Pre Ph.D (Civil Engineering)

Department of Civil Engineering
DIT University Dehradun

Course Structure & Syllabus
for
Pre Ph.D. (Civil Engineering) Course Work
Session: 2018-19

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018

Pre Ph.D (Civil Engineering)

Course Category	Course Code	Course Name	Periods			Credits
			L	T	P	
UC	MB901	Research Methodology	4	0	0	4
DE		Elective 1	4	0	0	4
DE		Elective 2	4	0	0	4
DE		Elective 3	4	0	0	4
DC	DS001	Seminar	0	0	2	1

List of Electives

Subject Code	Course
CE941	Solid Waste Management
CE942	Advanced theory of Disasters and Mitigation Strategies
CE943	Material Characterization and Pavement Analysis
CE944	Advanced Hydraulics
CE945	Computational Hydraulics
CE946	Dynamics of Structures
CE947	Experimental Stress Analysis
CE948	Optimization Techniques in Structural Engineering
CE949	Theory of Elasticity and Plasticity
CE951	Composite Materials
CE952	Soil Dynamics
CE953	Advanced Foundation Design
CE954	Earthquake Resistant Design

Note : Apart from above listed Elective courses, Research Scholar may choose any course across departments being offered at PG level, if it is required/suggested by the Research Committee.

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Subject Code	MB901	Subject Title	Research Methodology						
LTP	4 0 0	Credit	4	Subject Category	UC	Year	1st	Semester	I / II

UNIT – I

Fundamentals of Research: Defining research, Objectives of research, types, research process, deductive and inductive reasoning;

Identifying and formulating a research problem, Literature review: Search for existing literature (World Wide Web, Online data bases), Review the literature selected (Case studies, review articles and Meta-analysis), Develop a theoretical and conceptual framework, Writing up the review,

Definition of variables: Concepts, indicators and variables, Types of variables, Types of measurement scales, Constructing the Hypothesis- Null(Research) and alternative, one-tailed and two-tailed testing, errors in testing. Ethical and Moral Issues in Research, Plagiarism, tools to avoid plagiarism – Intellectual Property Rights – Copy right laws – Patent rights

UNIT – II

Research Design: Design of Experiments: Research Designs -Exploratory, Descriptive and Experimental, Experimental designs- Types of Experimental Designs

UNIT – III

Sampling, Sampling distribution, and Data Collection: Sampling distribution, Normal and binomial distribution, Reasons for sampling, sampling technique, sampling errors. Sources of Data-Primary Data, Secondary Data, Data Collection methods

UNIT – IV

Statistical Data Analysis: Descriptive and inferential statistical analysis. Testing of hypothesis with Z-test, T-test and its variants, Chi-square test, ANOVA, Correlation, Regression Analysis, Introduction to data analysis data using SPSS20.0

UNIT – V

Research Report: Writing a research report- Developing an outline, Formats of Report writing, Key elements- Objective, Introduction, Design or Rationale of work, Experimental Methods, Procedures, Measurements, Results, Discussion, Conclusion, Referencing and various formats for reference writing of books and research papers, Writing a Research Proposal.

Books Recommended:

1. Ganesan R, Research Methodology for Engineers , MJP Publishers, Chennai. 2011
2. C.R.Kothari, "Research Methodology", 5th edition, New Age Publication,
3. Cooper, "Business Research Methods", 9th edition, Tata McGraw hills publication
4. Walpole R.A., Myers R.H., Myers S.L. and Ye, King: Probability & Statistics for Engineers and Scientists, Pearson Prentice Hall, Pearson Education, Inc. 2007.
5. Anderson B.H., Dursaton, and Poole M.: Thesis and assignment writing, Wiley Eastern 1997.
6. Bordens K.S. and Abbott, B.b.: Research Design and Methods, McGraw Hill, 2008.
7. Morris R Cohen: An Introduction to logic and Scientific Method (Allied Publishers) – P 197-222; 391–403

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Subject Code	CE941	Subject Title	Solid Waste Management						
LTP	4 0 0	Credit	4	Subject Category	DE	Year		Semester	

Course Objective:

The Course objective of this course is to learn basic concepts of Solid Waste Management and increase the ability to solve problems involving segregation of waste & resource generation from waste.

