00044

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

Study Programme	: Bachelor of Technology Honours in Engineering
Name of the Examination	: Final Examination
Course Code and Title	**: CVX7345 Highway Engineering and Design**
Academic Year	: 2021/2022
Date	: 03rd February 2023
Time	: 09:30 – 12:30
Duration	: **3 hours**

General Instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of Seven (7) questions in Four (4) pages.
3. Answer a total of Five (5) questions. All questions carry equal marks.
4. Answer for each question should commence from a new page.
5. This is a Closed Book Test (CBT).

01.

(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 four (4) 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 (2) classes, namely Class A (trunk roads), and Class B (main roads). Distinguish between these two classes of roads according to their expected functions. (05 marks)

(d). Draw a typical cross-section of an ancient paved Roman road indicating the different layers by correctly labeling them. (05 marks)

02.

(a). Describe the four (4) common causes for road accidents. (04 marks)

(b). Explain what is meant by an accident 'black spot'. (05 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)

03.

(a). A parking supply survey can be considered to consist of three (3) 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)

04.

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)

05.

(a). On an access road leading to a major industrial zone 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

(04 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). 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)

06.

(a). Write an expression to indicate the minimum radius (R_{min}) of a horizontal curve for a given vehicle speed (V). What is the minimum radius required for a vehicle travelling at 80 km/h, where maximum value of superelevation is 40% and maximum value of side friction is 0.26 (05 marks)

(b). Briefly explain the reason for introducing a 'transition curve' between a straight stretch of highway to a circular curve with a smaller radius in a highway. (05 marks)

(c). Write an expression to indicate the minimum superelevation lengths (L_{DS}) of a highway by explaining the meanings of the standard notations used in the expression. (05 marks)

(d). Indicate with a neat diagram of a vertical profile of a typical superelevation development of a two-lane two-way road. It should be the longitudinal section of the superelevation development indicating its important components. (05 marks)

07.

(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. (06 marks)

(b). Explain what is meant by 'flakiness index' and 'elongation index' of aggregate used for highway construction. (04 marks)

(c). 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

(06 marks)

(d). Discuss the advantages and disadvantages of an Asphaltic concrete surfacing when laid on a heavily trafficked road. (04 marks)