



MACHAKOS UNIVERSITY

UNIVERSITY EXAMINATIONS 2024/2025

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

**FIRST YEAR FIRST SEMESTER EXAMINATION FOR BACHELOR OF
SCIENCE IN CIVIL ENGINEERING**

ECV 111: MATERIAL SCIENCE

Date:

Time :

INSTRUCTIONS

- *This paper comprises of **FIVE** questions. Answer **THREE** questions*
- *Question one is **Compulsory** and carries 30 marks*
- *Answer any other **TWO** questions*

QUESTION ONE

a) Describe the following mechanical properties of engineering materials.

- Hardness (2 Marks)
- creep (2 Marks)
- Ductility (2 Marks)

b) Briefly explain the characteristics of covalent bond (4 Marks)

c) With the aid of a labelled diagram show the characteristics of a stress- strain curve for a tensile test on a mild steel test piece and explain the various stages as relates to the behavior of the test piece during the testing process (4Marks)

- d) Explain the three key stages of fatigue (3Marks)
- e) What are the main Properties of Cement: (4Marks)
- f) Explain how rubber polymers vary the strength and the viscoelastic properties of the bitumen.
(4Marks)
- g) A rod of 150 cm long and of diameter 2.0 cm is subjected to an axial pull of 20kN. If the modulus of elasticity of the material of the rod is $2 \times 10^5 \text{ N/mm}^2$;
Determine
i. The stress
ii. The strain
iii. The elongation of the rod (3Marks)
- h) Elaborate the special properties that make fibers very attractive for numerous applications
Low number of defects;

QUESTION TWO

- a) List and discuss the effects of common alloying elements in steel (10Marks)
- b) Discuss the advantages and disadvantages of ferrous metals (10Marks)

QUESTION THREE

- a) State the explain the Advantages of Reinforced Concrete (10Marks)
- b) Discuss why Bitumen is used in road construction (10Marks)

QUESTION FOUR

- a) What Are the Main Uses of Fiber-Reinforced Plastic? (5 Marks)
- b) Discuss the chemical properties of plastics (8Marks)
- c) Discuss the classification of ceramics based on composition (8 Marks)

QUESTION FIVE

- a) What are the factors to be considered during selection of materials (5 Marks)
- b) Describe how hardness of engineering materials can be determined (6Marks)
- c) Discuss the following mechanical tests
 - i. Impact tests
 - ii. Creep tests
 - iii. Fatigue tests (9Marks)