Detailed Syllabus

Unit 1 **(10 hrs)**

Introduction

Sources, types, quantity, characteristics of solid wastes. Health & environmental implication of solid waste handling. Sampling & analyses of solid wastes, storage, collection, transfer, and transportation.

Unit 2 **(10 hrs)**

Composition and quantity of solid waste

Terminology and classification, need for analysis, field investigations, number of samples to be collected, collection of samples of solid waste, physical characteristics: density, moisture content, size of waste constituents, calorific value, chemical characteristics.

Unit 3 **(12 hrs)**

Treatment & disposal of solid wastes

Sanitary land filling, Indore & Bangalore methods of composting, factors affecting the composting process, different designs and configurations ofanaerobic digestion, different types of incineration plant, Indian scenario for adoption of incineration technology, pyrolysis/gasification.

Unit-4 **(10 hrs)**

Resource Conservation and Recovery

Sorting at source, centralized sorting, sorting prior to waste processing or landfilling, biological processes, thermal processes, other processes

Unit- 5 **(10 hrs)**

Legal Aspects and Financial Evaluation

Present scenario of legal aspects, proposed legal provisions, examples of enforcement

Present financial provision, expenditure and cost of solid waste management, project life cycle analysis, principle elements of the financial management plan.

Learning Outcome

At the end of the course, the student can :

CO1. Identify principals of solid waste management community waste management problems.

CO2. Apply Standard rules of waste management prescribed by Government of India.

CO3. Optimization of transportation of solid waste.

CO4. Assessing the resources value of solid waste.

Text book [TB]:

Handbook of solid waste management, second edition by George Tchobanoglous and Frank Kreith

Reference books [RB]:

Manual on municipal solid waste management, Ministry of Urban Development, Government of India, year 2000

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Subject Code	CE942	Subject Title	Advanced theory of Disasters and Mitigation Strategies						
LTP	4 0 0	Credit	4	Subject Category	DE	Year		Semester	

Course Objective:

To achieve the advanced knowledge about Natural and human made disasters and mitigation measures

Detailed Syllabus

Unit I **(10 hrs)**

Introduction

Inter relation between Nature, Humanity and Development, vulnerability of disasters, socio economic effects of disasters, political crisis, population migration, and destruction of resources, non-uniform distribution of emergency resources, cultural changes, epidemics, and degradation of natural resources.

Unit II **(10 hrs)**

Fundamentals and characteristics of Natural Disasters

Characteristics of particular hazards and disasters, earthquakes, tsunamis, tropical cyclones, storm surges, floods, droughts, environmental pollution, deforestation, desertification, volcanoes, landslides, avalanches, mud flow, cloud burst, lava flow, dynamics of disasters.

Unit III **(10 hrs)**

Human Induced Disasters

Civil war, chemical and biological war, industrial accidents and leakages. Human induced Deforestation, Social-political movements, contribution to greenhouse gas and ozone layer depletion, rapid ground water exploitation, damage of surface water resources, over utilizations of agricultural pesticides and associated effects, Impact analysis.

Unit IV **(10 hrs)**

Qualitative and Quantitative Assessment

Measurement of Environmental degradation, Impact assessment and associated Methodologies. Role of Remote Sensing and GIS in Environmental assessment, concepts of modeling of environmental parameters, concepts of Forecast, Hindcast and statistical analysis, Strategies of dissemination of information, public awareness.

Unit V **(12 hrs)**

Mitigation Measures, Guidelines, Standards

Latest State of art technologies to minimize the vulnerabilities, role of public and private organizations in India, Guidelines of United Nation, National Enforcements and laws, International laws and standards, guidelines and roles Issued by World Health Organization, United State Environmental Protection Agency, Intergovernmental Panel on Climate Change etc. The Organizational structure and responsibilities of agencies involved in disaster mitigation at national and regional levels.

Learning Outcome

CO1: Knowledge about the natural processes

CO2: Concepts of disasters and causes of those disasters

CO3: Knowledge of mitigation measures and various environmental regulations

Text book [TB]:

CK Rajan, N Pandharinath – 2009, Earth and Atmospheric Disaster Management: Nature and Man-made, BS publications

Singh B.K., 2008, Handbook of Disaster Management: Techniques & Guidelines, Rajat Publication.

