Internal Assessment Test 1-Solutions – Sept. 2017

Sub:	TRAFFIC ENGINEERING (Open Elective)	Sub Code:	15CV561	Branch:	CIVIL

1 (a)	A vehicle of mass 1800 kg has to accelerate at 2m/s^2 from a speed of 12 Kmph to 22 Kmph in the first gear. The gradient has +1.2% and coefficient of rolling resistance is 0.025. The frontal area and coefficient of air resistance are 2.38 m^2 and 0.39 kg/m^2 respectively. The transmission and rear axle gear ratios are 2.85:1 and 3.87:1 respectively. The radius and deformation factor of the tyres are 0.35 m and 0.945 respectively. Determine the engine horse power required and the speed of the engine if transmission efficiency is 0.88.	[08]
	Resistances – 4 marks Power output- engine -2 marks Speed in rpm- 2 marks	
	Average speed = (12+22)×0.5= 17 Kmph Rolling resistance= mgf = 1800×9.81×0.025 = 441.45N Air resistance = $C_D Av^2$=0.39 × 2.38 × $\left[17 \times \left(\frac{5}{18}\right)\right]^2$ =20.69N Grade resistance= mgi = 1800×9.81×0.012 = 211.9N Inertial resistance = ma= 1800×2 = 3600 N Total resistance = 4274.04N Power output= 4274.04 × $\left[17 \times \left(\frac{5}{18}\right)\right]$=20.2×10^{3}kW = 27.46 HP Power output at engine =27.46/0.8= 31.2 HP $17 \times \left(\frac{5}{18}\right) = \frac{0.35 \times 0.945 \times 2 \times 3.14 \times N}{3.87 \times 2.85 \times 60}$ N= 1503rpm	
(b)	Explain the different urban traffic problems. Suggest a few sustainable solutions to solve the same.	[07]
	Problems- 4 Nos with description-4marks Solutions-3 Nos with description-3marks	
	There are many problems and issues that need to be addressed in order to make these efforts successful in achieving sustainability in transportation for Indian cities. • ***Transport planning and modelling*** One of the reasons for unregulated urban growth and sprawl in India is the lack of integration of land-use and transportation planning. Also, traditional four-stage demand modelling process is the main modelling technique employed in India for all transportation planning processes. There is no/little use and understanding of other modelling techniques like activity-based modelling, etc. • ***Non-motorized transport*** CBDs are mostly pedestrian/bi-cyclists zones and/or public transport only zones; in Indian cities they 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. Another common issue with respect to pedestrian facilities in India is the encroachment of footpaths by hawkers/vendors. They are desirable to the road users and pedestrians because the services provided by them are cheap and convenient to them. However, the same hawkers/ vendors cause inconvenience to them while using walkways for their movement. This contradictory perception of people changes according to their needs and class.	

- ***Public transport***

An affordable public transport with a desired minimum level of service would always attract ridership in Indian cities; however, the majority of public transport riders in Indian cities are captive riders. This is the major reason behind the increasing trend of motorization because, as soon as the captive rider turns into a choice rider, public transport becomes the less-preferred mode.

- ***Driver behaviour and road safety***

India tops the lists of road accidents and fatalities in the world. Of the causes of road accidents reported in India, inappropriate driving behaviour plays a major role as compared to pavement and geometric design faults or mechanical defects in the vehicles.

- ***Traffic management***

Infrastructure measures are currently under planning and implementation in a big way in India. Numerous flyovers have been constructed and road widening has taken place in urban areas in a quest to meet the exponentially increasing travel demand. However, these measures have proved to be insufficient in tackling the issue of transport sustainability in India and thus clearly indicate the need for a mechanism to improve the existing traffic flow and also control/reduce the travel demand instead of trying to increase infrastructure capacity all the time.

Sustainable solutions:

- Congestion pricing is another good instrument to control travel demand.

