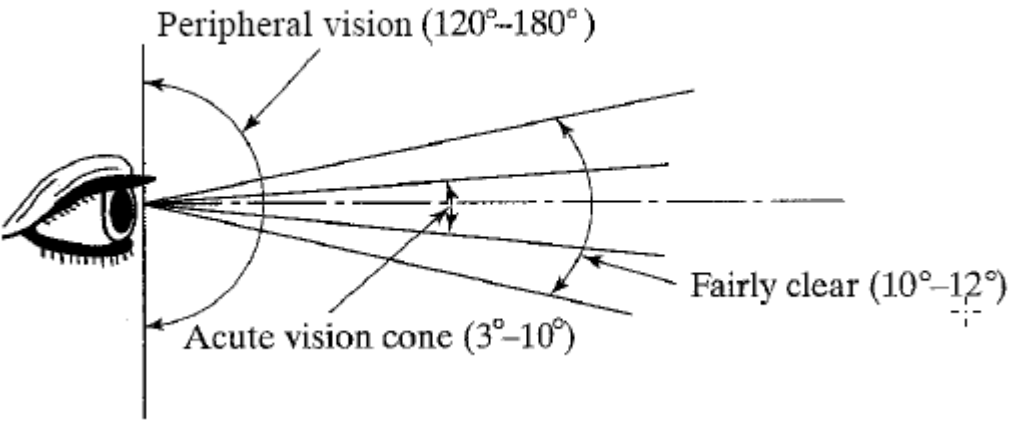
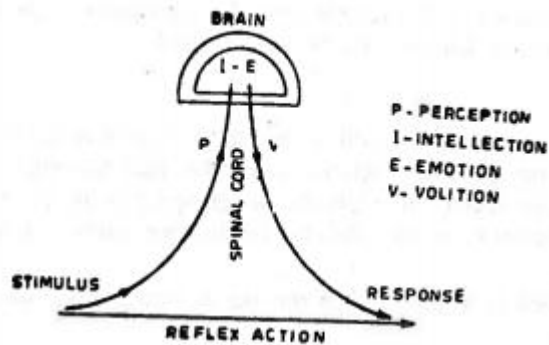


## Fifth Semester B.E. Degree Examination, Dec 2017/Jan 2018

### Traffic Engineering

1a	<p>List the different road user characteristics and explain the concept of PIEV theory. <span style="float: right;">(8 marks)</span></p>
	<p>The different road user characteristics are          Physical – Vision and Hearing          Mental- stress and tension          Psychological- Fear, Anger and mental conditions and          Environmental factors- climatic condition like rain, snow, frost etc.</p> <p>Vision:</p> <p><i>Acute or clear vision cone</i>-3" to 10" around the line of sight; legend can be read only within this narrow field of vision.</p> <p><i>Fairly clear vision cone</i>-10" to 12" around the line of sight; color and shape can be identified in this field.</p> <p><i>Peripheral vision</i>-This field may extend up to 90" to the right and left of the centerline of the pupil, and up to 60" above and 70" below the line of sight.</p> <div style="text-align: center; margin: 10px 0;">  </div> <p>The fields of vision affect a number of traffic engineering practices and functions. Traffic signs, for example, are placed so that they can be read within the acute vision field without requiring drivers to change their line of sight. Thus, they are generally placed within a 10" range of the driver's expected line of sight, which is assumed to be in line with the highway alignment.</p> <p>Peripheral vision is the single most important factor when drivers estimate their speed. The movement of objects through the peripheral vision field is the driver's single most important indicator of speed.</p> <p>PIEV theory splits the reaction time of driver into 4 components.          Perception : time required to perceive an object or situation. [function of eyes, ears]          Intellection : time required for understanding the situation. [function of brain]          Emotion : based on our emotions at the time [fear, anger etc] we reach the decision</p>

weather we want to stop or not. [function of brain]  
 Volition : once the decision of stopping has been finalised, time required for moving the foot from the gas to the brake peddle. [function of hands or legs]



1b Discuss various urban traffic problems that India is facing. List some remedial measure also.  
 marks)

**Urban Traffic Problems**

**1. Urbanization:**

An urban area is an area with an increased density of human-created structures in comparison to the areas surrounding it. In Indian context urban area is one with the following characteristics:

- All places having 5000 or more inhabitants
- A density of not less than 400 per square kilometre
- At least three fourths of the adult male population employed in pursuits other than agriculture, are treated as urban areas’.

**2. Motorization**

Booming economy, aspirations to own a car, unmatched public transport (with respect to demand, comfort or both), the government’s encouraging policies (open car market, easy loan schemes), etc. are a few reasons for increasing motorization at a rapid rate.

**Modal share**

A major portion of vehicular composition during peak hour on important corridors in the metropolitan cities consists of cars, two wheelers and Intermediate Public Transport (IPT) (even though their mode share is less compared to PT), which clearly indicates the reason for extreme congestion on Indian urban roads during peak hours

**3. Effects on mobility**

Mobility can be assessed in terms of speed, travel times, delays, etc. along the important corridors of the city. The average journey speed on important city corridors is in the range of 17–26 kmph. For the major cities, 0.25 is the average congestion Index index on a scale of 0–0.6, where ‘0’ indicates good and ‘0.6’ indicates poor index value. the congestion index is calculated as  $(1 - x/y)$ , where x is the observed speed and y is the expected speed. The average volume to capacity (V/C) ratio on major corridors within cities (in 2007) has already reached values closer to or exceeding 1.

**4. Effects on safety**

According to WHO, India topped in road accident fatalities, than any other country in the world.

