Faculty of Civil Engineering
UTM
UNIVERSITI TEKNOLOGI MALAYSIA

FINAL EXAMINATION
SEMESTER 2, SESSION 2017/2018

COURSE CODE	:	SKAA3842
COURSE	:	TRAFFIC ENGINEERING
PROGRAMME	:	SAW
DURATION	:	2 HOURS
DATE	:	JUNE 2018

INSTRUCTION TO CANDIDATES:

1. ANSWER ANY FOUR (4) QUESTIONS.
2. YOU ARE NOT ALLOWED TO REFER TO ANY NOTES.

WARNING!

Students caught copying/cheating during the examination will be liable for disciplinary actions and the faculty may recommend the student to be expelled from the study.

This examination question consists of (7) printed pages only.

Q1. (a) Criteria for the geometric design of highways are partly based on the characteristics of vehicles. Briefly explain about these characteristics.

(5 marks)

(b) Discuss the following items:

i) Running speed and journey speed

ii) Headway and spacing

(10 marks)

(c) A study of freeway flow at a particular site has resulted in a calibrated speed–density relationship as follows:

$$u = 70\ (1 - 0.008\ k)\ \text{km/hr}$$

For this relationship, determine the following information:

i) Free-flow speed

ii) Jam density

iii) Speed-flow relationship

iv) Flow-density relationship

v) Capacity

(10 marks)

(25 marks)

Q2. (a) A traffic study was conducted in Johor Bahru, Johor to determine the speed of vehicles. Discuss two methods that can be used to obtain the speed of vehicles.

(8 marks)

(b) Table Q2 shows speed data collected along a road section in Johor Bahru, Johor.

Table Q2

Speed class (km/hr)	**Frequency**
30-35	5
35-40	7
40-45	9
45-50	19
50-55	21
55-60	29
60-65	43
65-70	45
70-75	21
75-80	11

Draw the histogram and cumulative frequency curve of the speed data.

i) Determine:

- The mean speed
- The mode
- The standard deviation
- The median, P_{15}, P_{50} dan P_{85}.

ii) If the posted speed limit of the road section is 60 km/hr, what can be concluded on the traffic and road condition in the study area?

iii) If the project required that the confidence level be 95% and the limit of acceptable error was 0.5 km/hr, did the sample satisfies the project requirement?

(17 marks)

(25 marks)

Q3. For the geometric and traffic characteristics shown in Table Q3, determine a suitable signal phasing system and phase lengths for the intersection if the turning radius, R = 25 m and the slope from east is +4%. The average passenger car equivalent are 1 HGV = 1.8 pcu and for other vehicles, 1 veh = 1.1 pcu. Show the traffic phase sequences and timing diagrams if all red period may be taken as 2 sec/phase, starting delays equal to 2 sec/phase and an amber period of 3 sec. Other adjustment factors are as given in Tables 1 – 4 (page 7).

Table Q3

	Width (m)	Traffic Volume			% HGV
		Left	Through	Right	
West	7	85	360	90	5
East	7	50	180	80	5
North	7	95	300	170	15
South	7	85	200	150	15

(25 marks)

Q4. (a) Briefly explain the traffic conflict points at intersection.

(5 marks)

(b) Selection of an appropriate traffic phase is one of the important elements in designing the traffic signal control system. Consideration on the separate phase for right-turning vehicles should be based on several criteria. Briefly discuss the criteria.

(8 marks)

(c) Calculate the stopping sight distances of a driver travelling at a speed of 90 km/h with road coefficient of friction is 0.25 and driver reaction time is 1.5 sec under the following condition.

i) The road is flat
ii) At an upgrade section of 3%
iii) At a downgrade section of 4%

Explain the factor that might influenced the stopping sight distances of a driver.

(12 marks)

(25 marks)

Q5. (a) According to Arahan Teknik (Jalan) 13/87, installation of traffic signal system is warranted if one or more requirements in the warrants are satisfied. Briefly discuss the warrants.

(10 marks)

(b) A section of a road with a design speed of 80 km/h has the coefficient of friction of 0.12 and 6% super-elevation needs to be designed with a circular curve. The curve deflection angle is 35^0. Determine:

i) The minimum radius of the curve
ii) The curve length
iii) If the point of intersection (P.I) is located at station 300+15, find the station for point of curvature (P.C) and point of tangent (P.T)
iv) Justify the need to provide a pair of transition curves when designing a curve on high speed road.

