SYLLABUS FOR COMPUTER BASED TEST AT THE GRADES OF E-3, E-2 & E-1

CIVIL ENGINEERING

1. **Surveying**
   Principles of surveying, measurement of distance, chain surveying, working of prismatic compass, compass traversing, bearings, local attraction, plane table surveying, theodolite traversing, adjustment of theodolite, Levelling, Definition of terms used in levelling, contouring, curvature and refraction corrections, temporary and permanent adjustments of dumpy level, methods of contouring, uses of contour map, tachometric survey, curve setting, earth work calculation total station and its important features.
2. **Site investigation and sub- soil exploration**
   Methods of sub soil exploration, Open test pit, Tube Test pit, Tube borings, Auger Boring. Wash Boring. Advantages, Disadvantages, Percussion drilling Diamond drilling, Rotary Drilling and Advantages Disadvantages of each method, standard Penetration Test, Sampling, Preservation of Samples. Interpretation of geo-technical parameters C,O, E.
3. **Compaction of soil**
   Laboratory compaction tests, standard proctor Compaction, tests, modified proctor Test. Theory of Compaction. Hogentoeler's Lubrication Theory, Factors affecting compaction, Effect of Compaction on the properties of Soil, Selection of passes for rollers and field trial, type of rollers, Field control of compaction, Determination of density in the field, Sand Replacement Method, Core Cutter Method, Rubber Ballon Method, Water Replacement Method, Consolidation, Difference Between Compaction and Consolidation.
4. **Construction of foundations:**
   Soil classification, Bearing capacity, Determination of bearing capacity, Types of Foundation-Spread Foundations, Raft or Mat, Foundation, stepped Foundation, Pile Foundations, Friction piles, End Bearing Piles, frication cum End Bearing piles, Castin-situ concrete piles, Group of Piles, Pile cap, Causes of foundation Failure, Excavation of Foundations, Timbering of Foundation Trenches, Components of Well Foundation Pile load test, Sonic test on Piles. Pile Integrity test, Deep excavation. Slope Stability, Liquefaction.
5. **Cement concrete and reinforced cement concrete construction**
   Properties of cement, Principles of setting and hardening of cement, Fine Aggregate, Course Aggregate, General Qualities for food Aggregates, Water Cement Ratio and its impact on concrete strength, Workability, Slump Test, Admixtures, Mix Design, Recommended slump for various types of structural components, Compressive strength of concrete, and methods of testing, Transporting concrete, placing of concrete, compacting concrete, construction joints, curing of concrete and methods of testing, transporting concrete, placing of concrete, compacting concrete, construction joints, curing of concrete, placing concrete under water, use of tremie, reinforced cement concrete, its properties and advantages, various types of Form work for concrete structures, Fundamentals of Form Design, Deflection of forms, arrangements of form work, bending moments & shear force in columns, simply supported and cantilever beams, one and two ways RCC slabs, Admixtures R.M.C, fixidity of junction of slab/beam with wall /column with reinforcement detailing to achieve required fixidity, Weathering , Common repair techniques of cracks , spalling Delamination, Efflorescence Corrosion, Carbonation depth, Corrosion mapping and Sulphate Attack.
6. **RCC design**
   RCC Design: RCC beams-flexural strength, shear strength, bond strength, design of singly reinforced and double reinforced beams, cantilever beams, T-beams, lintels, One way and two way slabs, isolated footings, Reinforced brick works, columns, staircases, retaining wall, water tanks.
7. **Environmental engineering**