**5. Effects on environment**

	<p>Transport sector has a major share of 26% of total carbon emissions as compared to other sectors. Also, within the emissions from the transport sector, road transport has a major share of 65% as compared to rail, air and water transport. The major share of fuel consumption as well as emissions is by cars and two-wheelers as compared to buses. This scenario clearly results from the prevailing imbalance in modal split, which is not only affecting mobility, but also the environment.</p> <p><b>Solutions:</b></p> <p><b>Transport planning and modelling</b>  One of the reasons for unregulated urban growth and sprawl in India is the lack of integration of land-use and transportation planning. Traditional demand modelling techniques which adopt trip-based approach and uses ‘trips’ as the basic unit of analysis have limitations of dealing with behavioural issues, for instance, modelling multistop tours, etc. Top-down approach should be resorted to wherein we start with a set of goals/objectives.</p> <p><b>Non-motorized transport</b>  In Indian cities, CBD’s are the most congested/polluted parts and NMT unfriendly because the private vehicles are allowed to enter a CBD and it is perceived as good for businesses located inside a CBD. Study on impact of NMT and/or PT zones on the overall mobility within and outside a CBD, and on the businesses in general.  Improve pedestrian facilities.</p> <p><b>Public transport</b>  An affordable, networked public transport with a desired minimum level of service would always attract ridership in Indian cities  Good integration of multi-modal mass transit systems to serve the overall mobility needs of the city. Inter- and intra-connectivity that utilizes public and private mode and develop an efficient transport system.</p> <p><b>Driver behaviour and road safety</b>  Introducing an effective and comprehensive driver licensing and testing programme all over the country  Effective and comprehensive driver education courses.</p> <p><b>Traffic management</b>  Levying parking charges in CBDs and other busy areas.  Develop a clear parking policy which would guide the fixation of tariffs and other restraints on vehicular parking.  Congestion pricing is another good instrument to control travel demand.</p>
2a	<p>What are the different vehicular characteristics which affect road design? Explain. (8 marks)</p>
	<p><b><i>Vehicular characteristics influence road designs are broadly classified as (a) Static characteristics and (b) Dynamic characteristics.</i></b>  <b><i>Static characteristics (i) Vehicle dimension (ii) Vehicle weight</i></b>  Width of the vehicle influence width of the road, capacity, and traffic flow and traffic density.  Length of vehicle- apart from geometric design it is also influence the size of parking lot. Length of vehicle influences its turning radius.  Height of the vehicle influences the design of underpasses, height of barricades with respect to type of vehicles etc.  Apart from this position of headlights, seat height etc influence visibility of road.</p>

Vehicle weight influences the thickness design of roads. The vehicle weight is indirectly dependent upon the size of the vehicle and its turning radius.

**Dynamic characteristics** are operational characteristics that involve the forces that cause the motion of vehicle. The different dynamic characteristics are

- Power performance of vehicles
- Braking system
- Acceleration and deceleration characteristics
- Speed of the vehicle

**Power performance of vehicles:** power developed by the engine should be sufficient to overcome all resistance to motion at the desired speed and to accelerate at any desired rate to the design speed. The various forces that are acting are

- Rolling resistance
- Air resistance
- Grade resistance
- Inertia force during acceleration and deceleration
- Transmission losses

**Braking system:** when brakes are applied, friction between road surface and tyre comes into play and the vehicles come to a stop. This depends upon the roughness of the surface and whether it is dry/wet.

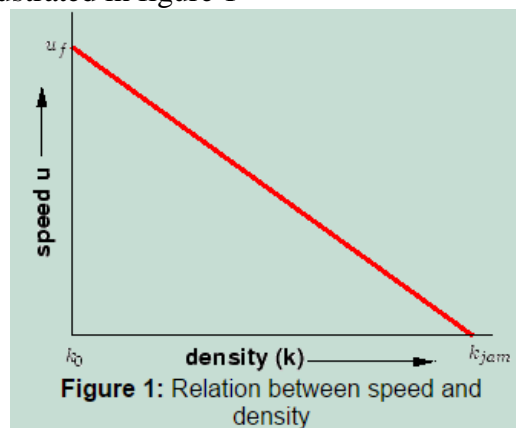
**Acceleration and deceleration characteristics:** maximum acceleration is achieved at low speeds. Cars have higher acceleration than commercial vehicles. Deceleration is caused when the engine is shut off and vehicle is allowed to coast and brakes are applied. This is dependent upon, the efficiency of brakes and coefficient of friction at the interface.

**Speed of the vehicle:** this will influence, acceleration and braking characteristics, braking sight distance and different sight distances.

2b Write short notes on (i) Fundamentals of traffic flow (ii) Integrated planning of town. (8 marks)

Fundamentals of traffic flow

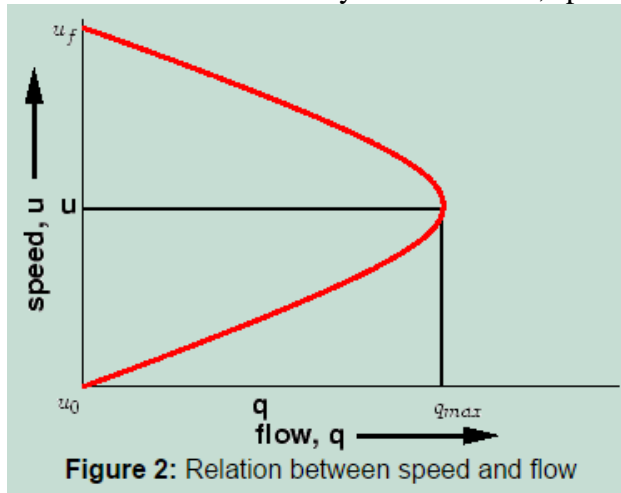
Macroscopic stream models represent how the behaviour of one parameter of traffic flow changes with respect to another. Most important among them is the relation between speed and density. The first and most simple relation between them is proposed by Greenshield. Greenshield assumed a linear speed-density relationship as illustrated in figure 1



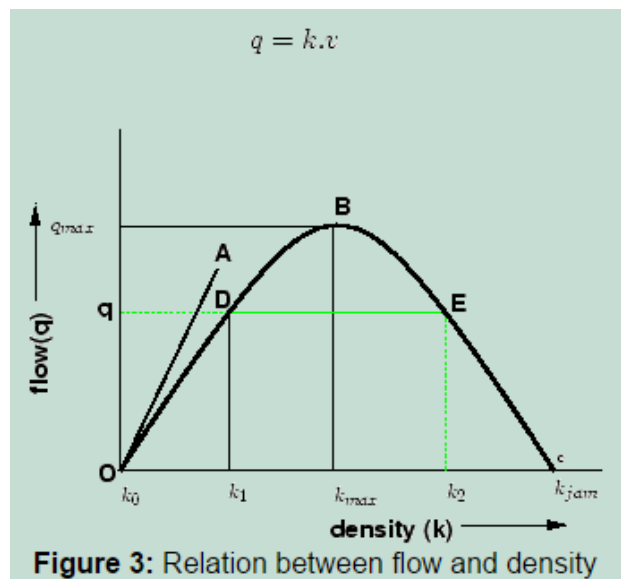
The equation for this relationship is shown below.

$$v = v_f - \left[ \frac{v_f}{k_j} \right] \cdot k$$

where  $v$  is the mean speed at density  $k$ ,  $v_f$  is the free speed and  $k_j$  is the jam density. This above equation is often referred to as the Greenshields' model. It indicates that when density becomes zero, speed approaches free flow speed



Similarly when the flow is less, density will be very less. As flow increases, traffic density decreases and speed decreases. When the vehicles are in jam condition also flow will be zero.



