



UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER II
SESSION 2009/2010**

SUBJECT NAME : TRAFFIC ENGINEERING AND SAFETY
SUBJECT CODE : BFC 3082
COURSE : 3 BFF
EXAMINATION DATE : APRIL/MAY 2010
DURATION : 2 HOURS 30 MINUTES
INSTRUCTION : ANSWER THREE (3) QUESTIONS ONLY

THIS PAPER CONSISTS OF SEVENTEEN (17) PAGES

- Q1** (a) Sketch a curve which relates density and flow, and prove that optimal density, $k_m = k_j / 2$. (5 marks)
- (b) Figure **Q1** shows vehicles traveling at constant speeds on a two-lane highway between sections X and Y with their positions and speeds obtained at an instant of time by photography. An observer located at point X observes the four vehicles passing point X during a period of T sec. The velocities of the vehicles are measured as 72, 72, 64 and 48 km/h respectively. Calculate:
- (i) Flow, (1 mark)
 - (ii) Density, (1 mark)
 - (iii) Time Mean Speed, and (1 mark)
 - (iv) Space Mean Speed. (2 marks)
- (c) **Table 1** shows the frequency distribution table for set of speed data collected on a rural highway in Malaysia during a speed study. The posted speed limit of the road is 60 km/h.
- (i) Complete the **Table 1**, develop the frequency histogram, the frequency distribution and the cumulative distribution of the data. (6 marks)
 - (ii) Determine the arithmetic mean speed (1 mark)
 - (iii) Determine the standard deviation (1 mark)
 - (iv) Determine the median speed (1 mark)
 - (v) Determine the pace (1 mark)
 - (vi) Determine the 85th-percentile speed (1 mark)
 - (vii) As a traffic engineer, assess the above findings and comment about the speeding at this rural highway. (4 marks)

- Q2**
- (a) Describe briefly the function of spiral curve in horizontal alignment of road and sketch the position of spiral on road alignment. (2 marks)
- (b) Explain and sketch tangent runout and superelevation runoff. (5 marks)
- (c) Part of a road section has a grade length in excess of the critical grade length. Discuss its effect on the traffic. (2 marks)
- (d) Give **THREE (3)** requirements for climbing lane. (3 marks)
- (e) The following data will be used in the design of a crest vertical curve road construction.
- Gradient G1 = + 2.0 %
Gradient G2 = - 3.0%
Length of curve = 300 m
Elevation at: Beginning of Vertical Curve, BVC = 19.0 m
Vertical Intersection Point, VIP = 22.0 m
End of Vertical Curve, EVC, = 17.5 m
- (i) Using **Table 2**, design the stations for the crest vertical curve at 50 m intervals. (10 marks)
- (ii) Determine the location of the maximum point on the curve. (3 marks)

Q3 (a) Define 'accident reduction' and 'accident prevention' in your own words. (5 marks)

(b) The pedestrian and motorcyclist are the groups of road users which can be categorized as the Vulnerable Road User, which poses high risk of fatalities in road accident. List **THREE (3)** safety programmes for each of the groups and explain how the programmes may improve the safety. (6 marks)

(c) Figure **Q3** shows Blackspot area of Jalan Bunga Raya. Based on the collision diagram and roadside environment, determine the problems and propose the countermeasures needed for each problem. (6 marks)

(d) Two people were traveling at 110-120 km/h for the past 10 km since leaving a bar where they had been excessively drinking. The driver unnoticed a sharp bend and loses control causing the vehicle to strike a tree. The passenger is partly ejected and killed. The driver sustained minor injuries. The rescue team arrived one hour later.

Based on the incidence, fill in **Table 3** with respect to the Haddon Safety Planning Matrix.

(6 marks)

(e) In Malaysia, road accidents that were recorded in the year 1996 are 189,109 cases while in the year 2005 are 328,268 cases. Therefore, there is 74 percent of increase in road accidents within those years and majority was the head-on crashes.

As a traffic engineer, suggest **TWO (2)** solutions that may overcome such type of collision.

