

**QUESTION BANK**

**CE 6006 TRAFFIC ENGINEERING AND MANAGEMENT**

**UNIT I TRAFFIC PLANNING AND CHARACTERISTICS**

**2MARKS**

**1. Define - Traffic Engineering**

Traffic Engineering is that branch of engineering which deals with the improvement of traffic performance of road networks and terminals. This is achieved by systematic traffic studies, scientific analysis and engineering applications.

**2. What is the scope of traffic engineering?**

The basic objective of traffic engineering is to achieve efficient free and rapid flow of traffic, with the least number of traffic accidents. Factual studies of traffic operations provide the foundation for developing methods for improvement in general and for solving specific problems.

**3. What are the various vehicular characteristics affecting the road design?**

The various vehicular characteristics affecting the road design may be classified as static and dynamic characteristic of vehicles.

**4. State the static and dynamic characteristics of vehicle.**

Static characteristics of the vehicles affecting the road design are the dimensions, weight and maximum turning angle.

Dynamic characteristics of vehicles affecting road design are speed, acceleration and braking characteristics and some aspects of vehicle body design.

**5. What are the factors which affect the characteristics of road users?**

The various factors which affect road user characteristics are classified as follows:

- a) Physical characteristics
- b) Mental characteristics
- c) Psychological characteristics
- d) Environmental characteristics

**6. How does age of the driver influence driving behaviour?**

As the age of the driver is associated with factors like, his vision, hearing, strength and reaction time, which are associated with the driving behaviour, the age of the driver influences driving behaviour.

**7. What is meant by cone of vision?**

The cone of vision can be explained as follows:

The zone of acute vision is formed by a cone whose angle is 30 about the centre of the retina. This signifies that for very distant vision, the objects should be within this narrow cone for satisfactory perception. The vision will still be satisfactory when the angle of the cone of vision is upto 100 or 120. This is important when locating traffic signs and signals. The cone of peripheral vision has an angle of about 1600 in the horizontal direction and 1150 in the vertical direction. Peripheral vision deals with the total visual field for the two eyes.

**8. What are the psychological human factors governing road user behaviour?**

The various psychological human factors governing road user behaviour are:

- a) Perception
- b) Intellection
- c) Emotion
- d) Volition

**9. What are the various resistances to the motion of a vehicle?**

The various resistances to the motion of a vehicle are:

- a) Rolling resistance
- b) Air resistance
- c) Grade resistance
- d) Inertia forces during acceleration and deceleration

**10. What is the significance of braking test?**

The significance of braking test is that, by conducting the braking test on the road at the desired running speed, the skid resistance of the pavement surface under prevailing conditions can be measured.

**11. In a braking test, vehicle travelling at a speed of 80 km/hr was stopped by applying brakes fully and the skid marks were 7.8 m. Determine the average skid resistance of the pavement surface.**

Initial speed,  $u = 80/3.6 = 22.22$  m/s

Braking distance,  $L = 7.8$  m =  $u^2/2gf$

Average skid,  $f = (22.22)^2/(2 \times 9.8 \times 7.8) = 493.72/152.88 = 3.22$

Average skid,  $f = 3.22$

**12. What is off tracking?**

The difference in distance between the curved wheel paths of a particular set of front and rear wheels (i.e., either the set of front and rear wheels on the outer side of horizontal curve or the set on the inner side) is called off-tracking or the mechanical widening for a vehicle. Off tracking =  $l^2 / 2R$  (where 'l' is the wheel base in meters and 'R' is the radius of the curved path in metres).

**13. State the components of traffic engineering.**

The components of traffic engineering are:

- a) Road characteristics
- b) Traffic characteristics
- c) Land use characteristics

**14. What are the interactions between land use and traffic characteristics?**

It is observed that various kinds of activities based on land use, generated different amounts and kinds of traffic. The most basic level of action for a long-run solution of the traffic problems is the planning, guidance and control in the pattern of land use. Just as transport is a function of land use, the reciprocal statement that land use is a function of transport is also true. As systems of transport are built, the land use pattern that follows has a close relation to the accessibility that has been made possible.

**16 MARKS**

**1.Explain In Detail About Road User Characteristics.**

Human beings performing different roles in the traffic are most important elements of the traffic and so we have to study their characteristics and behavior. Various roles of human are such as driver, pedestrians, cyclists etc. The physical, mental and emotional characteristics of human

beings affect their ability to operate motor vehicle safely or to service as a pedestrian. Hence it is important for a traffic engineer to study the characteristics and limitations of the road users.

