

**THE OPEN UNIVERSITY OF SRI LANKA
DIPLOMA IN TECHNOLOGY (CIVIL) - LEVEL 4
FINAL EXAMINATION - 2014/15**

00076



CEX4236 - HIGHWAY ENGINEERING

Time allowed : Three hours

Date : Sunday, 09th August 2015

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.

- (a). Explain the meaning of the terms (i). Average daily traffic, (ii). Average annual daily traffic, and (iii). Peak hour volume. List the various uses of these traffic volume parameters. (09 marks)
- (b). It is required to obtain the following information in regarding 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

Briefly explain the method that you would adopt, highlighting all the important points. (06 marks)

- (c). If the data is required for a continuous period of several months instead of just one day, state the steps that you would follow (05 marks)

02.

- (a) The spot speeds of vehicles at a location on a road in open country were measured manually by a single observer. The passage by vehicles of two reference marks, spaced 100 m, on the roadside was noted with the help of a stop watch. Indicate all the shortcomings of this method, and suggest ways of improving the method in order to obtain an accurate measure of speed. (06 marks)
- (b). A survey of Spot speeds was conducted on a road under free flowing conditions. The results are shown in table below.

Speed Range (km/h)		Number of Vehicles observed
Greater or equal to	Less than or equal to	
30	39	01
40	49	09
50	59	12
60	69	18
70	79	16
80	89	10
90	99	05

Draw the histogram and frequency distribution curve, and find the modal speed. Also find the average speed & 85% percentile speed. (06 marks)

- (c). Describe what is meant by (i) Time Mean Speed, and (ii) Space Mean Speed.

A spot speed survey was conducted at a particular location on Nawala-Narahenpita road on a weekday. Following speeds (in km/h) were recorded.

79	57	49	67	31	70	58	69	71	86
66	46	62	45	62	43	53	50	68	57
75	61	53	45	47	57	56	75	57	65
65	66	64	76	83	62	78	79	46	57
74	78	76	63	74	80	82	84	81	86
90	59	85	65	83	95	97	65	61	49
74	72	64	94	47	76	53	92	77	85
65									

Calculate the (i) Time Mean Speed, and (ii) Space Mean Speed. (08 marks)

03.

- (a). List five (05) types of pedestrian crossings and briefly discuss each of them. (05 marks)
- (b). Briefly describe four (04) commonly used arrangements of street lanterns along straight stretches of roads illustrating with neat diagrams. (05 marks)
- (c). What are the main factors that control the glare from street lanterns? Explain briefly how they affect the glare. (05 marks)
- (d). In a highway development project the fact-finding survey plays an important role. Mention the main constituents that are used to gather information in these surveys. Also list down the studies that should be included in these surveys. (05 marks)

04.

- (a). Write down the empirical formula developed by Dickens which is used to calculate the flood runoff estimation, explaining all its terms. (05 marks)
- (b). Although Dickens formula is popularly used for flood runoff calculations it has its limitations. Write down three (03) main limitations of the formula. (05 marks)
- (c). Briefly describe the following terms which are used in highway drainage computations. If required you may get the support of neatly drawn sketches. (i) catchment boundary, (ii) rainfall intensity, (iii) runoff coefficient, and (iv) time of concentration. (05 marks)
- (d). Bed level of a stream drops 3 feet in a distance of 1 mile. This stream crosses a highway and the point of crossing is 2 miles away from the start of the stream. Calculate the time of concentration of the stream catchment above the point of crossing the highway assuming the inlet time is 10 minutes. You may also use the data given in the table below for your calculations.

Average gradient of stream percent	Average velocity in (ft/sec)
$0 < 1$	1.5
$0 \leq 2$	2.0
$2 \leq 4$	3.0
$4 \leq 6$	4.0
> 6	5.0

(05 marks)

05.

- (a). List six (06) surface application types available for road surface construction and briefly explain for what purposes they can be used. (06 marks)
- (b). Briefly describe what "Bitumen Macadam" surfaces are and discuss the advantages and disadvantages of "Bitumen Macadam" surfaces. (05 marks)
- (c). Discuss the advantages and disadvantages of an Asphaltic concrete surfacing when laid on a heavily trafficked road. (05 marks)
- (d). Explain the difference between a 'seal coat', and a 'tack coat' as road surface treatments. (04 marks)

06.

- (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)

07.

Describe the following (with sketches where necessary)

- (a). 'Zoning' in origin-destination surveys. (05 marks)
- (b). 'Desire lines' in origin-destination surveys. (05 marks)
- (c). Passing sight distance. (05 marks)
- (d). Transition curves on roads. (05 marks)

08.

- (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

(06 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.

(06 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)