Internal Assessment Test II Solution – June 2021

Sub:	TRAFFIC ENGINEERING					Sub Code:	18CV652	Branch:	CSE/ISE/ME
Date:	24.06.2021	Duration:	90 min's	Max Marks:	50	Sem / Sec:	6 Sem Open Elective		OBE

1	Explain the need for traffic forecasting and the different methods of traffic forecasting with neat sketches.	05

Need for traffic forecast: Scarcity of capital, to meet the traffic demand

Factors influencing traffic forecast

1. Population Growth/Migration
2. Land Use Changes
3. National/Regional Economy
4. Vehicle Operating Costs
5. Capacity Restraints
6. Induced Traffic due to new road facilities nearby
7. Vehicle ownership levels
8. Availability of alternative transport modes

Data for traffic prediction

Time series data consist of data that are collected, recorded, or observed over successive increments of time.

Cross-sectional data are observations collected at a single point in time.

Panel data are cross-sectional measurements that are repeated over time, such as yearly passengers carried for a sample of airlines.

Traffic forecast - Models

Linear trend

$$Y_t = \beta_0 + \beta_1 t + \varepsilon$$

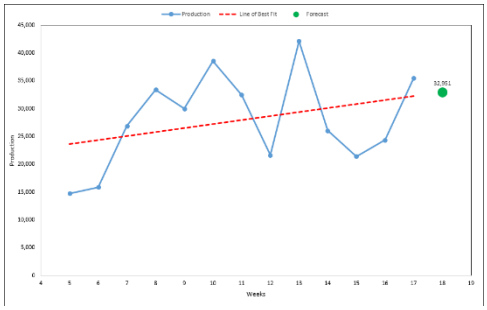
Exponential Trend

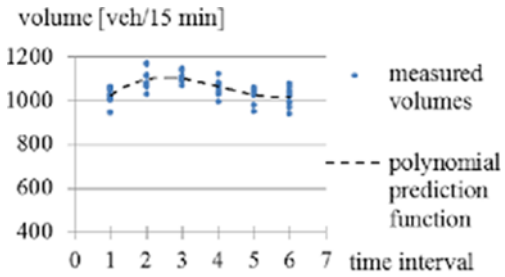
$$Y=a(1+b)^T \quad or \quad \ln(Y) = \ln(a) + T \times \ln(1+b)$$

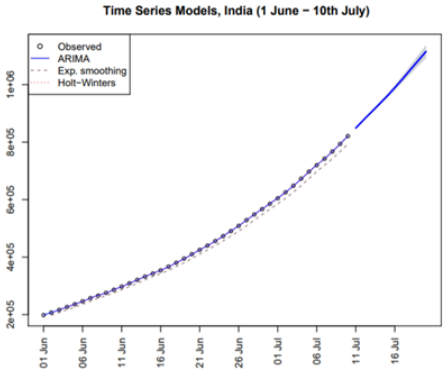
Polynomial Trend Analysis

$$Y= a + bT + cT^2$$

Forecasts based on Past Trends and Extrapolation – this can be done based on experience







Need for forecast – 1

Three methods with sketches - 4

2	Explain concept of Level of Service and its applications.	05

Level of service:

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.

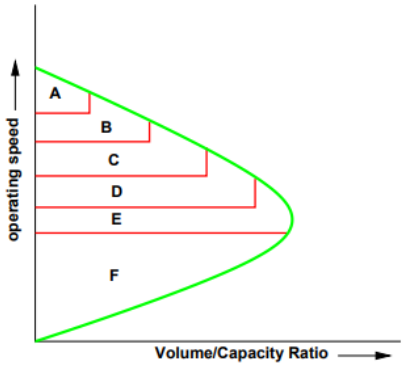
LOS are designated using letter A to F

LOS A represents best operating conditions and LOS F is the worst

Each LOS represents a range of operating conditions and the driver's perception of those conditions.

Safety is not included in the measures to establish LOS

Six LOS are defined for each type of facility



Performance measures	Operational measures
➢ Travel speed ➢ Traffic density ➢ Delays at signalized intersections ➢ Walking speed for pedestrians	➢ Dependent upon type of facility. ➢ Also called as measure of Effectiveness (MOE) for each facility type ➢ Typically three parameters are used under this and they are speed and travel time, density, and delay

Definition - Quality measure + Figure + 6 levels and their mapping to road serviceability + how they are defined – 1+2+ 2 = 5

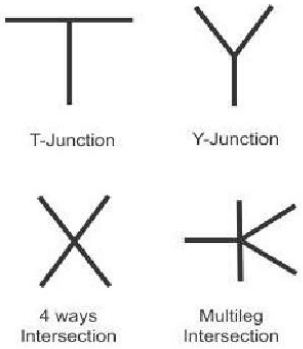
3	With neat sketches explain at grade and grade separated intersections. Compare the merits of grade separated intersection over at grade intersections	08

Depending upon the crossing conflicts the intersections are classified as follows (i) At Grade Intersection and (ii) Grade Separated Intersection.

