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Department of Civil Engineering
SYLLABUS FOR ENTRANCE TEST FOR Ph.D. IN CIVIL ENGINEERING

The PET (Ph.D. Entrance test) for Ph.D. in Engineering and Technology consists of two parts:

- Part I: Subject Specific
- Part II: Research Methodology

Paper on section A:

Common to all specializations of Civil Engineering

Engineering Mechanics: System of forces, free-body diagrams, equilibrium equations; Internal forces in structures; Friction and its applications; Centre of mass.

Solid Mechanics: Bending moment and shear force in statically determinate beams; Simple stress and strain relationships; Simple bending theory, flexural and shear stresses, shear center.

Structural Analysis: Statically determinate and indeterminate structures by force/ energy methods; Method of superposition; Analysis of trusses, arches, beams, cables and frames; Displacement methods: Slope deflection and moment distribution methods; Influence lines; Stiffness and flexibility methods of structural analysis.

Construction Materials and Management: Construction Materials: Structural Steel – Composition, material properties and behavior; Concrete - Constituents, mix design, short-term and long-term properties. Construction Management: Types of construction projects; Project planning and network analysis - PERT and CPM; Cost estimation.

Concrete Structures: Working stress and Limit state design concepts; Design of beams, slabs, columns; Bond and development length; Prestressed concrete beams.

Steel Structures: Working stress and Limit state design concepts; Design of tension and compression members, beams and beam-columns, column bases; Connections - simple and eccentric, beam-column connections, plate girders and trusses; Concept of plastic analysis - beams and frames.

Soil Mechanics: Three-phase system and phase relationships, index properties; Unified and Indian standard soil classification system; Permeability - one dimensional flow, Seepage through soils – two – dimensional flow, flow nets, uplift pressure, piping, capillarity, seepage force; Principle of effective stress and quicksand condition; Compaction of soils; One-dimensional consolidation, time rate of consolidation; Shear Strength, Mohr's circle, effective and total shear strength parameters, Stress-Strain characteristics of clays and sand; Stress paths.

Foundation Engineering: Sub-surface investigations - Drilling bore holes, sampling, plate load test, standard penetration and cone penetration tests; Earth pressure theories - Rankine and Coulomb; Stability of slopes – Finite and infinite slopes, Bishop's method; Stress distribution in soils, Pressure bulbs, Shallow foundations- bearing capacity theories, effect of water table; Combined footing and raft foundation; Contact pressure; Settlement analysis in sands and clays; Deep foundations – dynamic and static formulae, Axial load capacity of piles in sands and clays, pile load test, pile under lateral loading, pile group efficiency, negative skin friction.

Fluid Mechanics: Properties of fluids, fluid statics; Continuity, momentum and energy equations and their applications; Potential flow, Laminar and turbulent flow; Flow in pipes, pipenetworks; Concept of boundary layer and its growth; Concept of lift and drag.

Hydraulics: Forces on immersed bodies; Flow measurement in channels and pipes; Dimensional analysis and hydraulic similitude; Channel Hydraulics - Energy-depth relationships, specific energy, critical flow, hydraulic jump, uniform flow, gradually varied flow and water surface profiles.

Hydrology: Hydrologic cycle, precipitation, evaporation, evapo-transpiration, watershed, infiltration, unit hydrographs, hydrograph analysis, reservoir capacity, flood estimation and routing, surface run-off models, ground water hydrology - steady state well hydraulics and aquifers; Application of Darcy's Law.

Irrigation: Types of irrigation systems and methods; Crop water requirements - Duty, delta, evapo-transpiration; Gravity Dams and Spillways; Lined and unlined canals, Design of weirs on permeable foundation; cross drainage structures.

Water and Wastewater Quality and Treatment: Basics of water quality standards – Physical, chemical and biological parameters; Water quality index; Unit processes and operations; Water requirement, Water distribution system; Drinking water treatment.

Sewerage system design, quantity of domestic wastewater, primary and secondary treatment. Effluent discharge standards; Sludge disposal; Reuse of treated sewage for different applications.

Transportation Infrastructure: Geometric design of highways - cross-sectional elements, sight distances, horizontal and vertical alignments. Geometric design of railway Track – Speed and Cant. Concept of airport runway length, calculations and corrections; taxiway and exit taxiway design.