- **Introduction:** Importance of water supply, need for protected water supply, objectives of water supply system, role of agencies, water supply and sanitation development in India, Quantity water: Estimating requirements, design period, per capita consumption, fluctuation in rate of consumption, numerical problems,
- **Sources of water supply:** Major (surface and underground) water sources, quality and quantity of water in surface and underground sources, selection of suitable sources of water supply, necessity &determination of the capacity of storage reservoir by Mass curve method.
- **Intakes and Conveyance of water:** intakes, types of intakes, location and requirement of an intake, types of conduits, pipe material, various types of pipe joints, laying of pipes, hydrostatic test
- **Quality of Water:** Impurities in water and their importance, collection of water samples, physical chemical and bacteriological analysis of water, standards of quality for domestic water supply
- **Sedimentation:** Sedimentation aided with coagulation, various coagulants, mechanism of coagulation and floc formation, stage in coagulation, design of sedimentation tank
- **Filtration:** Theory of filtration, types of filters, working and comparison of slow and rapid sand filter, sectional elevation and plan of slow sand filter and rapid sand filter, pressure filter,
- **Disinfection of water:** Necessity of disinfection, requirements of good disinfectant, methods of disinfection, theory of disinfection by chlorine, chlorine demand, different practices of chlorination, sketch of chlorinator, use of bleaching power
- **Storage of clear water and its distribution:** Layout of water distribution systems along with their advantages and disadvantages, design of distribution system, causes, detection and prevention of wastage of water
- **Flow in sewers:** Quantity of sanitary and storm water, variations in flow of sewage and their importance, dry weather flow, types of sewer, condition of flow in sewers, self cleansing and limiting velocities in sewers
- **Construction and Maintenance of Sewers:** Sewer appurtenances, materials for sewer, laying of sewers, joints and Testing of sewer joints, maintenance, operation and precaution before entering a manhole
- **Characterization and Examination of Sewage:** Physical, chemical and biological characteristics of sewage, physical, chemical and biological examination of sewage including pH, BOD and allied numerical problems
- **Disposal of Sewage:** Methods of disposal, the conditions for adopting different methods, dilution methods, standards of dilution, self purification of natural streams, permissible loads and limits of pollution to be discharged into inland surface water and public sewer, disposal by land treatment method, treatment standards for sewage effluents, effluent irrigation and sewage farming, sewage sickness and it's preventive measures
- **Treatment of Sewage:** Definitions of preliminary, primary, secondary and tertiary treatment, types of treatment units employed in sewage treatment, their
- function and efficiencies comparative statement, grit chambers and detritus tanks, skimming tanks, primary sedimentation, filtration of sewage, tricking
- filters, activated sludge process, comparison of trickling filters and ASP, oxidation ponds Aerated lagoons
- **Septic and Immhoff Tanks:** Theory, working and design criteria of septic and immhoff tanks, advantages and Disadvantages of septic and immhoff tanks, Sectional elevation and plan of septic and immhoff tanks.
- **Air Pollution:** causes, effects and controls
- **Noise Pollution:** Causes, effects and controls

8. **Transportation engineering**

- **Highways:** Importance of highway transportation, IRC classification of roads, Indian Road congress
- **Road Geometries:** Right of way, formation width road margin, road shoulder, carriage way, side slopes, kerbs, formation levels, camber and gradients, sight distance, Different types of horizontal and vertical curves, super elevation, methods of providing super elevation, Traffic engineering , traffic study, origin and destination study, variation of traffic, speed flow density and their interrelationship, traffic signs, traffic markings, traffic islands and traffic signals, road safety
- **Highway Materials:** Soil aggregates and bituminous materials, properties and tests California Bearing Ratio Test
- **Earth and Gravel Roads:** construction details water bound macadam(WBM), Wet Mix macadam (WMM) roads, construction details Bituminous roads, Types of bituminous roads surface dressing, semi grouting-full grouting bituminous concrete
- Design of Flexible and Rigid pavements- Flexible pavement, Concrete pavement, types of construction of concrete roads, construction joints,
- **Hill Roads:** Factors considered in alignment, drainage of hill roads
- **Bridges:** Introduction- components of a bridge Factors governing the ideal site selection, bridge foundations, classification of foundations shallow foundations, deep foundation, pile foundation, Well foundations, types of piers, abutments and wing walls, types of super structure steel girders, types of girders, plate girder, box girder, Bridge bearings, types of bridge bearing, different types of bridges, maintenance of bridges.

9. Estimating and costing

- Introduction: Introduction to quantity surveying and its importance, Duties of quantity surveyor Types of estimates; preliminary estimates, plinth area estimate, cubic rate estimate, estimate per unit base, Detailed estimates; definition, stages of preparation details of measurement and calculation of quantities and abstract,
- Measurement, units of measurement for various items of work as per BIS:1200,rules for measurements, Earth work, Brick work (modular and traditional bricks), RCC works, shuttering wood work, painting, flooring, plastering etc,, different methods of taking out quantities-centre line method and long wall and short wall method
- Preparation of Detailed and Abstract Estimates from Drawings; A small residential building with a flat roof, pitched roof with steel truss, timber structures
- Earthwork for unlined channel, mid section formula, trapezoidal formula, Simpson's formula rule, water supply lines, sanitary and water supply fittings, septic tank for a domestic building and cost estimate of septic tanks, WBM road and pre-mix carpeting, tube well, isolated and combined footing, steel truss, piles and piles cap, Single span RCC slab culvert, earthwork for plain, hill roads, RCC work in beams, slab, column and lintel, Arches and their bar bending schedule
- Calculation of quantities of materials for cement mortars of different proportion, Portland cement concrete of different proportion, brick masonry in cement mortar, plastering and pointing, white washing, cement concrete flooring, terrazo flooring, stone masonry-random rubble and ashlar, Analysis of Rates: Steps involved in the analysis of rates, Requirement of material, labour, sundries, contractor's profit and overheads Analysis of rates for finished items when data regarding labour, rates of material and labour is given, Earthwork in excavation hard / ordinary soil and filling with a concept of lead and lift, cement concrete in foundation, RCC in roof slab, brick masonry in cement mortar, cement plaster, white washing
- Valuation: Value and cost, scrap value, salvage value, assessed value, sinking fund, depreciation &obsolescence, methods of valuation

