

## Syllabus for Transportation Engineer post:

### I. Syllabus: Civil Engineering

#### 1. General Knowledge

1.1 Questions of general interest and importance acquired by general observation or reading without specific text book study; subjects of national importance.

1.2 The standard of general knowledge may not be more rigorous than 12<sup>th</sup> standard.

#### 2. General Mathematics

2.1 Arithmetic, Trigonometry, statistical operations, graphs, fractions, percentage, averages.

2.2 Geometry – area & volumes up to 12<sup>th</sup> standard level.

2.3 Algebra – Simultaneous/Quadratic equations up to 12<sup>th</sup> standard level.

#### 3. Civil Engineering (General)

##### 3.1 Surveying

##### 3.2.1 Chain and Compass Survey –

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

##### 3.2.2 Plane Table Survey –

Techniques of using Distomat and total stations. Method of setting layouts & curves using these equipments.

##### 3.2.3 Levelling –

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

##### 3.2.4 Theodolite Survey –

Types of theodolites; measurement of horizontal angles, vertical angles, magnetic bearings and deflection 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 a tachometer.

### 3.2.5 Curves –

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

### 3.2.6 Set out works-

Setting out buildings, culverts, Central line of Railway alignment. Usage of GPS technology in setting out Centre line of Railway alignments.

### 3.3 Care & Custody of Survey Instruments –

Handling of instruments – Transport and protection; permanent adjustments; repairs and periodical overhaul.

## 4. Strength of Materials, Structural Designs & Drawings

### 4.1 Structural Design & Drawings

#### 4.1.1 Steel Structures-

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

#### 4.1.2 RCC Structures-

Slab – Single and 2-way reinforced; beams-rectangular, T and doubly reinforced; Bending shear reinforcement; design of columns; footings, IRS Code of Practice of RCC structures; sketching of RCC details of simple structures. Use of computer aided softwares such as STAD, FEM etc. Basic requirements for usage of these computerized softwares.

## 5. Construction materials

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

### 5.1 Material Testing – Soil, Aggregates and Steels

## II. Syllabus : Traffic and Transportation Planning

### 1 Pavement Materials

- 1.1 Subgrade functions, Importance of subgrade soil properties on pavement performance. Identification and significance of soil characteristics, Soil classification, Effect of water on swelling and shrinkage, Cohesion and Plasticity.
- 1.2 Road making aggregates – Classification, Properties of aggregates, design of aggregate gradation, texture, polishing and skid resistance.
- 1.3 Bituminous road binders – Straight-run bitumen, emulsions, Cutback and modified binders. Rheology of bituminous binders, modified binders – adhesion and stripping, penetration index, viscosity, temperature susceptibility of viscosity. Additives and their suitability, Fillers.
- 1.4 Design of Bituminous mixes – Marshall method and super paves procedure. Design of emulsified mixes, Visco-elastic and fatigue properties of bituminous mixtures, resilient modulus of pavement materials. Requirements of paving concrete, design of mixes – IRC, absolute volume, Road Note No.4, Vibrated Concrete mix design, design of DLC and SFRC mixes, Soil stabilization techniques.
- 1.5 Types of pavement distress, techniques for functional and structural evaluation of pavements, pavement rehabilitation techniques, Overlay design procedures, recycling of flexible and rigid pavements, maintenance of paved and unpaved roads.

### 2 Geometric Design of Transportation Facilities

- 2.1 Geometric design provisions for various transportation facilities as per AASHTO, IRC and other guidelines, Discussion of controls governing geometric design, route layout and selection.
- 2.2 Elements of design – sight distances, horizontal alignment, transition curves, super – elevation and side friction.
- 2.3 Vertical alignment – grades, crest and sag curves. Highway cross – sectional elements and their design for rural highways, Urban streets and hill roads.
- 2.4 At grade intersections – sight distance consideration and principles of design, Channelisation, mini round  
  - abouts, layout of round –abouts, Inter – Changes – major and minor interchanges, entrance and exit ramps, acceleration and deceleration lanes, Bicycle and pedestrian facility design, Parking layout and design, Terminal layout and design.

### **3 Traffic Flow Theory**

- 3.1 Component of Traffic Flow System, Traffic variables and parameters, Driver behaviour modeling, Simulation, Controlled – Access Concept, Freeway Concept, System performances, Measure of effectiveness.
- 3.2 Flow through transportation networks – various types of graphs, determination of link and chain flows, finding maximum flow values of capacitated networks. Capacity of a roadway, Botlenecks.
- 3.3 Approaches to traffic flow theory, Traffic flow relationships – flow at different densities, Shock wave phenomenon, time – Space diagram.
- 3.4 Mathematical modeling, Probabilistic and Stochastic models of traffic flow process, Discrete and Continuous modeling headways, Gaps and process of gap acceptance, Macroscopic models, Car – following model, Queuing models, fundamentals & developments of queuing process, Applications.
- 3.5 Indices of Level of Service (LOS) as offered to road users.

### **4 Analysis of Transportation Systems**

**Introduction to Transportation systems, Transportation innovations, Social and Economic impacts of Transportation, Decision makers and their options, Demand modeling and prediction, Supply and equilibrium flows, Modelling and transportation technology, Analysis of network flows, Transportation network, Network theory, Concepts in transportation models and location models, Analysis of utility maximizing systems such as entropy Concepts, Major transportation technologies, Cost functions and estimation, Urban transport economic policy, Models for selecting network investments and operation planning,**

### **5 Transport and Environment**

- 5.1 Modes of Transportation, Mixed traffic flow, Transport related pollution, Road transport related air pollution, Sources of air pollution, Effects of Weather Conditions, Vehicular emission parameters, Pollution standards, Measurement and analysis of vehicular emission, Mitigative Measures.
- 5.2 Urban and non-urban traffic noise sources, Noise level factors, Effects of traffic noise, Propagation and measurement of traffic noise, Prediction and control measures, Noise studies, Noise standards.
- 5.3 EIA requirements of highway projects, EIA procedures, guidelines, EIA practices in India.

