



## TECHNICAL UNIVERSITY OF MOMBASA

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FACULTY OF ENGINEERING AND TECHNOLOGY  
DEPARTMENT OF BUILDING & CIVIL ENGINEERING  
**UNIVERSITY EXAMINATION FOR:**  
BACHELOR OF SCIENCE IN CIVIL ENGINEERING

ECV 4507 : HIGHWAY ENGINEERING II

SPECIAL/SUPPLEMENTARY EXAMINATION  
**SERIES: JULY 2025**  
**TIME: 2 HOURS**

### **Instructions to Candidates**

You should have the following for this examination

*-Answer Booklet, examination pass and student ID*

This paper consists of five questions.

Attempt question ONE (Compulsory) and any other TWO questions.

**Do not write on the question paper.**

### **QUESTION ONE (COMPULSORY) 30 Marks**

- a) With the aid of a diagrammatic representation of the laboratory apparatus, outline how a Bitumen Penetration test is carried out (10 Marks)
- b) Explain the term 'stage construction' and highlight at least FIVE circumstances in which it is advantageous in Pavement design' (8 Marks)
- c) With the aid of a sketch, outline the FOUR layers of flexible pavements and briefly explain the function of each layer (12 Marks).

**ANSWER ANY TWO QUESTIONS FROM THIS SECTION**

**QUESTION TWO (20 Marks)**

- a) With the aid of a diagrammatic representation of the laboratory apparatus, outline how a CBR test is done in the laboratory (13 Marks)
- b) A CBR test on a sample of subgrade yielded the data shown in Table Q2b. Determine the CBR of the subgrade. Refer to Table Q2a for Standard force-penetration relationship (CBR = 100%) ( 7 Marks)

**Table Q2a.** Standard force-penetration relationship (CBR = 100%)

Penetration (mm)	Load (kN)
2	11.5
4	17.6
6	22.2
8	26.3
10	30.3
12	33.5

**Table Q2b** Laboratory CBR results of sample

Penetration (millimetres)	Load (kN)
0.5	1.6
1.0	3.3
1.5	4.9
2.0	6.6
2.5	8.2
3.0	9.3
3.5	10.5
4.0	11.4
4.5	12.2
5.0	13.0

### **QUESTION THREE (20 Marks)**

- a) Outline the three subgroups of flexible pavements (6 Marks)
- b) Discuss the two forms of maintenance of bituminous roads (14 marks)

### **QUESTION FOUR (20 Marks)**

- a) Discuss the main purpose of road drainage systems and highlight at least SIX defects caused by Improper Road Drainage (10 Marks).
- b) State at least FIVE advantages and THREE disadvantages of a rigid pavement as compared to a flexible one (8 Marks)
- c) Differentiate between Mechanical and Chemical stabilization (2 Marks).

### **QUESTION FIVE (20 Marks)**

- a) With the aid of a diagram, outline how a bitumen softening point test is done in the laboratory (12 Marks)
- b) A new road is proposed to have a design life of 20 years, average daily number of standard axles of 1,800 with an annual growth rate of 4%. Calculate the cumulative number of standard axles ( 8 Marks)