B.Tech. Degree II Semester Regular and Supplementary Examination in Marine Engineering September 2021

### 19-208-0206 MECHANICS OF SOLIDS
(*2019 Scheme*)

Time: 3 Hours

Maximum Marks: 60

$(5 \times 15 = 75)$

I. (a) A tapering rod has diameter d_1 at one end and it tapers uniformly to a   (7)
diameter d_2 at the other end in a length L. If modulus of elasticity of the
material is E, find its change in length when subjected to an axial force P.

(b) Three pillars, two of aluminium and one of steel support a rigid platform of   (8)
250 kN as shown in figure below. If area of each aluminium pillar is
1200 mm^2 and that of steel pillar is 1000 mm^2, find the stresses developed
in each pillar. Take Es = 2×10^5 N/mm^2 and Ea = 1×10^6 N/mm^2.
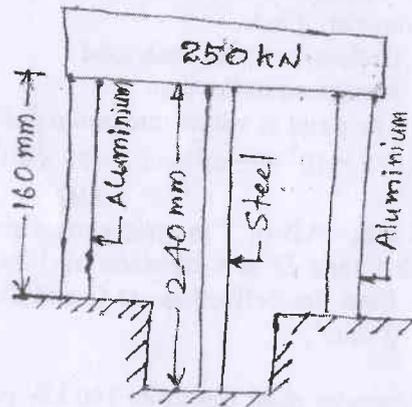
OR

II. (a) A 400 mm long bar has rectangular cross-section 10 mm × 30 mm. This bar is   (7)
subjected to
(i)   15 kN tensile force on 10 mm × 30 mm faces
(ii) 80 kN compressive force on 10 mm × 400 mm faces
(iii) 180 kN tensile force on 30 mm × 400 mm faces
Find the change in volume if E = 2×10^5 N/mm^2 and Poisson's Ratio = 0.3.

(b) State of stress at a point in a material is as shown in the figure below: (8)
Determine
(i)   principal stresses
(ii) maximum shear stress
(iii) plane of maximum shear stress
(iv) the resultant stress on the plane of maximum shear stress
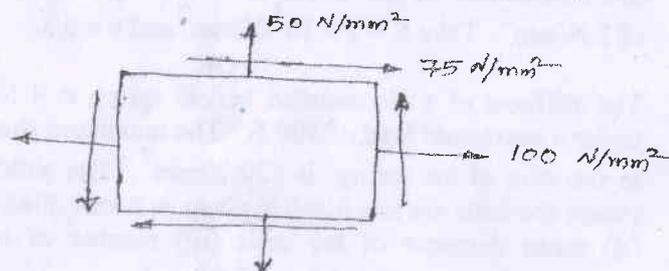
III.   Draw the SF and BM diagrams for the beam shown in Fig. shown below   (15)
         and find out the position and the magnitude of maximum moment.
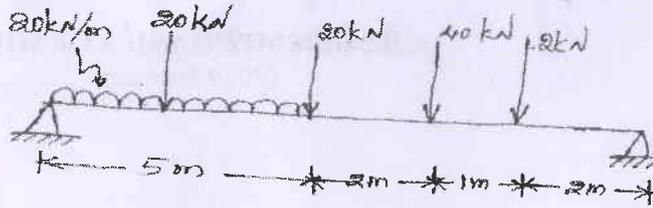
OR

IV.   A circular steel pipe of external diameter 60 mm and thickness 8 mm is   (15)
         used as a simply supported beam over an effective span of 2 m. If
         permissible stress in steel is 150 N/mm^2, determine the maximum
         concentrated load that can be carried by it at mid span.

V.   A beam of length 6 m is simply supported at its ends and carries two point   (15)
         loads of 120 kN and 60 kN at a distance of 1 m and 3 m respectively from
         the left support. Find:
         (i)   Deflection under each load
         (ii) Maximum deflection
         (iii) The point at which maximum deflection occurs.
         Given E = 2 × 10^5 N/mm^2 and I = 85 × 10^6 mm^4

OR

VI.   A fixed beam AB of 5 m span carries point loads of 120 kN and 60 kN   (15)
         at points C and D at a distance of 1 m and 3 m respectively from the
         end A. Find the deflections at C and D. Take E = 2 × 10^8 kN/m^2 and
         I = 8 × 10^8 mm^4.

VII.   A solid circular shaft transmits 100 kW power at 200 r.p.m. Calculate the   (15)
         shaft diameter, if the twist in the shaft is not to exceed 1^0 in 2 meters
         length of shaft, and shear stress is limited to 80 N/mm^2. Take Modulus of
         rigidity G = 1 × 10^5 N/mm^2.

OR

VIII.   A simply supported beam of length 4 meter is subjected to a uniformly   (15)
         distributed load of 40 Kn/m over the whole span and deflects 15 mm at the
         centre. Determine the crippling loads when this beam is used as a column
         with the following conditions:
         (i)   One end fixed and other end hinged
         (ii) Both the ends pin jointed

IX.   A cylindrical shell 3 meters long which is closed as the ends has an   (15)
         internal diameter of 1 m and a wall thickness of 15 mm. Calculate the
         circumferential and longitudinal stresses induced and also changes in
         the dimensions of the shell, if it is subjected to an internal pressure
         of 2 N/mm^2. Take E = 2 × 10^5 N/mm^2 and v = 0.3.

OR

X.   The stiffness of a close-coiled helical spring is 4 N/mm of compression   (15)
         under a maximum load of 100 N. The maximum shearing stress produced
         in the wire of the spring is 120 N/mm^2. The solid length of the spring
         (when the coils are touching) is given as 5 cm. Find: (i) diameter of wire,
         (ii) mean diameter of the coils (iii) number of coils required. Take
         Modulus of rigidity G = 4.5 × 10^4 N/mm^2.

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