The Open University of Sri Lanka
Faculty of Engineering Technology
Department of Civil Engineering

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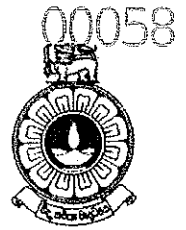
Study Programme	: Bachelor of Technology Honours in Engineering
Name of the Examination	: Final Examination
Course Code and Title	**: CVX4536/CEX4236 Highway Engineering**
Academic Year	: 2017/18
Date	:22nd January 2019
Time	: 0930-1230hrs
Duration	**: 3 hours**

General Instructions

1. Read all instructions carefully before answering the questions.

2. This question paper consists of **Eight (8)** questions in Four **(4)** pages.

3. Answer any **Five (5)** questions only. All questions carry equal marks.

4. Answer for each question should commence from a new page.

5. Relevant charts/ codes are provided.

6. This is a Closed Book Test (CBT).

7. Answers should be in clear hand writing.

8. Do not use Red colour pen.

(01)

   (a). Draw a neat cross-section of a four-lane, two-way road with a centre median running along a cut and fill section, clearly indicating and labelling all the important elements. (08 marks)

   (b). Write down at-least <u>four</u> (4) expected functions of a median. (04 marks)

   (c). Write down the functions of a shoulder. (04 marks)

   (d). When a carriageway is to be widened on a curve, what are the four main considerations to be taken in to account? (04 marks)

(02)

   (a). During an off-road parking supply survey, gathering information on 'off-road space inventory' is an important component. List and briefly explain the items that will be collected under this component. (06 marks)

   (b). Explain what is meant by a 'parking duration survey' and make clear how the 'concentration surveys' are combined with it. (04 marks)

   (c). What are the main objectives of a 'time limit parking scheme'? (04 marks)

   (d). Describe the following types of 'time limit parking management techniques'.
     (I). Traffic warden controlled
     (II). Parking meter controlled
     (III). Parking discs (or labels)

                                                 (06 marks)

(03)

(a). Distinguish between "time headway" and "space headway".

                                           (04 marks)

(b). Vehicle time headways and space headways were measured at a point along a highway, from a single lane, over the period of an hour. The average values were calculated as 2.5 s/veh for headway, and 60 m/veh for spacing. (i) Calculate the average speed of the traffic. (ii) Obtain the average speed of traffic directly from average headway and spacing value.

                                           (10 marks)

(c). In a uniform single lane traffic flow, where the headway between any two adjacent vehicles is 15 meters and length of each vehicle is 5 metres, the following speed measurements were recorded in a particular instant. 10 vehicles at 30 km/h, 15 vehicles at 35 km/h, and 25 vehicles at 40 km/h.

   Calculate the following for this vehicular flow.
   (i) vehicle density, (ii) space mean speed, and (iii) traffic volume.

                                             (06 marks)

(04)

(a) Briefly explain the following terms used to describe partical size distribution of coarse grained soils, (i). well graded, (ii). poorly graded, and (iii). uniformly graded soils. You may draw neat sketches to describe these. (06 marks)

(b) Define the terms 'degree of saturation', and 'porosity' of a soil. (04 marks)

(c) Explain briefly the meaning of 'textural classification' based on main <u>three</u> (3) groups of soil components. Draw a 'triangle textural classification diagram' neatly and indicate clearly on it the results of a sieve analysis of a certain soil indicated by 35% clay, 40% silt, and 25% sand. (04 marks)

(d) Natural rock aggregates have been classified by geologists into <u>three</u> (3) main groups as; (i) igneous, (ii) sedimentary, and (iii) metamorphic rocks, based on their method of origin. Briefly explain the <u>three</u> (3) categories.

(06 marks)

(05)

(a). Distinguish between 'road emulsions' and 'cut-back bitumen'. (06 marks)

(b). Explain briefly the softening point test carried out to evaluate the consistency of bitumen, indicating the type of apparatus used in the laboratory.

(07 marks)

(c). Explain <u>seven</u> (7) different types of failures that can be observed in highway pavements, explaining what happens under each type of failure.

(07 marks)

(06)

As a person working in a road rehabilitation project, you may be required to have an adequate knowledge of the modern surface laying methods, equipment that are used, and their proper usage, depending on the type of construction and expected function of the road.

(a) List <u>six</u> (6) different types of surface applications that are available in modern day road surface construction and discuss for what purposes they can be used.

(06 marks)

(b). Explain the steps involved in carrying out a (i) Single Base Surface Treatment (SBST), and (ii) Double Base Surface Treatment (DBST) dressing for a road surfacing process. (07 marks)

(c). Explain the difference between a 'seal coat', and a 'tack coat' as road surface treatments. Discuss also the advantages and disadvantages of each type of coat.

(07 marks)

(07)

(a). When planning a road network for a particular area, there are several road patterns or layouts that may be used as guidelines. With the help of neat diagrams indicate <u>three</u> (3) such patterns that could be used to fit a road network in a region under consideration.

(06 marks)

(b). Let us assume that there is a region that has to be developed and two (2) road systems are proposed to suit the development plan as indicated below. Calculate the agricultural, industrial and average utility factors for the two proposals separately. Based on your results indicate which proposal should be considered for implementation.

Proposal	Total Road Length (km)	Number of Population Centres with Population of		Productivity per Year	
		0 to 5000	5000 to 10000	Agriculture (Tonne)	Industry (Tonne)
A	990	35	45	90	120
B	1050	30	50	100	80

Use the following units for your calculations:

Every 5 tonnes of agricultural produce to be assigned one unit.
Every 10 tonnes of industrial produce to be assigned one unit.
Population group - 00 to 5000, take as 0.5 unit.
Population group - 5000 to 10000, take as 1.0 unit.

(10 marks)

(c). List the main factors taken into consideration when roads are classified and briefly describe them.

(04 marks)

(08)

(a). Draw a neat diagram of a hydrologic cycle and label all the important features on it. Briefly explain <u>six</u> (6) components that constitute the hydrologic cycle.

(12 marks)

(b). Water flows at uniform depth along a roadside drain of trapezoidal section with a slope of 0.002. The appropriate value of Manning's n is 0.014 and the side slope of the drain is 1:1. Given the bottom width of the trapezoidal section as 1.25 m, find the depth of flow for a discharge of 3.2 m^3/s in the drain.

(08 marks)

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