Menoufia University
Faculty of Engineering
Civil Engineering Dept.
Second Semester Exam, 2019-2020
Date of Exam: 9 / 8 / 2020

Subject: Transportation & Traffic Eng.
Code: CVE 730
Year: PhD course
Time Allowed: 3 Hours
Total Marks: 100 marks

Attempt all questions and assume any missing data.
Use sketches to describe your answers where appropriate.

Question 1 (13 marks)

a) Define the following terms: (a) home-based work (HBW) trips, (b) home-based other (HBO) trips, (c) non-home-based (NHB) trips, (d) production, (e) attractions, (f) origin, and (g) destination.

b) what are the three factors that influence the demand for urban travel.

c) List the types of trips in a traffic zone.

d) Explain the transportation forecasting process.

Question 2: (40 marks)

a) A study area divided into three transporting areas, and the amount of the trips generated (O_i) and the coefficient of attraction (A_j) in the peak hour for those areas was as follows:

Area number	O_i	A_j
1	2500	3
2	1300	5
3	3200	4

Described in the following table in minutes travel time between the areas of transportations as follows:

From / to	1	2	3
1	5	15	10
2	20	10	15
3	15	20	5

$$F_{ij} = m_{ij}^{-1.7}$$

It is required to distribute these trips between different regions of transportation using the (Gravity model).

b) If the utility function for the passenger who has the freedom to choose between two means of transportations (private car or bus) gives the following relation:

$$U = -0.18X1 - 0.03X2 - 0.04X3$$

where: X1 = the vehicle trip time in minutes, X2 = the time of the trip outside the vehicle in minutes, X3 = the cost of the trip in Piaster.

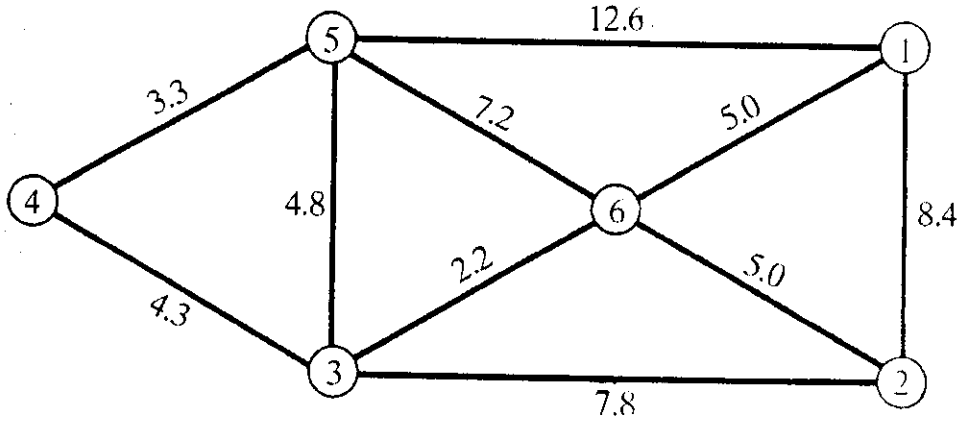
Mode	X1 (Minute)	X2 (Minute)	X3 (Piaster)
Private Car	15	5	100
Bus	35	9	25

The required is to know:

1. What is the probability that the passenger takes the bus or the private car to make a trip between these two areas.
2. If the number of trips between these two regions (a) & (b) equals 10000 trip/day, and the average of occupied places in the private car is 1.5 passengers and in the bus is 25 passengers, what is the expected number of private cars and buses in a day.
3. What is the influence of increasing the fee of transportation by bus to 40 piasters instead of 25 piasters on the number of the private cars and buses in a day.

c) The following Figure represents travel times on the links connecting six zonal centroids. Determine the minimum path from each zone to each other zone. Use the all-or-nothing trip assignment method to determine the total trips for each link after all the trips from the following two-way trip table have been loaded onto the network.

