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THE OPEN UNIVERSITY OF SRI LANKA
DIPLOMA IN TECHNOLOGY (CIVIL) - LEVEL 4
FINAL EXAMINATION - 2010/11

CEX4236 - HIGHWAY ENGINEERING

Time allowed : Three hours

Date : Sunday, 06th March 2011 **Time : 9:30 - 12:30**

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

01. (a). Sketch the carriageway markings, indicating the lengths of marks and gaps, for the following.
(i) centre line of a road.
(ii) warning lines on approach to a pedestrian crossing. (04 marks)

(b). There are six (6) classes of road markings. List them and briefly explain what they mean. (06 marks)

(c). Figure 1 shows a 7 meter wide road which is on a curve and having a 6% gradient (rising) from B to D, the lengths on either side of it being flat. The road is used by a considerable proportion of heavy goods vehicles. Draw on a clear diagram the carriageway markings that you would use along the road at a point on the flat (A) and on the incline and curve (C). Also, draw the road signs that you would erect for traffic approaching from both directions, indicating their locations.

(10 marks)

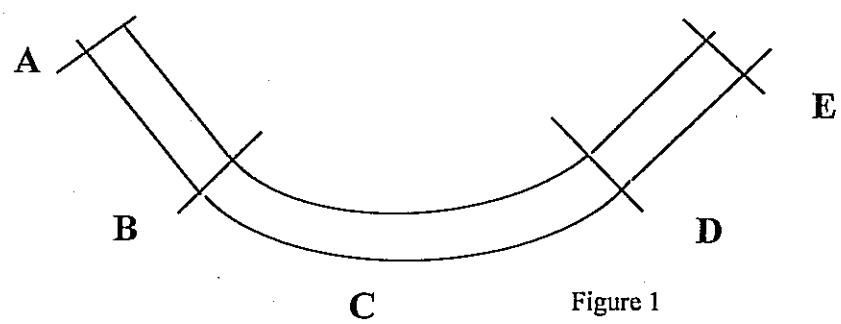

Figure 1

02. (a). Explain the difference between Average Daily Traffic (ADT) and Annual Average Daily Traffic (AADT). List the various uses of these two traffic volume parameters. (06 marks)

(b). It is required to obtain the following information in respect of a 2-way, 2-lane single carriageway road on a selected day.
(i) Rate of traffic flow in each direction
(ii) Variation in the rate of flow during the day
(iii) Classification of traffic by vehicle type
Briefly explain the method that you would adopt, highlighting all the important points. (08 marks)

(c). Determine the average future traffic flow after a period of 20 years on an arterial road, which has an annual average daily traffic of 5000 vehicles and a yearly growth rate of 4%. (06 marks)

03.

(a). Describe the characteristics that you expect the bitumen to possess to enable it to be used successfully in road surfacing. (06 marks)

(b). Describe a laboratory test each to determine the viscosity and ductility of a bituminous binder. (05 marks)

(c). Briefly describe the differences between open graded and dense bituminous mixes. (05 marks)

(d). List four (4) types of surface failures you may observe on the carriageway of a road, and briefly describe them. (04 marks)

04.

(a). Describe the method of measuring spot speeds of vehicles on a road using a radar gun as you have done in your practical sessions. State any shortcomings in this method. (07 marks)

(b). A survey of spot speeds of vehicles was conducted at a point on a road, and the results are given in the table below. Draw the histogram and the frequency curve. (07 marks)

Speed Class (km/h)	Number of Vehicles observed
20.0 – 24.9	1
25.0 – 29.9	20
30.0 – 34.9	61
35.0 – 39.9	103
40.0 – 44.9	168
45.0 – 49.9	87
50.0 – 54.9	40
55.0 – 59.9	18
60.0 – 64.9	2

(c). Also plot the cumulative frequency curve, and determine the median speed and the 85^{th} percentile speed. (06 marks)

05.

(a). Culverts are structures used to facilitate passing drainage water under the roadway when water paths cross it. With the help of a clear diagram indicate all the important features, both up-stream and down-stream, of a culvert. (06 marks)

(b). Explain why roadside drains are important, and describe the steps that should be taken to maintain roadside drains. (06 marks)

(c). A roadside canal with a trapezoidal section has a discharge of 2.8 cusecs. The canal has a side slope of 1:1 on both sides and a bottom width of 1.22 metre. If the approximate value of Manning's n is 0.014 and the canal slope is 0.001, find the depth of the flow. (08 marks)

06.

(a) Discuss the 'texture classification' of soils with the help of a suitable illustration. State the soil parameters which form the basis for this classification. (08 marks)

(b) In an attempt to calculate the 'flakiness index', 200 particles of aggregate passing and retaining on adjacent sieves were obtained as indicated in the table below. The particles were individually gauged using a thickness gauge. The total mass of each group of 200 particles and the mass of flaky particles in each group are tabulated in the same table.

From the information given in the table, calculate the flakiness index of the total aggregate sample.

Aggregate size fraction				
Passing sieve size in mm	Retaining sieve size in mm	% of size fraction in total sample	Mass of 200 particles in grams	Mass of flaky particles in grams
63.0	50.0	5	62250	15200
50.0	37.5	40	32500	13100
37.5	28.0	20	15350	5100
28.0	20.0	15	6550	1550
20.0	14.0	10	2050	800
14.0	10.0	5	950	300
10.0	6.3	5	600	150

(12 marks)

07.

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 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)

08.

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

(b) Explain the difference between 'off street parking' and 'on-street parking. (04 marks)

(c) What is meant by 'peripheral car parks? (04 marks)

(d) Describe the different parking management techniques listed below

(I).Park and walk
(II).Park and ride
(III).Kiss and ride

(06 marks)