The various factors which affect road user characteristics may broadly be classified under four heads:

1. Physical
2. Mental
3. Psychological
4. Environmental

- **Physical characteristics:** The permanent physical characteristics of the driver are vision, hearing, strength and the general reaction to the traffic situations.

1. **Vision** include the acuity of vision, peripheral vision and eye movement; glare vision, glare recovery and depth judgement. Field of accurate, clear vision is about a 3 degrees cone however the vision is fairly satisfactory up to 10 degrees in general and 20 degrees in horizontal plane. In vertical plane the vision may be limited to 2/3 of that in horizontal plane.

2. **Hearing** is helpful for drivers but of more important for the pedestrians and cyclists.

3. **Strength** Important factor in general , lack of strength may make parking maneuvers difficult, particularly for heavy vehicles.

- **Mental Characteristics:** Knowledge, skill, intelligence, experience and literacy can affect the road user characteristics. Knowledge of vehicle characteristics, traffic behavior, driving practice, rules of roads and psychology of road users will be quite useful for safe traffic operations.

- **Psychological factors:** These effect reaction to traffic situations of road users to a great extent. Attentiveness, anger, fear, anxiety, phobias, superstition, and impatience may effect the traffic performance to great extent.

- **Environment factors:** The various environmental conditions affecting the behavior of road user are traffic stream characteristics, facilities to the traffic, atmospheric conditions and locality. The traffic stream may consist of mixed traffic or heavy traffic whereas facilities to overtake to the faster vehicles may be limited. The behavior of the driver varies from one traffic stream to another.

Similarly the facilities of the traffic separators, multi-lanes etc will effect the performance. Surrounding environment effect the performance of the traffic because one will get slower at the market places and will be faster at the open places.

## **2.Explain In Detail About Vehicular Characteristics**

### **Vehicle Characteristics**

1. Size
2. Weight
3. Axle configuration
4. Power to weight ratio
5. Turning ratio
6. Turning path
7. Pollution created
8. Design vehicle

### **Size ,Weight ,Axle Configuration**

A vehicle has three dimension : length , width, height The height of vehicles are more important considered in placing of signals and designing over passes and under passes. Weight of the vehicle plays an important role in design of both flexible and rigid pavement. The weight of vehicle is transferred through axle ,it is important to design a pavement.

### **Power to Weight ratio of vehicle**

Human powered vehicles – cycles ,rickshaw have low powered to weight ratio and their acceleration characteristic , speed on slopes are low.

Motorized vehicle - have high power to weight ratio

Heavy vehicles- have poor power to weight ratio. Power to Weight ratio is important factors as it relates to operating efficiency of vehicles.

### **Minimum Turning Radius**

Minimum turning radius is the radius of the circle that will be traced by the front wheel if the vehicle moved with its steering maximum extend Big vehicle have bigger turning radius and small vehicle have smaller radius.

### **Turning path**

Since wheel turns the rear wheel are fixed and the vehicle body extend beyond the tyres, the effective width of vehicle on a turn is increases The width of the road on curves is increased in order to accommodate the increase effective width of vehicle

### **Vehicle Pollution**

Release hydrocarbons.

Hydrocarbons react with nitrogen oxide in the presence of sunlight to produce ozone

It releases major components of nitrogen which is the main causes of acid rain

Carbon monoxide reduces the flow of blood streams

Green house gases also emitted-carbon dioxide

Noise pollution-age of vehicle, tyre type etc.

Physiological problems-sleep ,concentration

### **Design Vehicle**

#### **Types Of Vehicles:**

- Motorized two wheeler
- Motorized three wheeler
- Passenger cars
- Buses
- Trucks
- Slownon motorized vehicle like cycles

Engineer needs to choose a type of vehicle based on the characteristic of vehicle the road must be designed

IRC –Indian Road Congress

AASHTO- The American Association of State Highway and Transportation Officials (AASHTO) gives the design of roads

#### **Design vehicle**

Selection of design vehicle can have a good effect on use of roadway facilities such as turning radius, turning pocket length, U-turn from left-turn-bay, and design of parking . Acceleration performance of vehicle Determination of length of acceleration lane when merging, dual objectives of greater power and improved fuel efficiency

### **3.Explain PIEV Theory**

PIEV Theory Splits the Reaction Time of Driver into 4 Components.

