

SYLLABUS OF MASTER OF CIVIL ENGINEERING

First semester

Category:- Departmental / Specialization Basket

PAPER-I

PG / CE / T / 111A - Dynamics of Structures

Introduction – Dynamic system with single degree of freedom and multi-degree freedom systems. Vibration of continuous elastic media – Beam, Plates. Earthquake analysis. Random vibration.

PG / CE / T / 111B - Wind Analysis and Design of Structures

Concept of wind; Wind mechanics; Effect of wind on tall structures; Buildings, chimneys; Towers etc. Wind effect on bridges, wind tunnel testing; Statistical analysis of wind; Different codes of practices related to wind; Field studies on wind Engineering, case studies.

PG / CE / T / 111C - Advanced Foundation Design

Bearing Capacity on Slopes, Settlement Analysis of Foundations in Sand and Clay, Settlement of Piles; Pile foundations – vertical and lateral loads; Negative skin friction of piles; Uplift capacity of piles and anchors; Foundations on expansive soils; Well foundations; Machine foundations.

PG / CE / T / 111D - Water Supply and Treatment

Water chemistry, Stabilisation of water, Adsorption, aeration, Sedimentation, Coagulation and flocculation, Filtration, Disinfection, water softening, Ion-Exchange.

PAPER II

PG / CE / T/ 112A - Concrete Science and Technology

Portland cement – its manufacture, physical and chemical properties; Standard test methods; Different types of Portland and other cements – a brief introduction; Properties of fine and coarse aggregates; Properties and standard test method concrete in fresh and hardened state; Mixing, transportation, placing and compaction of concrete; Effect of chemical admixtures on fresh and hardened concrete; Durability of concrete; Mix proportioning; Introduction to special concrete – Lightweight and foam concrete; High performance concrete; Ultra high strength concrete; Ready mix concrete, Roller compacted concrete, fibre reinforced concrete, high density concrete, pumped concrete etc.

PG / CE / T/ 112B - Repair and Rehabilitation of Structures

Appraisal of damage and deterioration of structures by non-destructive and other techniques; Cause of deterioration; Environmental aspects and earthquake effects; Repair and strengthening of superstructure – structural components, load bearing wall, panel walls; Strengthening of foundation; Grouting; Grout material, guniting, shotcreting, under pinning; Repair of steel structures – bridge, building, towers etc.,

monuments and historical structures. Prevention of water leakage in structures; Underwater repair; Durability of repairing material; Case histories.

PG / CE / T/ 112C- Advanced Theory of Soil Mechanics

Analysis of stresses and strains in soil; 2 and 3 dimensional stress tensors, Equation of equilibrium and compatibility, Plane stress and Plane strain problems, stress functions, equations in Cartesian and Polar co-ordinate system. Stress distribution in homogeneous, non-homogeneous, layered and anisotropic deposits; Effect of non-linearity. Shear strength of saturated and unsaturated soil. Failure criteria, Different types of laboratory shear tests, critical evaluation and application; In-situ shear strength; Hvorslev's parameters.

Consolidation of clays, one dimensional and three dimensional consolidation; Numerical solution, uniform and layered deposits. Sand drains – theory and applications.

Stress path and its application.

PG / CE / T/ 112D- Rock Mechanics and Tunnelling

Geological survey and exploration, Classification and characterisation of rock mass, in-situ determination of engineering properties of rock mass, in-situ stresses.

Underground openings, structural geology in rock tunnelling, Rock slopes, Rock foundations; Bearing Capacity of Rocks; Drilling and blasting of rocks; Grouting; Instrumentation and measurements in tunnelling.

PG / CE / T/ 112E - Wastewater Treatment and Disposal

Wastewater sampling, Waste water characterisation, Standards for treated effluents, physico-chemical and biological. Wastewater treatment, Sludge disposal, Tertiary treatment, Land application of wastewater effluent and sludge.

PAPER III

PG / CE / T/ 113A - Advanced Structural Design

Soil-structure interaction problems; Strip, Raft and Mat foundation: Underground Tunnels: Dry dock and Jetty, Structures for handling materials.

Waffle slab, Flat slab and Grid; Folded plates, cylindrical and Doubly curved shells, Helicoidal stair, cooling towers; Water tower, silo, Bunker and their supporting structures.

