TRANSPORTATION ENGINEERING

CIVIL

SEMESTER – FIFTH

These important questions have been prepared using your previous exam papers (PYQs), verified concepts, and additional reference from trusted online academic sources.
For deeper understanding, please refer your class notes as well.

Unit 1: Highway Planning & Alignment

1. Explain the objectives and main **recommendations of the Jayakar Committee**. Discuss the impact of its report on the development of Indian roads.
2. What are the **ideal requirements** for a good Highway Alignment? Explain the four major **factors affecting** the alignment of a new highway, and list the steps involved in the process of alignment surveying.

Unit 2: Geometric Design (Curves & Sight Distance)

3. Define **Super Elevation** and state its purpose. Derive the necessary expression for calculating the equilibrium super elevation required on a horizontal curve.
4. Define the different types of **Sight Distances**. Derive the expression for **Stopping Sight Distance (SSD)** and use the formula to calculate the minimum SSD required for a design speed of 65 kmph on a down-gradient of 3% (Assume coefficient of friction, f=0.35 and reaction time, t=2.5 seconds).
5. What is **Extra Widening (W_e)**? Draw a neat cross-section of a two-lane carriageway on a horizontal curve, showing and labeling the necessary elements like super elevation and extra widening.

Unit 3: Traffic Engineering

6. What are the three fundamental parameters of **Traffic Flow (Q, K, V)**? Explain the relationship between them. Using the moving observer method, explain how **Traffic Flow (Q)** and **Space Mean Speed (Vs)** are determined. (Focus on expressions and methodology).

7. Explain the objectives and scope of **Origin and Destination (O-D) Studies**. Describe the detailed methodology of the **Home Interview Method** for conducting O-D surveys.
8. Discuss the objectives of **Road Safety Auditing**. What are the primary **causes of road accidents** in India, and what are the three main "E"s (Engineering, Enforcement, Education) to reduce them?

Unit 4: Pavements (Materials & Design)

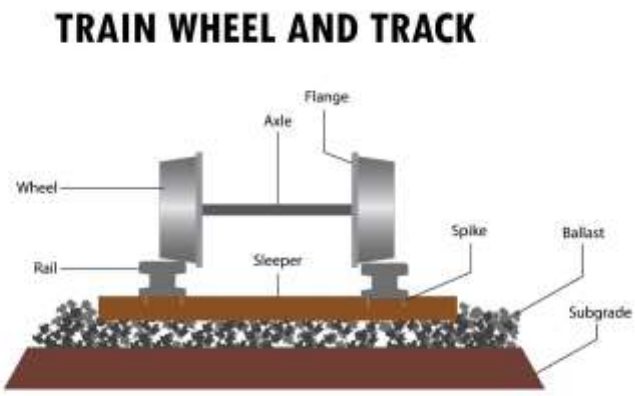
9. Explain the structure and function of the layers in both **Flexible Pavements** and **Rigid Pavements**. Give a detailed comparison of their **advantages, disadvantages, and suitability**.
10. Define **Optimum Moisture Content (OMC)** and **Maximum Dry Density (MDD)**. Explain the objective and procedure of the **Modified Proctor Test** used to determine these parameters for subgrade soil.
11. What is the significance of the **California Bearing Ratio (CBR) Test** in flexible pavement design? Describe the laboratory procedure of the CBR test and the use of the resulting value.
12. List the desirable **properties of Aggregates** used in road construction. Describe the laboratory procedure for conducting the **Los Angeles Abrasion Test** (for hardness) and the **Impact Test** (for toughness).

Unit 5: Construction & Maintenance

13. What is **Road Drainage**? Explain the necessity and objectives of a good drainage system. Differentiate between **Surface Drainage** and **Sub-Surface Drainage** systems.
14. List the different **types of Joints** provided in Cement Concrete Pavements. Describe the function of each joint with the help of a neat diagram.
15. List the desired properties of **Bitumen**. Describe the laboratory procedure for conducting the **Penetration Test** and the **Softening Point Test** on bitumen, stating the significance of each result.

Unit 6: Railway, Bridge & Tunnel Engineering

16. Draw a neat labeled diagram showing all the essential **component parts of a Railway Track** (Permanent Way). Explain the function of each component (e.g., Rails, Sleepers, Ballast).



17. Describe the different **component parts of a Bridge** (e.g., Abutment, Pier, Wing Wall). What are the key **factors considered for the selection of a Bridge Site**?
18. List the advantages of constructing a **Tunnel** over open-cut excavation. Describe the different **shapes/cross-sections** used for tunnels and explain the concepts of **mucking** and **shafts** in tunnelling.

🎯 IMPORTANT SHORT QUESTIONS (Definitions & Concepts)

1. **Define and differentiate** between **Camber** and **Gradient**. Mention the IRC recommended values of Camber for different surfaces.
2. **Define:** Right of Way (ROW), Kerb, Median, and Shoulder.
3. **Explain** the objectives and use of **Spot Speed Studies** and **Speed and Delay Studies**.
4. **List and classify** the different types of **Traffic Signs** with one example of each type.
5. What are **Cutback Bitumen** and **Bitumen Emulsion**? State their respective uses.
6. Define **Equivalent Single Wheel Load (ESWL)**.
7. Define **Gauge** and **Coning of Wheels** in Railway Engineering.
8. Briefly define **Apron**, **Taxiway**, and **Runway** in Airport Engineering.