At Grade Intersections

It is an intersection that eliminates crossing conflicts at intersections by separation of roadways in space. It is at the same level.

Grade separated intersection are otherwise known as Interchanges. Grade separated intersections can be flyovers / underpasses or subways/interchanges.



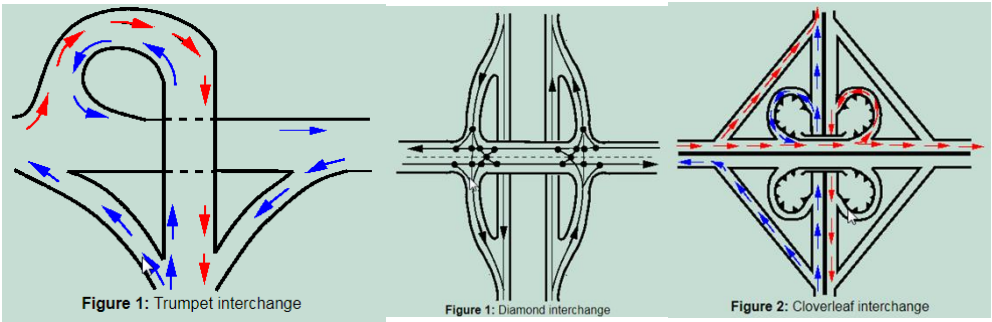


Figure 1: Trumpet interchange

Figure 1: Diamond interchange

Figure 2: Cloverleaf interchange

Advantages of Grade separated over at grade intersections:

- Grade separated intersections cause less hazard and delay than at grade intersections.

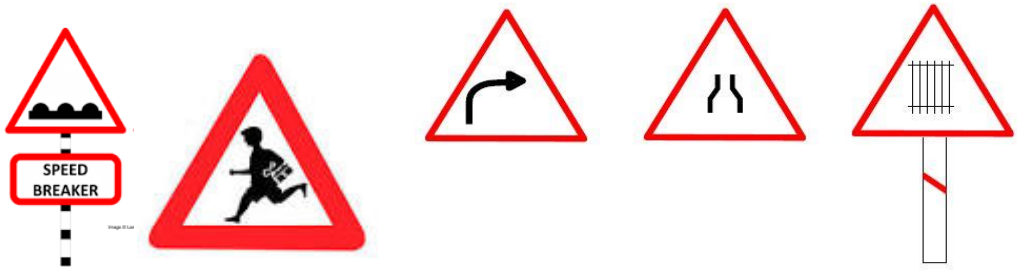
	➢ Route transfer at grade separations is accommodated by smooth interchange facilities consisting of ramps. ➢ It eliminates all grade crossing conflicts and accommodates other intersecting maneuvers by merging, diverging and weaving at low relative speed. ➢ When relative speed is low, the average motorist will accept a smaller time gap space between successive vehicles to complete his move. This condition increases roadway capacity. ***Definition +sketches – atleast two under each category – 4 marks*** ***Comparison – 4 points – 4 marks***	
4	With neat sketches, explain the different types of traffic signs (3 examples under each category). Define VMS signs.	08
	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** 1. Mandatory Signs 2. Cautionary Signs / Warning 3. 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.  **Figure: Stop sign, give way sign, signs for no entry, sign indicating prohibition for right turn, vehicle width limit sign, speed limit sign** **Cautionary Signs/Warning** These are used to war 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 borer and black symbols 	

Figure: speed breaker, school, Right hand curve sign board, signs for narrow road, sign indicating railway track ahead)

Informatory Signs: These signs provide information to the driver about the facilities available ahead, and the route and distance to reach the specific destinations

- Variable message signs (VMS) is an electronic traffic sign often used on roadways to give travellers information about special events.
- The information comes from a variety of traffic monitoring and surveillance systems.
- It is expected that by providing real-time information on special events on the oncoming road, VMS can improve motorists' route selection, reduce travel time, mitigate the severity and duration of incidents and improve the performance of the transportation network.
- Such signs warn of traffic congestion, accidents, incidents, roadwork zones, or speed limits on a specific highway segment.
- In urban areas, VMS are used within parking guidance and information systems to guide drivers to available car parking spaces.
- They may also ask vehicles to take alternative routes, limit travel speed, warn of duration and location of the incidents or just inform of the traffic conditions.
- The content of the sign will change, dependent on the situation. One should pay particular attention to these signs and messages.
- In recent years, some newer LED variable message signs have the ability to display colored text and graphics.
- Truck-mounted VMS's (also called Portable Changeable Message Signs or PCMS) are sometimes dispatched by highway agencies to warn traffic of incidents such as accidents in areas where permanent VMSes aren't available or near enough as a preventive measure for reducing secondary accidents.

