

SYLLABUS FOR PROMOTION TO THE POST OF AEN IN ENGINEERING DEPARTMENT AGAINST LDCE-30% QUOTA.

PAPER - I - 150 MARKS

GENERAL KNOWLEDGE – 50 MARKS – common topics on general knowledge, current affairs, Railway Management.

Note: Optional questions to the extent of 15 marks on official language and policy will be included in the paper.

PROFESSIONAL SUBJECT – 100 MARKS

Syllabus for Professional Subject

CIVIL ENGINEERING (GENERAL)

1. *Surveying*

(a) *Types*

(i) *Chain and Compass Survey-*

Basic principles; base lines; Check lines; tie lines; perpendicular and oblique offsets; conventional signs; plotting of survey; true and magnetic bearings, open and closed traverses; recording and plotting of traverses closing errors.

(ii) *Plane Table Survey*

Plane table out fit; methods of radiations; intersection and traversing; contouring with plane table using telescopic alidade; merits and de-merits.

(iii) *Leveling -*

Level lines- datum, bench marks, simple leveling, fly leveling; recording the levels in field book; method of reducing levels; arithmetical Check; longitudinal and cross section contouring.

(iv) *Theodolite Survey*

Types of theodolites; measurement of horizontal angles, vertical angles, magnetic bearings and deflections angles; prolonging a straight line; traversing by method of included angles; balancing the survey closing errors; calculations of latitude and departure; use of theodolite as tachometer.

(v) *Curves*

Elements of simple circular, curves; setting out simple circular curves; different methods.

(vi) *Setting out works*

Setting out buildings, culverts, central lines of railway Alignment.

(b) *Care & Custody of Survey Instruments.*

Handling of instruments- Transport and protection; permanent Adjustments; repairs and periodical over haul.

2. *Strength of Materials, Structural Designs & Drawings*

(a) *Strength of Materials*

Stress, strain, Hooke's Law, working stress, factor of safety; bending moment and shear force in simply supported beams and cantilevers; simple theory of bending; moving loads on simply supported beams; influence lines for bending moment and shear force in statically determinate beams; short columns, long columns-empirical formulae.

(b) *Structural Designs & Drawings*

(i) *Steel Structures*

Riveted and welded joints; tension and compression members; plate girders; connections; IRS Code of Practice for Steel Structures; Sketching of connection details.

(ii) *RCC Structures*

Slab- singly and 2-Way reinforced; Beams rectangular, T and doubly reinforced; Bond; shear reinforcement; Design of columns, footings. IRS Code of Practice for RCC Structures; Sketching of RCC details of simple structures.

3. *Construction Materials*

Description specification properties and uses of building materials – Stones, sand, timber, bricks, cement, lime, building hardware, paints, varnishes, glasses, tiles

4. **Foundation & Construction Engineering**
- (a) **Soil Mechanics**  
Elements of Soil Mechanics- Physical properties of soils, compaction, field methods of compaction; Stabilization of soils; Safe bearing capacity of soils; determination of safe bearing capacity; earth pressure; plate loading test, specifications and construction of earth work in embankments & cuttings.
- (b) **Foundation Engineering**  
Functions of foundations; different types of foundations; settlement of foundations; methods of reducing differential settlement; pile foundations; well foundation for bridges.
- (c) **Buildings**  
Brick and stone machinery; construction details-roofs, floors, Staircases, joinery, scaffolding.
- (d) **Reinforced & Prestressed Concrete**  
Bending & placing of reinforcement; fine and coarse aggregates; concrete mixing, laying and compaction; finishing of RCC surface; formwork, curing, testing.
- (e) **Steel Structures -**  
Standard rolled sections; fabrication - templating, straightening, drilling, riveting, bolting and welding; match marking; trial erections, testing, site erections, equipment, methods.
- (f) **Construction Machinery & Equipment**  
Drilling and blasting equipment for quarrying, tunneling and excavation in rock, pile hammers and pile-driving equipment; pumps, concrete mixers, vibrators, grouting equipments, air compressors, pneumatic tools and different types of cranes.
5. **Hydraulics & Hydrology**
- (a) **Hydraulics**  
Elements of hydraulics - Open channel flow; in pipes frictional loss, empirical formulae.
- (b) **Hydrology**  
Rainfall and run-off; rainfall statistics; rain gauges, run -off calculations by empirical methods, flood discharge estimation; measurement of flood discharge - current meter.
- (c) **Hydraulic Structures**  
Design of bridges - alignment, number of spans; economic spans; waterway calculations; scour depth & afflux; clearance; depth of foundations; BOX and Pipe Culverts, river training works - spurs, groyens, aprons, levees
6. **Public Health Engineering**
- (a) **Water Supply**
- (i) **Quality of water - physical, chemical and bacteriological standards of water; water-borne diseases; water demand - methods of forecasting; sources of water; treatment of water aeration, sedimentation, filtration, (slow and rapid sand filters); dis-infection, hardness - methods of removal.**
- (ii) **Conveyance and Distribution**  
Pumping equipment; rising mains; systems of distribution, residual pressures; different types of pipes and fittings; testing of pipes.
- (b) **Sewerage.**  
Sewage; waste water - collection and carriage; design and sewers; house connections; storm water drains; disposal of sewage river pollution and control; sewage treatment; land irrigation septic tanks, primary clarifier, sludge and scum removal, trickling filters, activated sludge process, sludge digesting, principles of anaerobic digestion, sludge gas, sludge drying and disposal.

