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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER II
SESSION 2018/2019**

COURSE NAME : HIGHWAY TECHNOLOGY AND
TRAFFIC MANAGEMENT

COURSE CODE : BNP 20303

PROGRAMME CODE : BNA/BNB/BNC

EXAMINATION DATE : JUNE / JULY 2019

DURATION : 3 HOURS

INSTRUCTION : ANSWERS ALL QUESTIONS
ONLY

THIS QUESTION PAPER CONSISTS OF NINE (9) PAGES

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- Q1**
- (a) Name the most common method to determine the optimum bitumen content in ASTM 1559. (1 marks)
 - (b) Explain the meaning of ACBC-28 and ACWC-14. (2 marks)
 - (c) Differentiate between cutback bitumen and emulsified bitumen (4 marks)
 - (d) Sketch and explain **FOUR (4)** elements in the cross section of the road. (8 marks)
 - (e) As a technologist assigned in a road construction project, your task is to verify the material for the sub-base and road-base to be used in the project. Demonstrate **FIVE (5)** tests and limitations that need to be observed for each test that needs to be performed. (10 marks)
- Q2**
- (a) Ts. Sufian is a Road Engineer at JKR Muar, who was assigned to do a proposal on a new road connecting Jalan Pagoh at KM 15, Jalan Tanah Merah to Jalan Muar – Yong Peng. Propose **FOUR (4)** factors he needs to consider in choosing the alignment of the new road. (8 marks)
 - (b) You as a technologist, involving in road construction projects are required to monitor the ongoing Asphaltic Concrete work. Prepare **FOUR (4)** important points required to monitor the progress work. (8 marks)
 - (c) Design a road pavement for 2-lane road two direction with average daily traffic of 2000 vehicles/direction, 10% of which are commercial vehicles with an un-laden weight > 1.5 tons. Design life 15 years, terrain = rolling and annual total growth = 4%. CBR mean = 25%, CBR Standard Deviation = 5% by using Traditional Pavement with granular base by refer to **Table Q2 (i) – (vii)**. (9 marks)

- Q3**
- (a) State the full name of PCI. (1 marks)
- (b) Differentiate between non-destructive and destructive tests in structural evaluation of pavement. (5 marks)
- (c) Pavement Distress is usually caused by traffic loading, temperature, moisture or sub-grade movement. Analyze only **TWO (2)** of the pavement distress below. In your analysis state why the following defects occur and discuss the repairs need to be done. (10 marks)
- (i) Block cracks
 - (ii) Rutting
 - (iii) Pothole
- (d) According to accident statistics, the data increase on every rainy season. You are required to investigate **THREE (3)** major causes of the accident and suggest the solution. (9 marks)
- Q4**
- (a) **Table Q4** shows the data flow and saturation flow of traffic in each direction at the intersection of the input signal light. Given, yellow time, $a = 3s$, all red, $R = 2s$ and driver reaction time, ($l = 2s$ for phase 1 and phase 2) and ($l = 3s$ for phase 3 and phase 4).
- (i) Complete **Table Q4** and submit with your answer sheet. (6 marks)
 - (ii) Calculate the optimum cycle time. (4 marks)
 - (iii) Calculate the effective green time, actual green time and time controls set. (5 marks)
 - (iv) Sketch the time phase. (4 marks)
- (b) Sketch and describe on the following: - (6 marks)
- (i) Super elevation
 - (ii) Horizontal alignment
 - (iii) Climbing Lanes

- Q5** (a) List **TWO (2)** methods on manual and automatic count for calculating vehicles on the road. (4 marks)
- (b) Explain **THREE (3)** importance of traffic management. (6 marks)
- (c) Since the existing of Pagoh Education Hub, there was traffic congestion in Pekan Pagoh. You are required to develop **THREE (3)** proposals to overcome the congestion. (15 marks)

- END OF QUESTION -

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**Table Q2 (i)
 Axle Configuration and Load Equivalence Factors (LEF)**

