
6. Able to use New Marks Method for civil engineering problems.

Course Content:

Equation: Roots of algebraic transcendental equation, Solution of linear simultaneous equations by different methods using Elimination, Iteration, Inversion, Gauss-Jordan and Method, Homogeneous and Eigen Value problem, Non-linear equations, Interpolation
Finite Difference Technique: Initial and Boundary value problems of ordinary andpartial differential equations, Solution of Various types of plates and other civilengineering related problems
New Marks Methods: Solution of determinate and indeterminate structures usingNewmarks Procedure (Beam)
Statistical Methods: Method of correlation and Regression analysis for fitting apolynomial equation by least square
Initial Value problem: Galerkin's method of least square, Initial Value problem bycollocation points, Rungekutta Method
Solution: Implicit and explicit solution, solution for nonlinear problems andconvergence criteria

References:

1. Numerical Mathematical Analysis: James B. Scarborough Oxford and IBH Publishing, 1955.
2. Introductory Methods of Numerical Analysis: S.S. Sastry, PHI Learning (2012).
3. Introduction To Computer Programming and Numerical Methods by Xundong Jia and Shu Liu, Dubuque, Iowa: Kendall/Hunt Publishing Co.
4. Numerical Methods, J.B Dixit , USP (Laxmi publication),

DECE-14606 Finite Element Methods

Internal Marks: 40 L T P
External Marks: 60 3 1 0
Total Marks: 100

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Demonstrate the knowledge of theory of elasticity, solution of simultaneous equations by different techniques.
2. Understand the concept and terminology related to the concept of finite element analysis.
3. Apply different methods, such as Stationary principles, Rayleigh-Ritz, weighted residual method in the analysis.
4. Develop various types of matrix, such as element stiffness matrix, load vector, and equilibrium and compatibility conditions for different types of problems using different types of elements.
5. Analyze the determinate and indeterminate problems related to beams, frames, trusses, plates.
6. Execute the solution using a logic and structured approach offered by the finite element method.

Course Content:

Introduction: the finite element method - the element characteristic matrix - element assembly and solution for unknowns - summary of finite element history - basic equations of elasticity – strain displacement relations - theory of stress and deformation - stress-strain-temperature relations

The direct stiffness method: structure stiffness equations - properties of [K] - solution of unknowns - element stiffness equations - assembly of elements - node numbering to exploit matrix sparsity - displacement boundary conditions - gauss elimination solution of equations - conservation of computer storage - computational efficiency - stress computation - support reactions - summary of the finite element procedure

Stationary principles, Rayleigh-Ritz and interpolation: principle of stationary potential energy -problems having many d.o.f - potential energy of an elastic body - the Rayleigh-Ritz method -piecewise polynomial field - finite element form of Rayleigh-Ritz method - finite element formulations derived from a functional - interpolation - shape functions for C0 and C1 elements – lagrangian interpolation functions for two and three dimensional elements

Displacement based elements for structural mechanics: formulae for element stiffness matrix and load vector - overview of element stiffness matrices - consistent element nodal vector - equilibrium and compatibility in the solution - convergence requirements - patch test - stress calculation – other formulation methods

Straight sided triangles and tetrahedral: natural coordinates for lines - triangles and tetrahedral -interpolation fields for plane triangles - linear and quadratic triangle - quadratic tetrahedron

The isoparametric formulation: introduction - an isoparametric bar element - plane bilinear element -summary of gauss quadrature - quadratic plane elements - direct construction of shape functions for transition elements - hexahedral (solid) isoparametric elements -

triangular isoparametric elements - consistent element nodal loads - validity of isoparametric elements - appropriate order of quadrature - element and mesh instabilities - remarks on stress computation

Coordinate transformation: transformation of vectors - transformation of stress, strain and material properties - transformation of stiffness matrices - transformation of flexibility to stiffness – inclined support - joining dissimilar elements to one another- rigid links - rigid elements

Bending flat plates: plate bending theory - finite elements for plates - triangular discrete Kirchoff element - boundary conditions

Introduction to weighted residual method: some weighted residual methods - galerkin finite element method - integration by parts - axially loaded bar - beam - plane elasticity

Reference:

1. Desai C.S., *Elementary Finite Element Method,* Prentice Hall of India
2. Chandrupatla T.R. & Belegundu A.D., *Introduction to Finite Elements in Engineering,* Prentice Hallof India
3. Bathe K.J., *Finite Element Procedures in Engineering Analysis,* Prentice Hall of India
4. Gallaghar R.H., *Finite Element Analysis: Fundamentals,* Prentice Hall Inc.
5. Rajasekaran S., *Finite Element Analysis in Engineering Design*, Wheeler Pub.
6. Krishnamoorthy C. S., *Finite Element Analysis - Theory and Programming,* Tata McGraw Hill
7. Zienkiewics O.C. & Taylor R.L., *The Finite Element Method,* Vol I & II, McGraw Hill

DECE-14607 REINFORCED EARTH AND GEOTEXTILES

Internal Marks: 40	L T P
External Marks: 60	3 1 0
Total Marks: 100	

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Understand the principle of reinforced earth and different types of reinforcement techniques.
2. Identify the types and functions of geosynthetics.
3. Compare the different geosynthetics products for different construction projects.
4. Identify the testing methods for geosynthetics.
5. Compare natural and artificial geosynthetics.
6. Design of paved and unpaved roads, embankments and retaining walls with different types of geosynthetics.

Course Content:

Reinforced Earth – The mechanisms of the reinforced earth techniques – Design principles – Materials used for construction – Advantages of reinforced earth – Reinforced earth construction with GI sheets and strips

An overview of Geosynthetics, Description of Geotextiles – Geogrids – Geonets – Geomembranes –Geocomposites – Geocells –Geotextile properties and test methods – Functions of Geotextile –Methods for separation – stabilization – filtration – Drainage, Soil anchors, Application & Construction practices with Geotextiles, Geogrids, Geonets, Geomembranes.

Natural & Synthetic Geotextiles in Erosion Control : Introduction, Jute, coir& Synthetic production, Status of Geotextiles industry in India, Physical and chemical characterization, durability of Geotextiles, Test procedures, role of vegetation, erosion control products and their classification,erosion process, surface erosion control techniques, installation guide lines for slopes.

Designing with Geotextiles for retaining/earth wall, paved and unpaved roads, Embankments, Shallow foundations - Improvement in bearing capacity

References:

1. Robert M. Koerner, *Designing with Geosynthetics*, Prentice Hall – 1989
2. G.V Rao & GVS Suryanarayana Raju, *Engineering with Geosynthetics*, Tata Mc Graw Hill Publishing Co. New Delhi
3. Korener, *Construction & Geotechnical Methods in Foundation Engineering*, McGraw Hill
4. Shukla, S.K. and Yin, J.H. Fundamental of Geosynthetic Engineering, Taylor & Francis
5. Swamisaran, Reinforced Soil and its Engineering Application, New Age Publication
6. Gulati, S.K. and Datta, M., Geotechnical Engineering, TMH

DECE-14608 Infrastructure Development & Management

Internal Marks: 40 L T P
External Marks: 60 3 1 0
Total Marks: 100

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Understand the impact of infrastructure development on the economic development of a country.
2. Strategies the policy process for infrastructure development and to choose the best financing option for a project.
3. Demonstrate the construction components of various infrastructure sectors like highway, ports & aviation, oil & gas, power, telecom, railway and irrigation.
4. Remember the necessary conceptual insights, perspectives and the tools required for effective infrastructure management
5. Develop a skill to retrieve lessons from case studies in International/National project management.
6. Gather background information and research regarding various infrastructure sectors and to document the different phases in the life cycle of an infrastructure project.