10. **Finishing works**

- Granite flooring, laying clamp specifications, dry cladding tiles, polishing
- IPS flooring,
- Aluminum composite panels - fixing, properties, framing sealant
- Glass-properties for lamination, toughening, clamping, sealant
- Stainless Steel (SS)- Railing work, cladding works, canopy works, properties field test to verify grade 304 etc
- Calcium silicate board-fixing properties, baffle/ metal false ceiling
- GFRC screen/ panel-properties, fixing arrangement, quality control.

11. **Computer application**
    - Digital Computer systems, Characteristics, History, Computer Generations, Types of computers & their classifications, application of Computer in various fields, Computer Hardware & Software, Elements of computer hardware-CPU, I/O devices, storage media, Computer Software-Types of Software, System Software, Application Software
    - Basic concept & functions of an operating system, textual Vs GUI Interface, type of Operating Systems, concept of multiprogramming multitasking, multiprocessing, Introduction to disk operating system (DOS), Commands and utilities, working with MS Windows, Unix and Linux, Working knowledge of PC Software Word Processor
    - Computer Languages, Generation of Languages, Translators-Assemblers, Interpreters, Compilers, Algorithm, Pseudo-code, Flowcharts-rules & symbols, Structured Programming concepts, various techniques of programming, Use of programming
    - Introduction to 'C', importance of C, basic structure of a C program, constants, variables and data types, operators and expressions, managing I/O operators, Control Statement: IF statement and its various forms, go to statement, for, while and do-while loops, switch decision making statement Arrays: Array notation, storage and representation, Functions: user defined functions and their use

12. **Construction management and accounts**
    - Basic Principle of Managements: Management principles, planning, organizing, directing controlling, organization, structure of organization, structure of construction organization both government and project organizations
    - Accident, Safety and Housekeeping: Types, causes, cost and investigation of accidents, hazards safety analysis, planning, implementation and education,BIS measures for safety (specially construction industry),fire fighting, First aid, security, pilferage, job layout- location of store equipments, materials, project office, security guards etc
    - Industrial laws: Labour laws, factories act 1948, workmen's compensation act 1923, Minimum wages act 1948, ESI act 1948, EPF act 1952, Industrial Dispute act 1947, payment of wages act
    - Personnel Management: Man power planning, sources, recruitment and selection process, testing , interviewing, training and development strategies for workers, supervisors and managers, career planning, industrial relations, discipline, Industrial fatigue, leader ship, attitudes and human behaviour, motivation, duties towards workers peers and seniors, wage payment
    - Finance Management: Types of economic systems, ownership, Money banking, international trade, foreign exchange, taxes, finance forecasting, capital, sources of finance (loans from government and private), shares, debentures, mutual fund, types of accounts and account statements, final accounts and balance statements, demand and supply theories
    - Project Management: Project planning, Man, machine, money and material, work breakdown scheduling, Bar charts, CPM and PERT, types of construction machines-crawler and wheel tractors Power shovels, cranes, lifts, hoes, trenching machines, selection of equipment etc, Operation, cost, troubles and maintenance, store and Inventory

management, cash flow, depreciation, instalments, Interest, manpower planning, organization chart, purchasing, introduction to management software like primavera

- Quality Control: Specification, Inspection, stages of inspection, testing, tolerances, BIS code specifications, for cement, aggregates, steel, concrete & mild steel, Quality Management Systems ISO: 9000 series, Environmental Quality Management system-ISO: 14001 series, Total quality management
- Marketing in Civil Engineering: Importance of marking, marketing of housing, building materials, infrastructures, toll bridges, water supply and sanitation services, consultancy, pricing, construction equipment, shuttering and centering etc, market survey, marketing mix of product and services, tenders and contracts, quotations, branding and packaging, invoicing, property dealing, credit facilities and after sales maintenance etc
- Entrepreneur ship: Concept and need of Entrepreneurship, entrepreneurial qualities, small scale industries, procedure for setting up an industry, construction firm, project report preparation and approval procedure from the concerned agencies
- Professional Ethics: Ethics, morality, social and spiritual values and need, professional bodies, code of conduct, dilemma before a civil engineer, conflict management

13. **CAD in civil engineering practice**
    Introduction to Auto Cad, definition of various commands used, Simple exercises using Auto Cad commands, Double line plan, Front elevation and section of a one bed room set residential single storey building.

