THE OPEN UNIVERSITY OF SRI LANKA
DIPLOMA IN TECHNOLOGY (CIVIL) - LEVEL 4
FINAL EXAMINATION - 2008/09

CEX 4236 - HIGHWAY ENGINEERING

097

Time allowed : Three hours

Date : Saturday, 14th March 2009 **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). Explain the function of a 'drop structure' and explain why and when these structures are needed in road side drains along roads in hilly areas. Draw neat sketches where necessary. (06 marks)

(b). State Dickens formula which is used to calculate the flood discharge. Explain the different terms in this formula. Write down three (3) of the limitations of Dickens formula. (04 marks)

Using Dickens formula, determine the flood discharge for a basin of 6 sq. miles. Take the coefficient c as 1050. (02 marks)

(c). Water flows at uniform depth along a roadside drain of trapezoidal section with a slope of 0.003. The appropriate value of Manning's n is 0.015 and the side slope is 1:1. Given the bottom width of the trapezoidal section as 1.2 m, find the depth of flow for a discharge of 3.0 m^3/s in the drain. (08 marks)

02.

(a) The table below gives the frequencies of headways in 2 second class intervals.

Headway range (secs)	0 - 2	2 - 4	4 - 6	6 - 8	8 - 10	10 -12	12-14	>14
Frequency	0	60	22	11	4	2	1	0

(i) Determine the mean headway and its standard deviation. (05 marks)
(ii) Determine the traffic flow (05 marks)

(b) Briefly describe the following terms used in traffic engineering
(i) Average daily traffic
(ii) Normal traffic growth
(iii) Generated traffic
(iv) Development traffic
(v) Design year traffic volume

(10 marks)

03.

(a) On the access road leading to the Colombo harbour there are 150 passages daily of 3 axle trucks (with loads of 7,500 kg each on the middle and rear axles, and 3,000 kg on the front axle) and 200 passes daily of 2 axle trucks (with a load of 10,000 kg on the rear axle and 2,000 kg on the front axle). Assuming a 2% annual growth of traffic, calculate the cumulative number of standard axles on the road during the 10 years of design life. Use the equivalence factors given below.

Axle load (kg)	2,000	3,000	7,500	10,000
Relative Damaging Effect	0.003	0.01	0.65	2.3

(08 marks)

(b). Draw a typical cross-section of a two-way, two-lane dual carriageway road on (i) a cut-section (ii) fill-section. Label all the important components of sections. (04 marks)

(c). Describe the following elements of a highway cross-section

(i). Street line of the road
(ii). Formation width
(iii). Width of pavement.
(iv). Type of surfacing (08 marks)

04.

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

(i). Control of lane use (03 marks)
(ii). Converting traffic lanes to reversible lanes (03 marks)
(iii). Converting two-way roads to one-way roads (03 marks)
(iv). Provision of pedestrian precincts (03 marks)

(b). Briefly describe the different types of longitudinal lane markings. (04 marks)

(c). Briefly describe the precautions to be taken in planning and carrying out the moving observer method, and indicate the measurements that you have to take while in the test car. Also write down two advantages of this method. (04 marks)

05.

(a) Explain the following measures of specific gravity of rock aggregates.

(i).Bulk specific gravity
(ii).Apperent specific gravity
(iii).Saturated surface dry specific gravity (04 marks)

(b) Distinguish between 'cut-back bitumen' and 'bitumen emulsion'. (05 marks)

(c) Briefly describe the 'ductility test' that is carried out in the laboratory, explaining its significance. (05 marks)

(d) List down the steps involved in conducting a (i) Single Base Surface Treatment (SBST), and (ii) Double Base Surface Treatment (DBST) dressing in a road project. (06 marks)

06.

(a). Draw a sketch of a typical bridge across a river and indicate its main components. State the functions and the importance of each of these main components. (08 marks)

(b). Explain with neat sketches the composite action between precast prestressed concrete beam units and insitu concrete used in bridges. (06 marks)

(c). Draw clear diagrams of <u>three</u> (3) types of bridges that can be used across a wide river, and indicate clearly how the loads are transferred to the foundations. (06 marks)

07.

(a). A parking supply survey can be considered to consist of three stages, namely, (i) on-street road space inventory (ii) a road regulation inventory, and (iii) off-street space inventory. List down the information that should be collected under the three different inventory surveys. (08 marks)

(b). Briefly describe off-street parking, and list its advantages and disadvantages. (04 marks)

(c). Briefly describe on-street parking, and list its advantages and disadvantages. (04 marks)

(d). If the area available for off-street parking is limited, what options would you have? Discuss. (04 marks)

08.

(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)