National Institute of Technology Karnataka, Surathkal

Department of Civil Engineering

Ph.D. Program Structure

- The Ph.D. Degree Programme Structure consists of the following stages:
  (i) Ph.D. Course Work and Evaluation.
  (ii) MLC: SM900 Research methodology.
  (iii) Comprehensive Examination.
  (iv) Research Proposal Submission and Assessment.
  (v) Research Progress Assessment.
  (vi) Pre-Synopsis Seminar and Synopsis Submission.
  (vii) Ph.D. Thesis Submission and Assessment.
- The Minimum Course Credit Requirement is 12.
  (Courses carrying 'S'/'N' grades shall not be counted).
  Out of 12 credits required, only one self study course (900 level) with a maximum of 4 credits is permitted with the recommendation by the DRPC of the respective departments and approved by Dean (A). The student may also be allowed to do pre-approved certified MOOCs towards maximum of 4 credits. Examination to be conducted by the Department for such certified courses to award grades.
- The Course work must be completed within the first year of joining the program with a minimum CGPA of 6.0.
- In the case of Full time/External registrant sponsored student from the industry or other organizations, the minimum of one semester residential requirement may be waived by DRPC, on case-to-case basis. These students may be allowed to do pre-approved certified MOOCs and also a self-study course, towards 12 credits. Examination will be conducted for such certified courses to award grades, by the department. They also need to do a certified Research methodology course.
- Every research scholar is required to undergo registration at the commencement of each semester on the days fixed for such registration and notified in the academic calendar.

List of Self Learning Courses (Level 900) Offered by Department of Civil Engineering:

CV900 Soil Chemistry **4**

Introduction, Soil formation, Soil structure, Clay mineralogy, Chemical composition of soils, Soil-lime reactions, Flyash reactions, Soil-cement reactions, Reactions of various other chemicals with soil, Soil grouting, Colloid chemistry, Change in soil properties due to chemical reactions, Impact of environment on soil properties.

References: *Engineering Principles of Ground Modifications, McGraw-Hill. Renben H. Carol, Chemical Grouting and Soil Stabilization, M. Drekker Publishers, NY*.

CV901 Advanced Soil Reinforcing Techniques **4**

Historical background, Reinforced soil structures and RCC, Vidalean concept of reinforced earth, Triaxial studies on reinforced soil, Enhanced confining pressure concept and apparent anisotropic cohesion concept, Reinforcing man made slopes, and natural slopes, Reinforcement in body embankment stability of reinforced steep soil slopes, reinforced walls, type of reinforcements, properties of backfill soils, Soil-reinforcement interaction studies, pullout tests and direct shear tests, Reinforcement beneath foundations and embankments, Geosynthetics properties, tests and applications in civil engineering. Recent advances in Soil Reinforcing Techniques.

References: *CJFP Jones, Earth Reinforcement and Soil Structures, Butterworths, London. R. M. Koerner, Designing with Geosynthetics, Prentice-Hall.*

CV902 Vibration of Plates **4**

Strain energy of vibrating systems, free and forced vibration, continuum and discrete systems, differential equations of lateral motions, flexural vibration of plates, Hamilton's principle, Energy methods for determining natural frequencies, eigenvalue and eigenvector, solution methods.

References: *AW Leissa, Vibration of Plates, NASA SP-160.*

CV903 Hydrogeology **4**

Hydrological cycle, Aquifers, classification and characteristics, Groundwater distribution, occurrence, movements, Groundwater exploration, Geological, hydrological, geophysical and remote sensing methods, Groundwater budgeting, Groundwater recharge, Rainwater harvesting, Quality of groundwater, Groundwater management, Case histories of typical groundwater studies.

References: *David Keith Todd, Ground Water Hydrology, John Wiley and Sons. Karanth K. R., Groundwater assessment, development, management, Tata McGrawHill.*

CV904 Advanced Environmental Geotechnology **4**

Perspective of environmental geotechnology, Soil, environment, water interaction, mass transport, Energy gradient and conductivity, Sources of water contamination, Underground, groundwater flow conditions, Contaminate migration, Disposal and containment of solid, water remediation. Recent advances in Environmental Geotechnology.

