TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering and Technology
Department of Mechanical & Automotive Engineering
UNIVERSITY EXAMINATION FOR:
Diploma in Mechanical Engineering
EME 2206 : Solid & Structural Mechanics II
SPECIAL/ SUPPLEMENTARY EXAMINATION
SERIES: AUGUST 2019
TIME: 2 HOURS
DATE: Pick Date **Aug 2019**

Instruction to Candidates:

You should have the following for this examination

- *Student I.D. Card & Examination Pass*
- *Answer booklet*
- *Non-Programmable scientific calculator*

This paper consists of **FIVE** questions. Attempt any **THREE** questions.
Maximum marks for each part of a question are as shown.
Do not write on the question paper.

Question ONE

a) Working from the first principles show that for a solid shaft transmitting power

$$T/J=\tau/r$$

Where
T = torque transmitted
τ = Maximum shear stress
J= Polar second moment of area
r = Shaft radius

(8 marks)

b) A solid circular steel shaft 1.5m long has its diameter turned down from 45 mm to 35 mm diameter over a length of 0.5 m. it is used to transmit 80kw of power at 1400 rev/min. determine the maximum stress developed in the 45mm diameter section and the total angular twist in degrees. Take G = 80 GN/m^2.

(12 marks)

Question TWO

A laminated steel spring simply supported at the ends and centrally loaded with span of 0.8m is to carry a load of 10 kN and the central deflection is not to exceed 5 mm. The bending stress must not be greater than 400 MN/m^2. If the Young's modulus for steel is 200 GN/m^2 determine for the plates:

a) Thickness
b) The width
c) The number of plates
d) The radius to which the plates should be formed

Assume the width to be twelve times the thickness.

(20 marks)

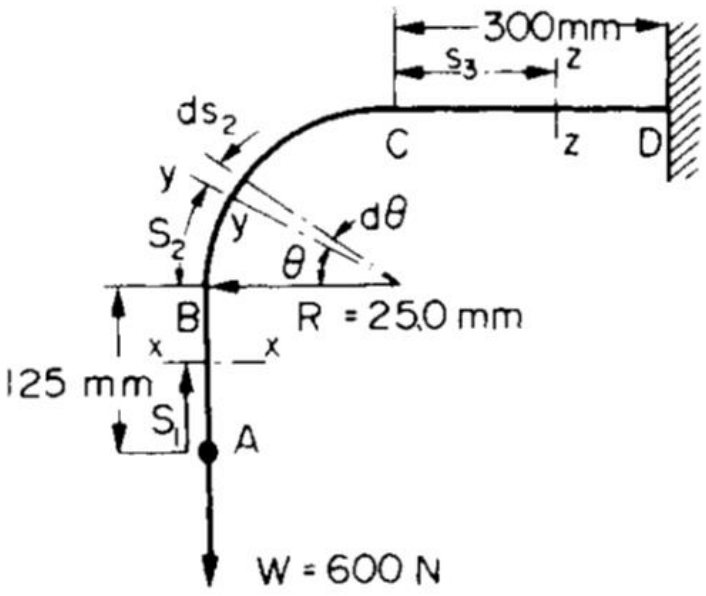
Question THREE

A close-coiled helical spring is to have a stiffness of 90 kN/m and to exert a force of 3 kN/m. the mean diameter of the coils is to be 75 mm and the maximum stress is not to exceed 240 MN/m^2. Calculate the required number of coils and the diameter of the steel rod from which the spring should be made. **(20 marks)**

Question FOUR

A hollow circular steel shaft is required to transmit 40 kW of power at a speed of 1200 rev/min. The inside diameter is to be half of the outside diameter. The maximum stress in the shaft should not exceed 45 MN/m^2 and the angular twist per metre length is not to exceed 1.2°. Find the minimum diameter of the shaft required. **(20 marks)**

Question FIVE



Determine by the method of either *unit load* or *Castigliano's first theorem*;

a) The vertical deflection of point A of the bent cantilever shown in the figure when loaded at A with a vertical load of 600N.
b) What will then be the horizontal movement of A?

The cantilever is constructed from 50 mm diameter bar throughout, with E = 200 GN/m^2.

(20 marks)