(15 marks)

(25 marks)

EQUATIONS

The symbols indicate parameters usually used.

$$Q_{AB} = \frac{X_{AB} + (Y_1 - Y_2)_{AB}}{t_A + t_W}$$

$$t_{AB} = t_W - \frac{(Y_1 - Y_2)_{AB}}{Q_{AB}}$$

$$u = u_f - \left(\frac{u_f}{k_j}\right) \times k$$

$$q = k_j \times u - \left(\frac{k_j}{u_f}\right) \times u^2$$

$$q = u_f \times k - \left(\frac{u_f}{k_j}\right) \times k^2$$

$$\overline{V_i} = \frac{\sum (f_i V_i)}{\sum f_i}$$

$$SD = \sqrt{\left(\frac{\sum f_i V_i^2}{\sum f_i} - \left(\frac{\sum f_i V_i}{\sum f_i}\right)^2\right)}$$

$$\text{Perception Distance} = 0.28Vt$$

$$\text{Braking distance} = \frac{V^2 - u^2}{254(f \pm G)}$$

$$A = G_2 - G_1 \qquad r = \frac{G_2 - G_1}{L}$$

$$Y_X = \frac{rx^2}{2} + G_1 x + Y_0$$

$$\frac{dY_X}{dx} = rx + G_1$$

$$R = \frac{V^2}{127(e + f)}$$

$$\alpha = \theta - 2\theta_P, \; \theta_P = 57.3\frac{L_P}{2R}$$

$$\text{Length of circular segment, } L_B = R \times \frac{2\pi\theta}{360}$$

$$\text{Length of transition curve, } L_P = \frac{V^3\left(1 - \frac{R.g.e}{V^2}\right)}{c.R}$$

$$L = \frac{AS^2}{2\left(\sqrt{h_1} + \sqrt{h_2}\right)^2}$$

$$L = 2S - \frac{2\left(\sqrt{h_1} + \sqrt{h_2}\right)^2}{A}$$

$$S_R = \frac{b}{\left(1 + \frac{1.524}{r}\right)}$$

b = 1800 for single lane
b = 3000 for two lanes

I = R + a , S = 525W

$$a = \frac{V}{2A} + \frac{W' + L'}{V} \qquad y_i = \frac{q_i}{S_i}$$

$$Y = \sum_{i=1}^{n} y_i \qquad L = \sum_{i=1}^{n} R_i + \sum_{i=1}^{n} l_i$$

$$N = \left(\frac{z\sigma}{d}\right)^2 \qquad z = \frac{(x - \mu)}{\sigma}$$

Optimum Cycle Time, $C_O = \frac{1.5L + 5}{1 - Y}$

Effective green, $g_i = \frac{y_i}{Y}(C_O - L)$

Actual green time $G_i = g_i + l + R$

Controller green time $K_i = g_i + l - a$

Table 1: Saturation flow for lane width equal to 5.5 m or less

W	3.00	3.25	3.50	3.75	4.00	4.25	4.50	4.75	5.00	5.25
S	1845	1860	1885	1915	1965	2075	2210	2375	2560	2760

Table 2: Adjustment factors for the effects of gradient

Adjustment factor, Fg	Conditions
0.85	for upgrade 5%
0.88	for upgrade 4%
0.91	for upgrade 3%
0.94	for upgrade 2%
0.97	for upgrade 1%
1.00	for flat road
1.03	for downgrade 1%
1.06	for downgrade 2%
1.09	for downgrade 3%
1.12	for downgrade 4%
1.15	for downgrade 5%

Table 3: Adjustment factors for turning radius effects

Adjustment factor, Ft	Conditions
0.85	for turning radius, $R < 10m$
0.90	for turning radius where $10m \leq R < 15m$
0.96	for turning radius where $15m \leq R < 30m$

Table 4: Adjustment factors for the effects of turning movements

% turning traffic	Factor for right-turn, Fr	Factor for left-turn, Fl
5	0.96	1.00
10	0.93	1.00
15	0.90	0.99
20	0.87	0.98
25	0.84	0.97
30	0.82	0.95
35	0.79	0.94
40	0.77	0.93
45	0.75	0.92
50	0.73	0.91
55	0.71	0.90
60	0.69	0.89