# UNIVERSITI TUN HUSSEIN ONN MALAYSIA

## FINAL EXAMINATION
## SEMESTER 1
## SESSION 2013/2014

COURSE NAME            :  HIGHWAY ENGINEERING

COURSE CODE            :  BFC 3042/BFC 31802

PROGRAMME              :  3 BFF

EXAMINATION DATE       :  DECEMBER 2013/JANUARY 2014

DURATION               :  2 HOURS 30 MINUTES

INSTRUCTION            :  ANSWER FOUR (4) QUESTIONS

THIS QUESTION PAPER CONSISTS **FIVE (5)** PAGES

**Q1**  (a)  All roadbase materials shall fulfill the California Bearing Ratio (CBR) test. Briefly explain how to get the CBR value from the equation below;

$$CBR = \frac{\text{Test Unit Stress}}{\text{Standard Unit Stress}} \times 100\%$$

Give an example in your explanation.

(5 marks)

(b)  Selection of suitable soils is important for the highway foundation. List the **THREE (3)** properties that we can consider as a good sub-grade.

(3 marks)

(c)  Explain what you understand by soil stabilization.

(2 marks)

(d)  List **TWO (2)** testing to be conducted on the sub-base and sub-grade and state the function for each testing.

(4 marks)

(e)  Give **FOUR (4)** advantages of chip seal.

(4 marks)

(f)  Discuss the process and purpose of the Marshall Mix Design of asphalt concrete.

(7 marks)

**Q2**     A rigid pavement was designed with the condition given below:

- Modulus of Subgrade Reaction of combined subbase/subgrade = 30 MPa/m
- Concrete flexural strength = 4.5 MPa
- Load Safety factor = 1.1
- Thickness of concrete slab = 20 cm

For a single axle load of 130 kN and 6300 expected repetitions during the design life, determine its contribution to fatigue and erosion for the following type of pavement:

i.     Slab with dowel joint and concrete shoulder.

(5 Marks)

ii.     Slab with dowel joint without concrete shoulder.

(5 Marks)

iii.    Slab with aggregate interlock joint and concrete shoulder.

(5 Marks)

iv.    Slab with aggregate interlock joint without concrete shoulder.

(5 Marks)

v.     What conclusion regarding the effect of type of joint and shoulder may be drawn from your answers on the questions above?

(5 Marks)

**Q3** (a) Describe the differences between prime coat and tack coat in terms of application, type of bitumen used and functions.

(6 marks)

(b) Specification for a highway requires that the soil be compacted 95 % of standard laboratory dry density. Tests on soil in one section of the road indicate that it has a maximum dry density of 1950 kg/m$^3$ at optimum water content 11.8 %. Field density is conducted at three locations. The results are as detailed below

(a) Nuclear densometer :
   Total density = 2090 kg/m$^3$
   Water Content = 14.0 %

(b) Test hole:
   Volume = 917.7 cm$^3$
   Total mass of soil = 2046 g
   Dry mass soil = 1822 g

(c) Test hole:
   Volume = 1003 cm$^3$
   Total mass of soil = 19863 g

Sample of soil tested for moisture content:

   Original mass = 199.5 g
   Dried mass   = 183.7 g

Calculate the degree of compaction work and give your comment.

(8 marks)

(c) Embankment is to be built with 15 km length of proposed road with 2 m height of road embankment. The cross sectional area of embankment and distance of borrow pit from embankment are 30 m$^2$ and 10 km respectively. Soil is to be compacted to 97 % of the max dry density. Information given as follows:

(a) Results from laboratory compaction test:
   Max dry density = 1.80 Mg/m$^3$
   Optimum water content = 12 %

(b) Borrow material:
   Dry density = 1.70 Mg/m$^3$
   Water content = 8 %

Calculate volume of additional water required for the entire volume of the embankment.

(5 marks)

(d) Discuss **THREE (3)** factors and criteria that affecting compaction in road construction.

(6 marks)

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Q4    (a)    What are the basic purposes of a Pavement Management System?

(2 marks)

(b)    Surface deformation is one type of pavement distress. Briefly explain the following surface deformation categories:

(i)    Rutting
(ii)   Depression
(iii)  Corrugation
(iv)   Shoving

(8 marks)

(c)    Discuss in detail **ONE (1)** of Non-destructive Deflection Testing (NDT) method for pavement structural evaluation.

(5 marks)

(d)    After conducted a pavement condition survey in Jalan Parit Botak (J9), it can be concluded that the average PCI value was 50 and considered as fair, mainly due to the surface defects. As an engineer, propose **TWO (2)** techniques of rehabilitation method to treat the road. Give your justification for each technique chosen.

(10 marks)

Q5    (a)    The serviceability of a highway is greatly dependent on the adequacy of its drainage system. Adequate and proper drainage is important for protection of road structure and safety of the road users. Briefly explain effects of water ponding on highway structure and road users.

(6 marks)

(b)    The present of water often results in premature failure of pavement and influence the strength and shortens its design life. What are the **TWO (2)** sources of water on highway engineer is primarily concerned with? Briefly describe each.

(6 marks)

(c)    Entrances of water into the road sub-grade can seep from the slope, unpaved shoulder, percolates down through the pavement structure itself, natural water table rise and fall during the rainy day. Based on that statement, using the appropriate diagrams propose and describe the suitable drainage system to prevent the effects of water destruction on road pavement.

(13 marks)

- **END OF QUESTION** -