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**PAPER - II - 150 MARKS**

**Professional Subject (Civil Engineering -Railway), Establishment and Finance Rules.**

**Part-I (Marks: 100): Professional Subject (Civil Engineering -Railways)**

1. **Railway surveys & Construction**  
Classification of Surveys; principles governing location; ruling gradients; compensation for curves; vertical curves; hill surveys; catch sidings; tunnels; preparation of drawings; design of large bridges; progress report on surveys; project estimates; standards of construction; junction arrangements; project report; preliminary arrangement for construction of new lines; letting-out contracts; programme of work; critical path net works; execution of works and measurements; progress reports; completion of works.
2. **Railway Track**  
Description, specifications and functions of track structure elements; Rails, sleepers, fastenings, ballast, formation and other sub-structures; points and crossing, geometry and design features; track lay-outs.
3. **Maintenance of Permanent Way**
  - (a) Duties, duties of Assistant Engineers; duties of Permanent Way Inspectors; duties of Works Inspectors; duties of Bridge Inspectors; duties of Mates, Keymen and gangmen.
  - (b) Maintenance of Permanent Way: Methods of maintenance; Beater packing, Measured Shovel Packing, Machine packing, Systems of maintenance; overhauling, Systematic through packing, picking up slacks, Directed Track Maintenance, Miscellaneous works; lifting and lowering of track, screening of ballast, maintenance of drains, lubrication of rail joints, adjustment of creep, maintenance of level crossing maintenance of points and crossing.
  - (c) Special Maintenance Works :  
Maintenance of short welded rails, Long welded rails and continuous welding rails; maintenance in electrified section; special precautions; maintenance of track-circuited sections; special precautions.
  - (d) Maintenance of curved track and realignment of curves: Curvature, transitions, super-elevation of curves, safe speed, cant deficiency, speed on curves with turnouts, Realignment of Curves: methods of Re-alignment
  - (e) Testing of track with track recorders: The Hallade Track recorder; Amsler Oar; Oscillograph Car; Interpretation of track recording charts; Attention to track defects and records of track defects.
4. **Maintenance of bridges**  
Inspections of bridges: Records of inspection; details of bridge inspection; works connected with maintenance of bridges; laying of bridge sleepers; replacing cracked bed blocks; painting of steelwork.
5. **Inspection and Maintenance of tunnels**  
Inspection of tunnels: Records of inspection; equipment for inspection; details of tunnel inspection; works connected with maintenance of tunnels.
6. **Inspection and maintenance of turntables and weigh bridges pits**  
Condition for satisfactory working of turntables; adjustment and overhauling of turntables; inspection and maintenance; erection and dismantling of turntables; weighbridge pits and approaches - responsibility of engineering staff; drainage of weighbridge pits; construction of new weighbridges.
7. **Inspection and maintenance of buildings and structure other than bridges**  
General instructions; additions and alterations to quarters; transfer of building; building registers; scale of accommodation and other facilities; vacant railway buildings; maintenance of buildings- inspection and repairs; petty repair books; periodical inspections; details of inspections.
8. **Maintenance of sanitary and hygienic conditions; in station yards and railway colonies, water supply, drainage and sewerage**
  - (a) Sanitation: Formation of sanitation committees; inspection by sanitation committee; sanitary arrangement, in stations and colonies; drinking water wells- protection; cleaning of wells; disinfections; prevention of infectious diseases; disinfections of Quarters.
  - (b) Water Supply: Sources of water supply; water sample analysis; open wells-size; pumping capacity, improving yield; shallow tube-wells; deep tube-wells; impounding reservoirs; storage capacity; flood discharge; records of water levels in wells; rainfall registers; high level storage tanks; precaution against pollution; pumps-types, selection, installation; aqua ducts and pipelines - types, selection, lying; estimating requirements of water; layout of distribution system; water supply from outside sources; maintenance and operation of water supply installation- responsibilities of Engineering department and Mechanical department.
  - (c) Drainage and sewerage: Drainage system; waterborne sewerage; sizes of sewers; sewage; sewage treatment systems; sewage disposals; sewage purification systems; surface drainage - layout, size of drains; disposal of sludge, affluent; drainage of latrines; maintenance of sewerage and drainages systems; maintenance of open sludge drains; storm water drains; house connections; conservancy and sanitary arrangements; responsibilities of engineering staff.
9. **Acquisition management and disposal of land**  
General Code Rules: Ownership of railway land; sanctioning authority for acquisition and relinquishment; principles for acquisition and relinquishment; procedure for acquisition and relinquishment; plans and schedules; taking over and handing over; demarcation of boundaries; land records - demarcation and verification of railway boundaries; maintenance of rights of way; religious structures; management of railway land leasing of licensing; lease or license of land; merchants and vendors at stations, bulk oil installations, natural products and grazing; construction of buildings near railway land; sale of natural products; falling of trees-within railway land, outside railway land; falling of trees near electric or telegraph wires.
10. **Large scale Permanent Way renewals**  
Classifications of routes and tracks; track renewal programmes; factors governing permanent way renewals; preparation for relaying; preliminary work; systematic operation for complete relaying; speed restrictions to be observed during relaying; post relaying work; classification and disposal of released materials.
11. **Rehabilitation of bridges**  
Precautions when working on bridges; rebuilding or alterations to bridges; design and execution of bridge works; temporary arrangements; false work for erection of girders; assembly and erection of girders; cranes for erection of girders; testing of girders; proposals for strengthening existing girder spans; methods of Regirdering major bridges.