Course Content:

Introduction: Impact of Infrastructure development on economic development, standard of living and environment. Reasons for rise of public sector and government in infrastructural activities, Changed socio-economic scenario and current problems and related issues

Policies on Infrastructure Development: A historical review of the Government policies on infrastructure. Current public policies on transportations, power and telecom sectors, Plans for infrastructure development, Legal framework for regulating private participation in roads and highways, Ports & Airports, Power and Telecom

Construction and Infrastructure: Construction component of various infrastructure sectors highway, ports and aviation, oil and gas, power, telecom, railways, irrigation. Current scenario, future needs, investment needed, regulatory framework, government policies and future plans, Technological and methodological demands on construction management in infrastructure development projects.

Infrastructure Management: Importance, scope and role in different sectors of construction. **Highway Sector:** Repayment of Funds, Toll Collection Strategy, Shadow tolling, and direct tolls, Maintenance strategy, Review of toll rates & structuring to suit the traffic demand, **Irrigation Projects:** Large / Small Dams - Instrumentation, monitoring of water levels, catchments area, rainfall data management, prediction, land irrigation planning & policies, processes Barrages, Canals.

Power Projects: Power scenario in India, Estimated requirement, Generation of Power distribution strategies, national grid, load calculation & factors, Hydropower - day to day operations, management structures, maintenance, Thermal Power, Nuclear Power.

Airports: Requisites of domestic & International airports & cargo & military airports, facilities available, Terminal management, ATC.

Railways: Mass Rapid Transport System MRTS, LRT, Multi-modal Transport System.

References:

1. Chandra, Prassanna, “Projects, Planning, Analysis, Selection, Financing, Implementation andReview”, Tata McGraw-Hill, New Delhi, 2006.
2. Raghuram, G. & Jain, R., “Infrastructure Development & Financing towards a Public-Private
Partnership”, Macmillan India Ltd., New Delhi, 2002.
3. India Infrastructure Report 2001 & 2002, Oxford University Press, New Delhi, 2001/02.
4. NICMAR, “Construction Business Opportunities in Infrastructure Development in India”, NICMAR, Mumbai, 2001.
5. Parikh Kirit S., “India Development Report, 1999-2000”, Oxford University Press, New Delhi,2002.
6. GOI Rakesh Mohan Committee, “The India Infrastructure Report”, National Council of Applied Economic Research, New Delhi, 1996.

OECE-14601 Building Maintenance & Safety

Internal Marks: 40 L T P
External Marks: 60 3 1 0
Total Marks: 100

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Establish robust maintenance and safety management systems.
2. Understand the principles and importance of maintenance and the factors affecting decision to carryout maintenance.
3. Describe various materials for maintenance and able to evaluate the compatibility and durability of various repair materials.
4. Identify various maintenance problems and their associated root cause.
5. Strategies the process for investigation and diagnosis for repair of structures.
6. Identify and compare various remedial measures for building defects and choose best remedial measure for building defect.
7. Assess features for maintenance of multi-storied buildings, including fire protection system, elevators booster pumps and generator sets.

Course Content:

Principles of Maintenance:
Importance of maintenance, deterioration and durability, factors affectingdecision to carryout maintenance, maintenance and GNP, agencies causingdeterioration, effect of deterioration agencies on materials

Maintenance Management:
Definition, organization structure, work force for maintenance, communication needs, building inspections, maintenance budget and estimates, property inspections and reports, specification for maintenance jobs, health and safety in maintenance, quality in maintenance, maintenance manual and their importance.

Materials for Maintenance:
Compatibility of repair materials, durability and maintenance, types of materials, their specification and application, criteria for selection of material, use of commercial available materials in maintenance.

Maintenance Problems and Root Causes:
Classification of defects, need for diagnosis, type of defects in building elements and building materials defect location, symptoms and causes

Investigation and Diagnosis for Repair of Structures:
Basic approach to investigations, physical inspection, material tests, non destructive testing for diagnosis, estimation of actual loads and environmental effects, study of design and construction practices used in original construction, retrospective analysis and repair steps.

Remedial Measures for Building Defects:
Preventive maintenance and special precautions - considerations, preventive maintenance for floors, joints, wet areas, water supply and sanitary systems, termite control, common repair

techniques, common methods of crack repair - Repair of existing damp proofing systems in roofs, floors and wet areas - Protection, repair and maintenance of RCC elements - Repair, maintenance of foundations, basements and DPC - Repair of finishes - Repair of building joints - Repair of water supply and sanitary systems, underground and over head tank - Common strengthening techniques - Maintenance of Industrial Floors

Maintenance of Multi-storey Buildings:

Specials features for maintenance of multi-storied buildings, including fire protection system, elevators booster pumps, generator sets.

OECE-14602 Project Monitoring & Management

Internal Marks: 40	L T P
External Marks: 60	3 1 0
Total Marks: 100	

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Understand the need of project planning and device a plan to define the work to be performed in construction project.
2. Utilize various tools and techniques of project management and develop more realistic schedule by identifying the central problem and analyze the alternatives.
3. Analyze time estimates of different activities and events in a network for better controlling of project by identifying critical path.
4. Determine minimum total cost in minimum time by conducting a crash program.
5. Develop understanding about techniques of updating, allocation of resources and rescheduling a project.
6. Apply computer skills to project management and evaluation.

Course Content:

Introduction: Need for project planning & management, time, activity & event, barchart, Milestone chart, uses & draw backs.

PERT : Construction of PERT network, time estimates, network analysis, forward pass &backward pass, slack, critical path, data reduction, suitability of PERT for research project, numerical problems.

CPM: Definitions, network construction, critical path, fundamental rules, determination of project schedule, activity time estimates, float types, their significance, numerical problems.

Cost Analysis and Contract: Type of costs, cost time relationships, cost slopes, conducting a crash programme, determining the minimum total cost of project, numerical problems, updating a project, when to update, time grid diagram, resource scheduling, planning of different components of engineering projects.

Introduction of relevant open source software(s)

REFERENCES:

- PERT and CPM - L.S.Srinath, East West Press
- Management Guide to PERT & CPM - Wiest & levy; Prentice Hall
- Construction Equipment & Planning and Application. - Mahesh Verma , Artec Publication.
- Construction Planning and Management by U. K. Shrivastava; Galgotia Publications Pvt. Ltd.

CE-14609 Geotechnical Engineering Lab

Internal Marks: 30 L T P
External Marks: 20 0 0 2
Total Marks: 50

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Understand the procedure for classifying coarse grained and fine grained soils.
2. Evaluate the index properties of soil.
3. Determine the engineering properties of soil.
4. Interpret the results of compaction test for relative compaction in the field.
5. Apply modern engineering tools effectively and efficiently for geotechnical engineering analysis.
6. Conduct experiments, analyze and interpret results for geotechnical engineering design.

Course Content:

1. Determination of in-situ density by core cutter method and Sand replacement method.
2. Determination of Liquid Limit & Plastic Limit.
3. Determination of specific gravity of soil solids by pyconometer method.
4. Grain size analysis of sand and determination of uniformity coefficient (Cu) and coefficient of curvature (Cc).
5. Compaction test of soil.
6. Determination of Relative Density of soil.
7. Determination of permeability by Constant Head Method.
8. Determination of permeability by Variable Head method.
9. Unconfined Compression Test for fine grained soil.
10. Direct Shear Test
11. Triaxial Test
12. Swell Pressure Test

References:

Soil Testing Engineering, Manual by Shamsher Prakash and P.K. Jain, Nem Chand & Brothers

CE-14610 Computer Aided Analysis & Design

Internal Marks: 30 L T P
External Marks: 20 0 0 2
Total Marks: 50

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Use software applications effectively in the analysis and technical reports writing
2. Produce working structural drawings.
3. Analyze the buildings located in some seismic zone.
4. Design overhead water reservoir.
5. Understand and interpret design aids.
6. Design and draw the building for wind load.

Course Content:

1. To analyze the beams with different end conditions using structural software.
2. To analyze & design the 2-D frames with computer aided software.
3. To analyze & design the 3-D structure with computer aided software.
4. To analyze the building for seismic (static & dynamic) load using computer aided software.
5. To analyze the building for wind load using computer aided software.
6. To analyze the truss used in industrial structure.
7. To analyze and design the over head service reservoir.
8. To analyze the bridge deck for moving load as per IS guidelines.

