UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2011/2012

COURSE NAME	:	TRANSPORTATION ENGINEERING
COURSE CODE	:	BFT 4033 / BFT 40303
PROGRAMME	:	BFF
EXAMINATION DATE	:	JUNE 2012
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **FOURTEEN (14)** PAGES

Q1 (a) Draw the curves that best describe the relationships between speed and density, speed and flow, and flow and density. Also, state the location of the maximum flow at curves

(6 marks)

(b) Explain the difference between space mean speed, vs and time mean speed, vt. State the equation for both mean speeds.

(4 marks)

(c) Traffic on a congested two lane- highway in Salak Selatan is moving at 1650 veh/h at a speed of 35km/h and a density of 50 veh/km, when an overloaded truck enters this highway and travel for 2 km before exiting, a platoon forms behind the truck at a flow rate of 1200 veh/h and density of 180 veh/km. The rear of platoon is jointed by other vehicles.

(i) Calculate the shock-wave velocities
(ii) Sketch the shock-wave measurements on the flow-density curve
(iii) Find the time the truck spends on the highway
(iv) Find the time to dissipate the platoon
(v) Find the time needed for the traffic flow to return to normal

Assume $k_i = 210$ veh/km and the mean free speed $v_f = 50$ km/h. Also assume that after the truck leaves the highway, the traffic stream picks up speed to 25km/h with density of 105 veh/km.

(15 marks)

Q2 (a) Define the following,

(i) Study Boundary

(2 marks)

(ii) Zones

(2 marks)

(iii) Link and Nodes

(2 marks)

(b) Given,
Auto: $U_a = - 0.3 - 0.04X - 0.1Y - 0.03C$
Transit: $U_t = - 0.04X - 0.1Y - 0.03C$

Where,
U_i = utility function of mode i
X = in-vehicle travel time
Y = waiting time
C = cost of travel/income

A traffic zone has the following characteristics:

	Auto Travel	**Transit Travel**
In vehicle time (min)	15	20
Waiting time (min)	5	10
Travel cost	300	75

Determine the probability that a person with income of RM10,000.00 will travel by transit.

(12 marks)

(c) Describe steps in Trip Assignment.

(7 marks)

Q3 (a) Determine level of service (LOS) of a Class II two-lane highway segment on a scenic and recreational route using the following information.

Demand volume for the full peak hour = 1,050 veh/h (two-way volume)
Directional split = 70/30
Percentage of truks and buses = 5 percent
Percentage of RVs = 7 percent
Peak Hour Factor = 0.85
Base Free Flow Speed = 90 km/h
Terrain = Rolling
Lane width = 3.0 m
Shoulder width = 10.6 m
Roadway Length = 10 km
Percentage of no-passing zones = 60 percent
Number of access point = 6 points/km.

Since V/PHF = 1,050/0.85 = 1,235, select truck equivalencies and grade adjustment factors for flow rates greater than 1,200 pc/h.

(25 marks)

Q4 (a) Define Traffic Impact Assessment (TIA).

(3 marks)

(b) Generally, there are **TWO (2)** categories of increased trips in TIA.

(i) Name the categories.

(2 marks)

(ii) Discuss each category.

(6 marks)

(c) The traffic impact caused by the proposed development is defined as the negative change in the indicators.

(i) List the **THREE (3)** mentioned indicators.

(3 marks)

(ii) Describes each indicator.

(6 marks)

(d) List **FIVE (5)** details of land use item in a TIA report.

(5 marks)

Q5 (a) Travel Demand Forecasting is a multi-stage process, and there are several different techniques that can be used at each stage. Generally, Travel Demand Forecasting involves **FIVE (5)** interrelated tasks. Describe the tasks mentioned.

(10 marks)

(b) Transportation facilities are classified into the uninterrupted and interrupted flow. Explain **TWO (2)** differences with example of both facilities.

(6 marks)

(c) Table **11** and **12** shows the performance of Junction 1 and 2 at a study area of TIA with the consideration of situation 1 and 2 mentioned as follows:

Situation 1: Junction 1 has been treated as a left in and left out T-junction while Junction 2 has been analysed on the basis of a full turning movement signalised junction.

Situation 2: Both Junctions 1 and 2 have been treated as signalised intersections that permit full movements.

Evaluate the performance and propose better option.