PG / CE / T/ 113B - Bridge Engineering

Site Investigation, Bridge Hydrology, Geometry of Bridges, Steel, R.C.C., Prestressed Road and Rail Bridges; Suspension and Cable Stayed Bridges: Bearings, Joints, etc. Foundation, construction and erection; Maintenance of bridges; Codes of Practice; Multi-beam multi-cell R.C.C. bridges, curved and Skew Bridges, Dynamic Analysis of Bridges;

PG / CE / T/ 113C - Slope Stability and Earthen Dam

Effective stress analysis; Stability of earth and rock fill dams; Steady state seepage and rapid draw down cases. Design of earth dams; Pore pressure during construction stage; Methods of seepage control in earth dams. Seismic analysis of embankment. Analysis of reinforced slope.

PG / CE / T/ 113D - Geotechnics for Highway Engineering

Highway embankments ; Design and construction of embankments , Stage construction, Reinforced Earth design and construction, Pavement design, Different design methods for Highway and Airport Pavements, Construction materials and construction processes, Pavement evaluation and performance, Mathematical model for Pavement systems

PG / CE / T/ 113E - Seismic Design of Foundation

Elements of earthquake, Seismic loading; Soil properties for seismic design; Earth pressure under seismic condition; Liquefaction of soil; determination of ground acceleration; Damping of soil; Foundation design under earthquake loading; Seismic design of slopes.

PG / CE / T/ 113F - Solid Waste Management

Solid Waste survey, Source, Quality and composition of solid waste, Collection, transfer, processing and and transportation, Method of disposal, Sanitary landfill, Composting, Incineration, Pyrolysis, Energy recovery.

Category:- Interdisciplinary Basket

PAPER IV

PG / CE / T/ 114A - Theory of Elasticity and Elastic Stability

2 and 3-dimensional stress tensors, equations of equilibrium and compatibility, plane stress and plane strain problems, stress functions, constitutive relationship. Equations in Cartesian and Polar coordinates systems, bending of beams and plates, torsion of shafts, Introduction to bifurcation of equilibrium, beam column, plates under axial compression, finite element formulation of geometrically non-linear problem.

PG / CE / T/ 114B -Remote Sensing and Its Application

Energy sources, energy interaction in the atmosphere, data acquisition and interpretation, types of scanning and sensing system. Concept of GPS and its application. History of Indian Remote Sensing. Image interpretation. Digital Image Analysis - rectification and restoration. Image enhancement, manipulation techniques, Image classification. Post classification Smoothing; classification accuracy assessment; Principles of GIS. Application of Remote Sensing and GIS in Engineering Problems.

PG / CE / T/ 114C - Environmental Impact Assessment

Legal Aspects of EIA, Objectives of EIA, General Methodology of EIA, Base line Studies, Screening, Scoping, Public Consultation, Data Collection, Environmental Impact Analysis, Mitigation and Impact Management, Case Studies, Environmental Audit.

PAPER V

PG / CE / T/ 115A - Computer Methods and Finite Element Analysis

Matrix Algebra – methods for matrix inversion and solution of simultaneous equations – band and sparse matrix techniques-stiffness and flexibility matrices of structural elements – various co-ordinate system and their transformation and

synthesis-matrix formulation of force and displacement methods – member approach. Finite element concept in Engineering Analysis – Displacement model shape functions and element properties. Analysis of plane stress/strain – axi-symmetric stress analysis. Weighted residual methods and variational formulation of Finite Element Analysis. Isoparametric element – Potential flow and heat transfer in 2-Dimension – Numerical integration – assemblage of elements. Solution techniques – Finite element programming – use of package programmes. – Boundary element method.

PG / CE / T/ 115B - Subsoil Investigation

Problems and phases of foundation investigations; Methods of exploration, geophysical and conventional methods; Sounding, drilling and boring technique; Ground water table determination; Application of Remote sensing in subsoil classification. Field tests – penetration tests, vane shear tests, pressuremeter test, plate load test, field permeability test, critical evaluation of different tests; Preservation and transportation of samples; Selection of type of laboratory tests, analysis and interpretation of results, Site evaluation and reporting.

PG / CE / T/ 115C - Environmental Pollution and Management

Wastes: types and sources , Water pollution: characterisation of liquid wastes and effects, Stream sanitation, Treatment methods. Air pollution: Effects, dispersion and monitoring and control methods. Solid Wastes Management : Characterisation, disposal methods.

Elements of noise pollution , Environmental Acts and Regulations.

PAPER VI

PG / CE / T / 116A - Theory of Plates and Shells

Differential equation of plate under transverse load, series solution; Plates with different boundary conditions and their finite difference solutions; Stress-strain relations and finite element formulation of plate bending problem; Classical theory of shells – membrane and bending theories; Shallow shell theory; Cylindrical and spherical shells – membrane theory and edge disturbance. FEM & BEM formulation of shell element and application.