Reference books [RB]:

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Subject Code	CE943	Subject Title	Material Characterization and Pavement Analysis						
LTP	4 0 0	Credit	4	Subject Category	DE	Year		Semester	

Course Objective:

The objective of this course is to make the student aware with the concepts of various materials being used as pavement materials and the properties affecting the design of pavements in the field.

Detailed Syllabus

Unit 1 **(10 hrs)**

Characterization of pavement materials

Components of a pavement structure. Subgrade, aggregates, bitumen, cemented material, bituminous and concrete mixes. Material stabilization.

Unit 2 **(12 hrs)**

Testing of materials

Plate Load Test, CBR test, Triaxial test, Stabilometer and cohesiometer test, Indirect tensile test, Resilient modulus test, Complex (dynamic) modulus test, Dynamic (Repeated flexural) stiffness, Creep test. Material modelling: viscoelastic, viscoplastic behavior.(6 Hours)

Unit 3 **(12 hrs)**

Parameters of pavement analysis

Wheel loads and configurations, Lane distribution factor, Vehicle damage factor, Equivalency factor, tyre pressure, contact pressure, tyre imprint, temperature, friction, types of distress.(8 Hours)

Unit-4 **(08 hrs)**

Stresses in flexible pavement

Burmister analysis, layered system concept-two layers and three layers and its solution.(15 Hours)

Unit- 5 **(10 hrs)**

Stresses in Rigid Pavement

Radius of relative stiffness, modulus of subgrade reaction, stresses due to wheel load, warping and friction. Stresses in dowel bar and tie bar.(15 Hours)

Learning Outcome

At the end of the course, the student can :

CO1. Identify the various materials which are being used as pavement materials.

CO2. Identify the various tests conducted on pavement materials to characterize and analyze them.

CO3. Comprehend the various parameters on which design of pavement is dependent

CO4. Compute the stresses in flexible pavement and how they affect the properties of flexible pavement

CO5. Compute the stresses in rigid pavement and how they affect the properties of rigid pavement

Text book [TB]:

1. Yoder, E.J., Witczak, M.W., "Principles of Pavement Design", 2nd edition, 2008, John Wiley & Sons, Inc.

2. Chakroborty, P., Das, A., "Principles of Transportation Engineering", 2014, PHI Learning Pvt. Ltd., Delhi.

3. Khanna, S.K., Justo, C.E.G., Veeraragavan, A., "Highway Engineering", 10th edition, 2017, Nem Chand and Bros, Roorkee

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Subject Code	CE944	Subject Title	Advanced Hydraulics						
LTP	4 0 0	Credit	4	Subject Category	DE	Year		Semester	

Course Objective:

The objective of this course is to learn fundamental concepts, advanced principles and application of hydraulic analysis and design and their application.

Detailed Syllabus

Unit 1 **(12 hrs)**

Open Channel Flow

Kinds of open channel flow, channel geometry, types and regimes of flow, Velocity distribution in open channel, wide open channel, specific energy, critical flow and its computation, Energy in non-prismatic channel, momentum in open channel flow, specific force.

Unit 2 **(12 hrs)**

Uniform Flow

Qualification of uniform flow, velocity measurement, Manning's and Chezy's formula, Determination of roughness coefficients, determination of normal depth and velocity, Most economical sections, non-erodible channels, flow in a channel section with composite roughness, flow in close conduit with open channel flow.

Unit 3 **(12 hrs)**

Varied Flow

Dynamic equations of gradually varied flow, assumptions and characteristics of flow profiles, Classification of flow profile, draw down and back water curves, profile determination, graphical integration, direct step and standard step method, Numerical methods, flow through transitions, dynamic equation of spatially varied flow, analysis of spatially varied flow profile, computation of spatially varied flow using numerical integration.

Unit 4 **(10 hrs)**

Hydraulic Jumps

Hydraulic jump, types of jump, basic characteristics of jump, length and location of jump, jump as energy dissipation, control of jump, surges, surge channel transitions

Unit 5 **(06 hrs)**

Flow through non-prismatic channel section

Sudden transition, sub-critical flow through sudden transition, flow through culverts, flow through bridge piers, obstructions, channel junction.

Learning Outcome

At the end of the course, the student can :

CO1. Understand the concepts of critical energy and flow computational.

CO2Qualification of uniform flow.

CO3. Concepts and applications of gradually varied flow

CO4. Effect of transitions in channels.

