Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2014/2015

COURSE NAME	:	TRAFFIC ENGINEERING AND SAFETY
COURSE CODE	:	BFC 32302
PROGRAMME	:	BACHELOR OF CIVIL ENGINEERING WITH HONOURS
DATE OF EXAMINATION	:	JUNE 2015 / JULY 2015
DURATION	:	2 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

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

Q1 (a) Explain briefly the interaction between traffic volume and traffic speed and give suggestion to prevent congestion and keep traffic flow stable.

(3 marks)

(b) i) Describe the need of conducting pedestrian volume count and vehicle classification count.

(4 marks)

ii) Compare the manual method with an alternative technology in highway speed detection. Explain the advantage and disadvantage of both methods.

(6 marks)

(c) Three cars travel over a 100m section of highway at constant speeds of 30, 32 and 40 m/s. Compute the time-mean speed and space mean speed.

(4 marks)

(d) Assume linear speed-density relationship. The free mean speed is 100 km/h and the jam density is 100 vehicles/km. Sketch the curves showing the relationship between speed and density (v-k), and speed and flow (v-q), Calculate the maximum flow and label the free mean speed, jam density and maximum flow on the sketch.

(8 marks)

Q2 (a) State **FIVE (5)** base conditions for basic freeway segments.

(5 marks)

(b) A one-hour traffic count was conducted at KM 85.0 of the North-South Expressway (E2) during the evening peak period in the Southbound direction. The traffic data is shown in **TABLE 1**.

Determine the peak hour factor.

(5 marks)

(c) KM 85.0 of the North-South Expressway (E2) is a rural freeway constructed on flat terrain with two 3.5 m lanes per direction. The lateral clearances are 2.5 m and 1.3 m on the left and right sides of the carriageway respectively. There are no interchanges located along this segment. Using the traffic data provided in **Q2(b)**, ***Figure Q2***, **TABLE 2** to **TABLE 6**, and assuming a base free flow speed of 120 km/h and all drivers are familiar with the route, determine the density and level of service of this segment during the evening peak in the Southbound direction.

(15 marks)

Q3 (a) Define traffic management.

(4 marks)

(b) Capacity improvement is one of the categories in traffic management

(i) State **TWO (2)** objectives under capacity improvement category.

(ii) Explain **TWO (2)** techniques of the capacity improvement category which can be implemented in Central Business District (CBD) area.

(6 marks)

(c) A city of 3 million inhabitants in a less developed country has significant congestion in peak periods and traffic growth is 5% per year. Explain **FIVE (5)** implications that may occur if traffic is not well managed in this city area.

(15 marks)

Q4 (a) List **THREE (3)** modes of traffic signal control.

(3 marks)

(b) Refer to the intersection shown in ***Figure Q4***. The saturation flow rates for three-phase design at the Intersection of Maple Street and Vine Street are given in **TABLE 7**. By using the data given;

(i) Calculate the sum of the demand-saturation flow ratios for the critical lane groups,

(10 marks)

(ii) By assuming 2 seconds of startup lost time and 2 seconds of clearance lost time (3 second of yellow time plus 2 second of all-red time), for each critical lane group, compute the lost time for the cycle.

(2 marks)

(iii) Calculate the optimal cycle lengths for the intersection of these streets.

(2 marks)

(iv) Determine the green time allocations for the 65-second cycle length for these streets.

(8 marks)

Q5 (a) The United Nation General Assembly has made a declaration on road safety the issues by launching the Decade Action for Road Safety 2011-2020. In line with this, Malaysian Government had launched a new National Road Safety Plan 2014-2020. Explain briefly **FIVE (5)** strategic pillars that must be implemented by the country to support the declaration.

(10 marks)

(b) (i) Explain the main goal of Road Safety Audit (RSA).

(3 marks)

(ii) You are assigned as Traffic Safety Engineer to looks into the safety aspect of existing roads, particularly along the two-lane Highway at F001 (Air Hitam–Yong Peng). Using RSA Stage 5 procedure, provide **FOUR (4)** significant items and propose list for each activity.