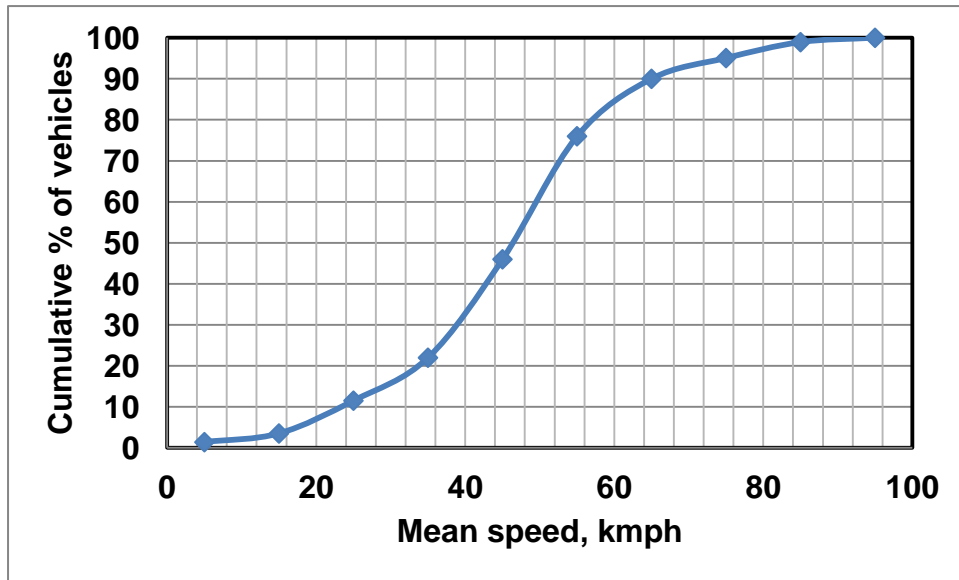
3a	Mention various applications of “O and D” study. Explain road side interview method of collecting “O and D” data. (8 marks)
	<p>The following objectives are identified for O-D studies:</p> <ul style="list-style-type: none"> <li>To judge the adequacy of existing routes and to plan new network of roads.</li> <li>To establish design standards for th road, bridges and culverts along the route</li> <li>To locate expressways or major routes along the desire lines.</li> <li>To establish preferential routes for various categories of vehicle including by-</li> </ul>

pass.  
 To locate new bridges as per traffic demands  
 To plan transportation system and mass transit facilities in cities including routes and schedules of operation.  
 To locate terminals and to plan terminal facilities.  
 To locate intermediate stops of public transport.

3b Spot speed studies were carried out at a certain stretch of a road highway and the consolidated data collected are given below:  
 Determine (i) Upper and lower values of speed limit for regulation (ii) Design speed for checking the geometric design element of the highway.  
 (8 marks)

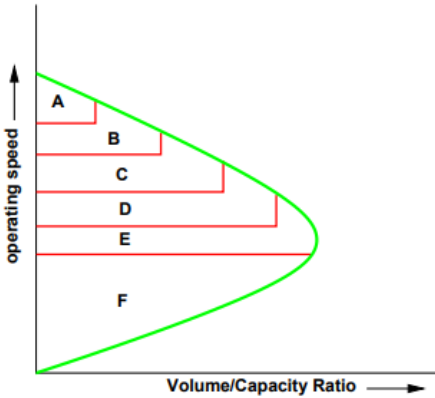
Speed Group (kmph)	0-10	11-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
No. of vehicles	12	18	68	89	204	255	119	43	33	9

Speed	5.00	15.00	25.00	35.00	45.00	55.00	65.00	75.00	85.00
No. of vehicles	12.00	18.00	68.00	89.00	204.00	255.00	119.00	43.00	33.00
% vehicles	1.41	2.12	8.00	10.47	24.00	30.00	14.00	5.06	3.88
Cumulative % vehicles	1.41	3.53	11.53	22.00	46.00	76.00	90.00	95.06	98.94

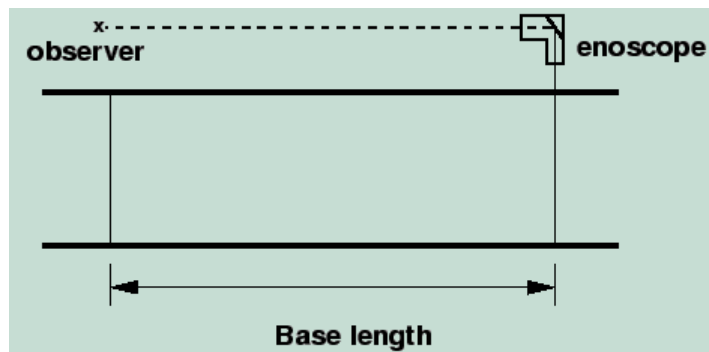


Upper and lower speed limits,  $V_{85}=60$  kmph  
 $V_{15}=28$  kmph  
 $V_{98}=80$  kmph

