

**M.Tech - 2nd(TE)**  
**Traffic Flow Theory**

Full Marks : 70

Time : 3 hours

Answer Q. No. 1, which is compulsory and  
any five from the rest

The figures in the right-hand margin indicate marks

1. Explain *all* the following in brief : 2 × 10
- (i) Time mean speed
  - (ii) Acute angle of vision
  - (iii) Importance of drivers' Literacy (education) in traffic engineering
  - (iv) Traffic density
  - (v) PCU (Passenger Car Unit)
  - (vi) Critical gap
  - (vii) Greenshields model

Length of the gap, $t$ seconds	Number of accepted gaps (less than ' $t$ ' seconds)	Number of rejected gaps (greater than ' $t$ ' seconds)
0	0	89
0.5	0	89
1.0	0	80
1.5	1	52
2.0	7	27
2.5	13	16
3.0	26	07
3.5	38	04
4.0	46	03
4.5	55	03
5.0	63	02
5.5	70	01
6.0	106	00

Determine the critical gap( $t_c$ ) by Raff's definition.

- (b) Explain the different types of "driver's error" as observed in the field. 3

(viii) Possible capacity

(ix) Free flow speed

(x) Time headway and space headway.

2. (a) For a section of road, "the speed-density relationship is linearly decreasing". Develop the generalized equation to represent the above statement and finally develop the expression to estimate the capacity. 5

(b) In order to check the validity of the Poissonian arrival (i. e. Poisson distribution) in a lightly trafficked street free from the influence of intersections or signals nearby a count of vehicles passing an observer was taken. The number of vehicles arriving in intervals of 10 s each was counted and recorded in table below : 5

Number of vehicles arriving in 10 s	0	1	2	3	4	5
Observed frequency	196	109	40	11	02	02

Compare the observed frequency with the theoretical frequency (i.e. expected frequency).

3. (a) The following 12 consecutive 5 minute vehicle counts were taken on an intersection approach.

60, 50, 40, 60, 90, 80, 100, 120, 140, 95, 60, 30

Calculate the PHF (peak hour factor). 3

(b) Explain in detail the importance of studying the driver behaviour in traffic engineering. 7

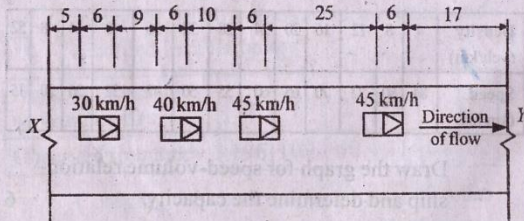
4. (a) Draw and explain "speed-flow" and "speed-density" diagram. 4

(b) The speed and density of vehicles were observed in a traffic stream of vehicles and the following data were obtained :

Density (veh/km)	4	8	12	16	20	24	28	32	36	40	44	48	52
Speed (km/hr)	84	80	72	70	65	60	55	50	42	32	26	20	15

Draw the graph for speed-volume relationship and determine the capacity. 6

5. (a) Explain the roadway factors affecting LOS (level of service) and capacity. 5
- (b) Explain the bottleneck formation at a roadway section. 5
6. (a) The figure below shows vehicles travelling at constant speeds on a two-lane highway between sections X and Y (90 m apart) with their positions and speeds obtained at an instant of time by photography. An observer located at point X observes the four vehicles passing point X during a period of T second. The speed of the vehicles are measured as 45, 45, 40 and 30 km/h respectively. Calculate the flow, density, time mean speed, and space mean speed. 7



- (b) What is the fundamental difference between "free flow condition" and "congested condition"? What should be the capacity of a roadway section in jam condition? 3
7. There is a single toll booth in operation and can handle 800 vph. The peak flow is 720 vph, and the vehicle arrivals being random, calculate (M/M/1 model): 10
- (i) average number of vehicles in the system
- (ii) average time a vehicle is in the system
- (iii) average time a vehicle is in the queue
- (iv) the chances of there being more than 4 (four) vehicles in the system
- (v) The percentage of time a toll booth operator is free, the probability that there is no vehicle in the system.
8. (a) The accepted and rejected gaps of vehicles on a minor road of an unsignalised intersection are as given below: 7