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ELECTRICAL ENGINEERING

1. Basic Concepts
2. Circuit law
3. Magnetic Circuit
4. AC Fundamentals
5. Measurement and Measuring instruments
6. Electrical machines
7. Fractional Kilowatt
8. Motors and single phase induction motors
9. Synchronous Machines
10. Generation
11. Transmission and Distribution
12. Estimation and costing
13. Utilisation and Electrical Energy
14. Basic Electronics
15. Electronic and Power
16. Power System and High Voltage Engineering
17. Control System
18. Installation, Commissioning and Maintenance of Transmission Elements
19. EHV Transmission Line

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FINANCE

1. **Advanced Accounting:**
    a. Indian Accounting Standards (Ind-AS) issued by the ICAI and problems based thereon and preparation of Final Accounts of Companies and Cash Flow Statements.
    b. Corporate financial reporting – issues and problems with special reference to LODR requirements.
2. **Management Accounting and Financial Management:**
    a. Project planning and capital budgeting: Techniques for evaluation like payback method, rate of return, IRR, NPV, etc.; preparation of project report; financial projections; sensitivity analysis in capital budgeting; Impact of inflation on capital budgeting decision; capital rationing; risk analysis in capital budgeting and evaluation of risk investments; social cost-benefit analysis; simulation and decision tree analysis.
    b. Special Features of Financial Management in Public Sector Undertakings.
    c. Tools of Financial Analysis and Planning; Ratio Analysis to evaluate performance and financial health, Application of ratio analysis in financial decision making; Analysis of cash flow and funds flow statements.
3. **Auditing:**
    a. Internal Control
    b. Audit of limited companies
    c. Audit under computerized environment
    d. Audit of payments, purchases sales, debtors, etc.
4. **Cost Accounting:**
    a. Cost Concepts in decision-making, relevant cost, differential cost, incremental cost and opportunity cost.
    b. Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even analysis, Cost-Volume-Profit Analysis. Various decision-making problems.
    c. Standard Costing and Variance Analysis.
    d. Budgetary Control; Flexible Budgets; Performance Budgets; Zero-based budgets.
5. **Management Information and Control Systems:**
    a. Information security: Importance and principles of information security, best approaches to implementing information security.
    b. Techniques in data processing - on line, batch mode, real time introduction to internet and other emerging technologies.
6. **Direct Taxes:**
    The Income Tax Act, 1961
7. **Indirect Taxes Including GST:**
    Maintenance of records, registers and filing of returns under CGST,SGST, IGST Acts / Rules.
8. **Corporate Laws:**
    The Companies Act, 2013

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HUMAN RESOURCES

1. **Manpower/workforce Planning:** Job Analysis, forecasting techniques, job design, Manpower Planning process, Forecasting techniques, Demand and Supply, Outsourcing, Current Trends.
2. **Recruitment and Selection :** Interviewing techniques, methods of selection, psychometric tools, Employee Value Proposition, Recruitment metrics, use of technology in recruitment, Employee onboarding, Employer branding, Government guidelines on Recruitment.
3. **Performance Management:** Balanced scorecard, force ranking method, performance appraisal system, Performance Appraisals Methods, feedback, Rating biases, career planning, job rotation, job enrichment, succession planning, Reward and Recognition schemes, 360 degree feedback, Assessment centers.
4. **Capability Building:** Training design and implementation models, Leadership theories, Training need analysis, Training evaluation models, leadership development programs, sensitivity trainings, knowledge management system, different approaches to learning – e-learning, micro-learning, Development Centers
5. **Compensation Management:** Job Evaluation, Internal and External equity, concept of cafeteria payments, Theories of compensation, concept of wages, job satisfaction , Government guidelines.
6. **Industrial Relations:** Conflict Resolution Techniques, Grievance Handling mechanisms, Negotiation styles, negotiation process, Collective Bargaining, history of industrial relations in India, Approaches to IR, Trade Union movement, Whistle Blower policy, Disciplinary action approach and process
7. **Labour Laws:** Introduction; Trade Union Act 1926, Industrial Dispute Act 1947, Industrial Employment Act (standing order act) 1946, Factories Act, 1948, EPF Act, 1952, ESI act, 1948, Workmen's Compensation Act 1923, Maternity Benefit Act, 1961, Payment of Gratuity Act, 1972, Contract Labor act 1970, Child Labor Act, 1970, Prevention Of Sexual Harassment (POSH) Act , New Labor Codes (The Code on Wages, 2019;The Occupational Safety, Health and Working Conditions Code, 2020;The Code on Social Security, 2020;The Industrial Relations Code, 2020)
8. **Organizational Development:** HRM Models, Change management theories, Motivation theories, Measures of employee engagement, Exit Interview analysis, Attrition Analysis, Employee engagement survey, basics of statistics, validity, reliability, measures of central tendency, frequency distribution, correlation and regression, Research design, sampling techniques, data collection techniques, culture dimension models, Employee Assistance program, personality theories, group dynamics, group formation process, group norms, organization structure – types, HR Audit, HR Scorecard, Emotional Intelligence, Values, communication modes, barriers to communication, Strategic HRM, Diversity and Inclusion, Organizational Citizenship Behavior
9. **Corporate Social Responsibility**
   Corporate Social Responsibility, Corporate Social Value, Employee Volunteerism,
10. **Human Resource Information System**
    Human Resource Management-Systems Approach, strategic Role of Information in HRM, Information Technology-Concepts & Issues, HRIS Philosophy, HRIS Implementation and Control, HR Analytics