(2 marks)

- Q4** (a) List **SIX (6)** techniques commonly used in road traffic system management. (3 marks)
- (b) Briefly describe the meaning of traffic congestion. (3 marks)
- (c) To reduce traffic congestion, the following techniques are commonly used. Explain the principles and mechanisms in each of these methods.
- (i) Road Pricing, (3 marks)
- (ii) Intelligent Transportation System, (3 marks)
- (iii) Pedestrianization. (3 Marks)
- (d) The management of a hypermarket has decided to expand its parking area for its customers. Due to limited space, they have agreed to construct an off-parking area.
- (i) Recommend **FIVE (5)** factors to be considered in the parking area design. (5 marks)
- (ii) If the suggested location area is 60 meter x 14 meter, suggest the best layout to maximize the number of vehicles that can park at the area. Discuss the advantages and disadvantages of your suggestion. (5 marks)
- Q5** (a) Explain **TWO (2)** uses of traffic islands at at-grade intersection to promote traffic safety. (4 marks)
- (b) Accident rates at unsignalized urban intersections have been steadily increasing over the past few years. Briefly describe **THREE (3)** principles of safe intersection design to minimize accidents at these intersections. (6 marks)
- (c) Given in Figure **Q5** is traffic flow data and saturation flow for each approach at traffic signal intersection consists an amber time, $a = 3s$, all red interval, $R = 2s$ and driver reaction time, $l = 2s$. Design a fixed-time traffic signal for intersection given as shows in Figure **Q5**. (15 marks)

- S1** (a) Lakarkan lengkung yang menunjukkan kaitan antara aliran dan ketumpatan, serta buktikan bahawa ketumpatan optimum, $k_m = k_j/2$.
(5 markah)
- (b) Rajah **Q1** menunjukkan perjalanan beberapa buah kenderaan pada kelajuan seragam di lebuh raya dua-lorong dari seksyen X ke seksyen Y pada kedudukan dan kelajuan dalam masa tertentu yang diambil menggunakan fotografi. Seorang pemerhati pada titik X telah melihat empat buah kenderaan melepasi titik X pada masa T saat. Halaju bagi setiap kenderaan tersebut ialah 72, 72, 64 dan 48 km/j. Kirakan:
- (i) Aliran,
(1 markah)
 - (ii) Ketumpatan,
(1 markah)
 - (iii) Laju Min Masa, dan
(1 markah)
 - (iv) Laju Min Ruang.
(2 markah)
- (c) **Jadual 1** menunjukkan jadual taburan frekuensi set data kajian laju yang telah dikumpulkan ke atas jalan luar bandar di Malaysia. Had laju jalan tersebut ialah 60 km/j.
- (i) Lengkapkan **Jadual 1**, bina histogram frekuensi, taburan frekuensi dan taburan kumulatif.
(6 markah)
 - (ii) Tentukan Purata laju
(1 markah)
 - (iii) Tentukan Sisihan Piawai
(1 markah)
 - (iv) Tentukan Laju Penengah
(1 markah)
 - (v) Tentukan *Pace*
(1 markah)
 - (vi) Tentukan 85-peratus laju
(1 markah)
 - (vii) Sebagai seorang jurutera trafik, berikan penilaian anda berdasarkan keputusan dan dapatan yang diperolehi di atas dan komen tentang kelajuan di jalan luar bandar tersebut.
(4 markah)

- S2 (a) Terangkan secara ringkas fungsi lengkung *spiral* di dalam laluan jalan mendatar dan lakarkan kedudukan *spiral* di atas laluan jalan. (2 markah)
- (b) Terangkan dan lakarkan *tangent runoff* dan *superelevation runoff*. (5 markah)
- (c) Sebahagian daripada seksyen jalan ada panjang cerun yang dikenali sebagai panjang cerun kritikal. Bincangkan kesannya terhadap trafik. (2 markah)
- (d) Nyatakan **tiga (3)** keperluan untuk menyediakan laluan mendaki. (3 markah)
- (e) Data berikut digunakan untuk merekabentuk pembinaan jalan satu lengkung tegak puncak.
- Cerun G1 = + 2.0 %
 Cerun G2 = - 3.0%
 Panjang Lengkung = 300 m
 Paras pada: Permulaan Lengkung Tegak, BVC = 19.0 m
 Titik Persilangan Lengkung Tegak, VIP = 22.0 m
 Penghujung Lengkung Tegak, EVC, = 17.5 m
- (i) Gunakan **Jadual 2**, rekabentuk stesen untuk lengkung tegak puncak pada sela setiap 50 m. (10 markah)
- (ii) Tentukan lokasi titik maksimum pada lengkung tersebut. (3 markah)
- S3 (a) Berikan definisi 'pengurangan kemalangan' dan 'pencegahan kemalangan' dengan menggunakan ayat anda sendiri. (5 markah)
- (b) Pejalan kaki dan penunggang motorsikal adalah kumpulan pengguna jalan raya yang boleh dikategorikan sebagai Pengguna Jalan Raya Tidak Kebal, yang mempunyai risiko kematian yang tinggi sekiranya terlibat dalam kemalangan jalan raya. Senaraikan **TIGA (3)** program keselamatan yang boleh dianjurkan kepada setiap kumpulan tersebut dan jelaskan bagaimana program tersebut boleh meningkatkan tahap keselamatan. (6 markah)