(9 marks)

S1 (a) Lukis rajah lengkungan yang menunjukkan hubung kait di antara laju dan ketumpatan, laju dan aliran serta aliran dan ketumpatan. Nyatakan juga kedudukan aliran maksimum pada rajah-rajah tersebut.

(6 markah)

(b) Terangkan perbezaan di antara laju purata ruang, v_s dengan laju purata masa, v_t. Tuliskan persamaan bagi kedua-dua laju purata tersebut.

(4 markah)

(c) Aliran trafik di sebuah jalan dua lorong di Salak Selatan bergerak dengan keadaan 1650 kenderaan/jam pada ketumpatan 50 kenderaan/km ketika sebuah lori yang sarat dengan muatan melalui jalan ini sejauh 2 km dan akhirnya menyusur keluar ke jalan lain. Platun telah terbentuk di belakang lori tersebut pada kadar aliran 1200 kenderaan/jam dan ketumpatan 180 kenderaan/km. Pertambahan kenderaan berlaku di belakang platun tersebut.

(i) Kira halaju gelombang-kejutan
(ii) Lakar gelombang – kejutan pada lengkung aliran – ketumpatan situasi di atas
(iii) Kira masa yang diperuntukkan oleh lori tersebut di atas jalan tersebut
(iv) Kira masa yang diperlukan untuk menghilangkan platun tersebut
(v) Kira masa yang diperlukan untuk aliran trafik kembali normal

Anggap k_i =210 kenderaan/km dan laju purata bebas v_f = 50 km/h. Apabila lori meninggalkan jalan tersebut, aliran trafik bertambah kepada 25 km/h dengan ketumpatan 105 kenderaan/km

(15 markah)

S2 (a) Berikan definisi,

(i) *Study Boundary*

(2 markah)

(ii) *Zones*

(2 markah)

(iii) *Link* dan *Nodes*

(2 markah)

(b) Diberi,
Auto: $U_a = - 0.3 - 0.04X - 0.1Y - 0.03C$
Transit: $U_t = - 0.04X - 0.1Y - 0.03C$

Di mana,
U_i = fungsi utiliti mod i
X = masa perjalanan *in-vehicle*
Y = masa menunggu
C = kos perjalanan/pendapatan

Zon trafik mempunyai ciri-ciri berikut:

	Perjalanan Auto	**Perjalanan Transit**
Masa *In vehicle* (min)	15	20
Masa Menunggu (min)	5	10
Kos Perjalanan	300	75

Hitung kebarangkalian seseorang dengan pendapatan RM10,000.00 akan membuat perjalanan menggunakan transit.

(12 markah)

(c) Terangkan langkah-langkah dalam *Trip Assignment*.

(7 markah)

S3 (a) Tentukan LOS segmen lebuhraya dua-lorong Kelas II sepanjang laluan rekreasi menggunakan maklumat yang diberi.

Isipadu permintaan untuk waktu puncak penuh = 1,050 kend/j (isipadu dua-arah)
Pembahagian searah = 70/30
Peratusan trak dan bas = 5 peratus
Peratusan kenderaan rekreasi= 7 peratus
Faktor Waktu Puncak (PHF) = 0.85
BFFS = 90 km/j
Muka bumi = Beralun
Lebar Lorong = 3.0 m
Lebar Bahu Jalan = 0.6 m
Panjang Jalan = 10 km
Peratusan zon dilarang memotong = 60 peratus
Bilangan titik masukan = 6 titik/km.

(Nota: Disebabkan V/PHF = 1,050/0.85 = 1,235, pilih keserataan trak dan factor pelarasan gred untuk kadar alir lebih besar daripada 1,200 kp/j.)

(25 markah)

S4 (a) Berikan definisi Penilaian Impak Lalu Lintas (TIA).

(3 markah)

(b) Secara umumnya, terdapat **DUA (2)** kategori perjananan meningkat di dalam TIA.

(i) Namakan kategori-kategori tersebut.

(2 markah)

(ii) Bincangkan setiap kategori.

(6 markah)

(c) Impak lalu lintas yang disebabkan oleh pembangunan yang dicadangkan ditakrifkan sebagai perubahan negative di dalam penunjuk (*indicators*).

(i) Senaraikan **TIGA (3)** penunjuk yang dimaksudkan.