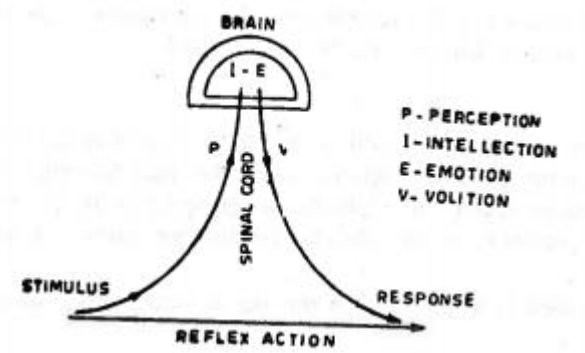
Congestion pricing = 1-x/y, where where x is the observed speed and y is the expected speed.

- Develop goal-oriented (top down) approach for developing urban transport strategies in India.
- In order to make sustainable in Indian cities, one of the important requirements is a good networked public transportation system with time-bound schedules, reliable services,comfort, competitive travel times and affordable prices. These features will improve the generalized cost of travel by PT modes and will make mass transit attractive and will thus bring about a shift from individual mode to public transport. possibilities of considering environmental and social cost as part of the planning process (particularlyfor planning a new urban mass transit or urban road corridor) rather than during post-planning impact assessment.
- Activity-based modelling to be attempted in India for possibly better travel demand modelling. On the traffic management aspect, issues like heterogeneity and non-lane-based traffic need to be addressed for any modelling or microsimulation tool to be really effective for Indian conditions, and which can then be used to identify and test different traffic management measures that are effective for Indian cities.
- More realistic assignment of trips to rail and bus networks taking into account the condition in trains, variations in bus speeds and frequency due to changes in overall traffic volume and fares.
- Orienting transport planning to address the climate change issues from developing countries such as India; introducing carbon footprint or ecological footprint as a planning parameter.

(c)	Define reaction time of a driver and hence explain PIEV theory.	[06]
	Fig- 1 mark Explanation-4 marks	

Definition-1 mark

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 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]

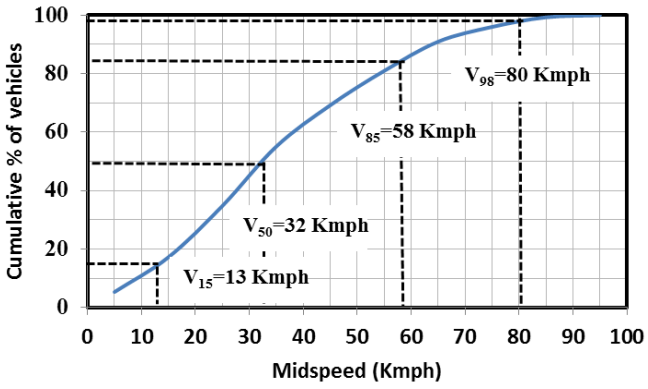


2 (a) Spot speeds studies were carried out at a city road during certain period of time and the data are tabulated as follows. Suggest (i) Speed limit for regulation (ii) Speed to check geometric design (iii) Lower speed group causing congestion (iv) Medium speed. [08]

Speed Group (kmph)	0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100
No. of vehicles	155	345	510	590	410	341	290	147	95	21

Tabulation-3 mark
Graph-3 mark
4 specified speed values- 2 mark

Mid speed	No. of vehicles	%	Cumulative %
5	155	5.34	5.34
15	345	11.88	17.22
25	510	17.56	34.78
35	590	20.32	55.10
45	410	14.12	69.21
55	341	11.74	80.96
65	290	9.99	90.94
75	147	5.06	96.01
85	95	3.27	99.28
95	21	0.72	100.00
	2904		



(b) Briefly explain the various vehicular characteristics affecting the road design. [07]

Static characteristics- 3 marks
Dynamic charcteristics- 4 marks

Vehicular characteristics influence road designs are broadly classified as (a) Static characteristics and (b) Dynamic characteristics.
Static characteristics (i) Vehicle dimension (ii) Vehicle weight
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. 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 1. Power performance of vehicles 2. Braking system 3. Acceleration and deceleration characteristics 4. 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.	
(c)	Explain the advantages of moving car observer method. 5 points- 5 marks	[05]
	Following are the advantages: 1. Gives an unbiased estimate of flow 2. More economical in terms of manpower because at a time itgives flow and speed in both directions 3. Measures speed and flow for a stretch and not for a point 4. Measures delays due to intersections, parking etc. 5. Measures both speed and flow at a time.	
3 (a)	What is Fundamental Flow Diagram? Describe the relationship between the flow parameters.	[06]
	(Figure + Explanation on each figure) for 3 figures – 6 marks 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	

