05M TRIBHUVAN UNIVERSITY

INSTITUTE OF ENGINEERING

Examination Control Division

2074 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

Subject: - Traffic Engineering and Management *(Elective II) (CE76513)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ ***All** questions carry equal marks.*
- ✓ ***Necessary Tables and Chart are attached herewith.***
- ✓ *Assume suitable data if necessary.*

1. Prove that q = k*v and find flow, average speed and density of the traffic stream if one measures the average headway and average spacing of passing vehicles as 3.2 seconds and 60 m, respectively. [8]
2. Two platoons of cars are timed over a distance of 0.5km. Their flows are recorded. The first group is timed at 40 seconds, with the flow at 1350 vehicles per hour. The second group takes 45 seconds, with a flow of 1800 vehicles per hour. Determine the maximum flow of the traffic stream. [8]
3. In a two lane, one way stream of 1000 vph with 360 vehicles in Lane A and the remaining vehicles in lane B. 8% of the vehicles in lane A have gaps less than 1 sec and 18% of the vehicles in lane A gaps less than 2 sec. Compute the time during which vehicles in Lane B may not change to Lane A in 1 hour. Assume driver required one second ahead and behind in making a lane change. [8]
4. A rural freeway has an ideal free-flow speed of 120 km/h and two 3.6 m lanes in each direction; with right shoulder lateral clearance of 1.2 m. Interchanges are spaced approximately 5 km apart. Traffic consists of 10 percent trucks and buses and 8 percent recreational vehicles. The adjustment for driver population factor is estimated to be 0.80. If the maximum 15-min flow rate is 1,7560 veh/h, what is the level of service? [8]
5. What do you mean by measurement of congestion? Describe regulatory measures for traffic management in Kathmandu. [8]
6. Determine the reserve capacity of a roundabout if the capacity is q and approach flows at entry from four approaches are qi, I = 1 to 4 [8]
7. For an intersection controlled with semi actuated signal with flow ratios for NS = 0.6 and EW = 0.12. The signal is expected to operate at a quality factors of 0.9. Assuming lost time of 4 s/phase, determine the cycle length and assign green times. [8]
8. An intersection approach at an isolated pre-timed signal with a cycle length of 90 s has a saturation flow rate of 1,700 veh/h. The length of the green is 25 s. the v/c ratio is 0.93. What is the expected level of service, if control delay is measured over a 15 min interval? [8]
9. Give reasons why pedestrian analysis is far more complex than vehicle traffic flow. Calculate time gap for a platoon of 27 school children 5 in a row, consecutive time 2 sec width of crossing section is 7.5 m and walking speed of children 0.9 m/s start up time 3 sec. [8]
10. The fuel consumption rate of a passenger car is given by F = A + B/V, F = fuel consumption. A and B are constants, V is mean speed. Using the data below derive the model ad interpret it. [8]