## 6 GIS Applications in Transportation Engineering

- 6.1 Remote sensing : Physics of remote sensing, Ideal remote sensing system, Remote sensing satellites and their data products, Sensors and orbital characteristics, Spectral reflectance curves, resolution and multi-concept, FCC, Interpretation of remote sensing images.
- 6.2 Digital image processing : Satellite image – characteristics and formats, Image histogram, Introduction to image rectification, Image enhancement, Land use and land cover classification system.
- 6.3 Geographic information system (GIS) : Basic concept of geographic data, GIS and its components, Data acquisition, Raster and vector formats, Topography and data models, Spatial modeling, Data output, GIS applications.
- 6.4 Global positioning system (GPS) : Introduction, Satellite navigation system, GPS-space segment, Control segment, User segment, GPS satellite signals, Receivers; Static, Kinematic and Differential GPS.
- 6.5 Applications in Transportation Engineering : Intelligent Transport System, Urban Transport Planning, Accident Studies, Transport System Management, Road Network Planning, Collecting Road Inventory.

## 7 Urban Transportation Systems Planning

Hierarchical levels of planning, Passenger and Good transportation, General concept and planning process, Urban Travel characteristics, Private and Public Travel Behaviour Analysis, Travel Demand Estimation and Forecasting, Trip Generation

- 7.1 Method and their comparison, Trip Distribution, Modal Split Analysis and Trip Assignment, Behavioural Approach.
- 7.2 Trip Generation modeling – variables influencing trip generation, Regression Analysis and Category Analysis, Trip distribution Modeling – factors governing trip distribution, Growth factor Method, Gravity Model, Intervening opportunity and Competing opportunity Models, Modal Split Modeling – factors influencing Mode choice, Two stage Modal Split Models, Discrete choice Models, Entropy Maximizing and Linear Programming Methods, Transport behaviour of Individuals and Households, Network and Route Assignment, Capacity Restrain and Simultaneous Distribution, Direct Demand Models, Land – Use Transport Planning, Transport Related Land – use

Models, Corridor Type Travel Planning, Statewide and Regional Transportation Planning, Introduction to Urban Freight Transportation.

## **8 Mass and Multimodal Transportation Systems / Integration**

- 8.1 Transportation scenario, Public Transportation, Demand characteristics, Spatial, Temporal and Behavioural Characteristics of Transportation Demand, Urban Mass Transportation Planning, Demand Surveys, Estimation and Demand Projection, Four stages of Planning, Performance Evaluation of Mass Transport System, Structure of Decision Making, Evaluation and Selection Methods, Selection Procedures, Economic Evaluation Methods, Terminals and their Functions, Design, Typical Characteristics Scheduling, Service Analysis, Vehicle Despatch Policy, Vehicle Requirements, Spacing of Bus Stops, Route Spacing and Performance, Operational and Management Issues, Reserved Bus Lanes, Signal
- 8.2 Preemption, Dial – a – Bus, Vehicle Monitoring and Control System, Modal Coordination, Underground Transportation, Rail Transit,.
- 8.3 MRTS, LRT, Street Car, Sky Train and other Multiple modes, Behaviour Analysis, Multinomial and nested logit modals, Revealed and Stated Preference, Parking facilities, Operation Strategy.

## **9 Traffic Engineering and Management**

- 9.1 Traffic Characteristics – road user and Vehicle Characteristics, Traffic Studies – Volume, Speed, O – D and Parking studies.
- 9.2 Capacity and Level of Service (LOS) analysis, Statistical analysis of traffic flow variables, Traffic Control – principles, methodologies and devices, advance technologies.
- 9.3 Fundamentals of Traffic Management, Principles and Methodology, Traffic Systems Management, Technique of management, Exclusive Bus Lanes Traffic management Techniques, Speed control and Zoning, Parking Control, Traffic Segregation and Channelization, Principles and Design of Traffic Signs, Their Placement and Visibility, Transportation System Management, Route and Network Management, Area Traffic Management, City wide Traffic Control and Management, Centralized Data Processing and Monitoring.
- 9.4 Element of traffic flow theory, Characteristics of Uninterrupted traffic, Characteristics of interrupted traffic.

## **10 Transportation Economics**

Economic significance of transport, Demand for transport – influencing factors, temporal

and spatial variations, elasticity of demand, Supply of transport Costs – Long – term and short – term Costs, fixed and variable costs, and marginal costs, Pricing of services, Road User Costs, Evaluation of transport projects – Cost – benefit ratio, first year rate of return, net present value and internal – rate of return methods, Project FIRR & EIRR, Indirect Costs and benefits of transport projects, Project ownership and financing, Highway finance and Taxation.

## **11 Environmental Impact Assessment and Auditing**

- 11.1 Environmental impact assessment (EIA): Environmental statement & target areas fixation, scoping, objectives, water & waste water quality assessment models related to EIA, Air pollutants transport models, noise propagation models, methods for carrying out EIA starting from feasibility studies; case studies of EIA with special emphasis on developmental projects like highways, dams, water supply & sewerage, power plants.
- 11.2 Preparation of environmental management plan (EMP) Procedure for obtaining environmental clearance, sitting guidelines for industries. Public participation in carrying out EIA and EMP. Environmental Auditing including resources auditing, water auditing, energy auditing, health auditing: advantages, procedure, .