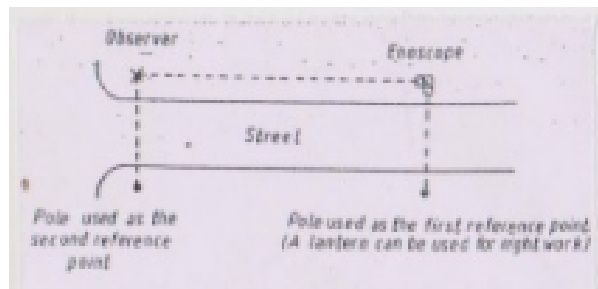
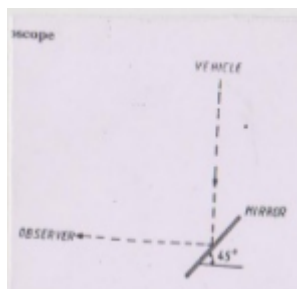
4a Explain the following terms:  
 Time headway (ii) Space headway (iii) Traffic volume (iv) Level of service  
 (8 marks)

	<p>Spacing is defined as the distance measure and headway as the time measure from head to head of each of the successive vehicles.</p> <p>Headway= spacing (m)/Speed(m/s)</p> <p>Time headway or simply headway (h), is the time interval between the passage of the fronts of successive vehicles at a specified point. It is measured in seconds.</p> <p>Space headway(s), is the distance between the fronts of successive vehicles. It is measured in metres.</p>
	<p>Traffic volume is defined as the number of vehicles passing a specified point during a stated period of time. It is usually measured in vehicles/ hour.</p>
	<p>Level of Service:</p> <p>This is defined as a quality measure describing operational conditions within a traffic stream, generally in terms of such service measures as speed and travel time, freedom to maneuver, traffic interruptions, and comfort and convenience.</p> <p>Six LOS are defined for each type of facility</p> <p>LOS are designated using letter A to F</p> <p>LOS A represents best operating conditions and LOS F is the worst</p> <p>Each LOS represents a range of operating conditions and the driver's perception of those conditions.</p> <p>Safety is not included in the measures to establish LOS</p> 
4b	<p>Define the term “spot speed study”. With neat sketch explain enoscope method of measuring spot speed study.</p> <p style="text-align: right;">(8 marks)</p>
	<p>Speed defines the distance travelled by user in a given time. The actual speed of traffic flow over a given route may fluctuated widely, as because at each time the volume of traffic varies. Accordingly, speeds are generally classified into three main categories:</p> <p>Spot speed, Running speed and Journey speed.</p> <p>Spot speed is defined as the instantaneous speed of a vehicle at any specific location. A spot speed is made by measuring the individual speeds of a sample of the vehicle passing a given spot on a street or highway. Spot speed studies are used to determine the speed distribution of a traffic stream at a specific location.</p> <p><b>Enoscope or Mirror box</b></p> <p>Enoscope consists of a simple open housing containing a mirror mounted on a tripod at the side of the road in such a way that an observer's line of sight turned through 90°. The observer stands at one end of section and on the other end enoscope is placed and measure the time taken by the vehicle to cross the section. Advantages of this</p>

method are that it is simple and eliminate the errors due to parallax and considerable time is required to time each vehicle, which lengthen the study period and under heavy traffic condition it may be difficult to relate observations to proper vehicle are the disadvantages of enoscope method.



If one enoscope is used the instrument is placed directly opposite the first reference point and observer stations himself at the other reference point as shown. If two enoscopes are used, the observer stations himself midway between the two reference point and starts the stop watch as soon as the vehicle crosses the first reference point and stops the stopwatch when it crosses the second reference point.



5a What are the advantages and disadvantages of rotary intersection? (8 marks)

**Advantages of rotary intersection**

- Traffic flow is regulated to only one direction of movement, thus eliminating severe conflicts between crossing movements.
- All the vehicles entering the rotary are gently forced to reduce the speed and continue to move at slower speed. Thus, none of the vehicles need to be stopped, unlike in a signalized intersection.
- Because of lower speed of negotiation and elimination of severe conflicts, accidents and their severity are much less in rotaries.
- Rotaries are self governing and do not need practically any control by police or traffic signals.
- They are ideally suited for moderate traffic, especially with irregular geometry, or intersections with more than three or four approaches.

**Disadvantages of rotary intersection**

- All the vehicles are forced to slow down and negotiate the intersection. Therefore, the cumulative delay will be much higher than channelized intersection.
- Even when there is relatively low traffic, the vehicles are forced to reduce their speed.
- Rotaries require large area of relatively flat land making them costly at urban





### Traffic signs

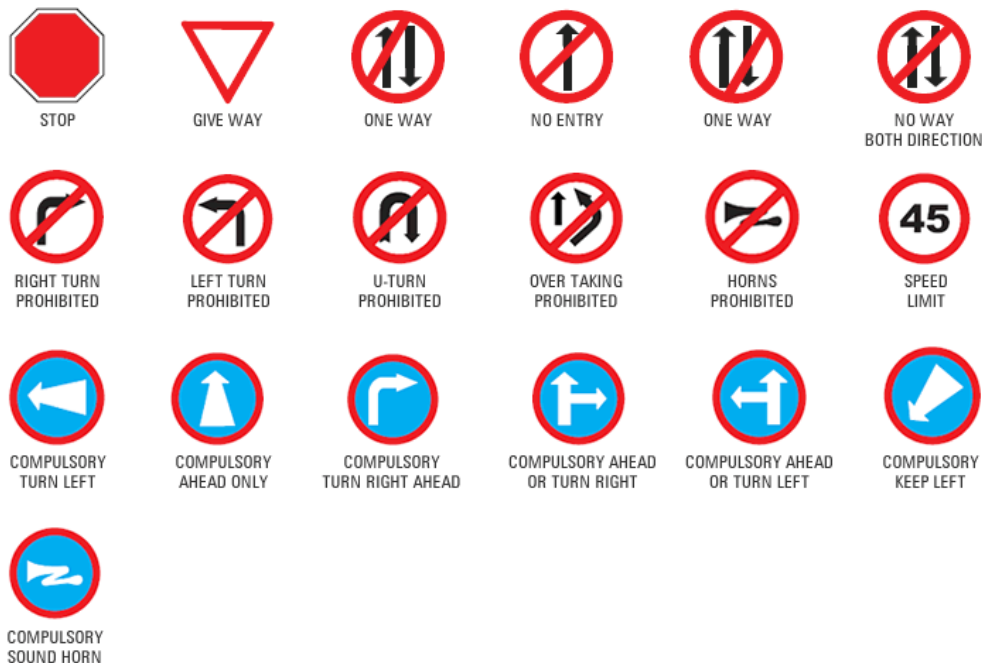
- Traffic signs and road markings are silent speakers to the road users.
- They give advance information about road conditions ahead.
- Road markings also give orders, warning or guidance to drivers or riders.
- It increases safety in road transport

### Types of Traffic signs

- Mandatory Signs
- Cautionary Signs / Warning
- Informatory Signs

### Mandatory Signs / Regulatory Signs

- These signs are used to inform road users of certain laws and regulations to provide safety and free flow of traffic.
- These include all signs which give notice of special obligation, prohibition or restrictions with which the road user must comply.
- The violation of these signs is a legal offence.