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LAW

1. The Constitutions of India, 1950;
2. The Indian Contract Act, 1872: Proposal, Acceptance , Revocation of Proposal and lawful consideration, Contracts without consideration, Agreements, Void & Voidable Contracts, Competency to contract, Agreements, Privity of Contracts, Special Contracts, Agency and performance of Contracts etc.;
3. The Indian Penal Code, 1860: Definition, General Exceptions, Criminal Conspiracy, Offences by or relating to Public Servants, Offences affecting the Human Body and property, Criminal Breach of Contracts, Defamation and offences relating to documents and property marks etc.;
4. The Code of Civil Procedure, 1908: Stages of Civil Suits, Decree, judgment, hierarchy of civil courts, Supplemental Proceedings, Reference, Review, Revision, Execution proceedings, court fee, Summary procedure, recoveries, injunction, Appeals, and Miscellaneous Provisions along with Orders & Rules etc.;
5. The Code of Criminal Procedure, 1973: Stages of criminal trial, enquiry, investigation, hierarchy of criminal courts, summons/warrants, , Summery Trial, Appeals, review, revision, bail and Miscellaneous Provisions along with Orders & Rules etc.;
6. The Indian Evidence Act, 1872: Interpretation, Relevancy of facts, admission/denial, oral/ documentary evidence, burden of proof, examination of witness etc.;
7. Labour Laws: Industrial Disputes Act, 1948, Industrial Employment (Standing Orders) Act, 1946, Factories Act, 1948, EPF Act, 1952, ESI Act, 1948, Employee's Compensation Act, 1923, Maternity Benefit Act, 1961, Payment of Gratuity Act, 1972, CLRA 1970, Child Labour Act, 1970, POSH-2013 and Trade Unions Act, 1926.;
8. New Labour Codes: Code on Wages, 2019, The Industrial Relations Code, 2020, the Code on Social Security, 2020, and the Occupational Safety, Health and Working Conditions Code, 2020;
9. Administrative Law: Disciplinary action, principles of Natural Justice;
10. Miscellaneous Acts & Statutory Provisions: The Arbitration and Conciliation Act, 1996, Company Laws, Limitation Act, 1963, Specific Relief Act, 1963, Contempt of Courts Act, 1971, MSMED Act, 2006 and Commercial Courts Act, 2015 and other Miscellaneous Provisions etc.

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COMPANY SECRETARY

1. Company Law
2. Cost and Management Accounting
3. Economic and Commercial Laws
4. Tax Laws and Practice
5. Company Accounts and Auditing Practices
6. Capital Markets and Securities Laws
7. Industrial, Labour and General Laws
8. Advanced Company Law and Practice
9. Secretarial Audit, Compliance Management and Due Diligence
10. Corporate Restructuring, Valuation and Insolvency
11. Information Technology and Systems Audit
12. Financial, Treasury and Forex Management
13. Ethics, Governance and Sustainability
14. Advanced Tax Laws and Practice
15. Drafting, Appearances and Pleadings
16. Banking Law and Practice
17. Capital, Commodity and Money Market
18. Insurance Law and Practice
19. Intellectual Property Rights - Law and Practice
20. International Business-Laws and Practices

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