

Sardar Vallabhbhai National Institute of Technology Surat
Department of Civil Engineering

Syllabus for PhD Entrance Test - Construction Technology and Management
section

CONSTRUCTION PROJECT PLANNING AND CONTROL (WEIGHTAGE: 25%)

Importance of sound planning, Scheduling, principles and techniques, Scheduling methods (AOA & AON), critical path method, concept of float, project evaluation and review techniques, line of balance variances in project duration and cost, network scheduling with limited resources, resource allocation, smoothing and leveling, updating the network, master networks, the time -cost trade-off approach, progress review and reporting, risk of schedule delays, missing milestone deliverables and its impact (from client and contractors view point) change management, contemporaneous records, documenting delays and maintaining records. Parameters of project performance, time, cost and quality and their interrelationships, schedule and cost control tools and techniques, performance reporting, audit, corrective and preventive actions, fund flow control, management information system and application of management software.

CONSTRUCTION CONTRACT AND LAW (WEIGHTAGE: 25%)

Concept of contract, types of contracts, joint venture, merging, acquisition, features and suitability, design of contract documents, international contract document, standard contract document, law of torts, Indian contract act 1872, Introduction to various standard forms of contract such as FIDIC, JCT and NEC. Prequalification and Bidding process, potential contractual problems, Rules of interpretation of contract clauses, Concession agreements. Sources of claims and disputes, construction claims procedure, methods of dispute resolution, alternative dispute resolution method, comparison of actions and laws, agreements, subject matter, violations, Arbitration and Conciliation act 1996 and recent amendments in 2015, Delay analysis, case studies, professional ethics, duties and responsibilities of parties.

CONSTRUCTION QUALITY AND SAFETY (WEIGHTAGE: 25%)

Road Map for TQM Implementation, Role of management in TQM, Quality improvement planning measurement, construction site implementation, six sigma in quality management. Safety and accidents in construction projects, theories of accident causation, health and illness related with construction works, cost of construction injuries, safety risk analysis and control, personal protective equipment, occupational and safety hazard assessment, legal implications, OSH Management System. Problem areas in construction safety, elements of an effective safety programme, job site safety assessment, safety meetings, and safety incentives Safety in construction contracts, substance abuse, safety record keeping.

PROJECT APPRAISAL AND FINANCE (WEIGHTAGE: 15%)

NPV, BCR, IRR, ARR, urgency-payback period, assessment of various methods, Indian practice of investment appraisal, international practice of appraisal, analysis of risk, different methods for selection of a project and risk analysis in practice, ownership structures; BOT, BOLT, BOOT models. Policy for working capital, estimating working capital need, inventory management, account receivable, credit and cash management, managing payments to supplies and outstanding, capital investment decisions, techniques of capital budgeting, cost of capital. Cash flow analysis.

CONSTRUCTION METHODS & EQUIPMENT (WEIGHTAGE: 10%)

Form work design and scaffolding, slip form and other moving forms, Shoring, Reshoring, and Back shoring in multistoried Building construction. Characteristics and performances of equipment for major civil engineering activities such as Earth moving, erection, material transport, pile driving, Dewatering, and Concreting, Ready mix concrete plants.

References

1. Harris, F, McCaffer, R and Edum-Fotwe, F (2006) Modern Construction Management, sixth edition, Blackwell Publishers.
2. Jha K N (2012) Formwork for Concrete Structures, Tata McGraw Hill, New Delhi.
3. Jha, K N (2015) Construction Project Management: Theory and Practice, Second Edition, Pearson Publishers, New Delhi.
4. Jimmie W Hinze (2013) Construction Contracts, 3rd Edition. McGraw Hill.
5. Levitt, R E and Samelson, Nancy Morse (1993) Construction Safety Management 2nd Edition, Wiley Publisher.
6. Prasanna Chandra (1995) Projects Preparation, Appraisals, Budgeting and Implementation, 3rd Edition, Tata Mc Graw Hill Publishing Co. Ltd.
7. Taylor, G A (1968) Managerial and Engineering Economy. East-West Edition.
8. Van Horne, J C (1990). Fundamentals of Financial Management, Printice-Hall of India Ltd.
9. Wu Chung, H (2006) Advanced Civil Infrastructure Materials, First Edition, Woodhead Publishing Limited.

Syllabus for PhD Entrance Test – Geotechnical Engineering Section

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.

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 – Boussinesq's theory; Pressure bulbs, Shallow foundations – Terzaghi's and Meyerhoff's 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.