PG / CE / T / 116B -Advanced Hydrology and Ground water

Hydrology in water resources planning, Water availability, water balance studies; Hydrologic data; Statistics in hydrologic analysis, frequency analysis, reliability of statistical analysis. Modeling aspects. Hydrograph analysis. Design flood, Flood frequency analysis, Flood forecasting; Flood Routing.

Ground Water, Aquifer properties, well hydraulics, estimation of ground water flow, sea water intrusion. Groundwater quality; Effect of withdrawal of ground water and ground subsidence; ground water recharge; ground water pollution and legislation.

PG / CE / T / 116C -Environmental Management & Ecology

Definition, Glossaries on different Environmental Descriptors, Natural and Anthropogenic pollution, Sustainable Development, Procedural interaction with legal

authorities, Environmental protection Acts, Rules, Statutory Standards, Conceptual aspects of EIA, ES, EMP, Hazardous substances & Risk Analysis.

Water and Atmospheric Pollution -- types, causes, sources, primary and secondary pollutants, effects, Dispersion of Air pollutants, Rudiments of Control Measures, Standards, Solid waste-classification, collection and disposal management, Noise Pollution - causes and effects, control measures, Global Atmosphere change.

Concept of Ecology, Productivity Cycle, Food chain, Limnology, Nutrient Cycle, Eutrophication, Ecopond System, A few case studies related to Environmental Issues.

PG / CE / T / 116D - Water pollution and Control

Water uses and Quality criteria, Water quality standards, Point and Non-point source of pollution, pollution monitoring and data interpretation, Pollution dynamics in natural water bodies, Water quality management, Legal aspects of water quality control..

PG / CE / T / 116E - Advanced Mathematics

Complex Variables: Elements of set theory, Set notations, Applications of set theory, Open & Closed Sets. Review of Complex variables, Conformal mapping and transformations, Functions of complex variables, Integration with respect to complex argument, Residues and basic theorems on residues.

Numerical Analysis: Introduction, Interpolation formulae, Difference equations, Roots of equations, Solutions of simultaneous linear and non-linear equations, Solution techniques for ODE and PDE, Introduction to stability, Matrix eigen value and eigen vector problems.

Optimisation Technique: Calculus of several variables, Implicit function theorem, Nature of singular points, Necessary and sufficient conditions for optimisation, Elements of calculus of variation, Constrained Optimisation, Lagrange multipliers, Gradient method, Dynamic programming.

Probability and Statistics: Definition and postulates of probability, Field of probability, Mutually exclusive events, Bayes' Theorem, Independence, Bernoulli trial, Discrete Distributions, Continuous distributions, Probable errors, Linear regression, Introduction to non-linear regression, Correlation, Analysis of variance.

Category: Sessional Courses

Sessional I

PG / CE / S / 111- Laboratory

Each Student will carry out a set of advanced experiments from his/her field of study/specialization offered by the department on the recommendation of his/her Sectional in-charge in the First Semester.

Sessional II

PG / CE / S / 112- Assignment

Each student will be given an Assignment design Project/Analysis/Software development etc), which he/she has to work on and submit a report.

Second semester

Category:- Departmental / Specialization Basket

PAPER VII

PG / CE / T/ 127A -Analysis and Design of Tall Structures

Structural planning of tall building; Dead load, Live load, earthquake load and wind load on buildings, Building frames, shear walls, Frame-shear wall interaction; other structural forms and their analysis, Temperature stress in buildings, High mast Towers Pylons and their supporting structures; chimneys hoists and cranes, Foundation of tall structures.

PG / CE / T/ 127B - Earthquake Analysis and Design of Structure

Characteristics of earthquake, Earthquake response of structures. Concept of earthquake resistant design. Code provision for design of buildings, design of liquid storage tanks, liquefaction, non-engineered construction, special topics – bridges, dams, strengthening of existing buildings.

PG / CE / T/ 127C - Soil Dynamic and Machine Foundation

Strength and deformation of soil under dynamic loads; Determination of dynamic coefficients, shear modulus and elastic constants of soil; Transient/shock loading on cohesionless soil; Damping in soil – geometrical and internal damping; Elastic wave propagation theory.

Vibration theory related to machine foundations; design of foundation for reciprocating and rotary machines, foundation for impact type loading; vibration isolation technique. Dynamic analysis of Pile Foundation. Dynamic Analysis of T.G. Foundation.