Text book [TB]:

"Advances in Hydroinformatics (Springer Hydrogeology)" by Philippe Gourbesville and Guy Caignaert

Reference books [RB]:

1. V.T. Chow: "Open-channel hydraulics." McGraw Hill Publications (1959,1973)
2. Rajesh Srivastava: "Flow through open channels". Oxford University Press (2008)
3. K. Subramanya: "Flow in open channels". Tata McGraw Hill (1997)
4. H. Chaudhury: "Open channel flow". Second Edition. Springer (2008)

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Subject Code	CE945	Subject Title	Computational Hydraulics						
LTP	4 0 0	Credit	4	Subject Category	DE	Year		Semester	

Course Objective:

The objective of this course is understand the governing equations and numerical methods used for solution of flow and transport phenomena.

Course Pre/Co- requisite (if any) :

Detailed Syllabus

Unit 1 **(10 hrs)**

Introduction

Introduction, Numerical integration, Numerical Solution of Ordinary Differential equations for non-linear reservoir routing.

Unit 2 **(12 hrs)**

Numerical methods

Overview and Mesh Generation, Finite Difference Method, Finite Volume Method, Mesh Reduction Methods, Solution Process.

Unit 3 **(12 hrs)**

GVF problems

Gradually varied flow problems, pipe networks, Finite Difference representation for fluid flows, transients in pipes, water hammer.

Unit 4 **(12 hrs)**

Interaction

Governing equations, method of characteristics, transients in pumping schemes and hydroelectric power schemes, Interaction of Different Types of Flow.

Unit 5 **(06 hrs)**

Unsteady free flow

Unsteady free surface flow, governing equations for 2D flow, dam break analysis.

Learning Outcome

At the end of the course, the student can :

CO1. Able to use numerical technique in solution of flow and transport phenomena.

CO2. Able to solve complex GVF equations.

CO3. Able to develop models which can be used in software for the solution

Text book [TB]:

Reference books [RB]:

1. Abbot, M.A. and Vervey, Computational Hydraulics, Elsevier Publications, 1996.
2. Hoffman, J.D., Numerical Methods for Engineers and Scientists, CRC Press, Special Indian edition, 2011.
3. M.H. Choudhary, Applied Hydraulic Transients, Van Nostrand Reinhold, New York, 1997.

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Subject Code	CE946	Subject Title	DYNAMICS OF STRUCTURES						
LTP	4 0 0	Credit	4	Subject Category	DC	Year		Semester	

Course Objective:

To understand the vibration theory of structures and apply to buildings.

Detailed Syllabus

UNIT I **(12 hrs)**

Theory of vibrations: Introduction - Elements of vibratory system - Degrees of Freedom - Continuous System - Lumped mass idealization - Oscillatory motion - Simple Harmonic motion - Vectorial representation of S.H.M. - Free vibrations of single degree of freedom system - undamped and damped vibrations - critical damping - Logarithmic decrement - Forced vibration of SDOF systems - Harmonic excitation -Dynamic magnification factor – Phase angle – Bandwidth.

UNIT II **(12 hrs)**

Introduction to Structural Dynamics : Fundamental objectives of dynamic analysis - Types of prescribed loading - Methods of discretization - Formulation of equations of motion by different methods – Direct equilibration using Newton's law of motion / D'Alembert's principle, Principle of virtual work and Hamilton principle.

Single Degree of Freedom Systems: Formulation and solution of the equation of motion - Free vibration response - Response to Harmonic, Periodic, Impulsive and general dynamic loadings - Duhamel integral.

UNIT III **(12 hrs)**

Multi Degree of Freedom Systems : Selection of the degrees of Freedom – Evaluation of structural property matrices - Formulation of the MDOF equations of motion - Undamped free vibrations - Solutions of Eigen value problem for natural frequencies and mode shapes - Analysis of Dynamic response – Normal co-ordinates – Uncoupled equations of motion - Orthogonal properties of normal modes - Mode superposition procedure.

UNIT IV **(08 hrs)**

Practical Vibration Analysis: Introduction - Stodola method - Fundamental mode analysis - Analysis of second and higher modes - Holzer method - Basic procedure.

UNIT V **(08 hrs)**

Continuous Systems: Introduction - Flexural vibrations of beams - Elementary case – Derivation of governing differential equation of motion - Analysis of undamped free vibrations of beams in flexure - Natural frequencies and mode-shapes of simple beams with different end conditions - Principles of application to continuous beams.