Syllabus for PhD Entrance Test – Transportation Engineering and Planning **Section**

MATERIALS AND PAVEMENTS

Soil – Soil classification and its systems, Manual identification tests, desirable properties of soil for road construction, Importance of soil subgrade, problems in soil subgrade, sub-soil drainage, soil stabilization, Strength properties of soils.

Road Aggregates –Origin, Physical, mechanical and durability properties of aggregates, desirable properties of aggregates for road construction.

Bitumen –Bitumen sources and manufacturing, bitumen constituents, structure and rheology, types of bituminous binders, their properties, tests and specifications

Pavement Structure: Components of pavement structure, functions of subgrade, subbase, base course, binder course and wearing course; specifications for construction of different layers of pavement, quality control during road construction.

Bituminous Mixes – Desirable properties of bituminous mixes for bound & unbound base courses and wearing course in accordance with MoRTH specifications, Design of bituminous mixes by Marshall and Superpave methods, fillers. Recent properties in Cold mix, Warm mix and Hot mix asphalt, Durability properties of bituminous mixes.

Flexible Pavements – Design approach, Elastic layer theory, Stresses in flexible pavements, Design of pavement as per IRC 37-2018, Reclaimed asphalt pavement design, Distresses, Evaluation and strengthening of pavements.

Rigid pavements – Components of rigid pavements, types of joints, dowel and tie bars and their design, wheel load stresses, temperature stress, warping stress, design of rigid pavements based on IRC: 58 2015, Dry lean concrete, PQC, Concrete block pavements, Types of cement, physical and mechanical properties of cement, Factors affecting concrete mix design, Design of concrete mixes, Distresses, Evaluation and strengthening of pavements.

TRAFFIC ENGINEERING AND MANAGEMENT

Traffic Engineering: Elements of traffic engineering, traffic stream characteristics, Traffic studies on flow, speed, travel time - delay and O-D study, PCU, peak hour factor, parking study, accident study and analysis, black spot identification, statistical analysis of traffic data; Microscopic and macroscopic parameters of traffic flow, fundamental relationships; Traffic regulations and control systems, signal design by Webster's method; Types of intersections and channelization; Highway capacity and level of service of rural highways and urban roads, Intelligent Transportation systems.

Geometric Design: Highway alignment and engineering surveys; Geometric design of highways - cross-sectional elements, sight distances, horizontal and vertical alignments

TRANSPORTATION PLANNING

Urban Transportation Planning: Urban growth mechanism – Urban morphology- Urbanisation & travel demand, Urban travel patterns - Study area delineation- Zoning - Planning surveys - Urban activity system- Sustainable urban transport - Systems approach; Travel demand estimation, data need and sources, survey methodology, trip generation, trip distribution, mode choice, route assignment, random utility models; Land use models - Land use transport models, Lowry & Garin – Lowry models; sustainable transportation – Walk, Bicycle and Public Transport, type and characteristics of urban mass transit systems

Public Transport Planning: Operational characteristics speed, capacity & payloads – Route capacity – Comfort conditions - Performance relationships - Public and Private Operations - Modes for Intercity Transport; Data requirements & Collection techniques, Conventional Methods - Destination Survey - Transit Stop & Ride Surveys and Analysis - Mode Split Models

- Captive and Choice Riders - Attitudes of Travellers - Patronage Determination; Frequency & headway determination methods – Rail operation design – Bus operation design – Way capacity & Station capacity – Transit level of service; Performance Evaluation – Efficiency, Capacity, Productivity and Utilisation – Performance Evaluation Techniques and Application– System Network Performance – Transit Terminal Planning and Design

TRANSPORTATION ECONOMICS

Generation and screening of project alternatives - Different methods of economic analysis: - Discounting and Non discounting criteria methods – NPV - IRR, Benefit/Cost analysis. Feasibility and evaluation, cost, impacts and performance levels, evaluation of alternatives, analysis techniques, cost benefit analysis, social and financial benefits, Internal Rate of return method for economic and financial viability, valuation of time.

Syllabus for PhD Entrance Test – Environmental Engineering Section

ENVIRONMENTAL CHEMISTRY AND MICROBIOLOGY

Microorganisms - classification, prokaryotic and eukaryotic cells, structure, characteristics, metabolism of microorganisms: Environmental factors, nutrition and metabolism, growth phases, Microbiology of drinking water: Distribution of microorganisms, indicator organisms, MPN index, M.F. technique, standards. Microbiology of wastewater treatment.

Basic Principles, stoichiometric calculations. Acid-Base equilibria, carbonate system in water, buffering in water system, titration curve. Solubility in water. Analysis and importance of common water/wastewater quality parameters.

