Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2016/2017

COURSE NAME	:	TRAFFIC ENGINEERING AND SAFETY
COURSE CODE	:	BFC 32302
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	JUNE 2017
DURATION	:	2 HOURS AND 30 MINUTES
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISITS OF **TEN (10)** PAGES

Q1 (a) **Table 1** shows the time taken for 10 vehicles to traverse a 400 m long section of a collector street. Calculate, in km/h, the time mean speed and space mean speed.

(8 marks)

(b) A spot speed study was conducted along a section of an urban state road with a speed limit of 70 km/h. The speed observations are given in **Table 2**.

(i) Plot a cumulative frequency distribution curve.

(7 marks)

(ii) Determine the 85^{th} percentile and median speeds.

(4 marks)

(iii) Estimate the standard deviation.

(3 marks)

(iv) If the pace is 54 – 64 km/h, determine the number of vehicles in pace.

(3 marks)

Q2 (a) The prediction of Level of Service (LOS) for multilane highway and basic segment expressway is different for free-flow speed calculation. Explain briefly the differences between these two facilities.

(5 marks)

(b) State **FIVE (5)** conditions for base condition of Multilane Highway.

(5 marks)

(c) A rural freeway has two 3.6 m lanes in each direction and a traffic stream composed of 12 percent recreational vehicles and 8 percent trucks and buses. There is a 3 percent upgrade, 1.7 km in length. There are no lateral obstructions. Interchanges are approximately 5 km apart. Given the current maximum hourly volume is 1,790 vehicles per hour, with a peak hour factor of 0.90, and the adjustment factor for the character of the traffic stream is 0.90. Determine the level of service.

(15 marks)

Q3 (a) One-way street systems represent the ultimate solution to elimination of right-turn conflicts at intersections and the congestion that they may cause. For high-density street networks with many signalized intersections, one-way streets are very attractive. List **THREE (3)** advantages of one-way streets.

(3 marks)

(b) Traffic calming is about preserving the function of local streets. List **THREE (3)** specific goals of traffic calming and discuss **TWO (2)** traffic calming devices under volume reduction category.

(7 marks)

(c) The most commonly used technique for observing duration and accumulation characteristics of on-street and off-street parking lots are the recording of license plate numbers of parked vehicles. At regular intervals, an observer walks a particular route (usually up one block face and down the opposite block face), and records the license plate numbers of vehicles occupying each parking space. Discuss **FIVE (5)** data that can be analyzed from the typical field sheet.

(10 marks)

(d) Pedestrians are one of vulnerable road users group. So, local authority should provide suitable facilities for pedestrians. State **FIVE (5)** factors to be considered when providing the facilities for pedestrians.

(5 marks)

Q4 **Figure Q4(a)** shows the layout of a proposed signalised T-intersection. The saturation flows (S) and demand flows (q) are given in passenger car units per hour (pcu/hr). **Figure Q4(b)** shows the 3-phase signal system that will be applied.

(a) Given that the all red time (R) = 2 sec, amber time (a) = 3 sec and driver reaction time (l) = 3 sec, calculate the

(i) Optimum cycle time (C_o).

(10 marks)

(ii) Actual green time (G) for each phase, if the cycle time (C) is taken as 90 seconds.

(6 marks)

(b) Determine the controller setting time and sketch a signal timing schedule.

(9 marks)

Q5 (a) Royal Malaysian Police reported that the road accident fatality for last year (2016) was significantly increased 6.3% from 6,706 in 2015 to 7,152. If a total registration of vehicles in year 2020 will be estimated 30 million units, determine percentage of targeted reduction in road accident fatality for 6,000 victims?

Note: Total vehicles registration in 2015 and 2016 were 26,301,952 units and 27,485,540 units respectively.

(5 marks)

(b) Based on annual road accident statistical report, more than 60% fatalities in road accident consist of motorcycle users. As a traffic safety engineer in City Hall Kuala Lumpur (DBKL), briefly discuss a proposal using engineering approaches to mitigate the problems on how to reduce the number of motorcycle user's fatality.

(10 marks)

(c) You are assigned as Team Consultant to look into the safety aspect of existing roads, particularly along the Multilane Highway at KM 19 – KM 33, FT050 (Parit Raja–Air Hitam). Using Road Safety Audit (RSA) Stage 5 procedure, select **FOUR (4)** significant items and propose a checklist for each activity.