Learning Outcome

At the end of the course, the student can :

CO1. Students will learn Degree of freedom.

CO2. Students will apply vibration theory to beams &columns

Text book [TB]:

Structural Dynamics by Mario Paz, C.B.S Publishers, New Delhi.

Reference books [RB]:

1. Dynamics of Structures by Clough & Penzien, McGraw Hill, New york
2. Dynamics of Structures by Anil K. Chopra, Pearson Education (Singapore), Delhi.
3. I.S: 1893 - 1984, "Code of practice for Earthquake resistant design of Structures" and
Latest I.S: 1893 - 2002 (version) Part-1

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Subject Code	CE947	Subject Title	EXPERIMENTAL STRESS ANALYSIS						
LTP	4 0 0	Credit	4	Subject Category	DE	Year		Semester	

Course Objective:

To Understand the Stress analysis & Elastic theory for Buildings.

Detailed Syllabus

UNIT I **(12 hrs)**

Plane Elasticity Theory: Introduction, Strain equations of Transformation, Compatibility, Stress-Strain Relations-Two dimensional State of Stress. The Plane-Elastic problem, The Plane-Strain Approach, Plane Stress, Airy's Stress function Cartesian Co-ordinates-Two dimensional problems in Polar Co-ordinates, Polar Components of Stress in terms of Airy's Stress function, Forms.

Principles of Experimental Approach: Merit of Experimental Analysis introduction, uses of experimental stress analysis, Different methods.

UNIT II **(12 hrs)**

Strain Measurement using Strain Gauges: Definition of strain and its relation to Experimental Determinations, properties of strain-gauge systems, Types of strain gauges, Mechanical and Optical strain gauges. Electrical Strain Gauges-Introduction, LVDT - resistance strain gauge - various types - gauge factor, Materials for adhesion base, etc.

UNIT III **(12 hrs)**

Brittle Coating Method: Introduction, Coating stresses - Failure theories - Brittle coating Crack pattern - Crack detection - Types of Brittle coating - Test procedures for brittle coating analysis - Calibration procedures - Analysis of brittle coating data.

UNIT IV **(08 hrs)**

Theory of Photo Elasticity: Introduction, Temporary double refraction - The stress opticlaw - Effects of stressed model in a Polaris cope for various arrangements – Fringesharpening, Brewster stress optic law

UNIT V **(08 hrs)**

Two Dimensional Photo Elasticity: Introduction, Isochromatic Fringe patterns – Isoclinic fringe patterns, passage of light through plane Polaris cope and circular Polaris cope, Isoclinic fringe pattern - Compensation techniques - calibration methods, separation methods, scaling Model to Proto type stress- Materials for photo - elasticity, properties of photo elastic materials.

Learning Outcome

At the end of the course, the student can :

CO1. Students will be able to measure stress & Strain.

CO2.Student will be able to know about photo Elasticity.

Text book [TB]:

Experimental Stress Analysis by J.W.Dally and W.F.Riley

Reference books [RB]:

1. Experimental Stress Analysis by Dr. Sadhu Singh.
2. Experimental Stress Analysis by Dove and Adams.

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Subject Code	CE948	Subject Title	OPTIMIZATION TECHNIQUES IN STRUCTURAL ENGINEERING					
LTP	4 0 0	Credit	4	Subject Category	DE	Year		Semester	

Course Objective:

Student will be able to apply Optimization at Structures.

Detailed Syllabus

UNIT I **(12 hrs)**

Introduction to Optimization: Introduction - Historical developments – Engineering applications of Optimization - Statement of an Optimization problem - Classification of Optimization problems - Optimization Techniques.

Optimization by calculus: Introduction - Unconstrained functions of a single variable - Problems involving simple constraints - Unconstrained functions of several variables - treatment of equality constraints - Extension to multiple equality constraints- The generalized Newton-Raphson method.

UNIT II **(14 hrs)**

Linear Programming: Introduction - Applications of linear programming – standard form of a linear programming problem - Geometry of linear programming problems - Definitions and theorems - Solution of a system of linear simultaneous equations - Pivotal reduction of a general system of equations - Motivation of the Simplex Method - Simplex Algorithm - Two phases of the simplex method.