12. **Works affecting railway safety and opening new works**  
 General - References to rules; works requiring sanction of the CRS and notice thereof; applications to the CRS - execution of works and Safety Certificates; documents to accompany application; submission of Safety certificate; deviations from plans approved by CRS; applications for running of new types of locomotives and/ or rolling stock and for increases in speed; notification to railway officials when opening works; works resulting from accidents; opening of new lines; infringement to Schedule of Dimensions - condonation; procedure thereof movement of ODCs - types and procedure for sanction for movement, precautions during movements.
13. **Railway Operation**
- (a) General: Reference to G. & S.R.; Types of signals and their significance; rules for working of trains; block working rules - types, introduction of temporary single line working.
- (b) Engineering restrictions and indicators: General - Definitions: Responsibility of the Inspector- In-charge; works of short duration; protection of line in block section and procedure for passing trains; work of long duration; temporary engineering fixed signals; arrangements prior to commencement of work; protection in block section for speed restrictions; procedure for blocking lines for engineering purpose; works at times of poor visibility; temporary signals in emergency, periodical notices of engineering restrictions; permanent speed restriction indicators; review of permanent speed restrictions; indicators-General.
- (c) Level Crossings: General - Classification, Standard Specifications; normal position of gates; level crossing equipment, traffic and engineering gates, siding gate lodges; appointment of gate men; duties of gate men; maintenance of level crossings; examination of gate equipment and gatemen in rules; level crossings registers; road traffic census; manning/de-manning of level crossings.
- (d) Working of trolleys; general instructions- rules for working; distinction between trolleys lorries, and motor trolleys; Certificate of competency; officials permitted to use trolleys and lorries; responsibility for safe working ; working at night or in bad weather; working on track, circuited sections; conveyance of non-railway officials; trolley permits for private sidings; trolley refuges; protection; equipments trolleys and lorries; working of trolleys and lorries; in block sections, in station limits.
- (e) Ballast and material trains; General Rules for working; Restrictions in running; ordering of ballast trains; issue of "fit to run" Certificate; equipment testing of brake power; working in block sections; running on Ghat section; loading from hopper wagons; attendance of police at accidents; driver's reports on defects in track; training out materials and daily reports of ballast train working; charges for ballast trains; register of Engineering vehicles.
14. **Accidents**  
 General - Observance of rules; intimation of accidents by station masters; duties and responsibilities of the engineering officials in the event of accident impairing through traffic action at site, reporting details of accident - provisions of Accident Manual; action in case of derailment; examination of site and preparation of sketches; recording track and rolling stock measurements - accidents, procedure; use of recorded data; restoration of through running; procurement and arrangement of labour and equipment; temporary arrangements at site of accident; transshipment; funds required during emergencies; attendance of police at accidents; driver's reports on defects in track; action on receipt of reports of defective track; abnormal occurrence attributable to oscillation of locomotives; accidents not impairing through traffic; records of accidents.