WATER TREATMENT

Important water treatment processes: Principles, working, design and maintenance of Sedimentation, Coagulation, filtration, Adsorption, gas transfer, chemical precipitation, water softening and disinfection processes. Household water treatment, Removal of specific pollutants such as arsenic, fluoride, iron, and nitrate

WASTEWATER TREATMENT

Principles, working, design and maintenance of the following wastewater treatment processes: aerobic/anaerobic, attached/suspended, activated sludge, tricking filter, SBR. Anaerobic processes – microbiology, process, design, Sludge treatment. Natural treatment processes. Tertiary treatment of wastewater and wastewater reuse

AIR AND NOISE POLLUTION

Air quality and standards, emission standards, important air pollutants - carbon monoxide, nitrogen dioxide, photochemical smog, ozone, particulate pollutants, oxides of sulphur, lead, hydrocarbon – their sources, effects. Application of Gaussian Plume model.

Control of suspended particulate matter, design criteria of settling chambers, cyclones, bag filters, scrubbers and electrostatic precipitators, control of gaseous pollutants.

Noise Pollution: Fundamentals and terminologies, health impacts, mitigation / control measures.

SOLID WASTE MANAGEMENT

Generation and composition of MSW, Characterisation of MSW. Materials recovery and treatment – composting, Concepts of waste-to-energy methods, Energy recovery - Incinerators. Landfills: Site selection, design and operation, drainage and leachate collection systems.

ENVIRONMENTAL IMPACT ASSESSMENT

Evolution of EIA – EIA at project – Regional and policy levels – EIA legislative and Environmental clearance procedures in India – EIA methodologies – Screening and scoping criteria – Rapid and Comprehensive EIA – Environmental health impact assessment – Significance of public participation. Baseline collection of data – Significant impacts – Assessment of impacts of physical, biological and socio – economic environment – Impact prediction tools / techniques such as Adhoc method, checklist method – Development of environment management plan – Post project monitoring – EIA report and EIS – Review process. Environmental Management, Environmental Audit – Life cycle assessment – ISO –14000

Syllabus for PhD Entrance Test – Water Resource Engineering Section

FLUID MECHANICS

FLUID STATICS -Fluid pressure at a point and its measurements, manometry, hydrostatic forces on plane and curved surfaces, buoyancy and floatation, relative equilibrium under linear acceleration and constant rotation.

FLUID KINEMATICS - velocity field, classification of fluid flows based on space & time, one-, two- and three- dimensional flows. Eulerian and Lagrangian approaches, stream lines, path lines and streak lines, stream tubes, continuity equation, translation, linear deformation, rotation and angular deformation of fluid elements, vorticity, rotational and irrotational flows, circulation, velocity potential and stream functions, flow net and its characteristics, local, convective and substantial acceleration of fluid particles.

FLUID DYNAMICS- Concept of control mass and control volume, Reynolds transport theorem, conservation of mass, momentum equation, Euler's equation, Navier-Stokes equations. Derivation of Bernoulli's equations from Euler's equation and applications of momentum and energy equations (pitot tube, weirs and sudden head loss due to expansion), energy and momentum correction factors.

FUNDAMENTALS OF BOUNDARY LAYER - Boundary layer concept, applications of boundary layer in various fields, thicknesses of boundary layer, laminar and turbulent boundary layers, laminar sub layer, application of Momentum equation, stream lined and bluff bodies, integral momentum equation, Prandtl's boundary layer equations. Boundary layer on rough surfaces, boundary layer separation and methods to avoid separation, wake, concepts of drag and lift on submerged bodies, types of drags and its determination.

PIPE FLOW PROBLEMS - Friction loss in pipes, minor losses in pipes, concept of equivalent length and diameter of pipes, siphons, parallel and compound pipe lines, branching of pipe lines, pipe networks and methods of analysis, three reservoir problem, water hammer and methods of analysis.

DIMENSIONAL ANALYSIS AND MODELLING -Dimensions, different systems of units, dimensional homogeneity, Buckingham's pi-theorem, non-dimensional numbers and their physical significance, Geometric, kinematic and dynamic similarities, model laws, model testing and its analysis, scale effects, undistorted and distorted models.

WATER RESOURCES ENGINEERING

IRRIGATION ENGINEERING -Definition of irrigation, necessity, drainage problems of irrigation, advantages and disadvantages of irrigation, types of irrigation, quality of irrigation water, various methods of irrigation, suitability of various methods of irrigation, Bandhara irrigation

WATER REQUIREMENTS OF CROPS -Classes and availability of soil water, available moisture depth, frequency of irrigation, relationship between duty a delta and base period, factors affecting duty, methods of improving duty, irrigation efficiencies, command areas, kharif, rabi and perennial crops, crop rotation, irrigation water requirement, design discharge of canal and storage capacity of reservoir based on irrigation requirement.

