Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2018/2019

COURSE NAME	:	HIGHWAY ENGINEERING
COURSE CODE	:	BFC 31802
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	DECEMBER 2018/ JANUARY 2019
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTIONS	:	ANSWER **FOUR (4)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF SEVEN **(7)** PAGES

Q1 (a) List **THREE (3)** test methods and its function for the following flexible pavement materials:

(i) Crushed aggregate
(ii) Bitumen

(6 marks)

(b) Describe the properties of good and poor sub-grades.

(4 marks)

(c) The bituminous mixture needs the proportion of material 25:25:46:04 with the specific gravity of 2.252, 2.263, 2.266 and 2.321 respectively. Calculate the specific gravity for the mixture.

(3 marks)

(d) Asphaltic concrete mixture contains 2220 kg of aggregate and 180 kg of asphalt binder per m^3. Asphalt absorption of the aggregates is 1.2%. The bulk relative density of the aggregates and asphalt are 2.67, and the relative density of the asphalt is 1.05.

(i) Determine the asphalt content, P_B, effective asphalt content, P_{BE} and asphalt absorption P_{BA}. Density of the asphalt concrete mixture is 2400 kg/m^3.

(6 marks)

(ii) Calculate void in mineral aggregate (VMA) and void filled with asphalt (VFA) if the air void content is 2.3 %.

(6 marks)

Q2 (a) List **THREE (3)** types of rigid pavement and explain the differences.

(6 marks)

(b) Calculate the Equivalent Standard Axle Load (ESAL) of different commercial vehicles (CVs) with total number of 120, 210, 150 and 120, if the equivalent factors are 0.001, 0.18, 1.56 and 7.21 respectively.

(4 marks)

(c) A concrete pavement was designed with the following conditions:

- Modulus of Subgrade Reaction of combined subbase/subgrade = 30 MPa/m
- Concrete flexural strength = 4.5 MPa
- Load Safety factor = 1.2
- Design life = 20 years
- Design daily truck traffic is 20% from the average daily traffic of 30,000.

Based on the data, determine the design slab thickness by starting the calculation with trial thickness of 190 mm. Do your calculation using **Table 1.**

(15 marks)

Q3 (a) The final work in flexible pavement construction are paving and compaction of the bituminous layer. State and explain the purpose of **THREE (3)** plants/machines that involve in these work.

(5 marks)

(b) **Table 2** shows the volume of cut and fill of the soil from mass haul diagram analysis. Based on the table, conduct the hauling process for this earthwork.

(3 marks)

(c) Prior to the construction of binder and wearing course, a thin layer of bituminous coats will be sprayed.

(i) Name **TWO (2)** of these bituminous coats and its location.

(2 marks)

(ii) Explain the purposes of each coat.

(5 marks)

(d) As an engineer, summarize the actions that need to be conducted to ensure the quality of the following road layers.

(i) Sub-grade, sub-base and road base layers.

(6 marks)

(ii) Binder and wearing coarse layers.

(4 marks)

Q4 (a) There are many types of asphalt defects and failures. Pavement failure occurs when an asphalt surface no longer holds its original shape and develops material stress which causes issues. List and briefly explain **THREE (3)** types of road failure that are commonly occured.

(9 marks)

(b) Pavement will serves as long as the underlying surface is stable and the traffic is light. When a pavement fails earlier than the design life, it is usually a result of general soil issues and engineering. Based on the statement above, briefly discuss **TWO (2)** of soil and engineering factors that may contribute to pavement failures.

(8 marks)

(c) Briefly explain **TWO (2)** importances of road maintenance work.

(8 marks)

Q5 (a) The present of water often results in premature failure of pavement. In accordance, discuss briefly **THREE (3)** sources of water in road structure.

(6 marks)

(b) Curb, gutter and gully are the common surface drainage systems used on the road.

(i) Briefly explain **THREE (3)** functions of these surface drainage system.

(6 marks)

(ii) Briefly explain **THREE (3)** effects if it is not provided to the road structure.

(6 marks)

(c) Road surface should be constructed and maintained with sufficient cross-fall to shed the stormwater to the edges and into the side drains. Based on that requirement:

(i) State the percentage of cross-fall that are normally adopted for paved roads, earth and gravel roads, and shoulders

(3 marks)

(ii) If a height of the fall is 2 m and the length of the base is 5 m, calculate the percentage of cross-fall and show all measurement in an appropriate diagram.

(4 marks)

–END OF QUESTIONS–

FINAL EXAMINATION

SEMESTER/SESSION : SEM I / 2018/2019
COURSE NAME : HIGHWAY ENGINEERING
PROGRAMME CODE : 3BFF
COURSE CODE : BFC31802
Student Name: .....
Matric No.: .....

Note: If you are answering **Q2**, please submit this sheet along with your answer script.

Table 1: Calculation of Pavement Thickness

Trial Thickness :	190 mm		**Doweled joints :**		
Modulus of Rupture, MR :			**Conrete shoulder :**		
Load Safety factor, LSF :	1.2		**Design period :**	20	years

Axle load (kN)	**Multiplied by LSF**	**Expected repetitions**	**Fatigue analysis**		**Erosion analysis**	
			Allowable repetitions	**Fatigue percent**	**Allowable repetitions**	**Damage, percent**
1	2	3	4	5	6	7

8. Equivalent stress :
9. Stress ratio factor :
10. Erosion factor:

Single Axle

Axle Load, kN						
125						
107						
98						
80						

11. Equivalent stress :
12. Stress ratio factor :
13. Erosion factor:

Tandem Axle

Axle Load, kN						
231						
213						
178						
142						

FINAL EXAMINATION

SEMESTER/SESSION : SEM I / 2018/2019
NAMA KURSUS : HIGHWAY ENGINEERING
PROGRAMME CODE : 3BFF
COURSE CODE : BFC31802

Table 2: Volume of cut and fill

Distance (m)	Volume (m^3)	
	Cut	Fill
150	12000	
130		15000
220	30000	
240		28000
540		60000
220	65000	

FINAL EXAMINATION

SEMESTER/SESSION : SEM I / 2018/2019
NAMA KURSUS : HIGHWAY ENGINEERING
PROGRAMME CODE : 3BFF
COURSE CODE : BFC31802

The following information may be useful. The symbols have their usual meaning.

$$\rho = \frac{M}{V}; \qquad P_B = \frac{M_B}{M}; \qquad P_{BE} = \frac{M_{BE}}{M}; \qquad P_{BA} = \frac{M_{BA}}{M};$$

$$AV = \frac{V_A}{V}; \qquad VMA = \frac{(V_{BE}+V_A)}{V}$$

$$VFA = \frac{V_{BE}}{(V_{BE}+V_A)};$$

$$V_{BE} = \frac{M_{BE}}{(R_{DB}(asp) \times \rho W)}$$

$$M_{BA} = P_{BA} \times M_G$$

$$M_{BE} = M_B - M_{BA}$$

$$V_A = V - (V_G - V_{BE})$$

$$SG_{mix} = \frac{100}{\frac{\%\ course\ Agg.}{SG\ course\ Agg} + \frac{\%\ fine\ Agg.}{SG\ fine\ Agg} + \frac{\%\ filler.}{SG\ filler} + \frac{\%\ bitumen}{SG\ bitumen}};$$

$$\rho_d = \frac{\rho_b}{1+w}$$

$$\text{Degree of Compaction} = \frac{\rho_d}{\text{Max. dry density}} \times 100$$