15. **Rivers & Floods pre-monsoon precautionary measures and patrolling of railway line**
- (a) Rivers and floods; General- behavior of rivers; watchmen at important bridges; pitching stones and boulder reserve; vigilance during floods; flood records; survey of the course of river; river protection works; types, design, repairs and maintenance; records, rivers and floods.
- (b) Pre-monsoon precautionary measures: Vulnerable sections materials for anticipated emergencies; monsoon emergency rakes; equipment, tools, rail clusters, temporary bridge spans; protective works; Railway affecting tanks; inspection & vigilance over railway affecting tanks; pre-monsoon, during monsoon.
- (c) Monsoon and emergency patrol: Kinds of patrolling, keymen's daily patrol; gang patrol during abnormal rain; systematic night patrolling during monsoon; stationary watchmen at vulnerable points; review of patrolling systems and vulnerable locations; security patrolling during civil disorders; protection of line in emergency; duties of patrolmen and their equipment; reporting damage and obstruction on track to Station Masters; check over patrolling; inspection of equipment; surprise checking at night.
16. **Preparation of plans and estimates**  
 Preparation of plans - General procedure; - plan for other departments; sizes of drawings; titles and numbering of drawings; scale of drawings; details on drawings; symbols and colours of drawings; Railway Board drawings; plans issued by the Chief Engineer's Office; Plans in Divisional Asstt. Engineer's / Inspector's offices; completion drawings; care and filing of tracings; preparation of estimates - Code rules; technical details rates and quantities; schedule of rates and price-listing of stores; report and justification; rent statement for staff quarters; special features of estimates, remodeling of station yards, track renewal works, deposit works, Urgency Certificate; Supplementary Estimates.
17. **Contracts and Execution of works**
- (a) Contracts: General-Code reference for contracts; lists of approved contractors and registration of applications; Schedule of Rates: Analysis, non-scheduled rates, special rates; tenders: procedure, tender documents, drawings and specifications, tender committees, acceptance of tenders, contracts; procedure, contract documents, General and special conditions of contract; loan of tools and plant to contractors; issue of departmental materials to contractors; lease or license of railway quarries; measurements and measurement books-code reference; recording measurements; on account Measurements; standard measurements; responsibilities of Inspectors and Asstt. Engineers for measurements of works; ballast measurements; computation of quantities; preparation of abstracts in measurement books; submission of bills; checking of bills, bill registers; disputes with contractors.
- (b) Execution of works; General instructions-code rules; agencies for executing works; responsibilities of executive officers; deposit works; excess and savings on estimates; attention to public interests; prevention of accidents; religious edifices and archaeological remains; provision of lightening conductors; planning critical path net works, PERT; departmental execution of works - records, progress reports, charges for stores and labour, execution of works in Engineering workshops; contracted works, issue of work orders; completion documents; works pertaining to other departments.