1. Perception : Time Required To Perceive an Object or Situation. [Function of Eyes, Ears]

2. Intellection : Time Required For Understanding The Situation. [Function of Brain]
3. Emotion : Based on Our Emotions at the time [Fear, Anger etc] We Reach The Decision Whether We Want To Stop or Not. [Function of Brain]
4. Volition : Once The Decision of Stopping Has Been Finalised, Time Required For Moving the

#### 4. Write short notes on Power Performance Of Vehicle

##### Resistance to motion of a vehicle

The power developed by the engine should be sufficient to overcome all resistance to motion at desired speed and to accelerate at any desired rate to the desired speed

- Rolling resistance
- Air resistance
- Grade resistance
- Inertia force during acceleration and de

acceleration

- Transmission losses

Tractive resistance

$P_p = P_f + P_a + P_i + P_j$  Foot From the Gas to the Brake Peddle. [Function of Hands or Legs]

##### Rolling Resistance

When the vehicle wheels roll over the road surface, the irregularities and roughness of the surface causes deformation of the tyres, and some times the road surface may go deformation

Rolling resistance  $P_f = m \times f \times g$

$m$  = mass of the vehicle in kg

$f$  = coefficient of rolling resistance

$P_f$  = rolling resistance in N

$G$  = acceleration due to gravity in  $m/sec^2$

Rolling resistance depend on speed also

$f_v = f_o [ 1 + 0.01 (V-50)]$

$f_v$  = coefficient of rolling resistance at speed  $V$

$V$  = speed in K.P.H

$f_o$  = coefficient of rolling resistance

### Air Resistance

- Resistance caused against side of vehicles body
- Wheel causes power loss
- It exert reaction pressure against the front of the vehicle

$$P_a = C_a \times A \times V^2$$

$P_a$  = air resistance in N

$A$  = projected front area

$V$  = velocity of speed in m/sec

$C_a$  = coefficient of air resistance

$G$  = acceleration due to gravity 9.81 m/sec<sup>2</sup>

### Grade Resistance

When a vehicle which has to moving on a level stretch at a particular speed has to move up in incline, addition work has to be done.

$$P_i = (m \times i \times g) / 100 \quad (+ \text{ or } -)$$

$P_i$  = grade resistance

### Inertia Force During Acceleration And Reacceleration

Inertia force

Force = mass x acceleration

$$P_j = m \times a = m \times (dv/dt)$$

$m$  = mass of vehicle in kg

$P_j$  = Inertia force

### **Transmission Losses**

- Losses in power from the engine to gear system. The vehicle has a system of gear to alter the speed.
- At starting of vehicle high power is needed and speed is low.
- For high power engine for climbing a hill the speed is reduced

### **5.write in detail about road characteristics**

It includes the following factors

1. Friction
2. Hardness/smoothness
3. Light reflecting characteristics
4. Surface slope

#### **1.Friction**

The frictional force between the tyres on the surface of the road is used to determine the following

1. Safe speed
2. Stopping distance
3. Turning distance
4. Super elevation
5. Skid resistance and slippage

#### **Slip**

Slip is defined as the movement of the vehicle due to the revolving of wheels more than the longitudinal movement and is occurring on a slippery and wet surface.

#### **Skid**

Skid is defined as the path travelled along the road surface which is more than the circumferential movement. skidding occurs when the wheels slide without revolving.

#### **2.Hardness/Smoothness**

Hardness/Smoothness of a road surface can be expressed by roughness index.roughness index is defined as the cumulative vertical deformation of the surface to the horizontal length.the unit is cm/km.it affects the following factors

1. Cost of the vehicle operation

- 2. Driver's comfort
- 3. Driver's safety

Based on the roughness index value the pavements are classified into the following categories and their values are given in table

<b>Pavement surface type</b>	<b>R.I Value ( cm/km )</b>
Good	150
Satisfactory	250
Uncomfortable	>320

### **3.Light Reflecting Characteristics**

Visibility of road surface is affected by the colour of the pavement surface.light coloured surface provides better visibility during driving,the glaring is more on wet surface than dry surface.Dark surface provides the poor visibility during nights.rough surface and well drained surfaces reduce the reflection.

### **4.surface slope**

The size of the camber required for a pavement can be determined by the ability of road to drain rain water.