### Cautionary Signs

These are used to warn the road users of certain hazardous conditions that exist on or adjacent to the roadway. They are in the shape of an equilateral triangle with its apex pointing upwards. They have a white background, red border and black symbols



6b

Write short notes on (i) Road markings (ii) Channelized intersections (iii) Unchannelized intersections.

(8 marks)

**Road Markings**

Road markings are defined as lines, patterns, words or other devices, except signs, set into applied or attached to the carriageway or kerbs or to objects within or adjacent to the carriageway, for controlling, warning, guiding and informing the users.

The road markings are classified as

- Longitudinal markings
- Transverse markings
- Object markings
- Word messages

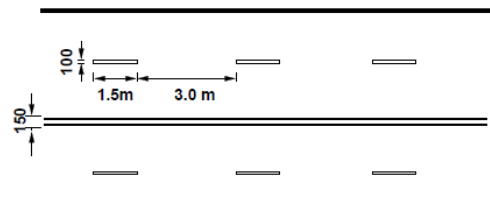
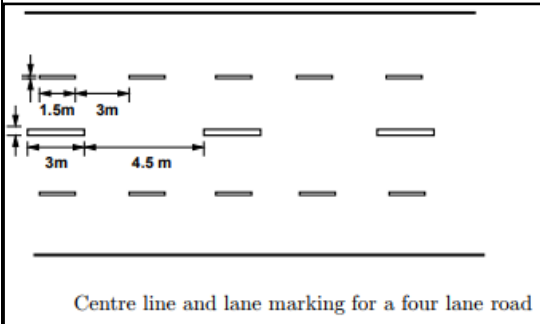
**Longitudinal markings**

- Broken lines are permissive in character and allows crossing with discretion, if traffic situation permits.
- Solid lines are restrictive in character and does not allow crossing except for entry or exit from a side road or premises or to avoid a stationary obstruction.
- Double solid lines indicate severity in restrictions and should not be crossed except in case of emergency.

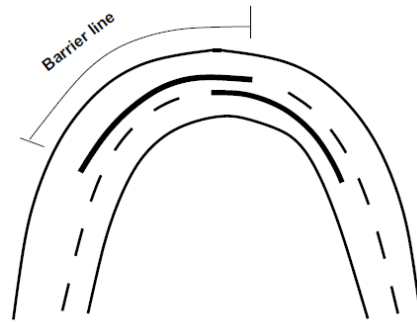
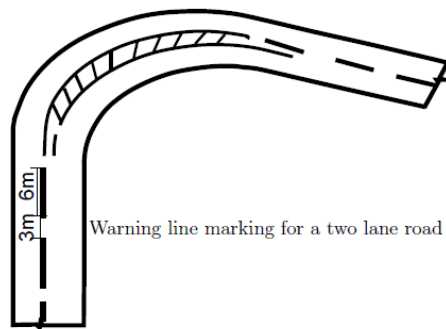
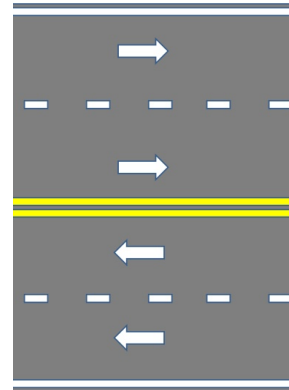
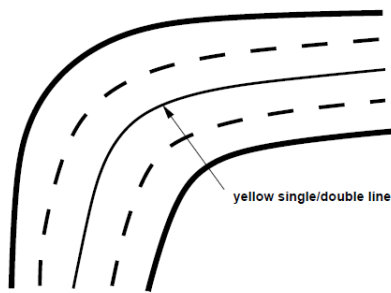
They are of the following types

- Centre-line marking
- Traffic lane lines
- No passing zones

- Warning lines
- Edge lines

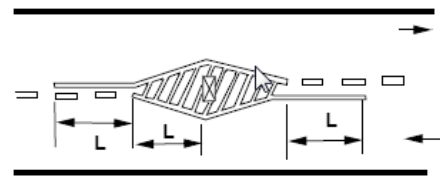
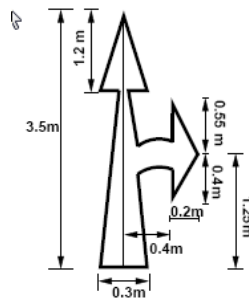
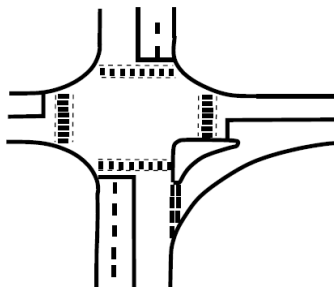


Lane marking for a four lane road with solid barrier line



**Transverse markings**

- Stop line:
- Pedestrian crossings
- Directional arrows



**Object markings**  
**Word messages**

### Channelized intersection

Vehicles approaching an intersection are directed to definite paths by islands, marking etc. and this method of control is called channelization.

#### Advantages:

- Provides more safety and efficiency.
- Reduces the number of possible conflicts
- Reduces the area of conflicts available in the carriageway.
- The presence of traffic islands, markings etc. forces the driver to reduce the speed and becomes more cautious while manoeuvring the intersection.
- A channelizing island also serves as a refuge for pedestrians and makes pedestrian crossing safer.