(3 markah)

(ii) Terangkan setiap penunjuk.

(6 markah)

(d) Senaraikan LIMA (5) perincian perkara guna tanah di dalam laporan TIA.

(5 markah)

S5 (a) *Travel Demand Forecasting* ialah proses multi peringkat, dan terdapat beberapa teknik berlainan yang boleh digunakan di setiap peringkat. Umumnya, *Travel Demand Forecasting* melibatkan lima gerak kerja yang saling berkait rapat. Jelaskan setiap gerak kerja yang dimaksudkan.

(10 markah)

(b) Fasiliti pengangkutan dikelaskan kepada aliran tidak terganggu dan terganggu. Terangkan **DUA (2)** perbezaan beserta contoh untuk kedua-dua jenis fasiliti.

(6 markah)

(c) Jadual **11** and **12** menunjukkan prestasi persimpangan 1 dan 2 di lokasi kajian suatu TIA dengan mengambilkira dua situasi seperti berikut:

Situasi 1: Persimpangan 1 telah ditambahbaik dengan masukan kiri dan keluar kiri persimpangan-T manakala persimpangan 2 telah dijadikan persimpangan berlampu isyarat untuk semua pergerakan membelok.

Situasi 2: Kedua-dua persimpangan 1 dan 2 ditambahbaik dengan dijadikan persimpngan berlampu isyarat yang membenarkan pergerakan penuh.

Nilaikan prestasi persimpangan dan cadangkan pilihan yang lebih baik.

(9 markah)

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FORMULAE

$$v_p = \frac{V}{PHF * f_G * f_{HV}}$$

$$f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$$

$$PTSF = BPTSF + f_{d/np}$$

$$BPTSF = 100\left(1 - e^{-0.000879 v_p}\right)$$

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TABLE 1 : LOS Criteria of Two-Lane Highways in Class I

LOS	Percent Time-Spent-Following	Average Travel Speed (km/h)
A	≤ 35	> 90
B	> 35–50	> 80–90
C	> 50–65	> 70–80
D	> 65–80	> 60–70
E	> 80	≤ 60

Note:
LOS F applies whenever the flow rate exceeds the segment capacity.

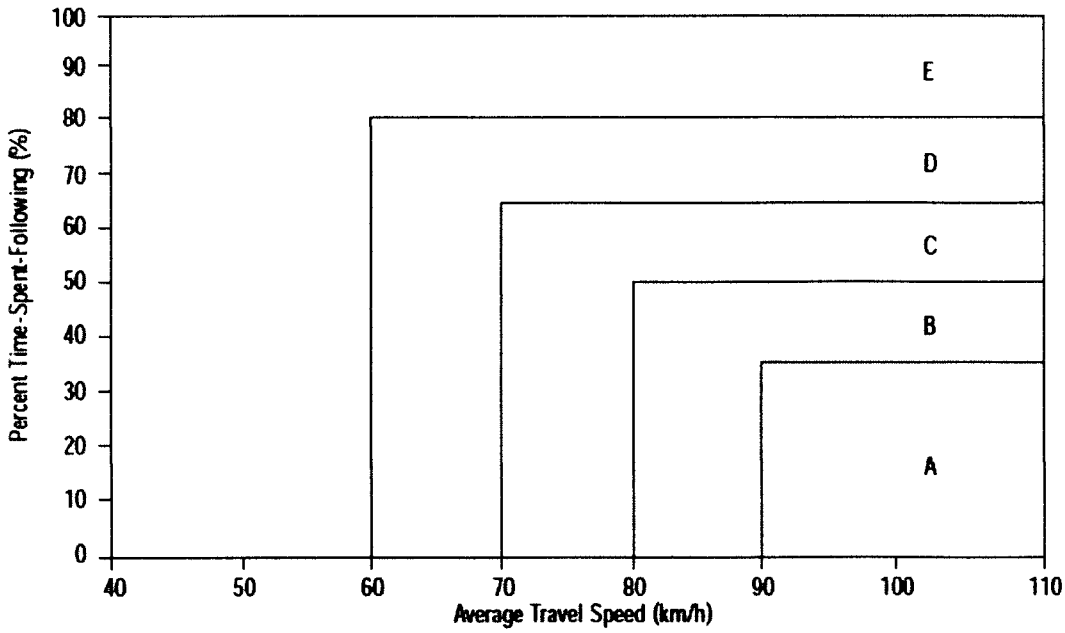

FIGURE Q3 : LOS Criteria (Graphical) for Two-Lane Highways in Class I

TABLE 2 : LOS Criteria of Two-Lane Highways in Class II

LOS	Percent Time-Spent-Following
A	≤ 40
B	> 40–55
C	> 55–70
D	> 70–85
E	> 85

Note:
LOS F applies whenever the flow rate exceeds the segment capacity.

