

BE



KIBABII UNIVERSITY

**UNIVERSITY EXAMINATIONS
2023/2024 ACADEMIC YEAR**

**THIRD YEAR FIRST SEMESTER
MAIN EXAMINATIONS**

FOR THE DEGREE OF BED (SCIENCE)

COURSE CODE: SPH 317

COURSE TITLE: PROPERTIES OF MATTER

DATE: 6/12/2023

TIME: 9:00-11:00AM

INSTRUCTIONS TO CANDIDATES

TIME: 2 Hours

Answer question ONE and any TWO of the remaining

KIBU observes ZERO tolerance to examination cheating

QUESTION ONE (30 marks) compulsory

- a) Define the following terms: (3mks)
- i) Rigid body
 - ii) Deforming force
 - iii) Elasticity
- b) Distinguish between perfect elastic bodies and perfectly plastic bodies. (2mks)
- c) State three types of stress (3mks)
- d) Define the term strain (1mk)
- e) Show that $Y = 3\kappa(1 - 2\sigma) Y$ where Y is the Young's modulus, κ is bulk modulus and σ is a Poisson's Ratio. (7mks)
- f) State three modulus of Elasticity (3mks)
- g) Consider a cylindrical rod of length, l radius r and modulus of rigidity n fixed at upper end and twisted at the lower free end by means of a couple moments I in a plane perpendicular to the length of the rod such that the axis of the twisting couple coincides with the axis of the cylinder. Show that the moment of this force is given by

$$\tau = \frac{\pi n r^4}{2l} \phi \quad (9mks)$$

- h) State any two differences between uniform bending and non – uniform bending (2mks)

QUESTION TWO (20 marks)

- a) State two applications of Girders (2mks)
- b) A solid cylinder of 2cm radius weighing 200g is rigidly connected with its axis vertical to the lower end of the wire. The period of oscillation of the cylinder under the influence of the torsion of the wire is 2 seconds. Determine the couple necessary to twist it through 4 complete turns. (10mks)
- c) Obtain an expression for depression of a cantilever of length, l fixed at one end and loaded at the other. (8mks)

QUESTION THREE (20 marks)

- a) Define the term angle of twist of a given material (1mk)
- b) Consider a cylindrical rod of length l , radius r and modulus of rigidity η fixed at upper end and twisted at the lower free end by means of a couple of moment τ in a plane twisting couple coincides with the axis of the cylinder. Obtain an expression for this couple of moment τ in terms of the aforementioned parameters. (8mks)

- c) Obtain an expression for moment of inertia of an irregular body. (6mks)
- d) Consider a wire AB of length l and radius r fixed at the upper end A and the lower end B clamped to the disc. Obtain an expression for its modulus of rigidity in terms of the time period of pendulum without any masses, T_0 (5mks)

QUESTION FOUR (20marks)

- a) State three key requirements for a good shaft. (3mks)
- b) Consider a solid and hollow shaft of same mass, length and material for hollow shaft of external and internal radii r_2 and r_1 respectively, subjected to an external couple, the couple unit twist. Show that hollow shaft is stronger than the solid shaft of same length, mass and material. (6mks)
- c) State any three properties of material selected for making shafts. (3mks)
- d) Obtain an expression for bending moment of a beam whose one end is clamped and the other end is depressed by a load, in terms of Young's modulus. (8mks)

QUESTION FIVE (20marks)

- a) What is a cantilever (1mk)
- b) The couple for unit twist for a certain solid cylinder of radius r is $100Nm$. Calculate the contribution of this couple due to the central part up to radius $\frac{r}{4}$ and due to the outer most part between radii $\frac{3r}{4}$ and r . (8mks)
- c) The modulus of rigidity and Poisson's ratio of the material of a wire are $2.87 \times 10^{10} N/m$ and 0.379 respectively. Find the Young's modulus of the wire. (4mks)
- d) For the same cross-section area, show that the beam of a square cross section is stiffer than the area of a circular cross-section of the same material. Find the ratio of the depression for a given load. (5mks)
- e) Define the following terms: (2mks)
- i) Moment of inertia
- ii) Radius of gyration