References: *Donald P. Coduto, Geotechnical Engineering, Principles and Practices, PrenticeHall. Daniel, D. E. Geotechnical Practice for Waste Disposal, Chapman and Hall, London. Reddi L. N., and Inyang. H. F. Geo environmental Engineering- Principles and Applications, Marcel Dekker, Inc.*

CV905 Special Concretes **4**

High performance concrete, definition, materials used, mix design methods, properties of fresh and hardened states, Recent advances in mix design procedure, Lightweight aggregate concrete, definition materials used, mix proportioning and properties, self-compacting concrete, definition, mix proportioning, testing at fresh state, no fines concrete, definition, mix design and properties.

References: *PC Aitcin, High Performance Concrete, E&FN SPON, London. AM Neville, Properties of Concrete, Longman Scientific and Technical Publishers.*

CV906 Mechanics of Composite Laminates **4**

Types and classification, Lamina stress strain relationship, Classification of laminates, Failure theories, Classical lamination theory, Stress strain variation in a laminate, Stress analysis, Intra and interlaminar stresses in

laminates, First and higher order deformation theories, Bending, vibration and buckling analyses using the above theories, Equilibrium equations using PMPE, Boundary conditions, Solution methods.

References: *RM Jones, Mechanics of Composite Materials, McGraw-Hill. JR Vinson and RL Seierakowski, The Behaviour of Structures Composed of Composite Materials, MartinusNijhoff Publishers.*

CV907 Basic Operation Research & Shape Optimisation 4

Structures, Hall marks of good structures, Stability Strength, Safety, Serviceability, Durability and economy, Need and scope for Optimization. Optimization basics, Classical methods, Numerical techniques, Objective function, Constraints, Problem formulation and solution. Structural Configuration, Inherent relationships between load and shape - topology. Minimum weight, minimum cost, Maximum strength to weight ratio, multi-objective techniques of topology.

References: *SS Rao, Optimization, Wiley Eastern Gallagher, Optimum Structural Design, Wiley, New York.*

CV908 Structural Systems for Tall Buildings 4

Configuration, Structural Concepts, Building frames, Hard and soft connections, Lateral loads, Stability, lateral load resisting systems, Shear walls, Shear cores, Tube-in-tube concept, soft tube structures, Core-frame interaction, Outriggers. Transmission line towers, Chimneys, Cooling towers, analysis and design, detailing.

References: *Taranath, Analysis and Design of Tall Buildings, McGraw Hill, New York Pinfold, RC Chimneys and Towers, Viewpoint Publ., London.*

CV909 Innovative Applications of Shellsin Foundations 4

Foundations, Criteria for design, General and local shear failures, Settlements, Bearing Capacity and Allowable Pressures, Conventional Foundation Types, shells and folded plates as foundations, Shell geometry, Classifications, Stability of shells and plates as footings, Strategic considerations for selection of type. Analysis, design and detailing of singly and doubly curved shell foundations, Applications of V and trough folded plates in footings and retaining structures.

References: *G. S. Ramaswamy, Design and Construction of shell roofs, CBS Publishers. N. P. Kurian, Design of Foundation Systems: Principles and Practices, Wesley Publishing Co.*

CV910 Numerical Analysis **4**

Solution of algebraic transcendental and polynomial equations. Newton-Raphson method, Muller method, Graeffe's and Bairstow's methods. Lagrange's, Hermite and Cubic Spline interpolation, Numerical differentiation and integration, Numerical solution to ordinary and partial differential equations, Finite element method, formulations using Galerkin and Ritz method. Gaussian integration, Frontal solution technique.

References: *MK. Jain, SRK. Iyengar and RK Jain, Numerical Methods for Scientific and Engineering Computations, Wiley Eastern. AR. Mitchell and R. Wait, Finite Element Method in Partial Differential Equations, John Wiley and Sons.*

CV911 Advanced Geotechnical Instrumentation **4**

Requirements of a good instrumentation; Theory, Design, Methods of analysis of data; laboratory and field instrumentation; Planning an instrumentation program; transducers, hydrometers, strain measuring devices, load cells, LVDTs, pH meter etc, measuring rock and rock mass properties; settlement gauges, inclinometers, earth pressure cells, piezometers, instruments used in geophysical exploration methods, ground probing radar and instruments used in field tests such as SPT, SCPT, DCPT etc., nuclear moisture meter/densitometer, frequency analyser, role of electronics in instrumentation; calibration, maintenance and installation of instruments, uncertainty analysis. Recent advances in Geotechnical Instrumentation.