Non-Linear Programming: Introduction - Unimodal Function - Unrestricted search - Exhaustive search - Dichotomous search - Interval Halving method - Fibonacci method - Golden section method - Comparison of elimination methods - Unconstrained optimization techniques - Direct search methods - Random search methods - grid search method - Univariate method - Powell's method - Simplex method - Indirect search methods - Gradient of a function - Steepest descent method - Conjugate gradient - Newton's method.

UNIT III **(12 hrs)**

Dynamic Programming: Introduction - Multistage decision processes - concept of sub optimization and the principle of optimality - computational procedure in dynamic programming - example illustrating the Calculus method of solution – example illustrating the Tabular of solution - conversion of a final value problem into an initial value problem - continuous dynamic programming - Additional applications.

UNIT IV **(10 hrs)**

Network Analysis: Introduction - Elementary graph theory - Network variables and problem types - Minimum-cost route - Network capacity problems - Modification of the directional sense of the network.

UNIT V **(04 hrs)**

Application of Optimization techniques to trusses Beams and Frames.

Learning Outcome

At the end of the course, the student can :

CO1.Student will be able to solve problems using programming

CO2.Undersatnd network analysis.

Text book [TB]:

Optimization: Theory and Applications by S.S.Rao.

Reference books [RB]:

1. Numerical Optimization Techniques for Engineering Design with applications by G.N.Vanderplaats.
2. Elements of Structural Optimization by R.T.Haftka and Z.Gurdal.
3. Optimum Structural Design by U.Kirsch.
4. Optimum Design of Structures by K.I.Majid.
5. Introduction to Optimum Design by J.S.Arora.

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Subject Code	CE949	Subject Title	THEORY OF ELASTICITY AND PLASTICITY						
LTP	4 0 0	Credit	4	Subject Category	DE	Year		Semester	

Course Objective:

To understand elastic & plastic behavior of stuctures.

Detailed Syllabus

UNIT-I **(12 hrs)**

Introduction: Elasticity - notation for forces and stress - components of stresses - components of strain - Hooks law. Plane stress and plane strain analysis - plane stress - plane strain - differential equations of equilibrium - boundary conditions - compatibility equations - stress function - boundary condition.

UNIT II. **(14 hrs)**

Two dimensional problems in rectangular coordinates - solution by polynomials - Saint- Venants principle - determination of displacements - bending of simple beams – application of corier series for two dimensional problems - gravity loading. Two dimensional problems in polar coordinates – stress distribution symmetrical about an axis - pure bending of curved bars - strain components in polar coordinates - displacements for symmetrical stress distributions - simple symmetric and asymmetric problems.

UNIT III. **(14 hrs)**

Analysis of stress and strain in three dimensions - principal stress - stress ellipsoid - director surface - determination of principal stresses - max shear stresses - homogeneous deformation - principal axes of strain rotation.

General Theorems: Differential equations of equilibrium – conditions of compatibility - determination of displacement - equations of equilibrium in terms of displacements - principle of super position - uniqueness of solution - the reciprocal theorem.

UNIT IV. **(08 hrs)**

Torsion of Prismatic Bars - torsion of prismatic bars - bars with elliptical cross sections – other elementary solution - membrane analogy - torsion of rectangular bars - solution of torsional problems by energy method - use of soap films in solving torsion problems - hydro dynamical analogies - torsion of shafts, tubes , bars etc.

UNIT V. **(04 hrs)**

Theory of Plasticity: Introduction - concepts and assumptions - yield criterions.

Learning Outcome

At the end of the course, the student can :

CO1. Understand 3d stress & strain analysis

CO2.Apply the stress & strain to Beam & columns

Text book [TB]:

Theory of Elasticity by Timeshanko, McGrawhill Publications.

Theory of Elasticity by Gurucharan Singh.

Reference books [RB]:

1. Theory of Plasticity by J.Chakarbarthy, McGrawhill Publications.
2. Theory of Elasticity by Y.C.Fung.

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Subject Code	CE951	Subject Title	COMPOSITE MATERIALS						
LTP	4 0 0	Credit	4	Subject Category	DE	Year		Semester	

Course Objective:

To understand the behavior of different types of Materials & application.

Detailed Syllabus

UNIT - I **(08 hrs)**

Introduction: Requirements of structural materials influence of nature of materials in structural form, Nature of structural materials- Homogeneous materials, composite materials.