F	0.4	0.1	0.12	0.08	0.06
V	2.5	10.2	14.8	25	52

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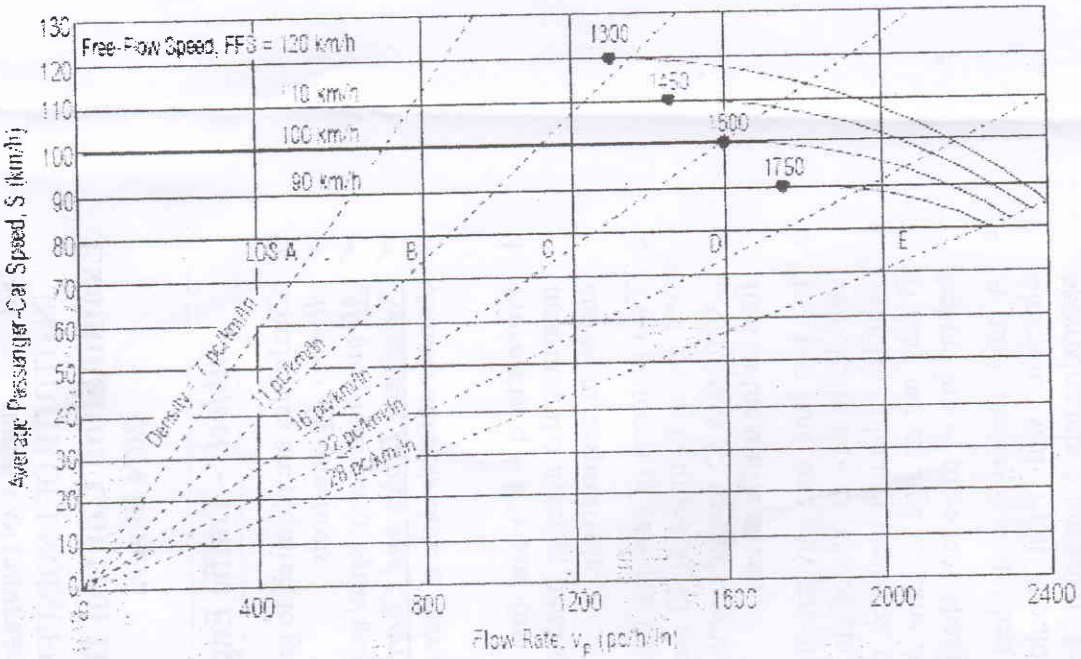
Free-Flow Speed, FFS = 120 km/h
110 km/h
100 km/h
90 km/h
1300
1450
1500
1750
LOS A
B
C
D
E
Density = 7 pc/km/ln
11 pc/km/ln
16 pc/km/ln
22 pc/km/ln
28 pc/km/ln
Average Passenger-Car Speed, S (km/h)
Flow Rate, v_p (pc/h/ln)
130
120
110
100
90
80
70
60
50
40
30
20
10
0
400
800
1200
1600
2000
2400

Lane Width (m)	Reduction in Free-Flow Speed, f_{LW} (km/h)
3.6	0.0
3.5	1.0
3.4	2.1
3.3	3.1
3.2	5.6
3.1	8.1
3.0	10.6

Right-Shoulder Lateral Clearance (m)	Reduction in Free-Flow Speed, f_{LC} (km/h)			
	Lanes in One Direction			
	2	3	4	≥ 5
≥ 1.8	0.0	0.0	0.0	0.0
1.5	1.0	0.7	0.3	0.2
1.2	1.9	1.3	0.7	0.4
0.9	2.9	1.9	1.0	0.6
0.6	3.9	2.6	1.3	0.8
0.3	4.8	3.2	1.6	1.1
0.0	5.8	3.9	1.9	1.3

Number of Lanes (One Direction)	Reduction in Free-Flow Speed, f_N (km/h)
≥ 5	0.0
4	2.4
3	4.8
2	7.3

Interchanges per Kilometer	Reduction in Free-Flow Speed, f_{ID} (km/h)
≤ 0.3	0.0
0.4	1.1
0.5	2.1
0.6	3.9
0.7	5.0
0.8	6.0
0.9	8.1
1.0	9.2
1.1	10.2
1.2	12.1

Factor	Type of Terrain		
	Level	Rolling	Mountainous
E_T (trucks and buses)	1.5	2.5	4.5
E_R (RVs)	1.2	2.0	4.0

5 M TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Magh

Exam.	New Back (2066 & Later Batch)		
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Programme	BCE	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

Subject: - Traffic Engineering and Management *(Elective II) (CE76513)*

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- ✓ ***<u>Necessary tables are attached herewith.</u>***
- ✓ *Assume suitable data if necessary.*

1. A section of highway has the following flow density relationship: $q = 50k - 0.156k^2$ What is the capacity of the highway section, the speed at capacity, and the density when the highway is at one quarter of its capacity?

2. The following travel times in seconds were measured for vehicles as they traversed a 3 km segment of a highway. Determine TMS, SMS and verify the relation.

Vehicle	1	2	3	4	5	6
Travel time	150	144	160	125	135	115

3. An observer has determined that the time headways between successive vehicles on a section of highway are exponentially distributed and that 65% of the headways between vehicles are 9 seconds or greater. If the observer decides to count traffic in 30-second time intervals, estimate the probability of the observer counting exactly four vehicles in an interval.

4. Consider an existing four lane free-way in rural area, having very restricted geometry with rolling terrain. Peak hour volume is 2000 veh/h with 5% trucks. The traffic is commuter type with peak hour factor 0.92 and interchange density as 0.6 interchanges per kilometer. Free-way consists of two lanes in each direction of 3.3 m width with lateral clearance of 0.6 m. Find the LOS of free-way during peak hour.