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TABLE 3 : Adjustment (f_{LS}) for Lane Width and Shoulder Width

	Reduction in FFS (km/h)			
	Shoulder Width (m)			
Lane Width (m)	≥ 0.0 < 0.6	≥ 0.6 < 1.2	≥ 1.2 < 1.8	≥ 1.8
2.7 < 3.0	10.3	7.7	5.6	3.5
≥ 3.0 < 3.3	8.5	5.9	3.8	1.7
≥ 3.3 < 3.6	7.5	4.9	2.8	0.7
≥ 3.6	6.8	4.2	2.1	0.0

TABLE 4 : Adjustment (f_A) for Access-Point Density

Access Points per km	Reduction in FFS (km/h)
0	0.0
6	4.0
12	8.0
18	12.0
≥ 24	16.0

TABLE 5 : Grade Adjustment Factor (f_G) to Determine Speeds on Two-Way and Directional Segments

Range of Two-Way Flow Rates (pc/h)	Range of Directional Flow Rates (pc/h)	Type of Terrain	
		Level	Rolling
0–600	0–300	1.00	0.71
> 600–1200	> 300–600	1.00	0.93
> 1200	> 600	1.00	0.99

TABLE 6 : Grade Adjustment Factor (f_G) to Determine Percent Time-Spent-Following on Two-Way and Directional Segments

Range of Two-Way Flow Rates (pc/h)	Range of Directional Flow Rates (pc/h)	Type of Terrain	
		Level	Rolling
0–600	0–300	1.00	0.77
> 600–1200	> 300–600	1.00	0.94
> 1200	> 600	1.00	1.00

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TABLE 7 : Passenger-Car Equivalents for Trucks and RVs to Determine Speeds on Two-Way and Directional Segments

Vehicle Type	Range of Two-Way Flow Rates (pc/h)	Range of Directional Flow Rates (pc/h)	Type of Terrain	
			Level	Rolling
Trucks, E_T	0–600	0–300	1.7	2.5
	> 600–1,200	> 300–600	1.2	1.9
	> 1,200	> 600	1.1	1.5
RVs, E_R	0–600	0–300	1.0	1.1
	> 600–1,200	> 300–600	1.0	1.1
	> 1,200	> 600	1.0	1.1

TABLE 8 : Passenger-Car Equivalents for Trucks and RVs to Determine Percent Time-Spent-Following on Two-Way and Directional Segments

Vehicle Type	Range of Two-Way Flow Rates (pc/h)	Range of Directional Flow Rates (pc/h)	Type of Terrain	
			Level	Rolling
Trucks, E_T	0–600	0–300	1.1	1.8
	> 600–1,200	> 300–600	1.1	1.5
	> 1,200	> 600	1.0	1.0
RVs, E_R	0–600	0–300	1.0	1.0
	> 600–1,200	> 300–600	1.0	1.0
	> 1,200	> 600	1.0	1.0

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TABLE 9 : Adjustment (f_{np}) for Effect of No-Passing Zones on Average Travel Speed on Two-Way Segments

Two-Way Demand Flow Rate, v_p (pc/h)	Reduction in Average Travel Speed (km/h)					
	No-Passing Zones (%)					
	0	20	40	60	80	100
0	0.0	0.0	0.0	0.0	0.0	0.0
200	0.0	1.0	2.3	3.8	4.2	5.6
400	0.0	2.7	4.3	5.7	6.3	7.3
600	0.0	2.5	3.8	4.9	5.5	6.2
800	0.0	2.2	3.1	3.9	4.3	4.9
1000	0.0	1.8	2.5	3.2	3.6	4.2
1200	0.0	1.3	2.0	2.6	3.0	3.4
1400	0.0	0.9	1.4	1.9	2.3	2.7
1600	0.0	0.9	1.3	1.7	2.1	2.4
1800	0.0	0.8	1.1	1.6	1.8	2.1
2000	0.0	0.8	1.0	1.4	1.6	1.8
2200	0.0	0.8	1.0	1.4	1.5	1.7
2400	0.0	0.8	1.0	1.3	1.5	1.7
2600	0.0	0.8	1.0	1.3	1.4	1.6
2800	0.0	0.8	1.0	1.2	1.3	1.4
3000	0.0	0.8	0.9	1.1	1.1	1.3
3200	0.0	0.8	0.9	1.0	1.0	1.1