Vehicle		Load Equivalence Factor (LEF)
HPU Class Designation	Class	
Cars and Taxis	C	0
Small Lorries and Vans (2 Axles)	CV1	0.1
Large Lorries (2 to 4 Axles)	CV2	4.0
Articulated Lorries (3 or more Axles)	CV3	4.4
Buses (2 or 3 Axles)	CV4	1.8
Motorcycles	MC	0
Commercial Traffic (Mixed)	CV%	3.5

Table Q2 (ii) Lane Distribution Factors

Number of Lanes (in ONE direction)	Lane Distribution Factor, L
One	1.0
Two	0.9
Three or more	0.7

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Table Q2 (iii) Terrain Factors

Type of Terrain	Terrain Factor, T
Flat	1.0
Rolling	1.1
Mountainous/Steep	1.3

Table Q2 (iv) Total Growth Factors

Design Period (Years)	Annual Growth Rate (%)					
	2	3	4	5	6	7
10	10.95	11.46	12.01	12.58	13.18	13.82
15	17.29	18.60	20.02	21.58	23.28	25.13
20	24.30	26.87	29.78	33.06	36.79	41.00
25	32.03	36.46	41.65	47.73	54.86	63.25
30	40.57	47.58	56.08	66.44	79.06	94.46

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Table Q2 (v) Traffic Categories used in ATJ (ESAL =80 kN)

Traffic Category	Design Traffic (ESAL x 10 ⁶)	Probability (Percentile) Applied to Properties of Sub-Grade Materials
▪ T 1	≤ 1.0	≥ 60%
▪ T 2	1.1 to 2.0	≥ 70%
▪ T 3	2.1 to 10.0	≥ 85%
▪ T 4	10.1 to 30.0	≥ 85%
▪ T 5	> 30.0	≥ 85%

Table Q2 (vi) Classes pf Sub-Grade Strength (based on CBR)

Sub-Grade Category	CBR (%)	Elastic Modulus (MPa)	
		Range	Design Input Value
▪ SG 1	5 to 12	50 to 120	60
▪ SG 2	12.1 to 20	80 to 140	120
▪ SG 3	20.1 to 30.0	100 to 160	140
▪ SG 4	> 30.0	120 to 180	180

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Pavement Type	Sub-Grade Category			
	SG 1: CBR 5 to 12	SG 2: CBR 12.1 to 20	SG 3: CBR 20.1 to 30	SG 4: CBR > 30
Conventional Flexible: Granular Base	BSC: 50 BC: 130 CAB: 200 GSB: 200 	BSC: 50 BC: 130 CAB: 220 GSB: 200 	BSC: 50 BC: 130 CAB: 200 GSB: 150 	BSC: 50 BC: 130 CAB: 200 GSB: 100 
Deep Strength: Stabilised Base	BSC: 50 BC: 100 STB 1: 130 GSB: 200 	BSC: 50 BC: 100 STB 1: 150 GSB: 150 	BSC: 50 BC: 100 STB 1: 100 GSB: 150 	BSC: 50 BC: 100 STB 1: 100 GSB: 100 
Full Depth: Asphalt Concrete Base	BSC: 50 AC/BS: 160 GSD: 200 	BSC: 50 AC/BS: 150 GSB: 150 	BSC: 50 AC/BS: 130 GSB: 150 	BSC: 50 AC/BS: 120 GSB: 100 

Table Q2 (vii) Pavement Structures for Traffic Category T3: 2.0 to 10.0 million ESAL

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Table Q4 Traffic Flow (pcu/hour) and Saturated Flow (pcu/hour) values for each phase and movement

Phase Movement	Phase 1		Phase 2		Phase 3		Phase 4	
	A	B	A	B	A	B	A	B
Traffic Flow, q (pcu/hour)	255	986	457	256	128	146	247	112
Saturated Flow (pcu/hour)	1785	3250	3250	1785	1785	3250	1785	3250
q/S								
Y								