	Trips Between Zones					
Zone	*1*	*2*	*3*	*4*	*5*	*6*
1	0	1000	1100	400	1000	1300
2	—	0	1050	700	1100	1200
3	—	—	0	1200	1150	1600
4	—	—	—	0	800	400
5	—	—	—	—	0	700
6	—	—	—	—	—	0



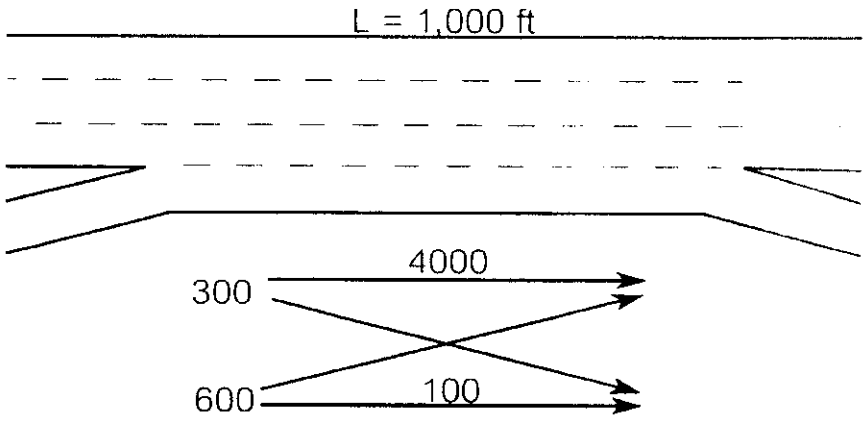
Question 3: **(47 marks)**

a) A section of highway has the following flow density relationship $q = 80k - 0.4k^2$ [with q in veh/h and k in veh/km]. 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.

b) An observer has determined that the time headways between successive vehicles on a section of highway are exponentially distributed and that 60% of the headways between vehicles are 13 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.

c) A divided multilane highway in a recreational area ($f_p = 0.90$) has four lanes (two lanes in each direction) and is on rolling terrain (E_T=2.5, E_R=2.0). The highway has 10-ft lanes with a 6-ft right-side shoulder and a 3-ft left-side shoulder. The posted speed is 50 mi/h. Previously, there were 4 access points per mile, but recent development has increased the number of access points to 12 per mile. Before development, the peak-hour factor was 0.95 and the directional hourly volume was 2300 vehicles with 10% large trucks and buses and 3% recreational vehicles. After development, the peak-hour directional flow is 2700 vehicles with the same vehicle percentages and peak-hour factor. What is the level of service before and after the development.

d) The following figure illustrate a typical ramp-weave section on a Four-lane freeway with FFS = 75 mph. The analysis is to determine the level of service of the weaving segment.



Intended Learning Outcomes (ILOs)

Question No.	ILOs
1	A-5-1, A-5-2, B-16-3, C-14-2
2	A-15-1, B-14-2, C-17-1, C-18-4
3	B-15-1, C-13-3, D-4-3, A-13-2,

Table 6.3 Adjustment for Lane Width

Lane width (ft)	Reduction in free-flow speed, f_{LW} (mi/h)
12	0.0
11	1.9
10	6.6

Access points/ mile	Reduction in free-flow speed, f_A (mi/h)
0	0.0
10	2.5
20	5.0
30	7.5
> 40	10.0

Total lateral clearance* (ft)	Reduction in free-flow speed, f_{LC} (mi/h)	
	Four-lane highways	Six-lane highways
12	0.0	0.0
10	0.4	0.4
8	0.9	0.9
6	1.3	1.3
4	1.8	1.7
2	3.6	2.8
0	5.4	3.9