PRCE-14601 Minor Project

Internal Marks: 30	L T P
External Marks: 20	0 0 1
Total Marks: 50	

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Find relevant sources of information
2. Conduct literature survey
3. Create a well organized document
4. Acknowledge the work of other in a consistent manner
5. Understanding of ethical and professional issues
6. Demonstrate effective oral communication and present the results appropriately

Course Content:

The students will have to do the literature survey, problem formulation, assessment for viability of the project, objectives and methodology for the Major project in 6^{th} semester. The same project problem is to be extended in the major project in $7^{th}/8^{th}$ semester. The minor project may be carried out by a group of students. The evaluation of the minor project will be held as per the rubrics. For report writing, the students have to follow the concerned guidelines.

CE-14801 Design of Steel Structures – II

Internal Marks: 40 L T P
External Marks: 60 3 1 0
Total Marks: 100

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Demonstrate knowledge of basic concepts for analysis and design of various structural steel elements like ties, struts, beams, columns and fasteners.
2. Identify importance of various elements of a plate girder and their design.
3. Compile various loads for a foot bridge, and thereby design its elements including wooden deck, cross beam and main girder
4. Plan structural framing of industrial building for given design data and design various elements like gantry girder, column bracket, mill bent and bracings.
5. Identify various loads and load combinations for design of different components of a railway bridge as per the railway code.
6. Design various elements of a railway bridge for given design data.

Course Content:

Note: *Use of relevant Indian Standards is allowed.*

1) Elements of a plate girder, design of a plate girder, curtailment of flanges, various type of stiffeners.

2) Design of steel foot bridge with parallel booms and carrying wooden decking, using welded joints.

3) Complete design of an industrial shed including:

i) Gantry girder

ii) Column bracket

iii) Mill bent with constant moment of inertia

iv) Lateral and longitudinal bracing for column bent

4) Design of single track Railway Bridge with lattice girders having parallel chords (for B.G.)

i) Stringer

ii) Cross girder

iii) Main girders with welded joints

iv) Portal sway bracings

v) Bearing rocker and rollers

References:

1) Limit state design of steel structures: S K Duggal

2) Design of steel structures: N Subramanian

3) Design of steel structures (Vol. 2): Ram Chandra

4) IS 800: 2007 (General construction in steel-Code of practice)*

5) SP: 6(1) (Handbook for structural engineers-Structural steel sections)*

6) Indian Railway Standard Code of Practice for the Design of Steel or Wrought iron Bridges Carrying Rail Road or Pedestrian Traffic, Research Design and Standard s Organization Lucknow, Govt. of India, Ministry of Railways, 2003.*
7) Rules Specifying the Loads for the Design of Super-Structure and Sub-Structure of Bridges and for Assessment of the Strength of Existing Bridge, Research Design and Standard s Organization Lucknow, Govt. of India, Ministry of Railways, 2003.*
* *permitted in Examination*

CE-14802 Elements of Earthquake Engineering

Internal Marks: 40 L T P
External Marks: 60 3 1 0
Total Marks: 100

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Identify and appreciate the role of earthquake forces in structural design of buildings.
2. Understand various parameters related to the seismic design of buildings.
3. Apply various codal provisions related to the seismic design of buildings.
4. Develop a skill to retrieve information from past structural failures and use it in future planning.
5. Analyse a structure subject to lateral forces due to earthquake.
6. Understand the concept and terminology related to the theory of vibrations.
7. Apply the concepts to analyze the dynamic behaviour of a structural system.

Course Content:

Note: *No Indian Codes of Practice and Design handbooks are permitted, so paper setter is expected to provide required data from relevant IS codes, for any numerical or design part.*

Introduction to Earthquakes, Causes of Earthquakes, Basic Terminology, Magnitude, Intensity, Peak ground motion parameters.
Past Earthquakes and Lessons learnt, Various Types of Damages to Buildings
Introduction to theory of Vibrations, Sources of Vibrations, Types of Vibrations, Degree of Freedom, spring action and damping, Equation of motion of S.D.O.F systems, Undamped, Damped system subjected to transient forces, general solution, green's function
Lateral Force analysis, Floor Diaphragm action, moment resisting frames, shear walls.
Concepts of seismic design, Lateral Strength, Stiffness, ductility and structural configuration
Introduction to provisions of IS 1893-2002 Part-I for buildings. Estimation of lateral forces due to earthquake
Introduction to provisions of IS 4326.
Introduction to provision of IS 13920.

References:

1. Earthquake Resistant Design of Structures, Pankaj Agrawal, Manish Shrikhande, PHI Learning
2. Dynamics of Structures: Theory and Applications to Earthquake Engineering, AK Chopra, Prentice Hall
3. Dynamics of Structures, R.W. Clough and Joseph Penzien, McGraw-Hill Education
4. Structural Dynamics by Mario & Paz, Springer.
5. Earthquake Resistant Design by David J. Dowrick, Wiley India Pvt Ltd
6. Elements of Earthquake Engg by Jai Krishna, A.R. Chandrasekaran, Brijesh Chandra, South Asian Publishers.
7. IS 1893:2002 -Indian Standard Criteria for Earthquake Resistant Design of Structures

8. IS 4326:2002 -Indian Standard for Earthquake Resistant Design and Construction of Buildings.
9. IS 13920:2002- Ductile detailing of Reinforced Concrete Structures subjected to Seismic Forces.

CE-14803 Irrigation Engineering-II

Internal Marks: 40 L T P
External Marks: 60 3 1 0
Total Marks: 100

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Understand the functioning and design consideration of various components of Diversion Head Work.
2. Analyze the various parameters of hydraulic structures for seepage and uplift pressure.
3. Recognize the concept and principles of silt control devices.
4. Design water distribution systems, regulators, canal falls, outlets, cross drainage works, weirs and barrages of irrigation network.
5. Apply knowledge to select best canal fall, outlet and cross drainage works according to real time situation.
6. Identify appropriate energy dissipation devices suitable for hydraulic structures as per site condition.

Course Content:

Head Works: Types of head works, Functions and investigations of a diversion head work :component parts of a diversion head work and their design considerations, silt control devices.

Theories of Seepage: Seepage force and exit gradient, assumptions and salient features of Bligh's Creep theory, Limitations of Bligh's Creep theory, salient features of Lane's weighted Creep theory and Khosla's theory, Comparison of Bligh's Creep theory and Khosla's theory, Determination of uplift pressures and floor thickness.

Design of Weirs: Weirs versus barrage, types of weirs, main components of weir, causes of failure of weir and design considerations with respect to surface flow, hydraulic jump and seepage flow. Design of barrage or weir

Energy Dissipation Devices: Use of hydraulic jump in energy dissipation, Factors affecting design, Types of energy dissipators and their hydraulic design.

Canal Regulators: Offtake alignment, cross-regulators – their functions and design, Distributory head regulators, their design, canal escape.

Canal Falls: Necessity and location, types of falls and their description, selection of type of falls, Principles of design, Design of Sarda type, straight glacis and Inglis or baffle wall falls.

Cross-Drainage works: Definitions, choice of type, Hydraulic design consideration, Aqueducts their types and design, siphon aqueducts – their types and design considerations, super passages, canal siphons and level crossing.

Canal Out-lets: Essential requirements, classifications, criteria for outlet behaviours, flexibility, proportionality, sensitivity, sensitiveness, etc. Details and design of non-modular, semi-modular and modular outlets

References:

1. Irrigation Engg. & Hydraulic Structure by Santosh Kumar Garg, Khanna Publishers
2. Design of Irrigation Structures by R.K. Sharma, Oxford IBH Pub
3. Irrigation Engg. and Hydraulics Structures by S.R. Sahasrabudhe, . Katson Publishing
4. Irrigation Practice and Design Vol. I to VII by K.B. Khushlani. Oxford IBH Pub
5. P.N. Modi; Irrigation with Resources and with Power Engineering, Standard Book House
6. Irrigation Engg. Vol. I & II by Ivan E. Houk, John Wiley and sons

CE-14804 Transportation Engineering – II

Internal Marks: 40 L T P
External Marks: 60 3 1 0
Total Marks: 100

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Understand the importance of railway infrastructure planning and design.
2. Identify the functions of different component of railway track.
3. Apply existing technology to design, construction and maintenance of railway track.
4. Apprehend the advanced international technology being used in the field of railway engineering.
5. Outline the importance of Airport Infrastructure planning and design.
6. Evaluate the major issues and problems of current interest to airport engineering.