QUICK REVISE

I. Highway Planning & Development

- **Jayakar Committee (1927):** Recommended roads be declared a **national interest**, proposed the formation of the **Indian Road Congress (IRC)**, and suggested creating a **Central Road Fund (CRF)**.
- **Road Classification (IRC): NH** (National Highway), **SH** (State Highway), **MDR** (Major District Road), **ODR** (Other District Road), **VR** (Village Road).
- **Alignment:** Affected by **Obligatory Points** (bridges, passes, restricted land), **Traffic**, **Economy**, and **Geometric Design** standards.

II. Geometric Design

- **Cross-Sectional Elements:**
  - **Right of Way (ROW):** Total land width acquired for the road and its future expansion.
  - **Camber (Cross Slope):** Provides lateral drainage. Varies with pavement type (steeper for WBM/Gravel, flatter for CC).
  - **Shoulder:** Strip adjacent to carriageway for emergency stopping and service.
- **Super Elevation (e):** Raising the outer edge of the pavement relative to the inner edge on horizontal curves to counteract **Centrifugal Force**.
  - **IRC Max e:** 7% in plains, 10% in snow-bound/hilly areas.
- **Extra Widening (W_e):** Required on curves to account for the **mechanical** widening (rear axle tracking) and **psychological** widening (driver discomfort).
- **Vertical Curves: Summit (Crest)** curves designed based on Sight Distance; **Valley (Sag)** curves designed based on Headlight Sight Distance/Riding Comfort.

III. Traffic Engineering

- **Traffic Parameters:**
  - **Flow (Q):** Vehicles passing a point per unit time (veh/hr).
  - **Density (K):** Number of vehicles per unit length (veh/km).
  - **Speed (V):** Average speed (kmph).
  - **Fundamental Relation:** $Q = K * V$
- **Traffic Volume Study:** Converts heterogeneous traffic into a single unit (**PCU - Passenger Car Unit**) for capacity analysis.
- **Speed Studies: Space Mean Speed** (true average speed of vehicles over a stretch) is preferred for design and capacity analysis over Time Mean Speed.

- **O-D Studies:** Determine movement patterns for transportation planning. Methods include **Home Interview, License Plate, Roadside Interview.**
- **Road Safety:** Accident reduction measures are classified as the **3 E's: Engineering, Enforcement, and Education.**
- **Capacity & LOS: Capacity** is the maximum hourly flow rate. **Level of Service (LOS)** measures the qualitative operational conditions (A is free flow, F is forced flow/jam).

IV. Pavements & Materials

- **Pavement Types:**
  - **Flexible:** Layers transfer load through grain-to-grain contact. Surface reflects subgrade deformation. (e.g., Bituminous roads)
  - **Rigid:** Load is distributed by the slab action of the Concrete layer. Joints are essential. (e.g., Cement Concrete roads)
- **Flexible Pavement Layers (Top to Subgrade):** Wearing Course, Binder/Base Course, Sub-Base.
- **Soil Subgrade:** Strength is the most critical factor. Measured by the **California Bearing Ratio (CBR) Test**; higher CBR is better.
  - **OMC & MDD:** Determined by the **Proctor Compaction Test**; required for quality control of embankment and subgrade.
- **Aggregates:** Must possess **Crushing Strength, Hardness (Abrasion resistance - LA Test), and Toughness (Impact Test).**
- **Bituminous Binders:**
  - **Penetration Test:** Measures **hardness** (higher pen value = softer bitumen).
  - **Softening Point Test:** Measures **temperature susceptibility** (temperature at which it softens).
  - **Types: Cutbacks** (liquefied with solvent) and **Emulsions** (bitumen + water + emulsifier).

V. Construction, Drainage & Structures

- **Bituminous Construction: Prime Coat** (applied on absorbent surface like WMM) and **Tack Coat** (applied on non-absorbent surface before laying hot mix).
- **Rigid Pavement Joints:**
  - **Contraction Joint:** Provided to prevent cracks from temperature decrease/slab shrinkage.
  - **Expansion Joint:** Provided to prevent crushing from temperature increase/slab expansion.

- **Highway Drainage:** Essential to prevent pavement damage caused by moisture. Involves **Surface Drainage** (gutters, side drains) and **Sub-Surface Drainage** (perforated pipes/filter trenches).
- **Railway Components (Permanent Way): Rails** (guide wheels), **Sleepers** (transfer load), **Ballast** (provides drainage and resilience), **Formation** (subgrade).
- **Bridges:** Components include **Substructure** (Abutments, Piers, Foundations) and **Superstructure** (Deck, Girders).
- **Tunnels: Mucking** is the removal of excavated debris. **Shafts** are vertical openings used for ventilation, construction access, or mucking.
- **EIA: Environmental Impact Assessment** is mandatory for major projects to predict and mitigate negative environmental and social consequences.