98-Civ-B10 Traffic Engineering

3 Hour Duration

NOTES

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper a clear statement of any assumptions made.

2. Any data required, but not given, can be assumed.

3. This is an **"OPEN BOOK"** examination. Any non-communicating calculator is permitted.

4. A total of **five** solutions is required. Only the first five as they appear in your answer book will be marked.

5. All questions are of equal value.

Grading Scheme:

Question 1: (5+15) marks

Question 2: (15+5) marks

Question 3: (8+12) marks

Question 4: 20 marks

Question 5: (5+5+5+5) marks

Question 6: (6+6+8) marks

1.   The table below gives location and speeds of vehicles on a two-lane highway at an instant of time over a 100 m section of the highway. Direction of traffic flow is west to east. Each vehicle is 6 m long.

Vehicle	Distance of the **rear of the vehicle** from west reference point (m)	Speed of the vehicle (km/h)
A	75	72
B	40	64
C	20	56
D	5	32

(a) Make a dimensioned sketch of the locations of the vehicles, showing each vehicle as a rectangle 6 m long.

(b) Determine flow, density time mean speed and space mean speed.

2.   (a) For the following data on speed and density, using the regression analysis, determine the equation of the best fit straight line of Greenshields' model.

(c) Also find the maximum flow and density corresponding to a speed of 30 km/h.

Density (veh/km)	Speed (km/h)
171	5
129	15
20	40
70	25

3.   An observer counts 360 veh/h at a specific highway location. Assume that the arrival of vehicles is Poisson distributed.

(a) What is the probability that the gap between successive vehicles will be less than 8 seconds?

(b) What is the probability that the gap between successive vehicles will be between 8 and 10 seconds?

4.   A convenience store has four available parking spaces. The owner predicts that the duration of customer shopping (the time that a customer's vehicle will occupy a parking space) is exponentially distributed with a mean of 6 minutes. The owner knows that in the busiest hour customer arrivals are exponentially distributed with a mean arrival rate of 20 customers per hour. What is the probability that a customer will not find a an open parking space when arriving at the store?

5.   A four- legged intersection consists of two lanes (each 3.75 m wide) in each direction, with 3-m wide crosswalks. The vehicle stop line is 1-m before the crosswalk. There is no pedestrian refuge for any of the crosswalks.

North -Bound traffic – 900 passenger cars and 25 buses
South- Bound traffic – 800 passenger cars and 22 buses
East-Bound traffic – 600 passenger cars
West-Bound traffic – 800 passenger cars
Pedestrian traffic = 150 per hour in each crosswalk

(a) If the average passenger car occupancy is 2.0 persons per car, and the average bus occupancy is 25 persons per bus in the north-bound direction and 15 persons per bus in the south-bound direction, calculate the arrival flow in pcu/h and persons per hour.

(b) If the basic saturation flow rate is 1900 passenger cars per hour, calculate the adjusted saturation flow rate in veh/h for the NB and SB approaches.

(c) If the amber interval is 3.0 s, passenger car length is 6 m and the vehicle clearing speed is 30 km/h, calculate the all-red interval (rounded to the nearest second), the intergreen period and the intersection lost time.

(d) Calculate the intersection flow ratio.

6.   For each fifteen-minute interval, the numbers of right-turns, left-turns, straight-through trucks, and straight-through passenger cars at an intersection are tabulated as shown below.

Time Interval	Left Turns	Right Turns	ST Trucks	ST Cars
5:00-5:15	6	15	8	26
5:15-5:30	5	10	6	30
5:30-5:45	7	16	8	40
5:45-6:00	4	7	10	35
6:00-6:15	9	12	12	55
6:15-6:30	10	13	6	49
6:30-6:45	12	12	10	50
6:45-7:00	14	15	8	65
7:00-7:15	9	12	4	30
7:15-7:30	10	9	8	39

If a truck is equal to 1.5 passenger cars and a right-turn is as well, and if a left-turn is equal to 2.5 passenger cars, then calculate

(a) the peak hour volume,
(b) peak hour factor (PHF), and
(c) the actual (design) flow rate for this approach.