GRAVITY DAM -Design of gravity dam, principal and shear stresses, failure of dam and its stability, elementary & practical profile of the gravity dam, joints, galleries, shafts, foundation treatment.

EMBANKMENT DAMS -Types of embankment dams, factors affecting design of embankment dam, causes of failure of embankment dams, criteria of design of earth dams, computation of free board in embankment dam, seepage analysis of homogenous and zoned dams, seepage control through embankment dam and its foundation, stability analysis of the earth dam

SPILLWAYS AND ENERGY DISSIPATION -Types of spillways, design aspects of ogee spillway, spillway gates, jump-height curve and tail water curves, different types of energy dissipaters.

HYDRAULIC STRUCTURE – Cross drainage works, canal regulation works, types, design aspects

HYDROLOGY-

PRECIPITATION AND ABSTRACTIONS - Mechanism of precipitation, types and forms of precipitation, measurement techniques, rain gauge network, variability in precipitation, estimation of missing data, test for consistency of rainfall record, rainfall hyetograph, rainfall mass curve, areal average rainfall, intensity duration curves, evaporation, factors affecting evaporation, evaporimeters, estimation of evaporation, evapotranspiration, measurement of evapotranspiration, initial loss, infiltration and infiltration indices.

RUN OFF AND HYDROGRAPH -Direct runoff and base flow; run off characteristics of streams, computation of runoff, rainfall-runoff relationships, components of hydrograph and factors affecting shape of hydrograph, base flow separation, effective rainfall hyetograph, unit hydrograph theory, derivation of unit hydrograph of different duration, synthetic unit hydrograph, IUH

STREAM GAUGING AND DESIGN FLOOD -Site selection for stream gauging, direct methods of discharge measurements, computation of design flood using rational, empirical, unit hydrograph and flood frequency methods.

GROUND WATER HYDROLOGY - Occurrence, distribution of ground water, specific yield of aquifers, movement of groundwater, Darcy's law, permeability, safe yield of a basin, compressibility of aquifer, storage coefficient, specific storage, hydraulics of wells under steady

& introduction to unsteady condition in confined and unconfined aquifers, yield of wells, pumping and recuperation tests, types of tube wells.

FLOOD ROUTING -Reservoir and channel flood routing methods

OPEN CHANNEL FLOW

BASIC CONCEPTS OF OPEN CHANNEL FLOW -Open channel flow vs pipe flow, classification of open channel flow based on space and time criteria, effect of viscosity and gravity; velocity distribution and pressure distribution in open channel, continuity equation, momentum equation and energy equation in open channel.

UNIFORM FLOW IN OPEN CHANNEL - Development of uniform flow, resistance law, factors affecting Manning's roughness coefficient, conveyance, section factor for uniform flow computations, computation of uniform flow, efficient channel sections, hydraulic exponent for uniform flow computations.

SPECIFIC ENERGY AND SPECIFIC FORCE -Specific energy, Specific energy curve and its limitations, critical depth and section factor for critical flow computations, open channel flow transitions, standing wave & Venturi flumes, control sections and hydraulic exponent for critical flow computations, specific force curve and its application in the analysis of hydraulic jump, hydraulic jump characteristics

GRADUALLY AND RAPIDLY VARIED FLOW -Assumptions in GVF analysis, dynamic equation of GVF, classification of channel slopes, GVF profiles, its identification and computation

UNSTEADY OPEN CHANNEL FLOW- Wave celerity, classification of water waves according to relative depth, orbital motions, superposition, wave trains and wave energy, transformation of waves, dissipation of wave energy, positive and negative surges in rectangular channel, Momentum and Continuity equations (Saint Venant Equation),

SPATIALLY VARIED FLOW - Basic principles and assumptions, dynamic equation and analysis of flow profiles, Numerical integration method, Isoclinal method, spatially varied steady and unsteady surface flows.

MECHANICS OF SEDIMENT TRANSPORT- Nature of sediment problems, Origin and formation of sediments, individual and bulk properties of sediments, competent velocity, lift force and critical tractive stress concept on cohesion less and cohesive soils; regimes of flow; Resistance to flow in alluvial streams, resistance relations based on total resistance and division of resistance into grain and form resistance, preparation of stage discharge curves for alluvial streams, velocity distribution in alluvial channel, sediment Petrography (Sediment sampling)Hydraulic geometry of alluvial streams, bed level variation of alluvial streams, aggradations and degradation models, reservoir sedimentation, local scours.