(12 marks)

-END OF QUESTIONS-

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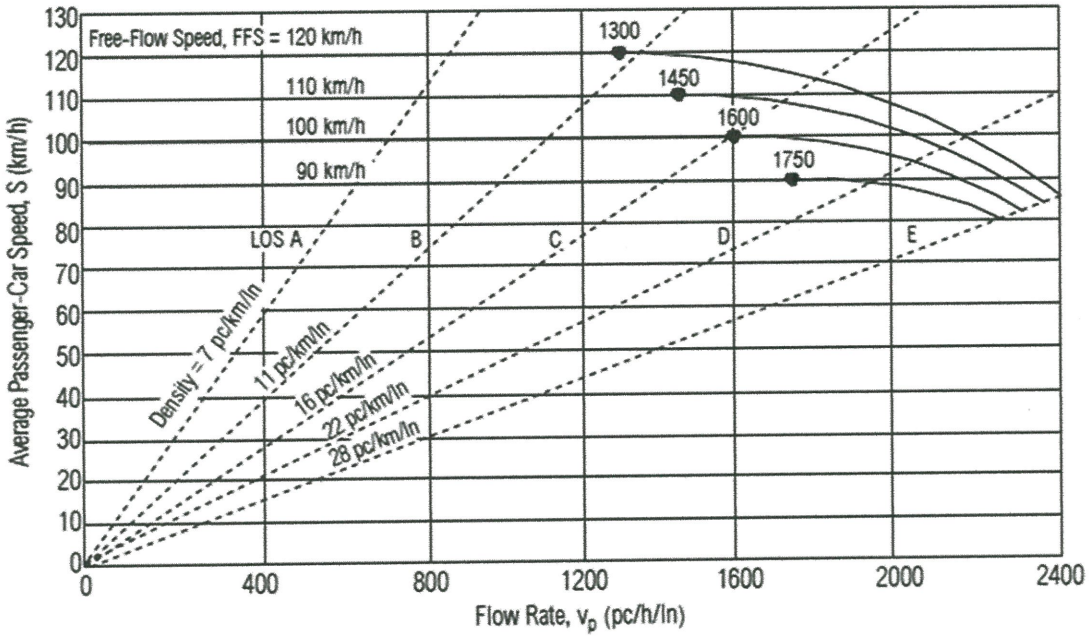

Note:
Capacity varies by free-flow speed. Capacity is 2400, 2350, 2300, and 2250 pc/h/ln at free-flow speeds of 120, 110, 100, and 90 km/h, respectively.

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 curves for basic freeway segments (HCM, 2000)

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TABLE 1: Traffic count at KM 85.0 North-South Expressway

Time	Vehicle Count			
	Class 1	Class 2	Class 3	Class 4
5:00 – 5:15	8	287	53	26
5:15 – 5:30	11	442	47	75
5:30 – 5:45	12	539	25	94
5:45 – 6:00	7	477	46	51

Note:
Class 1 – Motorcycles
Class 2 – Passenger Cars
Class 3 – Vans, medium trucks
Class 4 – Buses, large trucks

TABLE 2: Adjustment for lane width (HCM, 2000)

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 3: Adjustment for left shoulder lateral clearance (HCM, 2000)

Left 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

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TABLE 4: Adjustment for number of lanes (HCM, 2000)

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

TABLE 5: Passenger car equivalents on extended freeway segments (HCM, 2000)

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

TABLE 6: Adjustment for interchange density (HCM, 2000)