Course Content:

Railway Engineering

Introduction to Railway Engineering: History of Railways, Development of Indian Railway, Organisation of Indian Railway, Important Statistics of Indian Railways. Railway Gauges: Definition, Gauges on World Railways, Choice of Gauge, Uniformity of Gauge, Loading Gauge, Construction Gauge.

Railway Track: Requirements of a Good Track, Track Specifications on Indian Railways, Detailed Cross-Section of Single/Double Track on Indian Railways. Components of Railway Track: Rails, Sleepers, Ballast, Sub-grade and Formation, Track Fixtures & Fastenings, Coning of Wheels, Tilting of Rails, Adzing of Sleepers, Rail Joints, Creep of Rails.

Geometric Design of Railway Track: Alignment, Gradients, Horizontal Curve, Super-elevation, Equilibrium Cant, Cant Deficiency, Transition Curves.

Points and Crossings: Functions, Working of Turnout, Various types of Track Junctions and their layouts, Level-crossing.

Railway Stations & Yards: Site Selection, Classification & Layout of Stations, Marshalling Yard, Locomotive Yard, Equipment at Railway Stations & Yards

Signalling and Interlocking: Objectives, Classification of Signals, Types of Signals in Stations and Yards, Automatic Signalling, Principal of Interlocking.

Modernization of Railway Tracks: High Speed Tracks, Improvement in existing track forhigh speed, Ballast less Track, MAGLEV, TACV Track.

Airport Engineering

Introduction to Airport Engineering: Air Transport Scenario in India and Stages of Development, National and International Organizations

Airport Planning: Aircraft Characteristics, Factors for Site Selection, Airport Classification,General Layout of an Airport, Obstructions and Zoning Laws, Imaginary Surfaces, Approach Zones and Turning Zones,

Runway Orientation and Design: Head Wind, Cross Wind, Wind Rose Diagram, Basic Runway Length, Corrections, Geometric Design Elements, Runway Configuration.

Taxiway and Aircraft Parking: Aircraft Parking System. Main Taxiway, Exit Taxiway, Separation Clearance, Holding Aprons.
Visual Aids: Marking and Lighting of Runway and Taxiway, Landing Direction Indicator, and Wind Direction Indicator, IFR/VFR.

References:
1. Chandra S., and Aggarwal, "Railway Engineering", M.M. Oxford University Press, New Delhi,2007.
2. Saxena, S.C., and Arora, S.P., "A Text Book of Railway Engineering", Dhanpat Rai and Sons,Delhi, 1997.
3. J. S. Mundrey, "Railway Track Engineering", McGraw Hill Publishing Co., 2009
4. Khanna, S.K., Arora, M.G., and Jain, S.S., "Airport Planning and Design", Nem Chand & Bros. Roorkee, 1999.
5. Horenjeff, R. and McKelvey, F., "Planning and Design of Airports", McGraw Hill Company,New York, 1994.
6. Norman J. Ashford, Saleh Mumayiz, Paul H. Wright, "Airport Engineering: Planning, Designand Development of 21st Century", Wiley Publishers, 2011

CE-14805 Seminar

Internal Marks: 50 L T P
External Marks: -- 0 0 2
Total Marks: 50

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Find relevant sources of information, research and gather information.
2. Create a well organized document using appropriate format and grammatical structure.
3. Acknowledge the work of other in a consistent manner.
4. Understanding of ethical and professional issues.
5. Demonstrate effective written and oral communication.
6. Awareness of implications to society at large.

Course Content:

This is an unstructured open-ended course where under the overall supervision of a faculty member of his discipline, each student must submit report as a culmination of his endeavor and investigation. The course will aim to evaluate student's Understanding, Broadness, Diversity, Self-Learning and Service in the area of civil engineering.

**Students will prepare the individual seminar report as per the prescribed format (available at departmental website) and present it before the group of students.*

DECE-14806 Dynamics of Structures

Internal Marks: 40	L T P
External Marks: 60	3 1 0
Total Marks: 100	

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Demonstrate the fundamental theory of dynamic equation of motion for dynamic systems.
2. Identify the concepts of mathematics, science, and engineering by developing the equations of motion for vibratory systems and solving for the free and forced response.
3. Model the response of single-degree-of-freedom (SDOF) systems to pulse and harmonic and periodic excitations and discrete lumped mass multi-degree-of-freedom (MDOF) systems.
4. Understand the response spectrum concept.
5. Evaluate the solution of the problem through the concepts of viscous damping, coulomb damping (by friction) and equivalent damping.
6. Analyze dynamic analysis of various structures using Numerical Methods.
7. Understand the dynamic response of continuous system.

Course Content:

Overview of structural dynamics: Fundamental objective of structural dynamic analysis - types of prescribed loadings - essential characteristics of a dynamic problem - method of discretization: lumpedmass procedure - generalized displacements - the finite-element concept

Single degree of freedom systems: Components of the basic dynamic system formulation of theequations of motion - direct equilibration using D'Alembert's principle - principle of virtual displacements - *generalized SDOF systems* - rigid body assemblage

Free vibration response: Solution of the equation of motion - undamped free vibrations - damped free vibrations - critical damping - underdamped systems - overdamped systems - negative damping

Response to harmonic loading: Undamped system complementary solution - particular solution -general solution - response ratio - damped system - resonant response

Response to periodic loading: Fourier series expression of the loading - response to the fourier series loading - exponential form of fourier series solution

Response to impulsive loads: General nature of impulsive loads - sine-wave impulse – rectangular impulse - triangular impulse - shock load.

Response to general dynamic loading: Duhamel integral for an undamped system – numerical evaluation of the duhamel integral for an undamped system - response of damped systems – response analysis through the frequency domain

Multi degree of freedom systems: Formulation of the MDOF equations of motion - selection of the degrees of freedom - orthogonality conditions - normal co-ordinates - uncoupled equations of motion - undamped & damped - mode superposition procedure

Continuous parameter systems: Vibration analysis by Rayleigh's method - basis of the method - approximate analysis of a general system - selection of the vibration shape - improved RayleighMethod

Practical vibration analysis: Preliminary comments - stodola method - fundamental mode analysis – proof of convergence - analysis of second mode - analysis of third and higher modes – analysis of highest mode - Rayleigh's method in discrete co-ordinate systems.

References:

1. Clouch R.W. & Penzien J., Dynamics of Structures, McGraw Hill
2. Weaver W., Jr. Timoshenko S.P., Young D.H, Vibration Problem in Engineering, John Wiley
3. Meivovitch L., Elements of Vibration Analysis, McGraw Hill
4. Seto W.W., Mechanical Vibrations, Schaum's Outline Series, McGraw Hill
5. Srinivasan P., Mechanical Vibration Analysis, Tata McGraw Hill
6. A K Chopra; Dymanics of Structures; Prentice-Hall
7. Earthquake Resistant Design of Structures; Pankaj Agrawal, Manish Shrikhande; Prentice Hallof India

DECE-14807 Advanced Reinforced Concrete Design

Internal Marks: 40 L T P
External Marks: 60 3 1 0
Total Marks: 100

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Demonstrate the fundamental theory design of RC elements.
2. Apply the design principles to the large span concrete roofs as per IS code.
3. Analyze the behaviour of slabs for different loading and boundary conditions.
4. Design the components of chimney.
5. Analyze and design the different type of retaining systems as per requirements.
6. Design the water tanks of different shapes and capacities.