18. *Track Machines*  
Various types of track machines, rated out Put of track machines, pre-temping, post-temping operations, design lining and leveling.
19. *Miscellaneous*
- (a) Engineering Plant: General - Code rules, engineering plant reserve, plant register; valuation of plant maintenance, storage and repairs; requisitioning of plant, use of plant at site; maintenance of log books; hiring out of engineering plant; examination of boilers of the Engineering Department.
  - (b) Explosives: General - Issues of instructions on use of explosives; observance of rules; carriage of explosives; commonly used explosives; selection of explosives; storage and conveyance to work site; blasting operation; boring holes; amount of charge; preparation of charge; electrical and safety fuses; precautions to be observed during blasting; misfires; protection to trains and railway property; destruction of explosives; detonating signals - care and custody; use of detonators and testing.
  - (c) Management of Engineering Stores: General - Reference to code rules; procurement of stores- requisition acknowledgement of receipt, claims for short receipts, etc. custody of stores - classification, handling and storage; account heads of stores, operation, records and returns; disposal of released and surplus stores return to stores depot, disposal by auctions; verification of stocks and adjustment for shortage/excesses.
  - (d) Law and Order: Railway Police; loading of complaints; cooperation with Railway Police; cognizable offences; non-cognizable offences; powers of arrests by railway staff; warrants against railway staff; action by railway staff in cases of attempted sabotage; answering of court Summons; prevention of trespass; disposal of human bodies found run over; disposal of cattle found dead on the Line.

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**Establishment Rules: 25 Marks**

**A: PERSONNEL MANAGEMENT**

- a) Organisation of the Personnel Department in the Railways. The objectives of the Personnel Department, functions and policies of the Personnel Department in the Headquarters and on the Divisions.
- b) Classification of services – recruitment to the different services Group 'A' to 'D' – Recruitment of artisan staff, special reservation in Railway services – Role of the Railway Service Commission in recruitment, Recruitment other than through usual channels, promotion policy and methods.
- c) Personnel Supervision, leadership styles, formal and informal leadership, leadership qualities, different leadership styles, democratic or participative leadership style, advantages of participation, Count Councils of management, Negotiating Machinery scheme at zonal and Divisional corporate Enterprises groups.
- d) Inspections of Loco sheds, C&W Depots, Stations, Engineering offices.

**B: LABOUR RELATIONS AND WELFARE:**

**UNIONS AND THEIR ROLE.**

- a) Important recognized Trade Union in Railways, Role of unrecognized unions and methods of dealing with them.
- b) Industrial disputes and the Legislative Framework, causes of Industrial Disputes, basic remedies, the Industrial Dispute Act 1947. Strikes, Lock out and Lay Offs, handling of Grievances at Divisions and in the Headquarters, handling of grievances by Labour Enforcement Officers.
- c) The hours of Employment regulations, overtime, job-analysis and its mechanics.
- d) The factories Act, Special Rules for workshop staff in the Railways.
- e) The workmen's compensation Act, Ex Gratia payment, Incentive, Bonus Schemes.

**C: WELFARE**

- a) Pass Rules, leave rules
- b) Retirement benefits under the Provident Fund and Pension scheme, Final settlement.
- c) Welfare for the whole family of railway-men concept and practice obtaining on the Railways.

**Financial Rules: 25 Marks**

- a) Parliamentary control over Railway Finance, Public accountability of finance propriety.
- b) Financial Planning and Budgeting Budgetary and financial reviews / appropriation accounts.
- c) Rules of allocation, classification of Expenditure, Control over expenditure, Responsibility / accounting performance Budgeting, Exchequer control, financial results of working.
- d) Works Programme, Financial justification of work surveys, preparation of estimate, capital budget control over capital expenditure.
- e) Financial control over stores expenditure, purchase and stores keeping procedure, Inventory control and A.B.C. analysis.
- f) Financial and cost control in railway workshops.
- g) Rules and procedure relating to Tenders and contracts for execution of works, procurement of stores.
- h) Procedure for processing and finalizing the Audit objections and draft paras.
- i) Delegation of powers.
- j) Losses, Frauds and embezzlements.

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