Three different signs with examples - 6 marks
VMS – 2 marks

5	List the objectives and uses of conducting (i) Origin Destination studies (ii) Parking studies	08

	1. To judge the adequacy of existing routes and to plan new network of roads. 2. To establish design standards for th road, bridges and culverts along the route 3. To locate expressways or major routes along the desire lines. 4. To establish preferential routes for various categories of vehicle including by- pass. 5. To locate new bridges as per traffic demands 6. To plan transportation system and mass transit facilities in cities including routes and schedules of operation. 7. To locate terminals and to plan terminal facilities. 8. To locate intermediate stops of public transport Parking is a condition wherein roadusers utilize a space in the facility to store the vehicle. The space occupied can be on street or off-street. Objectives of on-street parking study 1. Evaluate congestion – since storage of vehicles reduce the effective width of the road, it reduces capacity of roads, increase journey time and produce more delays. 2. Accidents – Parking of vehicles can contribute to road accidents. Hence its impotant in investigating causes of road accidents 3. Accessibility of emergency services – use emergency services like ambulance, fire fighting etc will be affected because of the parked vehicles. Hence awareness of parking plays an important role here. 4. Environment – starting and stopping of vehicles can contribute to pollution. Hence its essential to know the parking of vehicles on a road stretch. 5. Origin destination study – OD studies are also supplemented with parking demands. 6. To estimate parking demand and its duration Off-street parking objectives 1. To evaluate parkin demand of a facility 2. To know the peak hours of parking demand 3. To optimize the availability of parking space with the type of vehicles ***Objectives of each study with 4 points – 4 marks for each***	
6	Discuss the causes of road accidents and also suggest measures to control accidents	08
	Causes – ➢ Road user – not using seat belts, drink and ride, fatigue, not wearing helmet ➢ Vehicular characteristics – inefficient brakes, worn out tyres and so on ➢ Road and its condition – slippery road, bad condition of road, pot holes ➢ Weather – rain, poor visibility due to fog and snow ➢ Improper road design – improper caber, sight distance, lack of channelixation, more conflict points ➢ Due to animals on road ➢ Accidents due to passengers – alighting/ boarding passengers ➢ Due to pedestrians – pedestrian crossing, pedestrian walking on road and so on Measures to control road accidents 3 E's such as Engineering, Enforcement and Education can be utilized to reduce accidents. **<u>Safety measures related to engineering</u>** Road designs: ➢ Sight distances, width , horizontal and vertical alignment, intersection design elements ➢ Pavement surface characteristics, skid resistance values ➢ Necessary bypasses may be constructed ➢ Grade separated intersections Preventive maintenance of vehicle ➢ braking system, steering system, lighting system should be checked regularly ➢ Heavy penalty on defective vehicles ➢ Special checks on public carriers Before and after study ➢ By comparing the condition and collision diagnosis "before and after" the introduction of preventive measures	

	➢ After necessary improvements in design and enforcing regulation Road lighting ➢ Proper road lighting especially at the intersections, bridge sites and at places where there are restriction in traffic movement **<u>Safety measures related to enforcement</u>** Speed control: ➢ Checks on spot speed of all vehicles should be done at different locations and timings and legal actions on those who violate the speed limit should be taken Training and supervision ➢ The transport authorities should be strict while issuing licence to drivers of public service vehicles and taxis. ➢ Driving licence of the driver may be renewed after specified period, only after conducting some tests to check whether the driver is fit. ➢ Medical check: The drivers should be tested for vision and reaction time at prescribed intervals of time **<u>Safety Measures related to education</u>** The various measures of education that may be useful to prevent accidents are enumerated below. *Education of road users:* ➢ The passengers and pedestrians should be taught the rules of the road ➢ Correct manner of crossing etc. ➢ Introducing necessary instruction in the schools for the children and ➢ Posters exhibiting the serious results due to carelessness of road users. *Safety drive:* ➢ Documentaries and films for road users and drivers ➢ Training courses and workshops ➢ Imposing traffic safety weeks ***Causes – 4 marks*** ***3E's – 4 marks***	
7	A vehicle of weight 30 tonnes skids through a distance equal to 50 m, before colliding with another parked vehicle of weight 3 tonnes. After collision, both the vehicles skid through a distance equal to 16 m, before stopping. Determine the speeds of vehicles assuming f is 0.4 (i) after collision (ii) at collision (iii) before collision.	08
	After collision **Initial velocity of A and B is v1** **Final velocity of A and B is 0** **S = 16 m** $\boldsymbol{v2^2 = v1^2 - 2aS}$ $\boldsymbol{0 = v1^2 - 2 \times 9.81 \times 0.4 \times 16}$ **v1 = 11.21 m/s** **At collision** **Initial velocity of A is va2 =?** **Initial velocity of B is vb1 = 0** **Final velocity of A and B is v1** **Equating momentum** $\boldsymbol{30 \times va2 + 3 \times 0 = 33 \times 11.21}$ **va2 = 12.33 m/s** **Before collision** **Initial velocity of A va1 =?** **Final velocity of A is va2 = ?** **S = 50 m** $\boldsymbol{va2^2 = va1^2 - 2aS}$ $\boldsymbol{12.33^2 = va1^2 - 2 \times 9.81 \times 0.4 \times 50}$	

	va1 = 23.33 m/s ***After collision – 3*** ***At collision- 3*** ***Before collision - 2***

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