

CVX7345 - Highway Engineering and Design

FINAL EXAMINATION - 2024/2025

Time Allowed: Three (03) Hours

Date: 2026 - 02 - 17 (Tuesday)

Time: 1330 - 1630 hrs.

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

Q1.

- Discuss the *four (04)* main considerations that need to be taken into account, according to the general rationale for classifications of highways. (06 Marks)
- Describe the main differences between the ancient paved 'Roman Roads' and the road deck construction method introduced by the French Engineer Tresaguet in the 18th century. (07 Marks)
- According to the course material, the planning procedure for a new highway development should consist of *four (04)* exercises. Identify and discuss these in the context of Expressway development in Sri Lanka. (07 Marks)

Q2.

- Briefly describe three (03) fundamental characteristics desirable for an efficient road (06 Marks)
- Outline and discuss the *four (04)* significant factors that should be taken into consideration in selecting the alignment, or in other words, the route for a proposed highway. (07 Marks)
- With cognisance given to general route for a proposed highway in the planning stages, implementation of the project will involve final alignment and detailing. Describe the *four (04)* stages through which final detail of a highway alignment could be laid out for construction. (07 Marks)

Q3.

- Describe with illustrations, the *two (02)* main categories and their sub division of "Interrupted Traffic Flow". (06 Marks)
- After differentiating between Time Headway and Space Headway for a traffic flow, compute the Average Speed of vehicular movement on a certain lane of a two lane highway if the, the average 'time headway' was evaluated to be 3.2 seconds/vehicle while the average space headway was evaluated to be 78 m/vehicle. (07 Marks)
- Uniform single lane traffic flow with a constant space headway of 18 m (an ideal situation), spot speed measurements on a stretch of the road using automated Doppler radar and imaging, at a time instant reported 07 vehicles at 40 km/h, 08 vehicles at 45 km/h, 12 vehicles at 50 km/h and 04 vehicles at 55 km/h. Evaluate; a) Vehicle Density, b) Space Mean Speed & c) Traffic Volume (07 Marks)

Q4.

- Define Stopping Sight Distance (SSD) and describe the *two (02)* main components of SSD. (05 Marks)
- Evaluate the Stopping Sight Distance (SSD) required by a vehicle travelling at 60 km/h, to avoid a crash if a pedestrian suddenly started to cross its path, given that coefficient of longitudinal deceleration (d) = 0.48 and SSD is given by the empirical formula; $SSD = R_T V / 3.6 + V^2 / (254 * d)$. Assume a realistic value for driver reaction time R_T in seconds (05 Marks)
- State and explain the *two (02)* types of sight distances in relation to 'Overtaking Sight Distance' which has to be maintained for a certain period of time to complete an overtaking manoeuvre. (05 Marks)



- iv.) Persons travelling in a vehicle going over a vertical curve would feel discomfort due to rapid changes of vertical acceleration. Describe the two levels in the 'Comfort Criteria' generally adopted in highway design and evaluate whether any one of these criteria gets satisfied at a vertical curve length of 60 m in a highway with a gradient change of 4% for a vehicle travelling at 40 km/h. [Use equation for vertical acceleration ' $a = v^2 A / (100L)$ ' - where A is the gradient change (%) and v is the vehicle speed in m/sec] (05 Marks)

Q5.

- Using a sketch of a cross section pertaining to a typical two lane highway, identify at least five (05) significant components and write a brief descriptive note on each. (05 Marks)
- Briefly describe the expected functions of a 'centre median' as a significant component of a two lane highway. (05 Marks)
- Briefly describe the expected functions of a 'shoulder' as a significant component of a highway. (05 Marks)
- Briefly describe the four main considerations to be accounted for, when a carriageway is to be widened on a curve. (05 Marks)

Q6.

- Bitumen is the most commonly used binder for flexible highway pavements and in the present day bitumen is available in at least three different forms for application. Out of these bitumen types, describe the similarities and differences between "Bitumen Emulsions" and "Cut-back Bitumen". (06 Marks)
- In detail describe different types of significant failures in highway pavements during their service life, along with explanations on the mechanisms related to each type of failure. (07 Marks)
- Flexibility of bitumen as a structural binder of aggregate for highway construction is generally determined by the ductility test conducted under laboratory conditions. Using a description of the related apparatus, describe this laboratory test. (07 Marks)

Q7.

- Based on the particle size distribution of coarse grained soils, they can be assigned different grading classes. With the aid of a neat sketch of a particle size distribution curve on a semi-log scale describe; a) well graded, b) poorly graded, c) gap graded soils (06 Marks)
- Describe the purpose and procedure adopted to conduct the California Bearing Ratio (CBR) test. (07 Marks)
- Clearly identify the three main constituents of a soil and explain the meaning of 'textural classification' based on these three constituents. With the aid of provided 'triangle of textural classification diagram' identify the classifications into which following soil samples fall.
 - Clay - 45%, Silt - 35% and Sand 20%
 - Clay - 20%, Silt - 40% and Sand 40%
 - Clay - 50%, Silt - 45% and Sand 05%

(07 Marks)

