

UNIVERSITY OF ESWATINI

FACULTY OF SCIENCE

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

MAIN EXAMINATION DECEMBER 2018

TITLE OF PAPER: **ENGINEERING MECHANICS AND MATERIALS SCIENCE**

COURSE CODE: **EEE201/EE201**

TIME ALLOWED: **3 HOURS**

INSTRUCTIONS:

1. Answer all **four (4) questions**
2. Each question carries 25 marks.
3. Marks for different sections are shown in the right-hand margin.

THIS PAPER SHOULD NOT BE OPENED UNTIL PERMISSION HAS BEEN GRANTED BY THE INVIGILATOR

Question 1

- a) Define the terms stress and brittleness of a material. (4 marks)
- b) Four horizontal wires are attached to a telephone pole and exert tensions of 50 N to the south, 60 N to the east, 50 N to the north-east and 50 to the north west. Determine the tension and direction of an additional horizontal wire that must be attached to the pole so that resultant force on the pole is zero. (13 marks)
- c) A copper rod of diameter 2 cm and length 4 m has a tensile force of 5 kN applied to it. If the modulus of elasticity for copper is 96 GPa, determine
- i) the stress in the rod, and (4 marks)
- ii) by how much the rod extends when loaded. (4 marks)

Question 2

- a) Give a definition of torsion of a shaft. (2 marks)
- b) A diesel engine of 67 hp transmits power to a generator at 300 revolutions per minute. The maximum shear stress in the shaft is limited to 64 MPa. Neglecting any transmission losses.
- i) Determine the torque applied to the shaft connecting the engine and the generator. (7 marks)
- ii) Determine the minimum permissible diameter of a solid circular section steel shaft. (9 marks)
- Given that the shaft is 1 metre long and 0.055 meter in diameter, and the rigidity modulus is 70 GPa. What would be the resulting angle (in degrees) of twist of the shaft due to the applied torque of 1.5708 kN m, (7 marks)
- [Note that $1 \text{ hp} = 745.7 \text{ W}$; $\frac{\tau}{r} = \frac{T}{J} = \frac{G\theta}{L}$ and $J = \frac{\pi r^4}{2}$].

Question 3

Determine the expressions for bending moment and for the simply supported beam shown in **Figure Q3** below, then plot the bending moment and shearing force diagram. (25 marks)

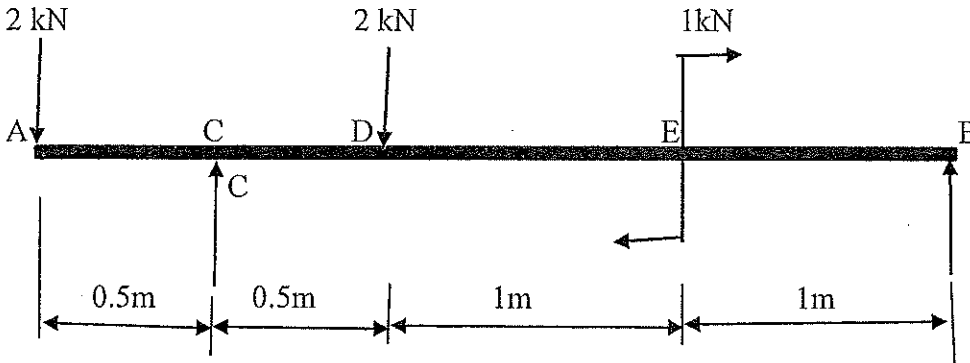


Figure Q3

Question 4

Find the reaction forces (R_1 , R_2 , R_3), and the internal forces (F_1 , F_2 , F_3) for the pin-jointed truss shown in **Figure Q4** below. (25 marks)

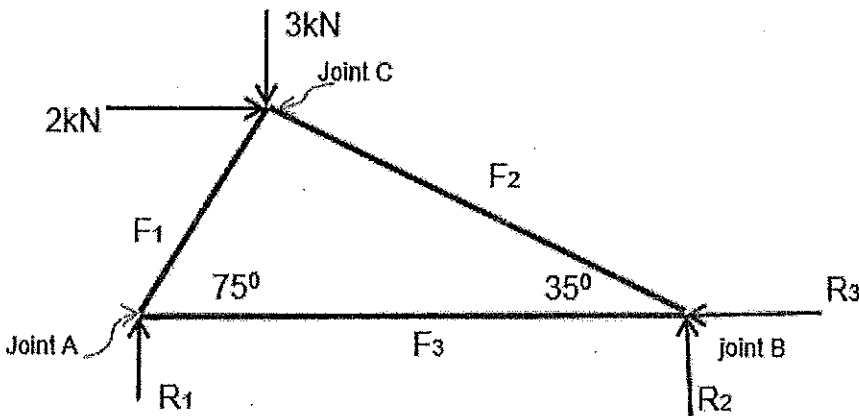


Figure Q4