



CVX7345 - Highway Engineering and Design

FINAL EXAMINATION - 2023/2024

Time Allowed: Three (03) Hours

Date: 2025 - 02 - 10 (Monday)

Time: 1330 - 1630 hrs.

Paper consists of Seven (07) questions. Answer any five (05) questions.

Q1.

- i.) Discuss the historical developments that led to modern highway construction, highlighting the four prominent types with similarities and differences (You may use sketches to convey significant points in the discussion).
(06 Marks)
- ii.) Describe the Macadam technique of road construction with the aid of an illustration of a cross section of such road deck highlighting significant structural and functional aspects of the construction.
(07 Marks)
- iii.) Describe the main considerations to be taken into perspective when classifications for highways are to be formed and clearly present the five classes of roads contained in the classification of roads in Sri Lanka by the Road Development Authority (RDA).
(07 Marks)

Q2.

- i.) In the process of planning a new highway, identification of the appropriate alignment is the most important initial step. Outline and discuss the significant four (04) factors that should be taken into consideration in selecting the alignment of a proposed highway.
(10 Marks)
- ii.) After identifying the general trace of a highway, describe the four (04) stages through which a suitable final alignment for the highway could be plotted for the construction work to commence.
(10 Marks)

Q3.

- i.) Define and differentiate between "Time Headway" and "Space Headway".
(06 Marks)
- ii.) On a certain highway lane through observations made during one hour, the average time headway was evaluated to be 2.5 seconds/vehicle while the average space headway was evaluated to be 60 m/vehicle. Based on these data evaluate the average speed of traffic directly as well as using the two average headway values.
(07 Marks)
- iii.) In an ideal situation of uniform single lane traffic flow with constant space headway of 15 m, GPS receivers mounted on a stretch of the road at a particular instant reported 10 vehicles at 30 km/h, 15 vehicles at 35 km/h and 25 vehicles at 40 km/h. Evaluate; a) Vehicle Density, b) Space Mean Speed & c) Traffic Volume
(07 Marks)



Q4.

- i.) Describe three similarities and three differences between "Bitumen Emulsions" and "Cut-back Bitumen".
(06 Marks)
- ii.) Describe at least four different types of failures observed related to highway pavements with explanations on the mechanisms related to each type of failure.
(07 Marks)
- iii.) For evaluation of the consistency of bitumen a common test is the 'Softening Point Test'. With description of the related apparatus describe this laboratory test.
(07 Marks)

Q5.

- i.) Sketch a cross section of a typical two lane highway highlighting each significant component.
(05 Marks)
- ii.) Briefly describe five expected functions of a 'center median' of a two lane highway.
(05 Marks)
- iii.) Briefly describe five expected functions of a 'shoulder' as a significant component of a highway.
(05 Marks)
- iv.) Briefly describe the four main considerations to be accounted for when a carriageway is to be widened on a curve.
(05 Marks)

Q6.

- i.) Briefly describe the particle size distribution of coarse grained soils (You may use neat sketches to describe); a) well graded b) poorly graded c) gap graded.
(05 Marks)
- ii.) Give definitions for the terms 'degree of saturation' and 'porosity' of a soil.
(05 Marks)
- iii.) Briefly explain the meaning of 'textural classification' based on the three main constituents of a soil. Draw a 'triangle of textural classification diagram' for a soil with 35% of Clay, 40% of Silt and 25% of Sand derived from sieve analysis results.
(05 Marks)
- iv.) Briefly explain the three rock types termed as a) Igneous, b) Sedimentary & c) Metamorphic based on geological classifications.
(05 Marks)

Q7.

- i.) Sketch a diagram of the hydrological cycle with all relevant components identified. Describe the six significant components that constitute the hydrological cycle.
(06 Marks)
- ii.) Discuss the factors and parameters that influence the drainage of storm water from a highway pavement so that skidding or instability of vehicles could be minimized.
(07 Marks)
- iii.) For storm water discharge along a highway shoulder, a trapezoidal cross sectioned drain is adopted. The longitudinal slope of the drain is maintained at 0.002 while the base of the trapezoid is 1.25 m with 45 degree side slopes. For a storm water discharge at a 0.8 m uniform depth evaluate the rate of discharge of water in m³/s. (Assume the Manning's formula to be $V = (1/n) * R^{2/3} * S^{1/2}$ and Manning's 'n' value to be 0.014 according to standard notations)
(07 Marks)