UNIT - II **(12 hrs)**

Macro mechanical Properties of composite Laminae: Introduction, Assumptions and Idealizations, Stress Strain relationships for composite Laminae- Isotropic, Orthotropic laminae, Strength Characteristics- Basic concepts, Strength hypothesis for isotropic and Orthotropic laminae.

Macro mechanical Analysis of composite Laminae: Introduction, Assumptions and Limitations, Stiffness characteristics of glass reinforced laminae- Stress- Strain relationships in continuous, discontinuous fibre laminae, Strength characteristics of glass reinforced laminae- Strengths in continuous, discontinuous fibre laminae.

UNIT - III **(12 hrs)**

GRP properties relevant to structural Design: Introduction, Short-term strength and stiffness-Tensile, Compressive, Flexural and Shearing. Long term strength and stiffness properties, Temperature effects, Effect of fire, Structural joints- Adhesive, mechanical, Combinational, Transformed sections.

UNIT - IV **(12 hrs)**

Behaviour of Glass Fibre-Reinforced laminates: Introduction, Stiffness characteristics of laminated composites- Behaviour of Laminated beams and plates, Strength characteristics of laminated composites- Strength analysis and failure criteria, Effect of inter laminar structures. uni directionally and multi directionally continuously reinforced laminates, discontinuously reinforced laminates – Stiffness and Strength properties.

UNIT - V **(08 hrs)**

Design of GRP Box Beams: Introduction, loading, span and cross-sectional shape, Selection of material, Beam manufacture, Beam stresses, Experimental Behaviour, Effect on Beam performance- Modulus of Elasticity, Compressive Strength, I value, prevention of compression buckling failure, Behaviour under long term loading.

Design of Stressed skinned roof structure: Introduction, loading and material properties, preliminary design, and computer analysis.

Learning Outcome

At the end of the course

CO1.Student will be able to use GRP Materials

CO2. Student will be able to use root structures &box beams

Text book [TB]:

Mechanics of Composite materials and Structures by Manjunath Mukhopadhyay;
Universities Press

Reference books [RB]:

GRP in Structural Engineering Holmes and D.J.Just.

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Subject Code	CE952	Subject Title	SOIL DYNAMICS						
LTP	4 0 0	Credit	4	Subject Category	DE	Year		Semester	

Course Objective:

To understand the behavior of different types of soils under Dynamic loading.

Detailed Syllabus

UNIT - I

Introduction:

Scope and objective. **(04 hrs)**

UNIT - II **(12 hrs)**

Soil Behavior under Dynamic and Cyclic Loading:

Elastic response of continua (one two and three dimensional wave equation), response of non-plastic and plastic soils under cyclic loading; stress-strain models(elastic, visco-elastic, nonlinear elastic, plasticity); Liquefaction.

UNIT – III **(12 hrs)**

Dynamic Soil Parameters:

Stiffness, damping, and plasticity parameters of soils and their determination (laboratory testing, and intrusive and non-intrusive insitu testing); Correlations; assessment of liquefaction potential.

UNIT - IV

Vibration theory: **(12 hrs)**

Undamped and damped free and forced vibrations, forced vibrations due to support motions, and rotating mass and constant force oscillators, non-harmonic forced vibration.

UNIT - V **(12 hrs)**

Machine Foundations:

Types of machines; Basic design criteria; Methods of analysis; Mass-Spring-Dashpot model; Elastic-Half-Space theory; Types of foundations; Modes of vibrations; Vertical, sliding, torsional (yawing) and rocking (and pitching) modes of oscillations; Design guidelines as per codes; Typical design problems.

Soil Improvement Techniques

Basic concept of soil improvement due to dynamic loading; various methods; Mitigation of liquefaction

Learning Outcome

At the end of the course, the student can able to:

CO1. Find out the dynamics soil properties and strength parameters of different types of soils.

CO2. Analyze &design machines foundation

Text book [TB]:

An Introduction to Soil Dynamics by Arnold Verruijt, Springer publications

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Subject Code	CE953	Subject Title	ADVANCED FOUNDATION DESIGN						
LTP	4 0 0	Credit	4	Subject Category	DC	Year		Semester	

Course Objective:

To understand the soil exploration Techniques field methods and detailed design of different type of foundation elements.

