MACHAKOS UNIVERSITY

University Examinations 2018/2019

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

THIRD YEAR SPECIAL/SUPPLEMENTARY EXAMINATION FOR

DIPLOMA IN MECHANICAL ENGINEERING

STRENGTH OF MATERIALS III

DATE: 1/8/2019 **TIME: 2.00-4.00 PM**

INSTRUCTIONS:

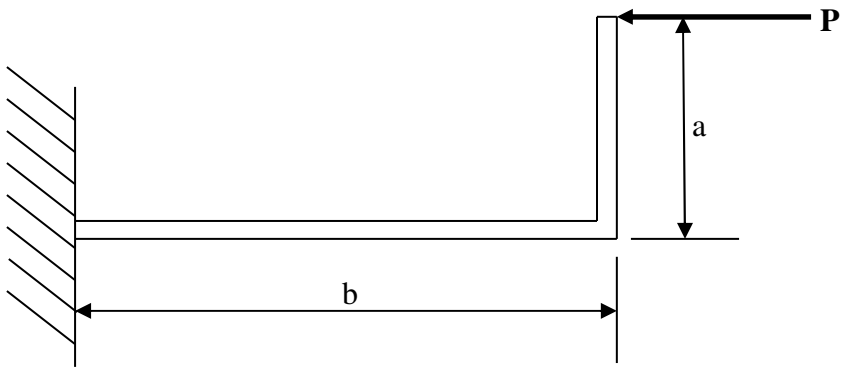
Answer Question One (Compulsory) and Any Other Two Questions

1. a) derive the equation for strain energy for a beam carrying:-

   i. shear load

   ii. bending load (20 marks)

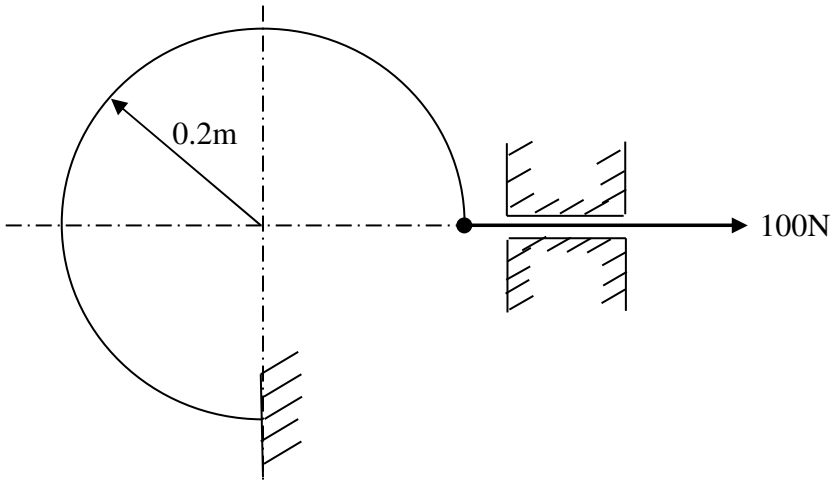
   b) A bar of constant section, second moment of area I, is bending as shown below, and fixed at one end. Find the horizontal deflection at the free end. (10 marks)



2. A solid steel rod 1m long has a diameter of 25mm except for the Centre portion 300mm long where diameter has been turned down to 15mm. Determine the strain energy stored in the rod when a tensile load of 50kN is gradually applied. Determine also the diameter required for a brass rod of the same length and of constant diameter which will have the

same proof resilience as the steel rod. E_{steel} = 210kN/mm^2, E_{brass} = 85kN/mm^2, yield stress: steel = 220N/mm^2, brass 140Nmm^2 (20 marks)

3. A steel rod, 10mm diameter, is bent into the shape below. One end being rigidly clamped, the other being constrained to move in a horizontal slide. Determine the horizontal deflection of the slider when acted upon by a force of 100N. E = 200GN/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:-

$$S = \frac{Gd^4}{8nD^3}$$ (10 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 = 85,000N/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:-

$$\delta = \frac{3WL^3}{8nEbt^3}.$$ (16 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 = 200GN/m^2. (4 marks)