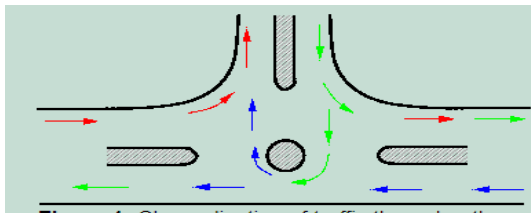


Figure 1: Channelization of traffic through a three-legged intersection

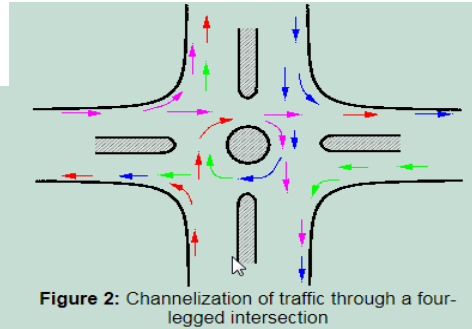


Figure 2: Channelization of traffic through a four-legged intersection

### Unchannelized intersections

These are intersections where there are no medians or islands to streamline the traffic. In such cases there will be more conflicting movements and proper road markings are the only way to streamline such traffic. Use of traffic signals can also be used to manage unchannelized three or four legged sections. Absence of channelizing islands will increase the chances of pedestrian accidents because, pedestrians have to travel more to cross the distance.

7a

What are the major sources of traffic related noise pollution? Explain.  
Explain controlling methods of noise pollution by traffic.  
(8 marks)

#### Noise pollution

Noise is the unwanted sound. Noise in cities is the result of a number of activities such as road traffic, aircraft, railways and industrial and constructional works.

Effect of noise: This can be classified into three

- (i) Subjective effects: this include disturbance, noisiness etc and is difficult to be measured.
- (ii) Behavioural effects: the noise can influence the behavior of people like sleeplessness, disturbance in studies, distraction in student's mind etc.
- (iii) Physiological effects: it can cause startle or fright phenomenon. Considerable exposure can even cause deafness

Generation of noise is by

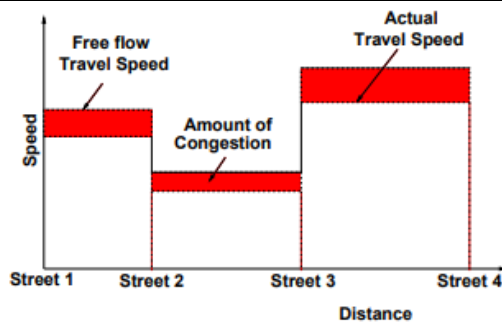
- (i) Various parts of the vehicle.
- (ii) Interaction between vehicle and road surface
- (iii) Noise dependent upon speed, flow and density of traffic.

Abatement measures:

- (i) Change in the design of vehicles- in India, Motor vehicles Act has made provisions to frame rules to control te noise produced by motor cycles.
- (ii) Changes in tyre/ surface characteristics- smooth surfaces result in less noise.

	<p>(iii) Elimination of noisier vehicles- old vehicles produce more sound.</p> <p>(iv) Modifications in traffic operations- rerouting commercial vehicles and buses from residential areas, providing by-pass to prevent high speed traffic from entering towns, ensure continuous and smooth and eliminate acceleration noise, prohibiting blow horns.</p> <p>Designing streets, buildings and areas for producing less noise- narrow streets create noise conditions (canyon effect). Hence, streets should be wide to reduce noise pollution. Shrubs, trees and grass on the side of the road act as sound barriers.</p>
7b	<p>What are the major air pollutants due to road traffic? Explain consequences of each. (8 marks)</p>
	<p>Air pollution</p> <p>The fumes and smell emitted by other vehicles makes urban streets unpleasant. The major pollutants are Carbondioxide, water vapour unburnt petrol, organic compounds produced from petrol, carbon monoxide, oxide of nitrogen, lead compounds, carbon particles (smoke).</p> <p><u>Effect of pollutants</u></p> <p>Carbondioxide is an important contributor to climate change.</p> <p>Carbon monoxide, oxide of nitrogen will be detrimental to the health of road user. Long term exposure of oxides of nitrogen can cause anxiety in road user.</p> <p>Lead compounds in small amount may not be detrimental. But over a long run, it can influence the well-being of residents.</p> <p>Smoke contains carbon particles. Smog is a combination of smoke and fog and it can cause hazards to driving and irritation to eyes.</p> <p><u>Abatement measures:</u></p> <ol style="list-style-type: none"> <li>1. Improve vehicle design and maintenance.</li> <li>2. Use of small cars instead of big ones.</li> <li>3. Patronage of public transport system.</li> <li>4. Use of alternative fuels and method of propulsion.</li> <li>5. Restraining traffic through road pricing.</li> <li>6. Stopping engines at the time of delays at intersections</li> <li>7. Constructing bypasses and ring roads.</li> <li>8. Staggering work hours</li> <li>9. Institution of parking restraint.</li> </ol>
8a	<p>Write various objectives of road accident studies. Explain in detail the causes for road accidents. (8 marks)</p>
	<p>Some objectives of accident studies are listed below:</p> <ul style="list-style-type: none"> <li>➤ To study the causes of accidents and suggest corrective measures at potential location</li> <li>➤ To evaluate existing design</li> <li>➤ To compute the financial losses incurred</li> <li>➤ To support the proposed design and provide economic justification to the improvement suggested by the traffic engineer</li> <li>➤ To carry out before and after studies and to demonstrate the improvement in the problem.</li> </ul>
	<p>The various causes of road accidents are:</p> <ul style="list-style-type: none"> <li>➤ <b>Road Users</b> - Excessive speed and rash driving, violation of traffic rules, failure to perceive traffic situation or sign or signal in adequate time, carelessness, fatigue, alcohol, sleep etc.</li> <li>➤ <b>Vehicle</b> - Defects such as failure of brakes, steering system, tyre burst, lighting</li> </ul>