References: *Hanna, T.H., Field Instrumentation in Geotechnical Engineering, Trans-Tech Publications. Bowles, J.E., Engineering Properties of Soils and their Measurements, McGraw-Hill.*

CV912 Earthquake Resistant Design of Structures **4**

Introduction to earthquake resistant design, seismicity and earthquake ground motions, dynamic characteristics of structures, dynamic response of structures, initial design considerations, calculation of earthquake induced forces, IS1893, purpose of seismic strengthening, common deficiencies, seismic vulnerability assessment, procedures for repair,

restoration and retrofitting of RC and masonry structures, examples seismic retrofitting.

References: *Williams A, Seismic Design of Buildings & Bridges, Engineering Press, 1998 Dowrick, Earthquake Resistant Design IS codes IS1893, IS 4326, IS13935, IS13920.*

CV913 Design of Structures with Seismic Isolation 3

Principles of base isolation, general considerations, basic elements of seismic isolation systems, energy dissipation, force deflection characteristics, seismic-isolation design principles, feasibility of seismic isolation, design methods, design examples

CV914 Performance Based Seismic Engineering 3

Seismic performance, damage control, life safety, collapse prevention, immediate occupancy, performance-based design, seismic demand and capacity, ADRS spectrum, target displacement, performance objectives, push-over analysis, capacity spectrum, static analysis, nonlinear analysis.

CV915 Geotechnical Earthquake Engineering 4

Introduction, seismology and earthquakes, strong ground motion, seismic hazard analysis, seismic wave propagation, dynamic soil properties, ground response analysis, local site effects and design ground motions, liquefaction, seismic slope stability, seismic design of retaining walls, soil improvement against seismic hazards.

References: *Cramer S L, Geotechnical Earthquake Engineering, Pearson Education 2003. Day, Geotechnical Earthquake Engineering Handbook.*

CV916 Seismic Design of RC & Steel Structures 3

Concrete structures: Design for inertial effects, estimates of demand and capacity, ductility in earthquake resistant design, behaviour of concrete members under earthquake-type loading, codal provisions, nonlinear response, design examples. Steel Structures: Introduction, codal provisions, design of moment resisting frames, design of concentrically braced frames, hysteretic energy dissipation capacity, design of eccentrically braced frames, design examples.

References: *Williams A, Seismic Design of Buildings & Bridges, Engineering Press, 1998 Dowrick, Earthquake Resistant Design IS codes IS1893, IS 4326, IS13935, IS13920.*

CV917 Design of Structures Against Blast Loading **3**

Introduction, partial safety factors in blast design, basic guidelines for enhancing building resilience, blast loading, structural response to blast loading, design of various structural elements for blast loading.

References: *Mays G C & Smith P D, Blast Effects on Buildings, Thomas Telford 1995.*

CV918 Advanced Offshore & Coastal Structural Engineering **3**

Introduction, deep water offshore structures, TLPs and compliant structures, dynamic analysis of offshore structures, breakwaters, jetties and other coastal structures, design parameters, codal provisions.

CV919 Structural Safety and Reliability **3**

Reliability theory, Structural reliability - levels 1, 2, & 3. FOSM and AFOSM methods of structural assessment, Interpretation of safety, determination of partial safety factors, reliability-based design examples.

References: *Ranganathan, Reliability analysis & design of structures*.

CV920 FEM Applications in Structural Engineering **4**

Types of elements-Discretization of structures-Interpolation Function-Generalised and natural coordinates formulation using variational method-Numerical integration-Timoshenko beam element-Plate bending elements-Co and C1 continuity elements-Mindlin element-Shell Elements-Formulation and program development for plate and shell elements-Techniques for material and geometric non-linear problems.

References: *Krishnamoorthy C.S, Finite Analysis: Theory and Programming, Tata McGraw-Hill. Zienkiewicz O.C and R.L. Taylor, The Finite Element Method (vol. 1 and vol. 2), McGraw-Hill*

CV921 Theory & Analysis Plates **4**

Thin and thick plates-Deflection of laterally loaded plates-Navier and Levy's method-Energy and finite difference methods-Plate subjected to in-plane and lateral loads-Circular plate with symmetrical loading-stiffened plates. Introduction to vibration and buckling of plates-Analytical and finite element methods to solve stress, vibration and buckling problems of plates.