Detailed Syllabus

UNIT - I **(10 hrs)**

Subsurface Exploration: Boring, Sampling, SPT, CPT, Geophysical methods, Bore log and soil report.

UNIT – II **(12 hrs)**

Shallow Foundations:

Terzaghi's, Meyerhoff, Hansens bearing capacity theories, based on SPT, layered soils, eccentric and inclined loads. Bearing capacity on slopes, Foundation settlements.

UNIT - III **(05 hrs)**

Design of Combined and Raft Foundations :

Design of combined footings by Conventional and elastic line methods.

UNIT - IV **(10 hrs)**

Design of Retaining walls :

Lateral earth pressure, Retaining wall stability.

UNIT - V **(10 hrs)**

Sheet Pile Walls :

Cantilever and Anchored sheet pile walls.

Pile Foundations :

Load transfer mechanism, Pile capacity in various soil types, negative skin friction, group action, settlements, laterally loaded vertical piles.

UNIT – VI **(05 hrs)**

Drilled Piers and Caissons, Reinforced Earth :

Design considerations, bearing capacity equations, Settlements, Lateral loads, Types of caissons, stability analysis. Materials and general considerations, Design and Stability.

Learning Outcome

At the end of the course, the student can :

CO1 Find the load transfer mechanism in different type of foundations.

CO2. To Analysis and Design of shallow and deep foundation, sheet pile wall and different foundation elements.

Text book [TB]:

Foundation Analysis and design by J E Bowels McGraw hill International 1995

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Subject Code	CE954	Subject Title	Earthquake Resistant Design						
LTP	4 0 0	Credit	4	Subject Category	DE	Year		Semester	

Course Objective:

The student will be able to learn earthquake resistant design

Detailed Syllabus

Unit -1 **(10 hrs)**

Elements of Earthquake Engineering: Earthquake magnitude and intensity, Focus and Epicentre, Causes and Effects of Earthquakes, Characteristics of Earthquake, Seismic zone mapping.

Structural Systems For Seismic Resistance: Structural systems – building configuration, frames, walls, dual systems – response in elevation – plan – influence of structural classification

Unit -2 **(10 hrs)**

Earthquake Resistant Design: Code based seismic design methods, Equivalent lateral force method, Response spectrum method, Time history method, Soil dynamics and seismic, Spectral analysis,Nonlinear and push over analysis, Effect of plan configurations on the response of the structure.

Unit-3 **(10 hrs)**

Analysis for Earth Quake Loads: Review of the latest Indian seismic code IS:1893: 2002 (Part-I) provisions for buildings, Earthquake design philosophy, Assumptions, Analysis by seismic coefficient and response spectrum methods, Displacements and drift requirements,Time history method. Provisions for torsion, Applications to multi-storied building frames – water tanks – chimneys

Unit-4 **(10 hrs)**

Ductile Detailing: Ductility of R.C structures- Confinement- detailing as per IS-13920-1993- moment redistribution – principles of design of beams, columns – beam column joints – soft story concept.

Unit-5 **(12 hrs)**

Seismic Design of Special structures: Elevated liquid storage tanks' hydrodynamic pressure in tanks, stack like structures; **IS-1893 Codal provisions for bridges:** Super structure, sub structure, submersible bridges.

Rectrofitting and base isolation technique: Retrofitting and strengthening of structures, Base isolation concept, isolation systems and their modeling; linear theory of base isolation;stability of elastomeric bearings; Codal provisions for seismic isolation, introduction to different types of seismic dampers

Learning Outcomes

CO1: The student will learn seismic design and all codal provisions

CO2: The student will learn Structural Systems for Seismic Resistance

CO3: Student will be able to analyze ductile detailing

Reference books [RB]:

1. Agarwal, P. and Shrikhande, M. (2007), Earthquake Resistant of Design of Structures, PHI Publications.
2. Biggs, J.M. (2004), Introduction to Structural Dynamics, McGraw Hill Publications, New York, USA.
3. Chopra, A.K. (2004), Dynamics of Structures, Pearson Education, New Delhi.
4. Duggal, S.K. (2008), Earthquake Resistant of Design of Structures, Oxford University Press, New Delhi.
5. IS: 1983. (1984), Criterion for Earthquake Resistant Design, Bureau of Indian Standards, New Delhi.
6. Paz, M. (1997), Structural Dynamics - Theory and Computation, Springer, New York, USA.