



MACHAKOS UNIVERSITY

University Examinations 2017/2018

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

THIRD YEAR SECOND SEMESTER EXAMINATION FOR DIPLOMA IN
MECHANICAL ENGINEERING
STRENGTH OF MATERIALS III

DATE: 15/12/2017

TIME: 8.30-10.30 AM

INSTRUCTIONS

- This Examination contains two sections A and B
- Section A is compulsory
- Attempt any other two questions from section B

SECTION A: COMPULSORY

1. a) Derive the equation for strain energy for a beam carrying:-
 - i. shear load
 - ii. bending load (20 marks)
- b) Show from first principles that for a bar of cross sectional area A, length L and subjected to a tensile force P, resilience is given by the expression;
$$resilience = \frac{1}{2} strain \times stress$$
 (10 marks)

SECTION B: SELECT ANY TWO QUESTIONS

2. a) Show that the torsional strain energy of a solid circular shaft transmitting power at a constant speed is given by the equation

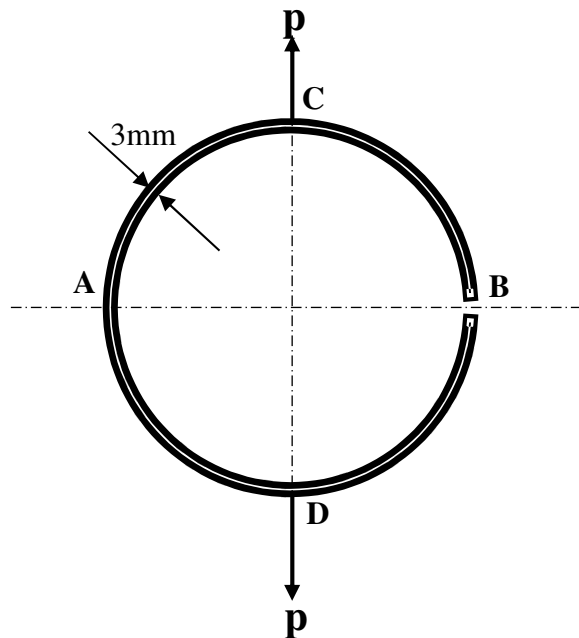
$$U = \frac{\tau^2}{4G} \times volume$$
 (10 marks)

- b) Two shafts are of the same material, length and weight. One is solid and 0.12m diameter and other is hollow. If the hollow is to store the same amount of energy as the solid shaft when transmitting torque, what must be its internal and external diameters? Assume the same maximum shear stress applies to both shafts.

(10 marks)

3. The ring below is made of flat steel strip 20mm x 3mm and is shaped in the form of a circle of mean diameter 0.2m. the ends at B are cut square and not jointed. A pull P is applied along the diameter CD which is at right angles to the diameter AB. If the maximum tensile stress due to P is 125MN/m^2 , find the increase in the opening at B due to P. $E = 200\text{GN/m}^2$.

(20 marks)



4. a) A close-coiled helical spring of mean diameter D is subjected to an axial load W. If the number of coils and wire diameter are n and d respectively, show from first principles that the spring rate S is given by:-

$$S = \frac{Gd^4}{8nD^3} \quad (10 \text{ marks})$$

- b) A close-coiled helical spring has to absorb 50 joules of energy when compressed 50mm. The coil diameter is eight times the wire diameter. If there are ten coils, estimate the diameters of coil and wire and the maximum shear stress $G = 85,000\text{N/mm}^2$.

(10 marks)

5. a) Show for a spring consisting of n parallel of width b carrying a central vertical load W which is balanced by equal end reactions that the deflections of the ends relative to the centre is:-

$$\delta = \frac{3WL^3}{8nEbt^3}. \quad (16 \text{ marks})$$

- b) A quarter-elliptic leaf spring has a length 0.5m and consists of plates each 50mm wide and 6mm thick. Find the least number of plates which can be used if the deflection under a gradually applied mass of 200kg is not to exceed 70mm.

$E = 200\text{GN/m}^2.$ (4 marks)