



JARAMOGI OGINGA ODONGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

SCHOOL OF ENGINEERING AND TECHNOLOGY

**UNIVERSITY EXAMINATIONS FOR THE DEGREE IN SCIENCE IN RENEWABLE
ENERGY TECHNOLOGY AND MANAGMENT**

2NDYEAR 1STSEMESTER 2018/2019 ACADEMIC YEAR

CENTRE: MAIN CAMPUS

COURSE CODE: TET 3212

COURSE TITLE: SOLID MECHANICS

EXAM VENUE: STREAM: BSc REN ENERGY TECH & MGT

DATE: ../12/2018 EXAM SESSION:

DURATION: 2 HOURS

Instructions

- 1. Answer question 1 (Compulsory) and ANY other two questions**
- 2. Candidates are advised not to write on question paper**
- 3. Candidates must hand in their answer booklets to the invigilator while in the examination room**

QUESTION ONE (COMPULSORY)

- a) Define stress and strain and give their SI units. (4 marks)
- b) Discuss any three types of stresses. (6 marks)
- c) What do you understand by the term volumetric strain? (2 marks)
- d) A rod 150cm long and of diameter 2.0cm is subjected to an axial pull of 20 kN.
If the modulus of elasticity of the material of the rod is 2×10^5 N/mm, determine:
(i) the stress
(ii) the strain, and
(iii) the elongation of the rods. (6 marks)
- e) Define strain energy (2 marks)
- f) Show that the expression for strain energy, U , stored in a body when the load is applied gradually is given by $U = \frac{\sigma^2 v}{2E}$, where the symbols have their usual meaning. (6 marks)
A tensile load of 50kN is gradually applied to a circular bar of 5cm diameter and 5m long. What is the strain energy absorbed by the rod? ($E = 200\text{GPa}$) (4 marks)

QUESTION TWO

- a) Define Hook's law and write the governing equation. (4 marks)
- b) Distinguish clearly between ductile material and brittle material giving example in each case. (4 marks)
- c) Draw standard stress - strain curve for a mild steel specimen when subjected to a tensile force and explain the salient points in the curve. (10 marks)

QUESTION THREE

- a) Differentiate between young's modulus and bulk-modulus. (2 marks)
- b) Define lateral strain and longitudinal strain. (2 marks)
- c) What do you understand by the term Poisson's ratio? (2 marks)
- d) State the relationship between Young's Modulus and Modulus of Rigidity. (2 marks)
- e) A tensile test was conducted on a mild steel bar. The following data was obtained from the test:
- Diameter of the steel bar = 3 cm
 - Gauge length of the bar = 20cm
 - Load at elastic limit = 250 kN
 - Extension at a load of 150 kN = 0.21 mm
 - Maximum load = 380 kN
 - Total extension = 60 mm
 - Diameter of rod at failure = 2.25 cm

Determine:

- i. The Young's modulus
- ii. The stress at elastic limit
- iii. The percentage of elongation
- iv. (4) The percentage decrease in area.
(12 marks)

QUESTION FOUR

- a) Define torsion (2 marks)
- b) The torsional equation is based on a number of assumptions, list any four of the assumptions. (4 marks)
Write the expression for torsional equation identifying each term in the equation. (4 marks)
- c) A hollow circular shaft 200mm thick is to be used to transmit power of 294Kw at 200 rpm. Determine the diameter of the shaft that should be used if shear strain due to torsion is not to exceed 0.00086. Take $G = 80\text{GN/m}^2$. (10 marks)

QUESTION FIVE

- a) Define and explain any three theories of failure. (6 marks)
- b) What do you understand by the word torsional rigidity (2 marks)
- c) In a close-coiled helical spring, the diameter of each coil is to be 12 times the diameter of the spring and the maximum shear stress is not to exceed 75 N/mm. Maximum permissible deflection under a load of 500 N is 12 cm. Taking shear modulus as $8 \times 10^4 \text{ N/mm}^2$, determine the number of coils, diameter of the coil and energy stored in the spring. (12 marks)