	<p>system .</p> <ul style="list-style-type: none"> <li>➤ <b>Road Condition</b> - Skidding road surface, pot holes, ruts.</li> <li>➤ <b>Road design</b> - Defective geometric design like inadequate sight distance, inadequate width of shoulders, improper curve design, improper traffic control devices and improper lighting,.</li> <li>➤ <b>Environmental factors</b> -unfavorable weather conditions like mist, snow, smoke and heavy rainfall which restrict normal visibility and and makes driving unsafe.</li> <li>➤ <b>Other causes</b> -improper location of advertisement boards, gate of level crossing not closed when required etc..</li> </ul>
8b	<p>Write short notes on (i) Promotion of non-motorized transport (ii) Measures to decrease accidents.</p> <p style="text-align: right;">(8 marks)</p>
	<p><b><i>Promotion of non-motorized transport</i></b></p> <p><i>NMT</i> i.e. walk, cycle and cycle rickshaw are green modes of transport that belong to the low carbon path, do not consume energy or cause pollution, provide social equity and in addition provides employment.</p> <p><b><i>Initiatives towards improving non-motorized transport (NMT)</i></b></p> <ol style="list-style-type: none"> <li>1. <b><i>National Urban Renewal Mission (NURM)</i></b> of Central Government would give priority to the construction of cycle tracks and pedestrian paths in all cities.</li> <li>2. <b><i>Formulation and implementation of specific “Area Plans” in congested urban areas</i></b> that propose appropriate mix of various modes of transport including exclusive zones for NMT.</li> <li>3. <b><i>Central Government Initiatives like Atal Mission for Rejuvenation and Urban Transformation –AMRUT, Smart Cities Mission</i></b></li> <li>4. Construction of segregated rights of way for walk and cycles.</li> <li>5. Segregation of vehicles moving at different speeds would enable full trips using NMT but also as a means of improving access to Public Transport stations.</li> <li>6. Creative facilities like shade giving landscaping, provision of drinking water and resting stations along bicycle corridors</li> <li>7. The use of the central verge along many roads, along with innovatively designed road crossings.</li> <li>8. Pedestrian and cycle facilities including crossing facilities at busy intersections should be well-maintained and kept free of encroachments.</li> </ol>
9a	<p>Define traffic congestion. Explain different methods of traffic restraint (reduction).</p> <p>A system is said to be congested when the demand exceeds the capacity of the section. Traffic congestion can be defined in the following two ways:</p> <ol style="list-style-type: none"> <li>1. Congestion is the travel time or delay in excess of that normally incurred under light or free flow traffic condition.</li> <li>2. Unacceptable congestion is travel time or delay in excess of agreed norm which may vary by type of transport facility, travel mode, geographical location, and time of the day.</li> </ol> <p>The definition of congestion is presented in the figure below.</p>



The solid line represents the travel speed under free-flow conditions and the dotted line represents the actual travel speed. During congestion, the vehicles will be travelling at a speed less than their free flow speed. The shaded area in between these two lines represents the amount of congestion.

Congestion countermeasures include supply measures and demand measures and an additional longer-term tool used against traffic problems is land-use planning and policy.

The other measures that can influence demand and supply are

1. Car pooling and other ride-sharing programmes
2. Peripheral parking
3. Chartered buses
4. Staggering of office hours
5. Internal shuttle service in CBD
6. Parking restraint
7. Road pricing/ Congestion pricing Congestion pricing is a method of road user taxation, charging the users of congested roads according to the time spent or distance travelled on those roads. The principle behind congestion pricing is that those who cause congestion or use road in congested period should be charged, thus giving the road user the choice to make a journey or not.
8. Entry fee
9. Priority for buses in traffic

9b

Explain Intelligent Transport System for Traffic Management.

(8 marks)

Intelligent Transportation Systems (ITS) is the application of computer, electronics, and communication technologies and management strategies in an integrated manner to provide traveler information to increase the safety and efficiency of the surface transportation systems. These systems involve vehicles, drivers, passengers, road operators, and managers all interacting with each other and the environment, and linking with the complex infrastructure systems to improve the safety and capacity of road systems.

ITS user services

Some of the user services offered by ITS are described as follows:

- Travel and traffic management: The main objective of this group of services is to use real time information on the status of the transportation system to improve its efficiency and productivity and to mitigate the adverse environmental impacts of the system. This includes pre-trip information, enroute information, route guidance, route matching and information, traveler service information etc.
- Public transportation operations: This group of service is concerned with improving the public transportation systems and encouraging their use. This



	<p>includes services like real time public transit services and its maintenance, enroute information,</p> <ul style="list-style-type: none"> <li>➤ <b>Electronic payment:</b> This user service allows travellers to pay for transportation services with a common electronic payment medium for different transportation modes and functions. Toll collection, transit fare payment, and parking payment are linked through a multi-modal multi-use electronic system. With an integrated payment system a traveller driving on a toll road, using parking lot would be able to use the same electronic device to pay toll, parking price and the transit fare.</li> <li>➤ <b>Commercial vehicle operations:</b> The aim is to improve the efficiency and safety of commercial vehicle operations including freight mobility, automated road side safety inspection, etc.</li> <li>➤ <b>Advance vehicle control and safety systems:</b> This user service aims to improve the safety of the transportation system by supplementing drivers' abilities to maintain vigilance and control of the vehicle by enhancing the crash avoidance capabilities of vehicles.</li> <li>➤ <b>Emergency management:</b> This includes emergency notification and personal security on the occurrence of an accident as well as emergency vehicle management.</li> <li>➤ <b>Information management:</b> This service is aimed to provide the functionality needed to store and archive the huge amounts of data being collected on a continuous basis by different ITS technologies.</li> <li>➤ <b>Maintenance and construction management:</b> This user service is aimed to provide the functionality needed for managing the fleets of maintenance vehicles, managing the roadway with regards to construction and maintenance and safe roadway operations.</li> </ul> <p><b>ITS Architecture</b> The ITS Architecture provides a common framework for planning, defining, and integrating intelligent transportation systems. It specifies how the different ITS components would interact with each other to help solving transportation problems.</p> <p><b>ITS Planning</b> ITS planning is to integrate ITS into the transportation planning process.</p>
10a	<p>Suggest some traffic regulatory measures suitable for urban areas.</p> <p style="text-align: right;">(8 marks)</p>
	<p>The different methods of traffic management are</p> <p>(i) <b>Restrictions on turning movements:</b> Turning movements always create chaos at intersections. Among the turning movements, right turns are more crucial. In such cases providing an exclusive right turning phase in signal schemes or providing an early cut-off or late start in signal timings can eliminate such traffic problems.</p> <p>(ii) <b>One-way streets:</b> since the traffic flows only in one direction, capacity of the stretch increases and delays also will be reduced (Based on the marks this can be elaborated). Proper signing is important as far as one way streets are concerned to ensure smooth and efficient traffic.</p> <p>(iii) <b>Tidal flow operations:</b> morning peak hours witness a huge traffic towards city centre, whereas in the evening it will be vice versa. Use of barricades such that more width of lane is available towards direction of movement is called as tidal flow/ reverse flow operation.</p> <p>(iv) <b>Exclusive bus-lanes:</b> stoppage of public transport at mid block sections can create long queue. Hence, reservation of an exclusive lane for buses provides convenience and safety to embarking and alighting passengers without interrupting traffic flow.</p>