Course Content:

Note: *No Indian Codes of Practice and Design handbooks are permitted, so paper setter is expected to provide required data from relevant IS codes, for any numerical or design part.*

Large span concrete roofs – Classification- Behaviour of Flat slabs- Direct design and equivalent frame method- Codal provisions Forms of Shells and Folded plates- Structural behaviour of cylindrical shell and folded plate- Method of analysis-beam action, arch action and membrane analysis- Codal provisions- Design of simply supported circular cylindrical long shells and folded plates.

Yield line analysis of slabs- virtual work and equilibrium method of analysis- simply supported rectangular slabs with corners held down- uniform and concentrated loads- design of simply supported rectangular and circular slabs

Analysis of deep beams- Design as per IS 456-2000, Analysis of stresses in concrete chimneys- uncracked and cracked sections- Codal provisions- Design of chimney

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

Overhead water tanks- rectangular and circular with flat bottom- spherical and conical tank roof staging-Design based on IS 3370

Reference:

1. Reinforced Concrete Structural Elements- Purushothaman. P, Tata Mc Graw Hill
2. Design and Construction of Concrete Shell Roofs- G.S.Ramaswamy
3. Reinforced Concrete – Ashok K Jain, Nem Chand Bros. Roorkee
4. Plain and Reinforced Concrete – Jain & Jaikrishna, Vol. I & II, Nem Chand Bros. Roorkee
5. Reinforced Concrete Chimneys- Taylor C Pere,
6. Yield Line Analysis of Slabs- Jones L L, Thomas and Hudson
7. Design of deep girders, Concrete Association of India
8. Reinforced Concrete, Mallick & Gupta- Oxford & IBH
9. IS 456-2000 Plain and Reinforced Concrete
10. IS 2210-1998- Criteria for design of reinforced concrete shell structures and folded plates
11. IS 4998-1998- Criteria for design of reinforced concrete chimneys
12. IS 3370- 1991- Part 1-4- Code of Practice for concrete structures for the storage of liquids

DECE –14808 Prestressed Concrete

Internal Marks: 40 L T P
External Marks: 60 3 1 0
Total Marks: 100

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Understand the material characteristics of structural materials, such as high strength concrete and high strength steel, etc.
2. Understand and apply the concept and terminology related to the prestressed concrete.
3. Analyze the beam sections carrying the prestressed force, external loads and time-dependant effects, such as creep, shrinkage and other losses.
4. Evaluate and interpret the use of different prestressing systems on the PSC beams.
5. Design prestressed concrete beams and slabs for flexure, shear and torsion.
6. Apply various provisions prescribed by IS 1343 to the design of prestressed concrete members.

Course Content:

Note: *IS 1343 is permitted in examination.*

Materials for prestressed concrete and prestressing systems
High strength concrete and high tensile steel – tensioning devices – pretensioning systems – posttensioning systems

Analysis of prestress and bending stresses
Analysis of prestress – resultant stresses at a sector – pressure line or thrust line and internal esisting couple – concept of load balancing – losses of prestress – deflection of beams.

Strength of prestressed concrete sections in flexure, shear and torsion
Types of flexural failure – strain compatibility method – IS: 1343 code procedure – design for imit state of shear and torsion.

Design of prestressed concrete beams and slabs
Transfer of prestress in pre tensioned and post tensioned members – design of anchorage zone reinforcement – design of simple beams – cable profiles – design of slabs.

References:

1. N. Krishna Raju, Prestressed concrete, Tata McGraw Hill
2. T.Y. Lin, Ned H. Burns, Design of Prestressed Concrete Structures, John Wiley & Sons.
3. P. Dayaratnam, Prestressed Concrete, Oxford & IBH
4. R. Rajagopalan, Prestressed Concrete.
5. IS 1343 2012 Code of Practice for Prestressed Concrete

DECE-14809 Pavement Design

Internal Marks: 40 L T P
External Marks: 60 3 1 0
Total Marks: 100

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Identify the different types of pavement and factors affecting their design.
2. Design the flexible pavement using different methods and as per latest Indian Standard.
3. Understand the factors affecting Bitumen mix design and design procedure of bitumen mix
4. Design the rigid pavement using different methods and as per latest Indian Standard.
5. Evaluate the pros and cons of various other low cost pavements proposed by IRC.
6. Assess the need of overlay and design accordingly.

Course Content:

Note: *Use of IRC: 37-2012 and IRC: 58-2011 shall be allowed in the examination.*

Introduction: Types of pavement structure. Functions of pavement components, Factors affecting pavement design, Design wheel load, Strength characteristics of pavement materials. Comparison of flexible and rigid pavements.
Design of Flexible Pavements: General design considerations, Methods for design of flexible pavements – Group Index Method, Triaxial Test Method, Hveem Stabilometer Method, McLeod's Method, Indian Roads Congress Method.
Design of Bituminous Mixes: Mix Design Approaches, Marshall Method of Bituminous Mix Design, Superpave
Design of Rigid Pavements: General design considerations, Westergard's Analysis, Methods for design of rigid pavements - PCA method, AASHTO Method, Indian Roads Congress Method, Types and design of Joints in cement concrete pavements.
Modern Design Concepts: Reinforced Concrete Pavement, Airport Pavement Design, Bituminous Pavement with Cemented Base, Interlocking Concrete Block Pavement, Full Depth Bituminous Pavement, Ultrathin White Topping, Perpetual Pavement, Pavement Overlays.

References

1. Yoder, E. J., and M. W. Witczak, "Principals of Pavement Design", Wiley Publication.
2. Khanna, S. K., and C. E. G. Justo, "Highway Engineering", Nem Chand & Bros., Roorkee.
3. Sharma, S. K., "Principles, Practice and Design of Highway Engineering", S. Chand & Co.
4. Chakraborty,P. and A.Das, "Principles of Transportation Engineering", Prentice Hall India.
5. Yang H. Huang, "Pavement Analysis and Design", Prentice Hall.

DECE-14810 Traffic Engineering

Internal Marks: 40 L T P
External Marks: 60 3 1 0
Total Marks: 100

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Understand the characteristics related to road user, vehicle, and traffic stream.
2. Conduct the various traffic studies to collect the data related to traffic.
3. Create the solution of the problem related to traffic regulation and control.
4. Design the traffic signal timing for pre-timed and traffic actuated signals.
5. Outline the procedure to assess the road safety audit.
6. Assess the need of modernization in traffic engineering.

Course Content:

Introduction: Elements of Traffic Engineering, Components of traffic system – road users, vehicles, highways and control devices.

Vehicle Characteristics: IRC standards, Design speed, volume, Highway capacity and levels of service, capacity of urban and rural roads, PCU concept and its limitations.

Traffic Stream Characteristics: Traffic stream parameters, characteristics of interrupted and uninterrupted flows.

Traffic Studies: Traffic volume studies, origin destination studies, speed studies, travel time and delay studies, parking studies, accident studies.

Traffic Regulation and Control: Signs and markings, Traffic System Management, At-gradeIntersections, Channelization, Roundabouts

Traffic Signals: Pre-timed and traffic actuated. Design of signal setting, phase diagrams, timing diagram, Signal co-ordination

Grade Separated Intersections: Geometric elements for divided and access controlled highways and expressways.

Traffic Safety: Principles and practices, Road safety audit.

Intelligent Transportation System: Applications in Traffic Engineering

References:

1. William, R.M. and Roger, P.R., “Traffic Engineering”, Prentice Hall.
2. Hobbs, F.D., “Traffic Planning and Engineering”, Pergamon Press.
3. Khisty, C.J. and Kent, B.L., “Transportation Engineering – An Introduction”, Prentice Hall ofIndia Pvt. Ltd.
4. Kadiyali, L.R., “Traffic Engineering & Transport Planning”, Khanna Publishers, New Delhi.
5. Mannering, “Principles of Highway Engineering & Traffic Analysis”, Wiley Publishers, NewDelhi.