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TABLE 10 : Adjustment (fd/np)for Combined Effect of Directional Distribution of Traffic and Percentage of No-Passing Zones on Percent Time-Spent-Following on Two-Way Segments

	Increase in Percent Time-Spent-Following (%)					
	No-Passing Zones (%)					
Two-Way Flow Rate, v_p (pc/h)	0	20	40	60	80	100
Directional Split = 50/50						
≤ 200	0.0	10.1	17.2	20.2	21.0	21.8
400	0.0	12.4	19.0	22.7	23.8	24.8
600	0.0	11.2	16.0	18.7	19.7	20.5
800	0.0	9.0	12.3	14.1	14.5	15.4
1400	0.0	3.6	5.5	6.7	7.3	7.9
2000	0.0	1.8	2.9	3.7	4.1	4.4
2600	0.0	1.1	1.6	2.0	2.3	2.4
3200	0.0	0.7	0.9	1.1	1.2	1.4
Directional Split = 60/40						
≤ 200	1.6	11.8	17.2	22.5	23.1	23.7
400	0.5	11.7	16.2	20.7	21.5	22.2
600	0.0	11.5	15.2	18.9	19.8	20.7
800	0.0	7.6	10.3	13.0	13.7	14.4
1400	0.0	3.7	5.4	7.1	7.6	8.1
2000	0.0	2.3	3.4	3.6	4.0	4.3
≥ 2600	0.0	0.9	1.4	1.9	2.1	2.2
Directional Split = 70/30						
≤ 200	2.8	13.4	19.1	24.8	25.2	25.5
400	1.1	12.5	17.3	22.0	22.6	23.2
600	0.0	11.6	15.4	19.1	20.0	20.9
800	0.0	7.7	10.5	13.3	14.0	14.6
1400	0.0	3.8	5.6	7.4	7.9	8.3
≥ 2000	0.0	1.4	4.9	3.5	3.9	4.2
Directional Split = 80/20						
≤ 200	5.1	17.5	24.3	31.0	31.3	31.6
400	2.5	15.8	21.5	27.1	27.6	28.0
600	0.0	14.0	18.6	23.2	23.9	24.5
800	0.0	9.3	12.7	16.0	16.5	17.0
1400	0.0	4.6	6.7	8.7	9.1	9.5
≥ 2000	0.0	2.4	3.4	4.5	4.7	4.9
Directional Split = 90/10						
≤ 200	5.6	21.6	29.4	37.2	37.4	37.6
400	2.4	19.0	25.6	32.2	32.5	32.8
600	0.0	16.3	21.8	27.2	27.6	28.0
800	0.0	10.9	14.8	18.6	19.0	19.4
≥1400	0.0	5.5	7.8	10.0	10.4	10.7

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TABLE 11: Intersection Performance Under Traffic Situation 1

		Performance Measure			
Junction Number	**Case No.**	**DOS**	**Max. Average Delay (seconds)**	**Queue Length (m)**	**LOS**
1	1	0.51	1.0	16	A
	2	0.41	0.6	11	A
	3	0.55	1.2	20	A
2	1	0.95	42.1	199	E
	2	0.89	40.5	128	E
	3	1.0	50.7	206	E

TABLE 12: Intersection Performance Under Traffic Situation 2

		Performance Measure			
Junction Number	**Case No.**	**DOS**	**Max. Average Delay (seconds)**	**Queue Length (m)**	**LOS**
1	1	0.69	9.3	59	B
	2	0.69	8.5	66	B
	3	0.69	9.7	64	B
2	1	0.81	18.2	74	C
	2	0.76	15.6	55	C
	3	0.86	21.8	99	C