(10 marks)

- END OF QUESTIONS -

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TABLE 1: Vehicle travel time data recorded on Collector Street

Vehicle	Travel Time (sec)
1	45.3
2	44.6
3	36.8
4	37.8
5	46.1
6	35.3
7	31.5
8	48.4
9	38.2
10	37.5

TABLE 2: Spot speed data observed on urban state road

Speed Class (km/h)	Number of Vehicles
30 - 39	12
40 - 49	34
50 - 59	36
60 - 69	45
70 - 79	26
80 - 89	24
90 - 99	15
100 - 109	8

TABLE 3: Vehicle Hourly Counts

Time Period	Counts (veh/15-min period)
5:30-5:45 PM	1200
5:45-6:00 PM	1400
6:00-6:15 PM	1100
6:15-6:30 PM	1300

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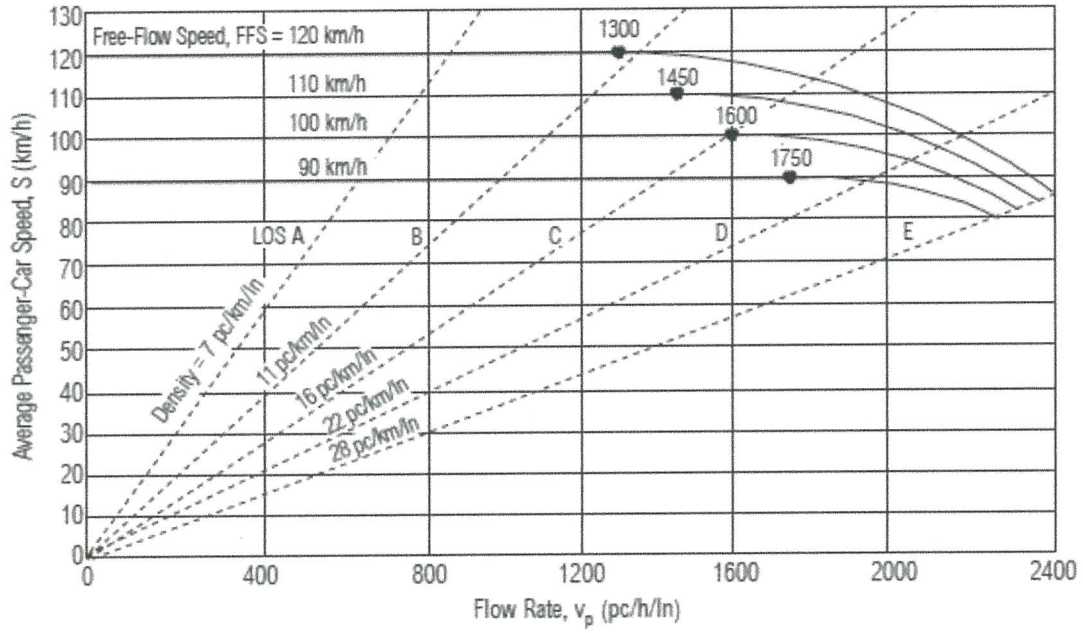

Note:
Capacity varies by free-flow speed. Capacity is 2400, 2350, 2300, and 2250 pc/h/ln at free-flow speeds of 120, 110, 100, and 90 km/h, respectively.

For $90 \le FFS \le 120$ and for flow rate (v_p)
$(3100 - 15FFS) < v_p \le (1800 + 5FFS)$,

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

For $90 \le FFS \le 120$ and
$v_p \le (3100 - 15FFS)$,
$S = FFS$

FIGURE Q2: Speed-flow curve and LOS for basic Freeway

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TABLE 4: Adjustment for lane width

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

TABLE 5: Adjustment for Left-shoulder lateral clearance

Left Shoulder Lateral Clearence (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

TABLE 6: Adjustment for number of lanes

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

Note: For all rural freeway segments, f_N is 0.0.

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TABLE 7: Adjustment for interchange density

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

TABLE 8: Passenger-car equivalents on Extended Freeway Segments

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

TABLE 9: Passenger-car equivalents for trucks and buses on specific upgrades

		Percentage of trucks and buses								
Grade %	Length, km	2	4	5	6	8	10	15	20	25
< 2	All	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
≥ 2 – 3	0.0-0.4	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
	>0.4-0.8	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
	>0.8-1.2	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
	>1.2-1.6	2.0	2.0	2.0	2.0	1.5	1.5	1.5	1.5	1.5
	>1.6-2.4	2.5	2.5	2.5	2.5	2.0	2.0	2.0	2.0	2.0
	≥2.4	3.0	3.0	3.0	2.5	2.0	2.0	2.0	2.0	2.0