DECE-14811 Bridge Engineering

Internal Marks: 40 L T P
External Marks: 60 3 1 0
Total Marks: 100

Course Outcomes

After completing this course the student must demonstrate the knowledge and ability to:

1. Learn the basics of bridge classification, choice of bridge type, investigations for the bridges.
2. Learn loadings on the bridge, IRC loadings, and load combinations for the specific problem.
3. Understand the load distribution on a specific bridge system.
4. Analyze and design Steel and RCC bridge deck system.
5. Conceptualize the design of bridge substructures.

Course Content:

Introduction: Definition and components of a bridge, Classification of bridges, Choice of abridge type.

Investigation for Bridges: Need for investigation, Selection of bridge site, Determination of design discharge for River Bridge, Linear waterway, Economical span, Vertical clearance, scour depth, Afflux, Traffic projection.

Standard Specifications for Road Bridges: IRC Bridge Codes, Width of carriageway, Clearances, Dead load, I.R.C. standard live loads, Impact effect, Wind load, Longitudinal forces, Centrifugal forces, Horizontal forces due to water current, Buoyancy effect, Earth pressure, Deformation stresses, Erection stresses, Temperature effects, and Seismic force.

Reinforced Concrete Bridges: Types of RCC bridges; Culverts - Box Culvert, Pipe Culvert, Solid slab bridge, T-beam girder bridges, Hollow girder bridges, Balanced cantilever bridges, Continuous girder bridges, Rigid frame bridges, Arch bridges, Pre-stressed concrete bridges.

Steel Bridges: Types of Steel bridges; Beam bridges, Plate girder bridges, Box girder bridges, Truss bridges, Arch bridges, Cantilever bridges, Cable stayed bridges, Suspension bridges.

Sub-structure and Foundation: Piers and abutments, materials for piers and abutments, Types of foundations; Shallow, Pile, and Well foundations. Relative merits of piles and well foundations, Pneumatic Caissons, Box Caissons.

Bearings, Joints & Appurtenances: Importance of Bearings, Different types of bearings- Expansion Bearings, Fixed Bearings, Elastomeric Bearings, Expansion joints, Wearing Course, Approach Slab, Footpath, Handrails.

Construction and Maintenance of Bridges: Methods of construction of concrete and steel bridges. Formwork and false work for concrete bridges, Causes of Bridge failures, Inspection and maintenance

References:

1. Johnson, Victor, “Essentials of Bridge Engineering”, Oxford University Press.
2. Khadilkar, C. H., “A Text book of Bridge Construction”, Allied Publishers.

3. Rangwala, S. C., “Bridge Engineering”, Charotar Publishing House Pvt. Ltd.
4. Raina, V. K., “Concrete Bridges Handbook”, Shroff Publishers and Distributors.
5. Ponnuswamy, S. “Bridge Engineering”, McGraw Hill Education.

DECE-14812 Matrix Methods of Structural Analysis

Internal Marks: 40 L T P
External Marks: 60 3 1 0
Total Marks: 100

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Demonstrate knowledge of basic structural analysis for beams, trusses, frames, etc.
2. Apply the basic matrix operations in the structural analysis.
3. Understand the concept and terminology related to the structural analysis using the matrix.
4. Develop matrix and flexibility matrix for different types of structural elements.
5. Analyze the determinate and indeterminate beams, frames, trusses using the matrix operations.
6. Evaluate and interpret the analysis results for their use in the design of various structural elements.

Course Content:

Flexibility Matrix (Physical Approach): Basic definitions and types of matrices, matrix operations, matrix inversion, solution of linear simultaneous equations, matrix partitioning, development of flexibility matrices for statically determinate and in determinate beams, rigid jointed plane frames and pin-jointed plane frames using physical approach.

Stiffness Matrix (Physical Approach): Development of stiffness matrices for statically determinate and indeterminate beams, rigid-jointed plane frames and pin-jointed plane frames using physical approach, reduced stiffness matrix, total stiffness matrix, translational or lateral stiffness matrix.

Stiffness Matrix (Element Approach): Transformation of system displacements to element displacements through displacement transformation matrix, transformation of element stiffness matrices to system stiffness matrix, development of stiffness matrices for statically determinate and indeterminate beams, rigid-jointed plane frames and pin-jointed plane frames using element approach, relation between flexibility and stiffness matrices.

Stiffness Method Of Analysis: Analysis of continuous beams, rigid-jointed plane frames and pin-jointed plane frames using the physical and element approaches, effect of support settlements, temperature stresses and lack of fit, comparison of flexibility and stiffness methods of analysis.

References:

1. Structural analysis- A matrix approach - GS Pandit and SP Gupta
2. Matrix analysis of framed structures - William weaver , Jr. James M. Gere
3. Basic structural analysis - C.S. Reddy

DECE-14815 Ground Improvement Techniques

Internal Marks: 40 L T P
External Marks: 60 3 1 0
Total Marks: 100

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Evaluate the existing characteristics of the soil to be improved.
2. Understand the mechanism of ground improvement.
3. Select a suitable type of ground improvement technique considering the existing soil.
4. Design various ground improvement techniques.
5. Monitor the efficiency of ground improvement methods.
6. Apply the selected ground improvement methods at site.

Course Content:

Introduction to soil improvement without the addition of materials - dynamic compaction equipment used - application to granular soils - cohesive soils - depth of improvement – environmental considerations - induced settlements - compaction using vibratory probes - vibro techniques vibro equipment - the vibro compaction and replacement process - control of verification of vibro techniques - vibro systems and liquefaction - soil improvement by thermal treatment - preloading techniques - surface compaction introduction to bio technical stabilization

Introduction to soil improvement with the addition of materials - lime stabilization - lime column method - stabilization of soft clay or silt with lime - bearing capacity of lime treated soils – settlement of lime treated soils - improvement in slope stability - control methods - chemical grouting – commonly used chemicals - grouting systems - grouting operations - applications - compaction grouting -introduction - application and limitations - plant for preparing grouting materials - jet grouting – jet grouting process - geometry and properties of treated soils - applications - slab jacking - gravel - sand - stone columns

Soil improvement using reinforcing elements - introduction to reinforced earth - load transfer mechanism and strength development - soil types and reinforced earth - anchored earth nailing reticulated micro piles - soil dowels - soil anchors - reinforced earth retaining walls

Geotextiles - Behaviour of soils on reinforcing with geotextiles - effect on strength, bearing capacity, compaction and permeability - design aspects - slopes - clay embankments - retaining walls – pavements

References:

1. Moseley, *Text Book on Ground Improvement*, Blackie Academic Professional, Chapman & Hall
2. Boweven R., *Text Book on Grouting in Engineering Practice*, Applied Science Publishers Ltd
3. Jewell R.A., *Text Book on Soil Reinforcement with Geotextiles*, CIRIA Special Publication, ThomasTelford
4. Van Impe W.E., *Text Book On Soil Improvement Technique & Their Evolution*, Balkema Publishers
5. Donald .H. Gray & Robbin B. Sotir, *Text Book On Bio Technical & Soil Engineering Slope Stabilization*, John Wiley
6. Rao G.V. & Rao G.V.S., *Text Book On Engineering with Geotextiles*, Tata McGraw Hill

7. Korener, *Construction & Geotechnical Methods in Foundation Engineering*, McGraw Hill
8. Shukla, S.K. and Yin, J.H. Fundamental of Geosynthetic Engineering, Taylor & Francis
9. Swamisaran, Reinforced Soil and its Engineering Application, New Age Publication
10. Gulati, S.K. and Datta, M., Geotechnical Engineering, TMH

DECE-14816 Soil Dynamics & Machine Foundation

Internal Marks: 40 L T P
External Marks: 60 3 1 0
Total Marks: 100

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Recognize the scope and significance of soil dynamics.
2. Apply the concept of theory of vibrations to find the behavior of soil under dynamic loading.
3. Understand vibration concepts in soils like damping, wave propagation, resonance and effect of modes of vibrations.
4. Employ the code of practice for design of foundations for reciprocating machines.
5. Design foundations subjected to impact loads.
6. Predict the influence of vibrations and selection of remediation methods based on the nature of vibration, properties and behavior of soil.