- (c) Rajah Q3 menunjukkan kawasan *blackspot* di Jalan Bunga Raya. Berdasarkan gambarajah pelanggaran dan persekitaran jalan, tentukan masalah dan cadangkan langkah mengatasi untuk setiap masalah tersebut.

(6 markah)

- (d) 2 orang sedang menaiki kereta dengan halaju 110-120 km/j sepanjang 10 km sejak meninggalkan sebuah bar setelah mengambil alkohol secara berlebihan. Pemandu tidak menyedari sebuah selekoh tajam dan hilang kawalan lalu merempuh sebatang pokok. Penumpang separuh tercampak dari kereta dan terbunuh. Pemandu pula mengalami kecederaan ringan. Pasukan penyelamat sampai sejam kemudian.

Berdasarkan insiden tersebut, lengkapkan **Jadual 3** dengan mengambil kira Matriks Perancangan Keselamatan Haddon.

(6 markah)

- (e) Kemalangan jalan raya di Malaysia pada tahun 1996 ialah sebanyak 189,109 kes manakala pada tahun 2005 ialah sebanyak 328,268 kes. Oleh itu, peningkatan yang telah berlaku ialah sebanyak 74 peratus dan majoritinya adalah pelanggaran depan.

Sebagai seorang Jurutera Trafik, cadangkan **DUA (2)** penyelesaian yang boleh digunakan untuk mengatasi jenis pelanggaran tersebut.

(2 markah)

- S4 (a) Senaraikan ENAM (6) teknik yang biasa digunakan dalam Pengurusan Sistem Trafik Jalan.

(3 markah)

- (b) Jelaskan secara ringkas tentang makna kesesakan trafik.

(3 markah)

- (c) Bagi mengurangkan kesesakan trafik, teknik-teknik berikut biasa digunakan. Jelaskan prinsip dan mekanisma bagi setiap kaedah tersebut.

- (i) *Road Pricing*,

(3 markah)

- (ii) *Intelligent Transportation System*,

(3 markah)

- (iii) *Pedestrianization*.

(3 markah)

- (d) Pihak pengurusan sebuah pasaraya telah membuat keputusan untuk memperbesarkan kawasan parkir bagi pelanggan-pelanggannya. Disebabkan oleh ruang yang terhad, pihak pengurusan bersetuju untuk membina kawasan parkir jenis *off-parking*.
- (i) Cadangkan **LIMA (5)** faktor yang perlu dipertimbangkan untuk merekabentuk kawasan parkir tersebut. (5 markah)
- (ii) Jika keluasan lokasi yang dicadangkan ialah 60 meter x 14 meter, cadangkan susun atur terbaik bagi memaksimumkan bilangan kenderaan yang boleh diletakkan di kawasan parkir tersebut. Bincangkan juga kelebihan dan kekurangan cadangan anda tersebut. (5 markah)
- S5** (a) Terangkan **DUA (2)** penggunaan "*Traffic Island*" di persimpangan searas untuk memastikan keselamatan trafik. (4 markah)
- (b) Kadar kemalangan di persimpangan tidak berlampu isyarat di kawasan bandar semakin meningkat sejak beberapa tahun yang lalu. Terangkan dengan ringkas **TIGA (3)** prinsip reka bentuk persimpangan yang selamat untuk meminimumkan kemalangan di persimpangan - persimpangan tersebut. (6 markah)
- (c) Diberi dalam Rajah **Q5** data aliran trafik dan aliran tepu bagi setiap arah masukan di persimpangan lampu isyarat yang terdiri dari masa kuning, $a=3s$, semua merah, $R=2s$ dan masa tindakbalas pemandu, $l = 2s$. Rekabentuk kawalan lalu lintas masa tetap untuk persimpangan sedia ada seperti yang ditunjukkan dalam Rajah **Q5**. (15 markah)