PG / CE / T/ 127D - Instrumentation and Case Histories in Geo technical Engineering

Types of field measurements; Principles of instrumentation; Settlement gauges, Piezometers, earth pressure cells and inclinometers; Planning of instrumentation; Vibration measurements.

Case histories; Building settlement; in-situ stresses in soils; Underground construction and tunnelling in soft ground; Dams and embankments; Failure investigations in Geo technical Engineering.

PG / CE / T/ 127E - Air Pollution and Control

Composition of air, Types, Sources and effects of pollutants, Green-house effect and ozone depletion, Air pollution meteorology, Measurement for meteorological parameters, Automobile emissions, Smog pollution, Air pollution monitoring, Stack monitoring, Transport of air pollutants, Urban air pollution modelling, Abatement and control of air pollution.

PG / CE / T/ 127F - Noise Pollution

Sound, Hearing mechanism, Noise measurement, Sound field, Road acoustics, Vibration control, Noise criteria, Noise control, case studies.

PAPER VIII

PG / CE / T/ 128A - Precast and Prestressed Concrete Structure

Precast concrete – definitions, advantages and disadvantages, type standardisation and component standardisation, constructional principles, manufacture of prefabricated components, analysis of typical structures, strength and serviceability requirements, classification of joints and their deformability, design examples of panels, walls etc. due to loads and temperature effects.

Prestressed concrete – specification of materials, methods of prestressing, losses, analysis and design of members for moment and shear, stresses in anchorage zones of pretensioned and post tensioned members, design of end block, partial prestressing, composite construction with prestressed concrete and reinforced concrete; two-way prestressing, circular prestressing, indeterminate structures.

PG / CE / T/ 128B - Advanced Concrete Science and Technology

Microstructural aspects of cement paste; Models of hydrated Portland cement gel; Mechanism, application and specification of chemical admixtures, mineral admixtures and other cement replacement materials; Special cementitious systems, viz., phosphate cement, magnesium oxychloride cement, regulated set cement, high alumina cement etc.; concrete- environment interaction; Marine concrete; Resistance of concrete to Fire and influence of temperature; Extreme weather concreting; Properties and mix proportioning of flyash concrete, silica fume concrete, fibre reinforced concrete, sprayed concrete, high performance concrete, self compacting concrete and geopolymer concrete.

PG / CE / T/ 128C - Retaining Structures and Underground Construction

Earth pressure theories, conditions of applicability, arching effect; Retaining walls, different types and their stability, design considerations, drainage provisions; Cantilever sheet pile wall; Anchored bulk head, Free and fixed earth support methods, types of sheet piles and construction aspects; cellular coffer dams, design procedures, interlock, piling rise and overturning; Braced excavation, types, earth pressure, effect of wall rigidity and sequence of construction, Design of wall and wall supports; tunnels and shafts, pressure distribution, design of tunnel lining, methods of tunnelling, ground loss.

PG / CE / T/ 128D - Analytical Geo mechanics

Applications of elasticity and plasticity theory; Yield functions; Flow rule; Hardening law; Failure criteria; Critical state Soil Mechanics; Elasto-plastic modelling and numerical methods.

PG / CE / T/ 128E- Process Design in Environmental Engineering

Collection of water, Water treatment units, water distribution networks, Design of water and wastewater treatment system, Sewerage and drainage, Waste water treatment units, Design of waste water treatment plant. Advanced water and waste water treatment.

PG / CE / T/ 128F - Hydraulics for Environmental Process Design

Fluid properties, Hydrostatics, Orifices, Gates, weirs, Flow trough pipes, Open channel with non-uniform flow, Measurement of flowing water, Pumps.

PAPER IX

PG / CE / T/ 129A -Offshore Structures

Concept of wave, Linear and non-linear wave theories, wave forecasting, fluid structure interaction problem, Analysis of fixed and floating type offshore structures, Fatigue analysis stochastic analysis of offshore structures, soil-structure interaction problem, Marine concrete, Construction of offshore structures, Marine pipelines, case studies.

PG / CE / T/ 129B - Plastic and Limit State of Structures

Simple cases of plastic collapse; Basic theorems and examples; General Methods of Plastic Design; Estimate of deflection; Factors affecting the fully plastic moment; Minimum weight design, variable and repeated loading, shake down theorem. Principles and philosophy of Limit state design, Members under flexure, shear bond and axial force, compatibility calculation for the analysis of structure, Yield line theory of slabs.