APPLICATION OF GEOSPATIAL AND COMPUTATIONAL TECHNIQUES

Remote Sensing Fundamentals of remote sensing - Interpretation - Equipment's - Techniques of data acquisition – Satellites and sensors – Digital Image processing

GPS Introduction to GPS - Working principle of GPS - Measurement and mapping techniques.

GIS Introduction - Geo referenced data - Data input & output - Data quality and management - GIS analysis functions - Implementation of GIS,

Statistical Method. Numerical Methods Finite difference schemes – Method of characteristics – Finite element method Advanced Techniques Genetic algorithm - Artificial Neural Network - Fuzzy logic – Hydro informatics.

Syllabus for PhD Entrance Test – Urban Planning Section

EVOLUTION OF TOWN PLANNING

Evolution in planning and physical form, Concept of urban human settlement, Differentiation between rural and urban settlement, concept of town, Evolved and Created Town Characteristics, Features of urban planning process, Role of urban planner, Genesis of urban form; Social, Geographical and Cultural impacts, Contemporary developments in planning, Impacts of Industrial revolution on town and regional planning, Contribution of eminent Planners: Lewis Mumford, Ebenezer Howard, Patrick Geddes, Sir Arthur Clarence Perry, Charles Correa, Le-Corbusier.

URBANISATION

Demography and Census Statistics- Significance of Census and Demographics- Planning policies framed based on Census-Use of Census Data in Urban Planning Rural and urban Migration, impacts of urbanization, socio – economic impacts of growth of population, Social and Economic Environmental Administrator, Levels of Urbanisation, Indian scenario - Issues and Policies, Global scenario, Future trends of urbanization - Impact of Government Policies on Urbanization GROWTH PATTERNS Elements of town structure, Town classification: Functional and geographical; City Centre, Walled city and Urban Fringe areas; classification based on socio-cultural characteristics, changes with time and growth, growth theories, Characteristics of the urban environment and its components, land use, Modern urban forms. Peri- Urban Areas- Urban Fringe- Issues URBAN LAND USE PLANNING Objectives and Principles of Urban planning; Different Land use planning norms, Environmental aspects of land use planning, Role of URDPFI guidelines in Town planning, Land use Structures, demand and supply of land relationship, Government policies of urban development, Role of Professional bodies

URBAN INFRASTRUCTURE PLANNING

Network and Services: Core Municipal Infrastructure Components and Significance, Technology, Cost recovery Water Supply and Sewerage network: Norms and Standards

HOUSING

Planning for Residential area: Building Bye Laws (GCDCR), Housing and neighborhood planning, Layout planning Housing for Urban Poor: Slum Scheme, rehabilitation, in-situ upgradation

PROJECT FORMULATION AND APPRAISAL

Project Formulation: Preliminary analysis, Feasibility report and clearance requirements Project Appraisal: Methods, Investment appraisal, Analysis of Risk, BOT, BOLT and BOOT Models

URBAN GOVERNANCE AND LEGISLATION

Indian system of Urban Government: Salient features of local government system, constitution Amendment Act. Urban Local Governance participatory processes: Role of Municipal bodies, Urban Development Authority - Function, Power and Organization

URBAN PLANNING FUNDAMENTALS

Growth Patterns: City Changes with time and growth, Growth theory, land use, Modern Urban forms. Planning Survey: Objectives, types, significance, methodology, analysis and application

SUSTAINABLE URBAN PLANNING PRACTICES

Urban Land Management: Models, issues, Planners Role, URDPFI and TCPO guidelines. Town Planning Scheme and Development Plan: Guidelines and processes

REGIONAL PLANNING

Regional Analysis: Introduction, Linear Programming, Analysis. Growth Models: Concept, Central Place Theory

TRAFFIC AND TRANSPORTATION PLANNING

Traffic Characteristics: Policies, traffic studies and problems. Traffic Planning and Management: Design Town Center and CBD Area, and management technique

Syllabus for PhD Entrance Test – Structure Engineering Section

ENGINEERING MECHANICS

SOLID MECHANICS

CONCRETE TECHNOLOGY

STRUCTURAL ANALYSIS - I & II

DESIGN OF CONCRETE STRUCTURES

DESIGN OF STEEL STRUCTURES

FINITE ELEMENT METHOD

STRUCTURAL DYNAMICS

EARTHQUAKE RESISTANT DESIGN OF STRUCTURES