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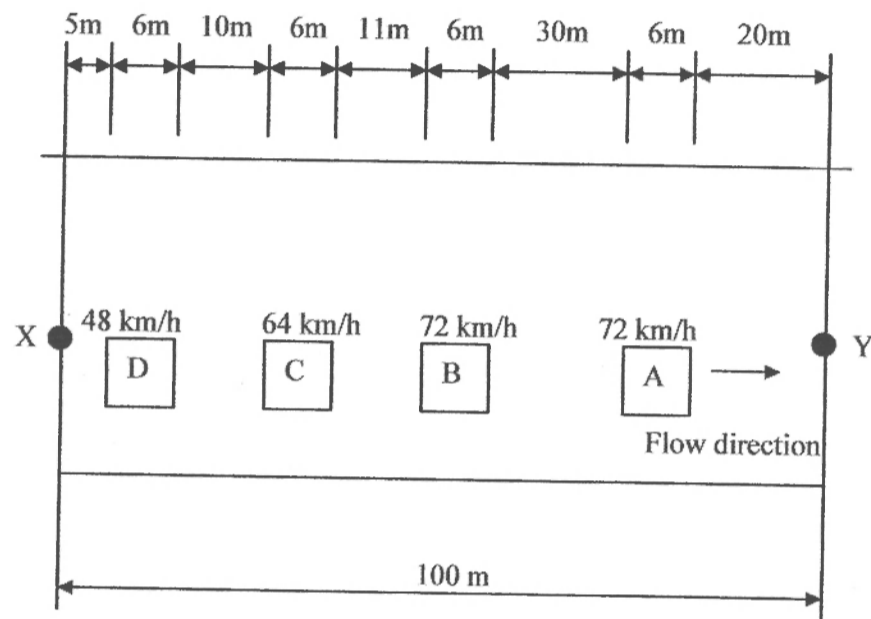


FIGURE O1

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Name : _____ Matrix Num. :

TABLE 1: Frequency Distribution Table for Speed Data set

Speed class	Class Midvalue, x	Class Frequency, f	fx	Percentage of Observations in Class	Cumulative Percentage of All Observations	fx ²
20 – 24.9	22.45	0				
25 – 29.9	27.45	5				
30 – 34.9	32.45	13				
35 – 39.9	37.45	27				
40 – 44.9	42.45	50				
45 – 49.9	47.45	66				
50 – 54.9	52.45	72				
55 – 59.9	57.45	52				
60 – 64.9	62.45	24				
65 – 69.9	67.45	15				
70 – 74.9	72.45	5				
75 – 79.9	77.45	0				
Total		329				

**Note: Please separate and attach this attachment in your answer script book.*

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Name : _____

Matrix Num.:

