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THE OPEN UNIVERSITY OF SRI LANKA
DIPLOMA IN TECHNOLOGY (CIVIL) - LEVEL 4
FINAL EXAMINATION - 2013/14

CEX4236 - HIGHWAY ENGINEERING

Time allowed : Three hours

Date : Monday, 11th August 2014 **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). 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). State the main factors taken into consideration when roads are classified? (05 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). Distinguish between these two classes of roads according to their expected functions. (04 marks)

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

02.

As a person working in a road construction 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 & briefly discuss for what purposes they can be used. (05 marks)

(b). Explain the steps involved in carrying out a (i) Single Base Surface Treatment (SBST) and (ii) Double Base Surface Treatment (DBST) for a road surfacing process. (05 marks)

(c). Explain the difference between a 'seal coat' and a 'tack coat' as road surface treatments. Discuss briefly the advantages and disadvantages of each type of coat. (05 marks)

(d). Mention the different types of road carriageway failures and briefly describe each type. (05 marks)

03.

(a). State five (5) factors that should be considered in locating of entrances and exits of parking areas. (05 marks)

(b). Draw a suitable layout for a commercial parking lot of 115 meter wide (street frontage) and 100 meter deep assuming that it has two driveways, one-way circulation, double-

loaded aisles, and a 75^0 parking angle. State that how many cars could be parked in this parking layout you propose. Standard size of a parking bay is 6 metre by 2.4 metres. (05 marks)

(c). Explain what is meant by a 'parking duration survey' and make clear how the 'concentration surveys' are combined with it. (04 marks)

(d). Describe the following types of 'time limit parking management techniques'.
(i). Traffic warden controlled
(ii). Parking meter controlled
(iii). Parking discs (or labels) (06 marks)

04.

(a). State five (5) factors that will affect the capacity of a road. (05 marks)

(b). With the help of a neat diagram explain the difference between headway and gap in a traffic flow. Indicate the direct relationship between h (average headway between vehicles in seconds) and q (traffic flow in vehicles per second). (03 marks)

(c). Briefly describe the following four (04) types of speeds commonly used in traffic engineering. (i) spot speed, (ii) average speed, (iii) running speed, and (iv) overall or travel speed. (04 marks)

(d). During a floating car method survey five runs were made in each direction along the two-way highway between Nawala and Rajagiriya (assume that the distance between Nawala and Rajagiriya to be 5 km). Flows were measured both with and against the moving vehicle, and the following observations were recorded.

(i). Vehicle travelling from Nawala to Rajagiriya

Trip		Number of vehicles		
Start (mm:sec)	End (mm:sec)	Overtaking the test car	Overtaken by the test car	Met in opposite direction
16:05	16:16	5	1	410
16:34	16:44	3	2	390
17:05	17:17	4	1	400
17:35	17:44	5	3	360
18:05	18:18	2	4	380

(ii). Vehicle travelling from Rajagiriya to Nawala

Trip		Number of vehicles		
Start (mm:sec)	End (mm:sec)	Overtaking the test car	Overtaken by the test car	Met in opposite direction
16:19	16:31	3	3	330
16:50	17:03	7	0	310
17:20	17:32	4	2	360
17:50	17:59	4	3	350
18:20	18:33	5	3	300

If $q = (x + y) / (t_w + t_a)$ and, $t = (t_w - y/q)$, where the terms in the expressions have the usual meanings,

(i). Calculate the average traffic flow in each direction. (04 marks)

(ii). Calculate the average journey speed from Nawala to Rajagiriya and from Rajagiriya to Nawala. (04 marks)

05.

(a). Explain the meaning of following terms.

(i). Average Daily Traffic (ADT) (02 marks)
(ii). Average Annual Daily Traffic (AADT) (02 marks)
(iii). Hourly Traffic Volume (HTV). (02 marks)
(iv). Peak Hour Traffic Volume (PHV) (02 marks)

(b). The following table indicates the 24-hour manual classified vehicle count data obtained at a certain observation point along an urban arterial road connecting two major towns. The traffic count has been conducted in the year 2010. Table also indicates the annual growth factors for each type of vehicles over the last few years.

	Motor-cycles	Three - wheelers	Cars	Trucks	Buses	Other vehicles
Vehicle numbers	400	500	1050	1200	900	200
Annual growth percentage (%)	10%	20%	2%	4%	5%	1%

Using the above information answer the following questions.

(i). What is the projected ADT in 20 years time (ie., 2030) ? (04 marks)

(ii). What is the percentage of 3-wheelers in the total ADT in the year 2015 ? (04 marks)

(iii). In which year will the total of three-wheelers and Motor cycles exceed 60% of total traffic? (04 marks)

06.

(a). Distinguish between 'road emulsions' and 'cut-back bitumen'. (04 marks)

(b). 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)

(c). Explain briefly the penetration test carried out to evaluate the consistency of bitumen, illustrating the type of apparatus used in the laboratory, and indicate the standard values used in the test. (06 marks)

(d). Based on a penetration test results what is indicated by (i) lower penetration value, and (ii) higher penetration value? (04 marks)

07.

(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.
With the help of separate diagrams explain how the (i) outlet control, and (ii) inlet control is carried-out in a properly designed culvert. (08 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 concrete drain in a heavily built up area has a discharge of 2 cusecs. The

canal has vertical side slopes on both sides and a bottom width of 0.5 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, and propose a suitable depth for the canal.

(06 marks)

08.

(a). List five (5) types of pedestrian crossings and briefly discuss each of them. (05 marks)

(b). Briefly describe four (4) 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). Indicate with a neat sketch the layout you may adopt for an emergency repair work of a kerb-side lane of a four lane two-way undivided carriageway. On this sketch clearly indicate all the traffic control tools that you will be using during the construction phase. (05 marks)