Course Content:

Introduction - nature of dynamic loads - stress conditions on soil elements under earthquake loading - dynamic loads imposed by simple crank mechanism - type of machine foundations – special considerations for design of machine foundations - theory of vibration: general definitions – properties of harmonic motion - free vibrations of a mass-spring system - free vibrations with viscous damping - forced vibrations with viscous damping - frequency dependent exciting force - systems under transient forces - Raleigh's method - logarithmic decrement - determination of viscous damping - principle of vibration measuring instruments - systems with two degrees of freedom - special response

Criteria for a satisfactory machine foundation - permissible amplitude of vibration for different type of machines - methods of analysis of machine foundations - methods based on linear elastic weightless springs - methods based on linear theory of elasticity (elastic half space theory) - methods based on semi graphical approach - degrees of freedom of a block foundation - definition of soil spring constants - nature of damping - geometric and internal damping - determination of soil constants - methods of determination of soil constants in laboratory and field based on IS code provisions

Vertical, sliding, rocking and yawing vibrations of a block foundation - simultaneous rocking, sliding and vertical vibrations of a block foundation - foundation of reciprocating machines – design criteria - calculation of induced forces and moments - multi-cylinder engines - numerical example (IS code method)

Foundations subjected to impact loads - design criteria - analysis of vertical vibrations – computation of dynamic forces - design of hammer foundations (IS code method) - vibration isolation - active and passive isolation - transmissibility - methods of isolation in machine foundations

Note: Use of I.S 2974 Part I and II will be allowed in the university examination

References:

1. Shamsher Prakash, *Soil Dynamics*, McGraw Hill
2. Das and Ramana, Principle of Soil Dynamica, Cengage Learning
3. Alexander Major, *Dynamics in Soil Engineering*
4. Sreenivasalu & Varadarajan, *Handbook of Machine Foundations,* Tata McGraw Hill
5. IS 2974 - Part I and II, *Design Considerations for Machine Foundations* *

6. IS 5249: *Method of Test for Determination of Dynamic Properties Of Soils*
* IS code marked with * is permitted in examination.

DECE-14817 Earth and Earth Retaining Structures

Internal Marks: 40 L T P
External Marks: 60 3 1 0
Total Marks: 100

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Design of earthen dams considering seepage analysis and seepage control.
2. Analysis of earth retaining structures for their stability against earth pressure.
3. Prediction of lateral earth pressures associated with different earth systems.
4. Applying engineering knowledge for the designing of earth retaining structures in various site conditions.
5. Evaluation of rigid retaining structures using appropriate design methods, factors of safety, earth pressure diagrams.
6. Evaluation of flexible retaining structures using appropriate design methods, factors of safety, earth pressure diagrams

Course Content:

Earthen Dam
Introduction to Earthen dams, types of dams, selection of type of dam based on material availability, foundation conditions and topography Design details – crest, free board, upstream and downstream slopes, upstream and downstream slope protection – central and inclined cores – types and design of filters Seepage analysis and control – seepage through dam and foundations – control of seepage in earth dam and foundation
Stability analysis – critical stability conditions – evaluation of stability by Bishop's and sliding wedge methods under critical conditions Construction techniques – methods of construction – quality control Instrumentation – measurement of pore pressures Earth pressure theories – Rankine's and Coulomb's earth pressure theories for cohesionless and
cohesive backfills – computation of earth pressures for various cases – inclined – with surcharge –submerged and partly submerged – stratified backfills
Rigid retaining structures – active and passive earth pressures against gravity retaining walls –computation of earth pressures by Trial wedge method – a mathematical approach for completely submerged and partly submerged backfills – Perched water table – importance of capability tension in earth pressure, Graphical methods of earth pressure computation – trial wedge method for coulomb's and Rankine's conditions, for regular and irregular ground and wall conditions – Rebhan's construction for active pressure – friction circle method – logarithmic spiral method, Design of gravity retaining wall – cantilever retaining walls
Flexible retaining structure – type and methods of construction – design strength parameters – safety factor for sheet pile walls – computation of earth pressures against cantilever sheet piles in cohesionless and cohesive soils – anchored sheet piles – free earth method – fixed earth method – Rowe's moment reduction method – stability of sheet piling
Diaphragm walls and coffer dams – type of diaphragm walls and their construction techniques in various soil types – earth pressure on braced cuts and coffer dams – design of coffer dams
References:
1. Huntington, Earth pressure on retaining walls.
2. Bowles, Foundation Analysis and Design.
3. Jones, Earth Reinforcements & Soil structures.
4. Prakash, Ranjan & Sasan, Analysis & Design of Foundation & Retaining Structures

DECE-14818 Advanced Environmental Engineering

Internal Marks: 40 L T P
External Marks: 60 3 1 0
Total Marks: 100

Course Outcomes

After completing this course the student must demonstrate the knowledge and ability to:

1. Understand the basic concepts of inter-relationship between different ecosystems with environment.
2. Compute the causes of different types of pollution along with related regulations (local, national, and international).
3. Explain the mechanisms of air pollutants transport/dispersion in the atmosphere and select the systems to control them at different sources.
4. Prepare the life cycle assessment of Solid waste from its generation to disposal.
5. Evaluate different methods of solid waste management and identify the suitable disposal alternatives available.
6. Explain different types of hazardous waste and correspondingly appropriate method for its treatment and disposal.

Course Content:

Introduction

Environment, Biosphere, Ecosystems; their interrelationships and pollution

Air Pollution & Control

Air pollution, Physical & chemical fundamentals, Air pollution standards, Effects of air pollution; climate change, Air pollution meteorology, Atmospheric dispersion of pollutants, Indoor air quality models, Air pollution control of stationary & mobile sources.

Noise Pollution & Control:

Introduction, Rating Systems, Sources & Criteria, Noise prediction and Control

Solid Waste Management:

Perspectives & properties, collection, transfer & transport, Life cycle assessment, Disposal in a landfill, Waste to energy, Composting, Resource conservation & recovery for sustainability

Hazardous Waste Management:

The hazard, risk, definition & classification RCRA &HSWA, CERCLA & SARA, Hazardous waste management, Treatment technologies, Land disposal, Groundwater contamination & remediation

.

References:

1..Davis & Cornwell, Environmental Engineering, Mc Graw Hill Int Ed
2..Peavy, H.S, Rowe, D.R, Tchobanoglous, G, Environmental Engineering, Mc Graw Hill
3..E.P. Odum, Fundamentals of Ecology, Oxford and IBH Pub.
4. Vesilind, Worrell and Reinhart, Solid Waste Engineering, Cengage Learning India
5. Rao and Rao, Air Pollution, Tata McGraw Hill Pub

DECE-14819 Environmental Impact Assessment

Internal Marks: 40	L T P
External Marks: 60	3 1 0
Total Marks: 100	

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Understand the concepts of environmental impact analysis and legislations involving EIA.
2. Identify the factors for assessing the impacts of field projects.
3. Use the methodologies to set up environmental indices and quantify the impacts.
4. Assess the environmental, socio-economic and health impacts of different projects.
5. Design an environmental proposal and evaluate the available alternatives.
6. Demonstrate knowledge of professional and ethical responsibilities.

Course Content:

Concepts of environmental impact analysis - key features of the National Environmental Policy Act and its implementation, screening in the EIA process, role of the USEPA, environmental protection and EIA at the national level, utility and scope of the EIA process

Planning and management of environmental impact studies Environmental impact - factors for consideration in assessing the impacts of water related projects, power projects, waste water treatment facilities etc .Concepts and terms in the impact assessment process, Socioeconomic impact analysis.

Simple methods for impact identification – matrices, net works and checklists. Description of the environmental setting Environmental indices and indicators for describing the affected environment.

Prediction and assessment- Prediction and assessment of the impact on surface water, soil,

groundwater, air, water quality, vegetation and wild life and biological environments. Case studies and examples. Prediction and assessment of visual impacts and impacts on the socio-economic setting, decision methods for evaluation of alternatives, public participation in decision-making Preparing the EIA document Environmental monitoring.