TABLE 2: Vertical Alignment Design

x	LP	x/L	$(x/L)^2$	$y_n = 4e(x/L)^2$	$L_x = LP - y_n$	Remarks

**Note: Please separate and attach this attachment in your answer script book.*

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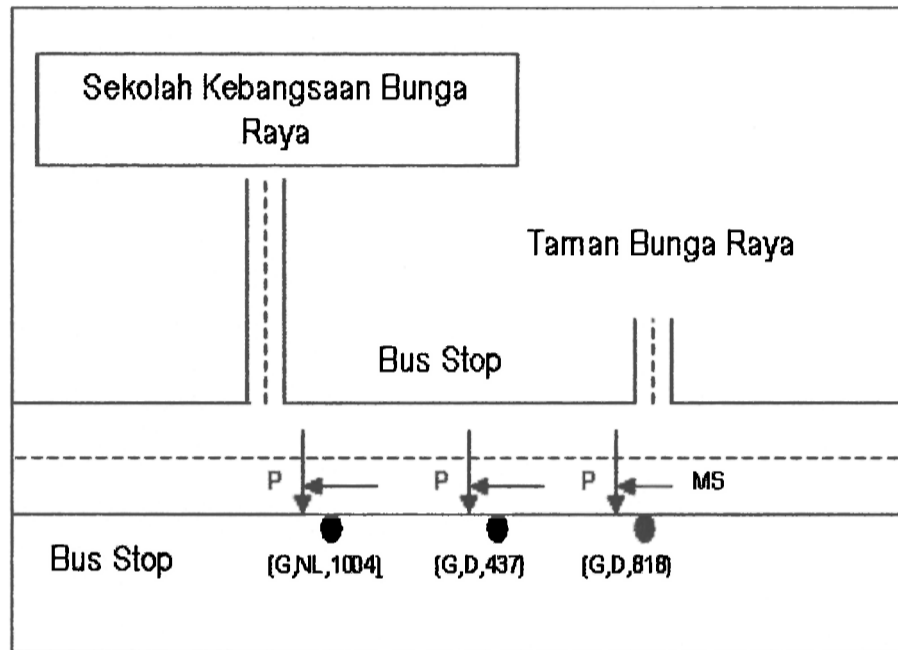


FIGURE 03

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Matrix Num.:

TABLE 3: Haddon Safety Planning Matrix

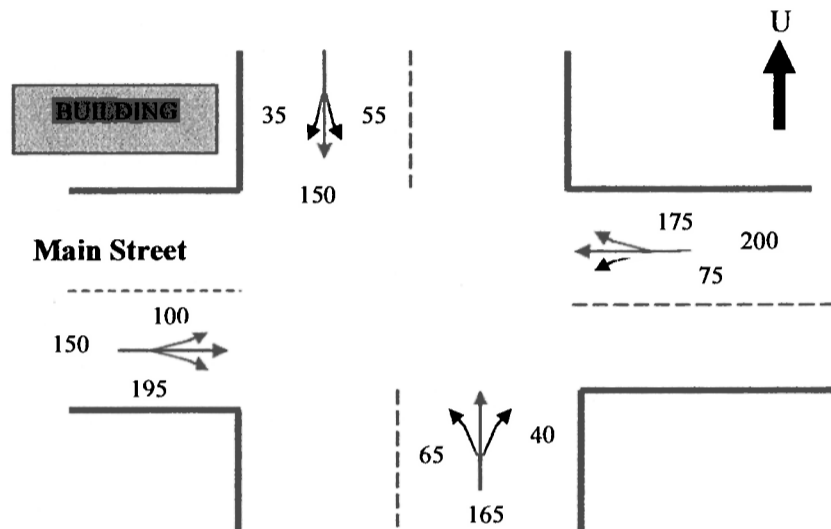
Factor \ Phase	Pre-Crash	Crash	Post-Crash
Human			
Vehicle			
Environment			

**Note: Please separate and attach this attachment in your answer script book.*

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Turning Radius = 12 m

Gradient N

S = 4%
 E — W = 0%

Additional Info:

Main street – 2 lanes
 Minor street – 1 lane
 Design for 3 phases

Approach	Saturation Flow, S (pcu/hr)
North	1965
South	1965
West	1915
East	1915

FIGURE Q5

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FORMULAE:

$$q = \frac{n \times 3600}{T}$$

$$k = \frac{n}{L}$$

$$v_t = \frac{\sum_{i=1}^n v_i}{n}$$

$$v_s = \frac{nL}{\sum_{i=1}^n t_i}$$

$$v_s = \frac{n}{\sum(1/v_i)}$$

$$\sqrt{\frac{\sum fx^2}{n-1} - \frac{(\sum fx)^2}{n(n-1)}}$$

$$LP_n = (G_1 \times \text{Interva}) + LP_{n-1}$$

$$L_{x_n} = LP_n + y_n$$

$$y_n = 4e \left(\frac{x}{L} \right)^2$$

$$e = \frac{AL}{800}$$

$$A = G_1 - G_2$$

$$\frac{\sum fx}{n}$$

$$L + \left[\frac{\left(\frac{n}{2} - f_l \right)}{f_m} \right] \times C$$