Highway Pavements: Highway materials - desirable properties and tests; Desirable properties of bituminous paving mixes; Design factors for flexible and rigid pavements; Design of flexible and rigid pavement using IRC codes

Traffic Engineering: Traffic studies on flow and speed, peak hour factor, accident study, statistical analysis of traffic data; Microscopic and macroscopic parameters of traffic flow, fundamental relationships; Traffic signs; Signal design by Webster's method; Types of intersections; Highway capacity.

Geomatics Engineering: Principles of surveying; Errors and their adjustment; Maps - scale,

coordinate system; Distance and angle measurement - Levelling and trigonometric levelling; Traversing and triangulation survey; Total station; Horizontal and vertical curves. Photogrammetry and Remote Sensing - Scale, flying height; Basics of remote sensing and GIS.

Reference Books:

1. Menon D., Structural Analysis, 3rd edition, Narosa Publishing House, 2022
2. Vallero, Daniel A. Fundamentals of air pollution. Academic press, 2014
3. Chitkara, K. K. Construction Project Management: Planning, Scheduling, and Controlling. New Delhi: Tata McGraw-Hill Publishing Company, 1998
4. Khanna, S.K., and C.E.G. Justo. Highway Engineering. 6th ed. Roorkee: Nem Chand & Bros, 1987
5. Jha, Kumar Neeraj. Construction Project Management: Theory and Practice. New Delhi: Pearson Education India, 2011
6. Jhamb, L. C. Inventory Management. New Delhi: Everest Publishing House, 2009
7. Kadiyali, L. R. Traffic Engineering and Transport Planning. New Delhi: Khanna Publishers, 1987
8. Paz, Mario. Structural Dynamics: Theory and Computation. 6th ed. New York: Springer, 2019
9. Metcalf & Eddy Inc., George Tchobanoglous, Franklin L. Burton, and H. David Stensel. Wastewater Engineering: Treatment and Reuse. 4th ed. Boston: McGraw-Hill, 2003
10. Subramanian, N. Design of Steel Structures. New Delhi: Oxford University Press, 2008
11. Karve, S. R., and V. L. Shah. Limit State Theory and Design of Reinforced Concrete. 7th ed. Pune: Structures Publications, 2010

Paper on section B:

Research Methodology

Research Methodology

Introduction to RM: Meaning of Research, Objectives of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Research Process, Criteria of Good Research, Defining the Research Problem, Selecting the Problem, Technique Involved in Defining a Problem, Research Design, Important Concepts Relating to Research: Design, Developing a Research Plan, Literature review.

Methods of Research: Qualitative and quantitative methods of research like Historical, case study, ethnography, exposit facto, documentary and content analysis, survey (Normative, descriptive, evaluative etc.) field and laboratory experimental studies. Characteristics of methods and their implications in research area.

Development of research proposal: Research proposal and its elements Formulation of research problem-criteria of sources and definition Development of objectives and characteristics of objectives. Development hypotheses and applications


Methods of data collection: Concept of sampling and other concepts related to sampling. Probability and non-probability samples, their characteristics and implications. Tools of data collections, their types, attributes and uses. Redesigning, research tools-like questionnaire, opinionnaire, observation, interviews, scales and tests etc.

Methods of data analysis: Analysis of qualitative data based on various tools. Analysis of quantitative data and its presentation with tables, graphs etc. Statistical tools and techniques of data analysis-measures of central tendency, dispersion. Decision making with hypothesis testing through parametric and non-parametric tests. Validity and delimitations of research findings.

Interpretation and Report Writing: Meaning of Interpretation, Techniques of Interpretation, Significance of Report Writing, Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Writing a technical paper, plagiarism and its implications.

Text and Reference Books

1. Creswell J. W., Research Design: Qualitative, Quantitative and Mixed Methods Approaches, 4th edition, SAGE Publications, Inc, 2014
2. Garg B. L., Karadia R., Agarwal F. and Agarwal U. K., An introduction to Research Methodology, RBSA Publishers, 2002
3. Kothari C. R., Research Methodology: Methods and Techniques. New Age International, 1990.
4. Merriam S. B., Tisdell E. J., Qualitative Research: A Guide to Design and Implementation, 4th edition, John Wiley & Sons, 2016.
5. Olsen C., Devore J., Peck R., Introduction to Statistics and Data Analysis, 5th Edition, Brooks/Cole, 2015.
6. Panneerselvam R., Research Methodology, 2nd edition, PHI Learning, 2014


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