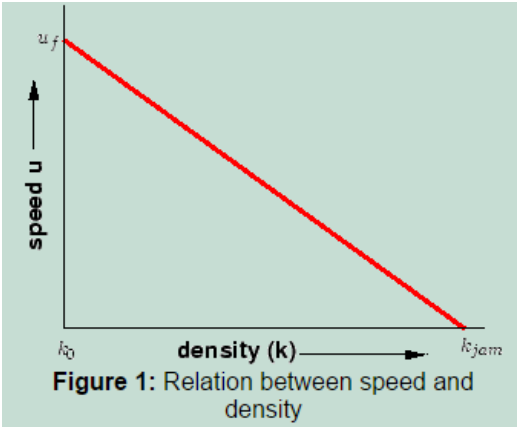


Figure 1: Relation between speed and density

The equation for this relationship is shown below.

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

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

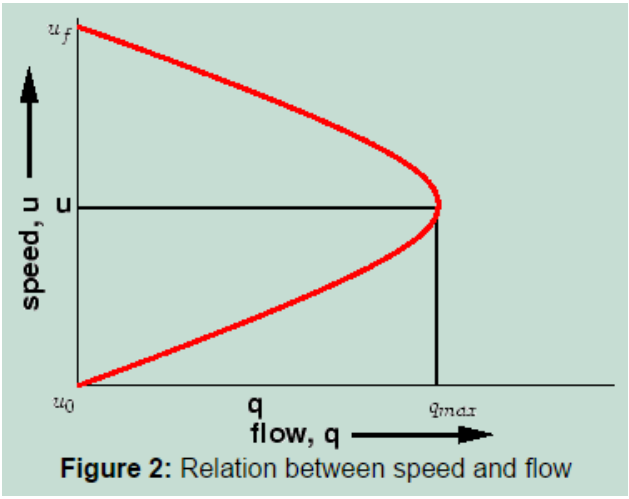


Figure 2: Relation between speed and flow

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.

$$q = k.v$$

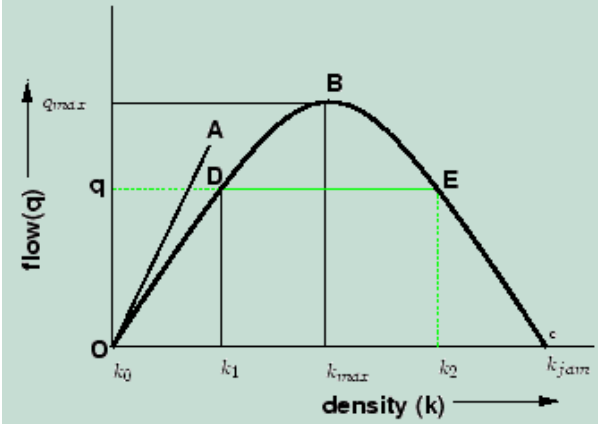


Figure 3: Relation between flow and density

(b)	Define (i) Average speed (ii) Running speed (iii) Space mean speed (iv) Time mean speed.	[04]
	Each definition – 1 mark 4 definition- 4 marks	
	(i) Average speed: It is the average of the spot speeds of vehicles. If there are n observations, Average speed $=\frac{\sum_1^n x_i}{n}$ (ii) Running speed: It is the defined as the ratio of length of course to the running time. Here the time does not consider delays. (iii) Space mean speed(v_s): It is the average of the spot speeds over space. (iv) Time mean speed (v_t): It is the average of spot speeds. If v_i is the instantaneous speed of vehicles, $v_t=\frac{\sum_1^n v_i}{n}$ also $v_s=\frac{n}{\sum\frac{1}{v_i}}$	