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THE OPEN UNIVERSITY OF SRI LANKA
DIPLOMA IN TECHNOLOGY (CIVIL) - LEVEL 4
FINAL EXAMINATION - 2011/12

CEX4236 - HIGHWAY ENGINEERING

Time allowed : Three hours

Date : Sunday, 26th February 2012 **Time : 9:30 - 12:30**

Answer any five (5) questions. All questions carry equal marks. Write down your Index Number clearly on the answer script.

01. Expressways are becoming a part of the national highway network of Sri Lanka. Therefore as highway engineers it is important to have a sound knowledge of the important features and operational aspects of expressways.

(a). List six (6) main features of expressways that are not in normal highways. Briefly describe the listed characters and how they differ from normal highways. (06 marks)

(b). Draw neat diagrams of six (6) types of grade separated junctions (entry/exit points) that can be seen in expressways indicating the traffic flow directions, and name them. (06 marks)

(c). What are the main problems encountered in 'Southern Expressway' initially when it was opened for public? Briefly discuss these problems and indicate your suggestions on how to overcome them. (08 marks)

02. (a). When planning a highway system for a particular area, what are the plans required to-be prepared, from the data collected during planning studies and surveys? Briefly describe what information these plans provide. (06 marks)

(b). What are the main factors taken into consideration when roads are classified? (04 marks)

(c). National highways are the main highways running through the country, which are maintained by Road Development Authority of Sri Lanka. These national highways consist of two classes, namely Class A (trunk roads), and Class B (main roads). Compare these two classes of roads based on their expected functions. (05 marks)

(d). Draw a typical cross-section of an asphalt pavement construction indicating the different layers by correctly labelling them. (05 marks)

03. (a). Describe the common causes for road accidents. (05 marks)

(b). Explain what is meant by an accident 'black spot'. (04 marks)

(c). Describe the six (6) basic steps, which are required for a detailed accident study of a particular road or a network of roads covering a particular area. (06 marks)

(d). Explain with illustrations what a 'collision diagram' is, and describe how it is prepared. (05 marks)

04.

(a). Discuss the advantages and disadvantages of the following traffic management measures.

(i). Parking controls
(ii). Closure of roads to certain types of vehicles
(iii). Prohibition of right turns
(iv). Provision of bus lanes
(v). U-turn regulation
(vi). Channelization of traffic

(12 marks)

(b). Briefly describe <u>four</u> (4) types of geometric controls that can be used in local roads for effective traffic management.

(08 marks)

05.

(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)

06.

(a). Standard Proctor compaction tests carried out on a sample of sandy clay yielded the following results:

Bulk density (kg/m^3)	2058	2125	2152	2159	2140
Moisture content (%)	12.9	14.3	15.7	16.9	17.9

1. Plot the curve of dry density against moisture content and hence find the maximum dry density and the optimum moisture content.

(04 marks)

2. Calculate the moisture content necessary for complete saturation at this maximum dry density if the specific gravity of the solid constituents is 2.73.

(04 marks)

(b). Distinguish between road emulsions and cut-back bitumen.

(06 marks)

(c). Explain how the flash and fire point test is conducted and discuss the significance of this test

(06 marks)

07. The aggregates used in road surface are subjected to wearing due to movement of traffic. Therefore, the road aggregates should be hard enough to resist the abrasion. Resistance to abrasion of aggregate is determined in the laboratory by Los-Angeles test machine.

(a) Briefly discuss the principle used in Los-Angeles abrasion test machine.

(05 marks)

(b) Draw a neat sketch of a Los-Angeles abrasion test machine and label the important parts of it.

(05 marks)

(c) Indicate the steps involved in conducting the Los-Angeles abrasion test in the laboratory.

(05 marks)

(d) Calculate the percentage of wear of aggregate if a sample has following measurements:

Weight of aggregate retained (1st sieve) = 2450 grams
Weight of aggregate retained (2nd sieve) = 2550 grams
Weight of empty pan = 847 grams
Weight of pan + oven dried aggregate = 3498 grams

(05 marks)

08.

(a) Distinguish between 'seal coat' and 'tack coat' of road surfacing. Discuss also the advantages and disadvantages of each type of coat.

(06 marks)

(b) State the advantages and disadvantages of asphaltic concrete for road surfacing.

(04 marks)

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

(06 marks)

(d) The ductility of a bituminous binder is expressed as the distance in centimetres, a standard briquette will elongate at a temperature of 25 ^{0}C before breaking. Explain why knowledge of ductility is important when bitumen is used in flexible pavements.

(04 marks)