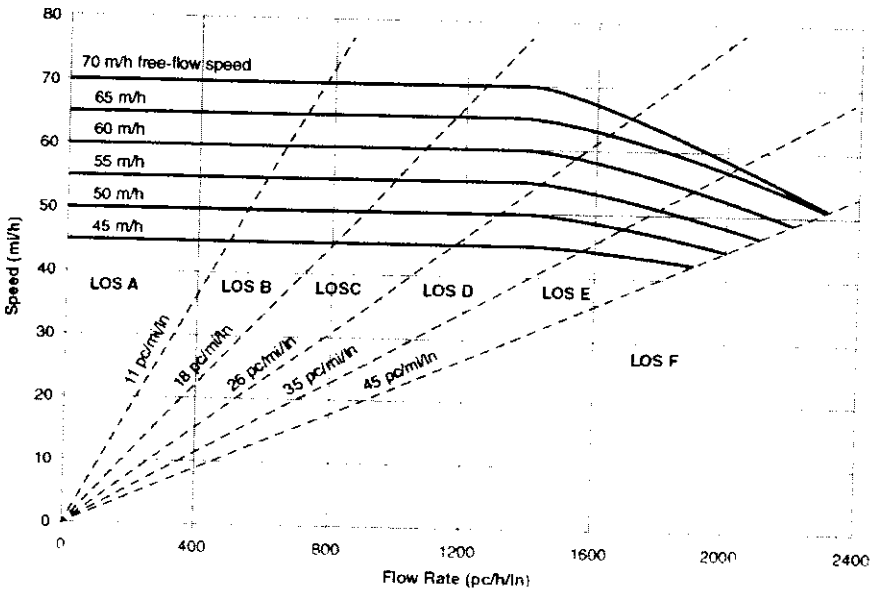


EXHIBIT 24-2. LOS CRITERIA FOR WEAVING SEGMENTS

LOS	Density (pc/mi/ln)	
	Freeway Weaving Segment	Multilane and Collector-Distributor Weaving Segments
A	≤ 10.0	≤ 12.0
B	> 10.0–20.0	> 12.0–24.0
C	> 20.0–28.0	> 24.0–32.0
D	> 28.0–35.0	> 32.0–36.0
E	> 35.0–43.0	> 36.0–40.0
F	> 43.0	> 40.0

EXHIBIT 24-7. CRITERIA FOR UNCONSTRAINED VERSUS CONSTRAINED OPERATION OF WEAVING SEGMENTS

Configuration	Number of Lanes Required for Unconstrained Operation, N_{wl}	N_w(max)
Type A	$0.74(N)\ VR^{0.571} L^{0.234}/S_w^{0.438}$	1.4
Type B	$N[0.085 + 0.703VR + (234.8/L) - 0.018(S_{nw} - S_w)]$	3.5
Type C	$N[0.761 + 0.047VR - 0.00011 - 0.005(S_{nw} - S_w)]$	3.0[a]

$$W = \frac{a(1+VR)^b \left(\frac{v}{N}\right)^c}{L^d}$$

	Constants for Weaving Speed, S_w				Constants for Nonweaving Speed, S_{nw}			
	a	b	c	d	a	b	c	d
Type A Configuration								
Unconstrained	0.15	2.2	0.97	0.80	0.0035	4.0	1.3	0.75
Constrained	0.35	2.2	0.97	0.80	0.0020	4.0	1.3	0.75
Type B Configuration								
Unconstrained	0.08	2.2	0.70	0.50	0.0020	6.0	1.0	0.50
Constrained	0.15	2.2	0.70	0.50	0.0010	6.0	1.0	0.50
Type C Configuration								
Unconstrained	0.08	2.2	0.80	0.60	0.0020	6.0	1.1	0.60
Constrained	0.14	2.2	0.80	0.60	0.0010	6.0	1.1	0.60

EXHIBIT 24-5. DETERMINING CONFIGURATION TYPE

Number of Lane Changes Required by Movement v_{w1}	Number of Lane Changes Required by Movement v_{w2}		
	0	1	≥ 2
0	Type B	Type B	Type C
1	Type B	Type A	N/A
≥ 2	Type C	N/A	N/A

Note:
N/A = not applicable; configuration is not feasible.