	<p>(v) <b>Closing side streets:</b> If there are many minor roads opening on main streets, it will cause interference to the main stream traffic. Hence, closing side streets, will reduce/ eliminate that traffic chaos.</p> <p>(vi) <b>Channelization:</b> Provision of medians or islands help in channelizing traffic and provides ease in commuting.</p> <p>(vii) <b>Roundabouts:</b> Rotary intersections or roundabouts are special form of at-grade intersections laid out for the movement of traffic in one direction around a central traffic island. Through and right-turn movements are converted into milder conflicts namely merging and diverging.</p> <p>(viii) <b>Traffic signals:</b> Provision of traffic signals help in reducing conflict points of at grade intersections on urban streets.</p>
10b	<p>Write short notes on</p> <ol style="list-style-type: none"> <li>i. Requirement of good pricing system</li> <li>ii. Travel Demand Management</li> <li>iii. Area Traffic Control</li> <li>iv. Traffic System Management</li> </ol> <p style="text-align: right;">(8 marks)</p>
	<p><b>Requirements of good pricing system</b></p> <ul style="list-style-type: none"> <li>➤ Charges should be closely related to the amount of use made on the roads.</li> <li>➤ It should be possible to vary the price for different roads, at different times of the day/ week/ year or for different classes of vehicles.</li> <li>➤ Prices should be stable and ascertainable by the road users before they commence a journey.</li> <li>➤ Method should be simple for road users to understand and policies to enforce.</li> <li>➤ It should be accepted by the public as fair to all.</li> <li>➤ Payment in advance should be possible although credit facilities in certain cases be possible.</li> <li>➤ Equipment used should be highly reliable.</li> <li>➤ The system should be amenable to gradual introduction commencing with experimental phase.</li> <li>➤ It should be capable being applied to the whole country.</li> <li>➤ It should be free from fraud and evasion, both deliberate and unconventional.</li> </ul>
	<p><b>Travel Demand Management</b></p> <p>TDM techniques are aimed at reducing the traffic flows, especially during the peak hour.</p> <p>Direct methods are the methods that can be directly quantified/ visible by the road user itself. Indirect methods are the methods which cannot be directly measured. Among the different techniques enlisted below, except road pricing all are direct methods.</p> <p>The different techniques adopted are</p> <ol style="list-style-type: none"> <li>1. Car pooling and other ride-sharing programmes</li> <li>2. Peripheral parking</li> <li>3. Chartered buses</li> <li>4. Staggering of office hours</li> <li>5. Internal shuttle service in CBD</li> <li>6. Parking restraint</li> <li>7. Road pricing</li> <li>8. Entry fee</li> <li>9. Priority for buses in traffic</li> </ol>

	10. Restrictions on entry of trucks during day-time.
	<p><b>Area Traffic Control</b>  This is defined as a technique which provides for a centralized control of numerous signal installation distributed throughout an urban area, such that there is a planned co-ordination between traffic signals at different junctions.  Objectives of Area Control System are  Minimizing journey time for vehicles.  Minimizing vehicular stops, resulting in less noise, less pollution and less consumption of fuel.  Reducing accidents.  Discouraging use of certain areas.  Minimizing person time.  Different traffic control methods are  Fixed time plan based on historical data and calculation off line by a computerized optimizing technique.  Co-ordinated systems with local response at each signal.  Fully responsive systems such as S.P.G (Signal Plan Generation) and PLIDENT ( Platoon Identification).</p>
	<p><b>Traffic System Management</b>  Traffic System Management/ Transport system Management is the planning, monitoring, and controlling or influencing of traffic modes. It aims to:</p> <ul style="list-style-type: none"> <li>• Maximise the effectiveness of the use of existing infrastructure;</li> <li>• Ensure reliable and safe operation of transport;</li> <li>• Address environmental goals; and</li> <li>• Ensure fair allocation of infrastructure space (road space, rail slots, etc.) among competing users.</li> </ul> <p>Transport System Management (TSM) maximises the capacity of the street system and reduces the demand on it. Although some of them may be expensive to implement, TSM measures are typically low cost localized improvements that attempt to take full advantage of the existing street infrastructure thereby increasing the efficiency of the street system.  The spectrum of TSM measures is wide; the measures that are applicable will generally fall into one of six categories listed below:</p> <ol style="list-style-type: none"> <li>1) Regulatory Techniques : This include One way Streets, Reversible Streets, Reversible lanes, Turning Moment Restrictions, Closing Streets</li> <li>2) Traffic Control Devices: The various traffic control devices used for the traffic management are: Traffic Signs, Traffic Signals, Road Markings, Computerised Signal Control device, Traffic Cone and Drums, Speed Breakers</li> <li>3) Traffic Segregation Techniques: The various traffic segregation techniques used are Vehicle-Vehicle Segregation, Pedestrian-Vehicle Segregation, Time Segregation</li> <li>4) Demand Management Techniques: The various demand management techniques used are Parking Restriction, Parking Pricing, Off Street Parking and Pay Area, On street parking meters, Park and ride systems</li> <li>5) Bus Priority Techniques: The various bus priority techniques used are: Bus Priority Manoeuvres, Bus Lanes, Bus Priority Signal system</li> <li>6) Self-Enforcing Techniques: The various techniques used are Central Divider, Railing, Channelisers.</li> </ol>