PG / CE / T/ 129C - Ground Improvement Techniques

Principles of ground improvement; Mechanical densification; Drop hammer and compaction pile; Compaction of cohesive soils, pre-loading and vertical drains, stone columns and granular piles; Admixture stabilisation; Grouting; Geotextile application.

PG / CE / T/ 129D - Environmental Geo technique

Source, production and classification of wastes; Environmental impact on geo technical problems; Site remediation; Soil pollutant interaction; Waste disposal facility; Liners and their stability; Elements of ground water contaminants; Geo technical aspects of waste management; Recycling of waste materials; Design of landfills; In-situ characterisation; Monitoring subsurface contamination.

PG / CE / T/ 129E-Industrial Waste Water Treatment

Industrial effluent standards, Industrial waste water survey, In-plant control measures, waste minimization Transportation of wastewater, Monitoring, Neutralisation, Equalisation, flotation and proportioning, Treatment, Disposal of sludge solids, Joint treatment, Disposal, Treatment of wastewater from steel and allied product manufacturing, Textiles, Food Processing and Dairy, Tanning, Pulp and paper industries, Power generation, Fertiliser.

PG / CE / T/ 129F- Sanitary Microbiology and Biochemistry

Classification, Chemical composition, Metabolism, Growth, Role of microorganisms in biogeochemical cycles, Biological waste treatment, Pathogenicity, Acids, Bases, pH, Buffer, Chemistry of carbohydrate, lipids, amino acids and proteins, nucleic acids, Carbohydrate metabolism (both aerobic and anaerobic). General metabolism of amino acids and proteins, Rudiments of lipid and nucleic acid metabolism, Integration of metabolism.

Category:- Interdisciplinary Basket

PAPER X

PG / CE / T/ 1210A - Advanced Computer Methods and Finite Element Analysis

Generalization of Finite Element concept. Lagrange multiplier and Penalty function. Non-linear analysis – total and updated Lagrangian formulation. Geometric non-linear analysis, truss, beam. Material non-linear analysis, Constitutive model, Plasticity. Dynamic problems and Finite Element analysis.

PG / CE / T/ 1210B - Structural Optimization

Classical methods – theory of layout – Differential calculus – simultaneous modes of failure – Fully stressed design – optimality criterial methods.

Mathematical programming and computer techniques – linear programming – Revised simplex method, non-linear programming fundamentals – Methods for one dimensional minimization – Direct search and gradient methods for unconstrained problems – use of penalty functions and sequential L.P. for constrained optimisation problems – Geometric programming and dynamic programming – application to structural engineering problem.

PG / CE / T/ 1210C - Hazardous Waste Management

Identification & Characterization of Hazardous Waste, Hazardous Waste Rules, Risk Assessment, Dose-Response Assessment, Exposure Assessment, Risk Characterization, Handling & Storage of Hazardous Waste, Transportation of Hazardous Waste, Treatment & Disposal of Hazardous Waste.

PG / CE / T/ 1210D - Coastal and Offshore Geo technology

Elements of physical oceanography related to coast and offshore including tides, currents, waves and littoral drift; Hydraulic and geo technical design of coastal structures.

Offshore site investigations, properties of marine soils; Soil behaviour under cyclic loading, design storm loading; Gravity structures; Dynamic response and cyclic displacements; Pile foundations for offshore structures, axial lateral and cyclic loads, types of foundation anchorage; Jack-up platforms; Rig foundations.

Category:- Sessional Courses

Sessional I

PG / CE / S / 123- Term Paper Leading to Thesis

Each student will be given a Thesis/Project problem at the beginning of Second Semester. He/She will work on the literature survey, scope of work, equipment development etc. and submit a report/dissertation. The main Thesis/Project work will, however, be done in the third and fourth semesters.

Sessional II

PG / CE / S / 122 - Seminar

Each student will present a seminar on an assigned problem in the Second Semester. The problem will be given to the student in the First Semester and the work will be

continued into the Second Semester. The student will be required to give a write up and present a seminar in the 2nd Semester.

THIRD and FOURTH SEMESTER

Category:- Sessional Courses

Sessional I

PG / CE / TH / 21- Thesis

Each student will devote full time in the Third Semester on a Thesis/Project on an assigned research problem of Design/Development work under the supervision of a Faculty Member. He/She will present a Thesis/Project Report at the end of the Third Semester which will be evaluated by a Board of Examiners consisting of the Supervision and External Examiner. The evaluation of the thesis will be followed by a viva-voce in front of faculty members and other post-graduate students.

Sessional II

PG / CE / VV/ 22- Viva-Voce