References: *Timoshenko S. P. and S.W. Kriegar, Theory of Plates and Shells, McGraw-Hill. Chandrashekara K., Theory of Plates, University Press, Hyderabad.*

CV922 Smart Materials & Structures **4**

Smart materials and their properties-Piezoelectric, magneto structures-Shape memory materials-Electro rheological fluids-Optical Fibres-Actuation-Sensing and control augmentation-Distributed and discrete sensing and actuation Methods of analyses-Finite Elements-Applications-Vibration Suppression-Shape Control-Sizing-Damage detection.

References: *Gandhi M.V.and Thomson, B.S. Smart Materials and Structures, Champan& Hall. Meirovitch L., Dynamics and Control of Structures, John Wiley.*

CV923 Geoenvironment **4**

Understanding the earth, atmosphere and processes governing environmental conditions. Study and Significance of natural resources; mineral, rock, water and Soil resources. Natural hazards- Volcanic eruption, earthquakes, landslides, Land subsidence, floods. Soil erosion - Soil profile, causes and effects of soil erosion, sitting of estuaries and reservoirs, Soil conservation coastal hazards - coastal processes, coastal protection Pollution - Definition, various contaminants, point and non-point sources. Surface water pollution, ground water pollution, ground water quality, health hazards associated with pollution, case histories Environmental impact of mining and quarrying Land use planning.

References: *Jain, Environmental impact analysis.*

CV924 Dynamic Soil-Structure Interaction **4**

Equation of motion in the time domain, correspondence principle, discrete Fourier transform, formulations in total displacements for flexible base and rigid base, Kinematic and inertial interactions, spatial variation of seismic loads, fundamentals of wave propagation, one dimensional wave equation, free field response of site, Direct analysis of total structure soil system, Substructure analysis.

References: *John. P. Wolf, Dynamic soil structure interaction, Prentice Hall.*

CV925 RS and GIS Applications in Engineering Geology 4

Introduction to remote sensing, spectral signatures, False colour concepts etc., Orbits, Flatforms, Sensors and Scanners. Indian satellite family. Launch vehicles, data products. Interpretation analysis techniques. Multispectral, multitemporal, multi-sensor and multistage concepts. Photo interpretation techniques for aerial photos and satellite imageries. Interpretation elements. Advanced GIS concepts, overlay analysis, network analysis, multi-criterion analysis, site suitability analysis, nearest neighbourhood analysis, Thiessen polygons, surface mapping, interpolations (including tins), Digital Elevation Models (DEM), terrain classification- slope, aspect and angle of incidence etc., applications of RS and GIS in Engineering Geology.

References: *Thomas N Lillesand and R. W. Keifer - Remote sensing and image interpretation. Atkinson P and Tata N. J.-Modeling scale in Geographic Information Science, John Wiley and sons, Chichesler.*

CV926 Ground Water Exploration and Development 4

Ground Water Exploration: Introduction, Regional Groundwater exploration, Hydrogeological exploration, pumping tests, Remote Sensing applications, Geophysical exploration - Electrical Resistivity method, Self-Potential method, Induced polarization method, Magnetic method, Seismic methods, Well logging methods. Groundwater exploration in different terrains - hard rock terrains, sedimentary rocks and coastal tracts. Groundwater Development: Groundwater developments in India, well design, construction and maintenance-types of wells, methods of construction, tube well, drilling techniques, dug wells, well failures, hydro fracturing, rain water harvesting, Recharge estimates, Conjunctive use, Ground water quality.

References: *Karanth, K. R., Groundwater Assessment, Development, Management, Tata McGraw-Hill Todd, David Keith., Ground water Hydrology, John Wiley and Sons.*

CV927 Advances in Hot Mix Asphalt Technology 4

Rheological Properties of asphalt binders: age hardening, temperature susceptibility, shear susceptibility, stiffness, and consistency. Pavement performance. Characterization of asphalt mixtures: criteria for asphalt mixture tests, physical properties, and mechanical and performance tests. Concepts of Superpave. Field compaction of asphalt mixture and mixture segregation. Special Mixtures, recycling, and additives.

References: *NAPA Education Foundation, Hot Mix Asphalt Materials, Mixture Design and Construction, Maryland, USA. The Asphalt Institute, Performance Graded Asphalt Binder Specification and Testing, SP1, Lexington, KY, 1995. The Asphalt Institute, Superpave Level 1 Mix Design, SP2, Lexington, KY, 1995.*