References:

1. Larry W Canter, Environmental Impact Assessment, McGraw Hill, Inc., 1996
2. Betty Bowers Marriot, Environmental Impact Assessment A Practical Guide, McGraw Hill, Inc., 997.
3. C.J. Barrow, Environmental & Social Impact Assessment – An Introduction, Edward Arnold,
2002.
4. Evan. K. Paleologos and Ian Lerche, Environmental Risk Analysis, McGraw Hill Inc., 2001
5. Peter Morris (ed.) and Riki Therivel (ed.), Methods of Environmental Impact Assessment, Routledge, 2001.

DECE-14820 Flood Control & River Engineering

Internal Marks: 40	L T P
External Marks: 60	3 1 0
Total Marks: 100	

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Appropriate the importance of river engineering and its social and environmental impacts.
2. Compute and forecast flood by various methods.
3. Identify suitable flood control method and select one according to economical condition.
4. Evaluate suitable method for river training and channel improvement.
5. Predict sediment load carried by river and its impact on flow.
6. Understand the concept of River Regime theories.

Course Content:

Introduction:
River Engineering, Flood forecasting, Flood Estimation, Estimating Design flood, Empirical formulate, statistical or Probability methods, Unit hydrograph method
Flood control and Economics of Flood control River Regime theories, River Modeling, Meandering River Training, Channel improvements; cut offs, River control structures
Sediment load, Resistance to flow, Social and environmental impacts.

References:

1.R.J. Garde, K.G. Ranga Raju, 1. Mechanics of Sedement Transportation and Alluvial Stream problems, Wiley Eastern Ltd.
2. V.A. Vanoni , Sedimentation Engg, John Wiley and Sons
3. .A. Raudkivi, Loose Boundary Hydraulics, Pergamon Press, Inc
4. P.N. Modi, Irrigation Water Resources and Water Power Engineering, Standard Book House
5. Manual on rivers, their behaviour and Training, Pub No. 60, CBIP, New Delhi

DECE - 14821 Hydrology and Dams

Internal Marks: 40 L T P
External Marks: 60 3 1 0
Total Marks: 100

Course Outcomes

After completing this course the student must demonstrate the knowledge and ability to:

1. Understand the importance of hydrological data in water resources planning.
2. Design of rain gauge network according to requirement.
3. Compute depth of precipitation, run-off and infiltration over the basin by different methods.
4. Design peak flow and fix design floods.
5. Compare suitable type of dams according to site requirements.
6. Design different types of dams i.e; gravity dams, earthen dams, arch and buttress dams.

Course Content:

Introduction, Precipitation: Importance of hydrological data in water resources planning. The hydrologic cycle, Mechanics of precipitation, types and causes, measurement by rain gauges, Gauge net-works, hyetograph, averaging depth of precipitation over the basin, mass-rainfallcurves, intensity duration frequency curves, depth area-duration curves

a) Interception, Evapo-transptration and Infiltration: Factors affecting interception, evaporation from free water surfaces and from land surfaces, transpiration, Evapo-transpiration.

b) Infiltration Factors affecting infiltration, rate, Infiltration capacity and its determination.

Runoff: Factors affecting runoff, run-off hydrograph, unit hydrograph theory, S-curve hydrograph, Synder's synthetic unit hydrograph.

Peak Flows: Estimation of Peak flow-rational formula, use of unit hydrograph, frequency analysis, Gumbel's method, design flood and its hydrograph.

Gravity Dams-Non Overflow Section: Forces acting, Stability factors, stresses on the faces of dam, Design of profile by the method of zoning, elementary profile of a dam.

Gravity Dams-Spillways: Creagers profiles neglecting velocity of approach, profile taking velocity of approach into account, Upstream lip and approach ramp, Advantages of gated spillways, Discharge characteristics of spillways.

Arch and Buttress Dams: Classification of arch dam- constant radius, constant angle and variable radius, Cylinder theory, Expression relating central angle and Cross-Sectional area of arch. Types of buttress dams, Advantages of buttress dams

Earth Dams: Components of earth dams and their functions, Phreatic line determination byanalytical and graphical methods.

Reference

1. Engineering Hydrology - J.Nemec, Prentice Hall
2. Engineering Hydrology by Stanley Buttler, John. Wiley
3. Ground Water Hydrology by TODD, John. Wiley
4. Engineering for Dams Vol. II & III by Creager Justin & Hinds. John. Wiley
5. Hydrology by. S.K.Garg, Khanna Pub
6. Hydrology Principles, Analysis and Design by. Raghunath, H M, New Age Int. Pub

DECE-14822 Disaster Management

Internal marks: 40 L T P
External marks: 60 31 0
Total marks: 100

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Identify various types of disasters, their causes, effects & mitigation measures.
2. Demonstrate the understanding of various phases of disaster management cycle and create vulnerability and risk maps.
3. Understand the use of emergency management system to tackle the problems.
4. Discuss the role of media, various agencies and organisations for effective disaster management & preparedness for future through various case studies.
5. Design early warning system and understand the utilization of advanced technologies in disaster management.
6. Compare different models for disaster management and plan & design of infrastructure for effective disaster management.

Course Content:

Introduction to Disaster Management: Define and describe disaster, hazard, emergency, vulnerability, risk and disaster management; Identify and describe the types of natural and non-natural disasters, Important phases of Disaster Management Cycle

Disaster Mitigation and Preparedness: *Natural Hazards*: causes, distribution pattern, consequences and mitigation measures for earth quake, tsunami, cyclone, flood, landslide drought etc. *Man-made hazards*: causes, consequences mitigation measures for various industrial hazards/disasters, Preparedness for natural disasters in urban areas.

Hazard and Risk Assessment: Assessment of capacity, vulnerability and risk, vulnerability and risk mapping, stages in disaster recovery and associated problems.

Emergency Management Systems (EMS): Emergency medical and essential public health services, response and recovery operations, reconstruction and rehabilitation.

Capacity Building: Gender sensitive disaster management approach and inculcate new skills and sharpen existing skills of government officials, voluntary activists, development of professional and elected representative for effective disaster management, role of media in effective disaster management, overview of disaster management in India, role of agencies like NDMA, SDMA and other International agencies, organizational structure, role of insurance sector, DM act and NDMA guidelines..

Application of Geoinformatics and Advanced Techniques: Use of Remote Sensing Systems (RSS) and GIS in disaster Management, role of knowledge based expert systems in hazard scenario, using risks-time charts to plan for the future, early warning systems.

Integration of public policy: Planning and design of infrastructure for disaster management, Community based approach in disaster management, methods for effective dissemination of information, ecological and sustainable development models for disaster management.

Case Studies: Lessons and experiences from various important disasters with specific reference to Civil Engineering.

References:

1. Natural Hazards in the Urban Habitat by Iyengar, C.B.R.I., Tata McGraw Hill, Publisher
2. Natural Disaster management, Jon Ingleton (Ed), Published by Tudor Rose, Leicester

3. Disaster Management, R.B. Singh (Ed), Rawat Publications
4. ESCAP: Asian and the Pacific Report on Natural Hazards and Natural Disaster Reduction.
5. www.http//ndma,gov,in
6. Disaster Management –Future Challenges & Opportunities by Jagbir Singh, I.K. International Publishing House.

PRCE-14701 MAJOR PROJECT

Internal Marks: 120	L T P
External Marks: 80	- - 3
Total Marks: 200	

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Identify a suitable problem after conducting a thorough literature survey .
2. Prepare hypothesis and select a suitable method to obtain the solution.
3. Design and conduct experiment
4. Record observations, data, and results and their interpretation
5. Use software applications effectively to write technical reports and oral presentations
6. Applying modern engineering tools for the system design, simulation and analysis.

Course Content:

Students are required to work on project in any of the areas related to Civil Engineering. The students will work 3 hours per week with his / her supervisor(s).