5. What is the difference between a stop sign and give way sign? Under what circumstances are they required? Illustrate with neat sketches.

6. A pretimed four-phase signal has critical lane group flow rates for the first three phases of 200, 187, and 210 veh/h (saturation flow rates are 1800 veh/h/ln for all phases). The lost time is known to be 4 seconds for each phase. If the cycle length is 60 seconds, what is the estimated effective green time of the fourth phase?

7. At a parking lot, vehicles arrive according to a Poisson process and are processed (parking fee collected) at a uniform deterministic rate at a single station. The mean arrival rate is 4.2 veh/min and the processing rate is 5 veh/min. Determine the average length of queue, the average time spent in the system, and the average waiting time in the queue.

8. Calculate the length required to park N number of vehicles in the case of on-street parking facility with the help of neat diagrams. Assume the dimensions of vehicle as 5.5m X 2.5m.Vehicles are parked at 60°.

9. A person standing at a stop line of signalized intersection found that the vehicles arrive at 3.7, 6.9, 9.7, 12, 14.1, 16, 17.9, and 19.8 seconds after the start of the green. The signal turns red at 20th second. Find the lost time, saturation flow and lane capacity. (Assume cycle is 60 second, amber is 3 s)

10. Discuss the following

    - ramp metering
    - types of traffic signals
    - pedestrian dynamics and
    - heterogeneous traffic

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1. Derive Greenberg's equation for speed and density data observed on a roadway as presented in the table. Also determine jam density and speed when flow is maximum

speed (kmph)	60	52	41	34	22
density (v/km)	11	43	62	80	103

2. A vehicle platoon was observed over a distance of 300m on a single lane urban street entering at section x and leaving at section y. refer table below. Determine the time mean and space mean speed of these six vehicles, average volume and density assuming the first 10 seconds at x as the period of observation.

	time in sec	
vehicle	time at x	time at y
1	0	35
2	2	37
3	3	39
4	5	42
5	6	44
6	8	48

3. A vehicle pulls out onto a single-lane highway that has a flow rate of 300 veh/h (Poisson distributed). The driver of the vehicle does not look for oncoming traffic. Road conditions and vehicle speeds on the highway are such that it takes 1.7 seconds for an oncoming vehicle to stop once the brakes are applied. Assuming a standard driver reaction time of 2.5 seconds, determine the probability that the vehicle pulling out will get in an accident with oncoming traffic.

4. A four lane undivided multilane highway has 3.4m lanes, 1.2m shoulders on both sides, and 6 access points per km. it is found that roadway currently operates at capacity with PHF = 0.8 and a driver population adjustment factor of 0.9. if the highway is on level terrain, with 8% trucks and buses, no recreational vehicles, and speed limit is 90 kmph, determine the directional hourly volume.

5. Briefly discuss the following as applied to uncontrolled intersection with suitable example. a) circulating traffic b) conflicting traffic c) gap and critical gap d) gap acceptance and uses, and e) follow up time

6. A four-phase signal system is to be designed for a major intersection in an urban area. The flow ratios are

   Phase A $(v/s)_A = 0.25$, Phase B $(v/s)_B = 0.25$, Phase C $(v/s)_C = 0.20$, Phase D $(v/s)_D = 0.15$ If the total lost time (L) is 3.5 secs/phase, determine

   a) The shortest cycle length that will avoid oversaturation.

   b) The cycle length if the desired critical v/c ratio is 0.95.

7. An intersection approach at an isolated pretimed signal with a cycle length of 90 s has a saturation flow rate of 1,700 veh/h. The length of the green is 25 s. The quality factor is 0.93. Determine the total delay if measurement time is 15 minutes. Comment on the answer.

8. At a parking lot, vehicles arrive according to a poisson process and are processed at an exponentially distributed rate with mean processing rate of 5 veh/min. The mean arrival rate is 4.2 veh/min. What would be the average length of queue, the average time spent in the system and the average waiting time in the queue.

9. Explain how different factors contribute to the following.

   a) Intensity and severity of congestion b) crash reduction due to facility improvement

   c) pedestrian flow, speed and LoS d) directional peak hour capacity of freeway

10. What is the difference between capacity and level of service of highway facilities? Explain the importance of classifying urban streets.

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