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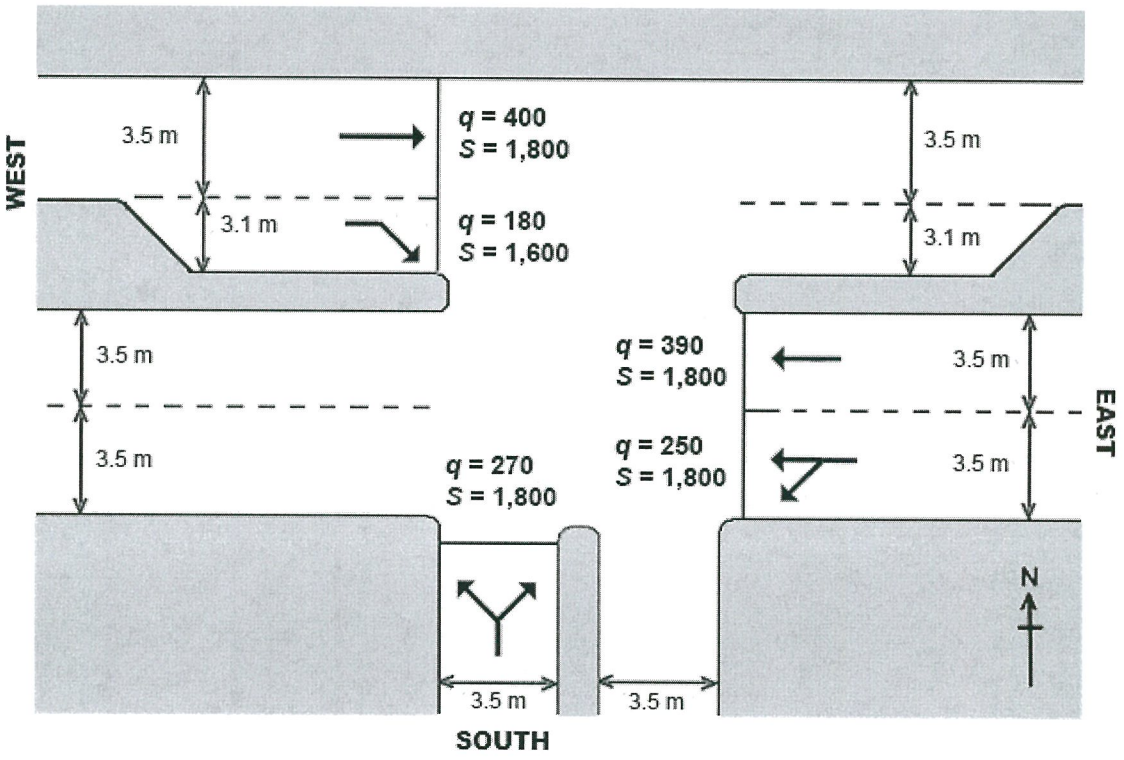

FIGURE Q4(a): Layout of proposed signalised T-intersection

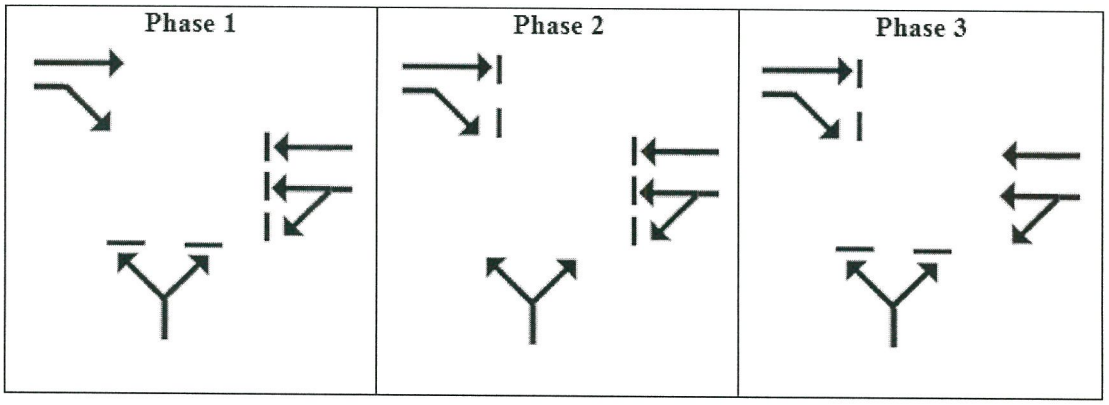

FIGURE Q4(b): Phasing diagram of proposed signal system

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List of Equations:

$$v_p = \frac{V}{PHF \times N \times f_{HV} \times f_p}$$

$$PHF = \frac{V}{4 \times V_{15max}}$$

$$f_{HV} = \frac{1}{1+P_T(E_T-1)} \quad D = \frac{v_p}{S} \quad F = P(1+i)^n$$

$$v_s = \frac{L}{\left(\frac{\sum t}{n}\right)} \qquad v_t = \frac{\sum\left(\frac{L}{t}\right)}{n} \qquad I = a + R \qquad y = \frac{q}{S}$$

$$C_o = \frac{1.5L+5}{1-Y} \qquad G = g + l + R \qquad k = G - a - R$$

$$C_o = \frac{1.5L+5}{1-Y} \qquad G_p = I + \frac{W}{1.22} - 5$$

$$L = \sum(I-a) + \sum \ell \qquad g_i = \frac{y_i}{Y}(C_o - L)$$

$$A = Q \times T$$

$$P = \frac{\left(\frac{A^M}{M!}\right)}{\left(1 + A + \frac{A^2}{2!} + \frac{A^3}{3!} + \frac{A^4}{4!} + \ldots + \frac{A^M}{M!}\right)}$$