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

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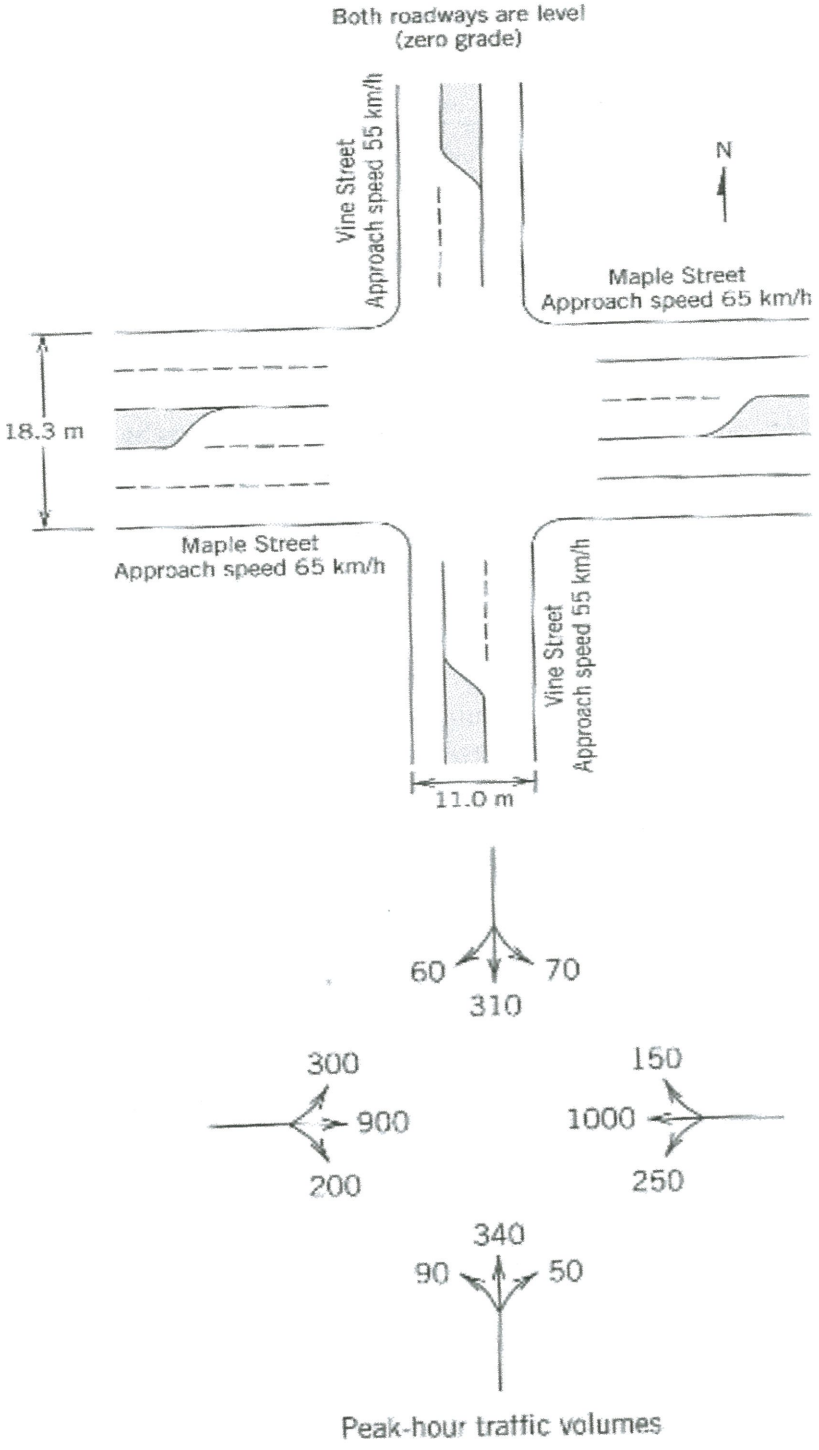

Figure Q4: Intersection Geometry and peak traffic volumes

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TABLE 7: Saturation Flow Rates for Three-Phase Design at Intersection of Evergreen Street and Banang Street.

Phase 1	Phase 2	Phase 3
EB L: 1750 veh/h	EB T/R: 3400 veh/h	SB L: 450 veh/h NB L: 475 veh/h
WB L: 1750 veh/h	WB T/R: 3400 veh/h	SB T/R:1800 veh/h NB T/R: 1800 veh/h

EB: Eastbound SB: Southbound L: Left Turn T: Through WB: Westbound
NB: Northbound R: Ringht Turn

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The following equations may be useful to you:

$$FFS = BFFS - f_{LW} - f_{LC} - f_N - f_{ID} \qquad D = \frac{V_p}{S}$$

$$v_p = \frac{V}{N \times PHF \times f_{HV} \times f_P} \qquad f_{HV} = \frac{1}{1 + P_T(E_T - 1)}$$

$$Y = \sum y_i$$

$$y = q/S$$

$$L = \sum (I - a) + \sum l$$

$$C_o = \frac{1.5L + 5}{1 - Y}$$

$$g_1 + g_2 + g_3 + \ldots + g_n = C_o - L$$

$$g_n = \frac{y_n}{y} \times (C_o - L)$$

$$G = g + l + R$$

$$K = g - l - a$$