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Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2018/2019

COURSE NAME	:	TRAFFIC ENGINEERING AND SAFETY
COURSE CODE	:	BFC 32302
PROGRAMME	:	BFF
EXAMINATION DATE	:	JUNE/JULY 2019
DURATION	:	2 HOURS
INSTRUCTIONS	:	ANSWER **THREE (3)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **NINE (9)** PAGES

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Q1 (a) The speed-density relationship for traffic moving along a highway was found to be best represented by the following linear equation:

$$v = 94 - 0.8k$$

where, v = mean speed (km/h) and k = density (vehicles/km).

(i) An accident on the highway has caused traffic to bunch up to 80 vehicles/km. Calculate the mean speed of vehicles in the traffic stream as a result of the accident.

(2 marks)

(ii) Determine the free mean speed, v_f and jammed density, k_j.

(3 marks)

(iii) Develop an equation that relates between flow, q and density, k. Sketch the flow-density curve.

(3 marks)

(iv) Estimate the maximum flow, q_{max} (in vehicles/hour) that can be accommodated by the highway.

(4 marks)

(b) A 6-lane urban freeway segment is located on flat terrain with 3.5 m lanes, 1.5 m shoulders and an average of 0.4 interchanges per km. 10% of the traffic is composed of trucks and buses. Traffic volume data collected during the peak hour is shown in **Table 1**.

(i) Calculate the peak hour factor, PHF.

(2 marks)

(ii) Determine the free flow speed, FFS (in km/h).

(4 marks)

(iii) Given that all drivers are familiar with the freeway, estimate the flow rate, v_p (in passenger cars/hour/lane).

(3 marks)

(iv) Evaluate the level of service (LOS) of the freeway segment.

(4 marks)

Q2 (a) There are many reasons why management of traffic at Kuala Lumpur is crucial. Discuss **THREE (3)** reasons to manage traffic.

(6 marks)

(b) The following techniques are commonly used for traffic management. Explain the **TWO (2)** objectives and **TWO (2)** techniques in each of these methods.

(i) Improve Capacity.

(4 marks)

(ii) Allocate Priorities.

(4 marks)

(iii) Restraint.

(4 marks)

(c) Briefly describe **TWO (2)** general principles to guide planning decision to support parking management.

(2 marks)

(d) The parking survey data were collected from a parking lot by using license plate method. The data is shown in **Table 8**. Determine:

(i) Parking duration for every bay.

(3 marks)

(ii) Average turnover.

(2 marks)

Q3 (a) Discuss how a good intersection can manage the followings :

(i) reduce number of conflicts and,

(3 marks)

(ii) minimize area of conflict.

(3 marks)

(b) When traffic engineers design an intersection, three major factors will be considered. Explain **THREE (3)** factors that influence intersection design with suitable example.

(9 marks)

(c) Based on demand flow values given in **Table 9** and the saturation flow values given in **Table 10** :

(i) Determine the demand-saturation flow ratio (Y) and give your comment on the calculated value.

(7 marks)

(ii) Suggest **THREE (3)** improvements to the traffic signal design or intersection design.

(3 marks)

Q4 (a) Commonly, the 3E's (Education, Enforcement, Engineering) solution has been adopted worldwide as straightforward approach to overcome road safety issues.

(i) State **FIVE (5)** programs under Engineering approach.
(5 marks)

(ii) Explain **TWO (2)** other new solutios apart from the 3E's solution.
(5 marks)

(b) UTHM main campus has more than 16,000 students that commute daily using public transports and private vehicles as well. Due to this situation, some issues regarding traffic conflict and motor vehicles accidents were recorded. Traffic Safety Team has given tasks to perform Road Safety Audit (RSA) to identify and propose mitigation measures. Using RSA Stage 5 procedure, identify **FIVE (5)** detailed items and propose a practical mitigation measures to overcome the problems.
(15 marks)

- END OF QUESTIONS -

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TABLE 1: Peak hour traffic count on a 6-lane urban freeway segment

Time	Number of Vehicles
7:30 – 7:45 AM	528
7:45 – 8:00 AM	614
8:00 – 8:15 AM	539
8:15 – 8:30 AM	486

TABLE 2: Adjustment for lane width

Lane Width (m)	Reduction in FFS, f_{LW} (km/h)
3.6	0.0
3.5	1.0
3.4	2.1
3.3	3.1
3.2	5.6

TABLE 3: Adjustment for left shoulder lateral clearance

Left shoulder lateral clearance (m)	Reduction in FFS, 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

TABLE 4: Adjustment for number of lanes

Number of lanes in one direction	Reduction in FFS, f_N (km/h)
≥ 5	0.0
4	2.4
3	4.8
2	7.3

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TABLE 5: Adjustment for interchange density

Number of interchanges per km	Reduction in FFS, 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

TABLE 6: Passenger car equivalents for heavy vehicles

Factor	Type of Terrain		
	Flat	Rolling	Mountainous
E_T (trucks and buses)	1.5	2.5	4.5
E_R (recreational vehicles)	1.2	2.0	4.0

TABLE 7: Level of service criteria

Level of Service	Density (pc/km/lane)
A	0 – 7
B	> 7 – 11
C	> 11 – 16
D	> 16 – 22
E	> 22 – 28
F	> 28

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TABLE 8: Parking survey data

Bay	**Time (A.M.)**			
	9:30-9:45	9:45-10.00	10.00-10.15	10.15-10.30
1	123	456	√	-
2	314	√	151	171
3	192	202	-	252
4		252	-	222

TABLE 9: Peak demand flows (pcu/hr) for 4-leg intersections

From Approach	**Left-turn traffic**	**Straight traffic**	**Right-turn traffic**
NORTH	50	310	60
SOUTH	90	320	50
EAST	350	1250	150
WEST	300	850	200

TABLE 10: Saturation flows (pcu/hr) for a 3-phase traffic signal system at the intersection

Phase 1	**Phase 2**	**Phase 3**
E_R : 2400 W_R : 1800	$E_{T/L}$: 2500 $W_{T/L}$: 3000	S_R : 1850 N_R: 1900 $S_{T/L}$: 2100 $N_{T/L}$: 2300

***Note:** As where;*
A = Approach and B = Turning movements
E = East, W = West, N = North, S = South
R = Right turn, T/L = Through and Left turns

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FORMULAS

$$q = vk \qquad q = \frac{3600}{h} \qquad k = \frac{1000}{s} \qquad h = \frac{s}{v}$$

$$g = h - \frac{L}{v} \qquad c = gv \qquad PHF = \frac{V}{4 \times V_{15}}$$

$$FFS = BFFS - f_{LW} - f_{LC} - f_N - f_{ID} \qquad D = \frac{v_P}{S} \qquad f_{HV} = \frac{1}{1 + P_T(E_T - 1)}$$

$$v_P = \frac{V}{PHF \times N \times f_{HV} \times f_P} \qquad S = FFS \text{ if } \; 90 \leq FFS \leq 120 \; \text{ and } \; v_P \leq (3100 - 15FFS)$$

$$\text{If } \; 90 \leq FFS \leq 120 \; \text{ and } \; (3100 - 15FFS) < v_P \leq (1800 + 5FFS)$$

$$S = FFS - \left[\frac{1}{28}(23FFS - 1800)\left(\frac{v_p + 15FFS - 3100}{20FFS - 1300}\right)^{2.6}\right]$$