INDIAN MARITIME UNIVERSITY

(A Central University, Govt. of India)

End Semester Examinations –June-July 2019

B. Tech (Marine Engineering)

Semester-II

Strength of Materials – I

(UG11T2204)

Date: 02-07-2019 **Max Marks: 100**

Time: 03 Hrs. **Pass Marks: 50**

Note: i. Use of approved type of scientific calculator is permitted.

ii. The symbols have their usual meanings.

Part –A
(Compulsory Question) (3x10 = 30 Marks)

1.(a) Write the relation between Modulus of Elasticity, Modulus of Rigidity and Bulk Modulus.

(b) Define Resilience, Proof Resilience, Modulus of Resilience.

(c)Explain with neat sketches the sign convention for drawing Shear Force Diagram and Bending Moment Diagram.

(d) Derive the formula for Hoop Stress in a thin cylindrical shell

(e) Write the formula for change in volume of a thin cylindrical shell, explaining the meaning of each and every variable.

(f) With a neat sketch, explain for a fillet weld the terms, the size of a fillet weld, the throat of fillet weld. State the relation between the two.

(g) For a simply supported beam of length L(m) carrying an uniformly distributed load 'w' (N/m),derive the formula for maximum bending moment.

(h) Define yield stress, working stress and factor of safety based on yield stress.

(i) Define the term Spring Constant for a spring, write the formula for Spring Constant, state the unit of spring constant.

(j) Define Torsional Stiffness. State its formula. Write the unit of Torsional Stiffness.

Part – B (5 x 14 = 70 Marks)

(Answer any five of the following)

Q.2 (a) If a round bar of 37.5 mm diameter and 2.4m length is stretched by 2.5mm, find its bulk modulus and lateral contraction. Take modulus of elasticity = 110 GN/m^2 and shear modulus = $42GN/m^2$ for the material of the bar. (4+3)

(b) A steel block 360mm x 160 mm x 80 mm is subjected to the following forces :

(i) A tensile force of 1280 KN on the 160mm x 80 mm face (take as a X-directions)

(ii) A tensile force of 3456 KN on 360mm x 80 mm faces (take as a Y – direction) and

(iii) A compressive force of 5184 KN on the 360mm x 160mm faces (take as a Z-direction).

Find the changes in the dimensions of the block and also the change in volume.(Take E=200 GN/m^2 and $\mu = 0.25$). (3+2+2)

Q.3(a) A steel rod of 30mm diameter and 5m long is connected to two grips and the rod is maintained at a temperature of 95^0 C. Determine the stress and the magnitude of the force exerted when the temperature falls to 30^0 C, if (i) the ends do not yield and (ii) the ends yield by 0.12cm. (Take E=$2x10^5$ MN/m^2 and $\alpha = 12 \times 10^{-6}/^oC$). (2+1+2+2)

(b) A copper rod 36mm diameter is encased and rigidly attached to a steel tube which is 50mm external diameter, wall thickness of the tube being 5mm.The composite section is subjected to an axial pull of 100kN. Find the stress induced in each metal and the extension on the length of 1.5m. (Take E_s =200 GN/m^2 and E_c= 110 GN/m^2). (4+3)

Q.4 (a) A mild steel plate is 400 mm long, 200 mm wide and 50mm thick is subject to sudden tensile load of 1200kN along its length. Calculate :(i) proof resilience (ii) modulus of resilience (iii)elongation(Take E = 200 x 10^3 MN/m^2). (7)

(b) A vertical rod, 1.5 m long is fixed at its upper end and a weight sliding freely on the rod, falls on the collar fixed firmly at its lower end. When the weight falls through a height of 10 mm, the maximum instantaneous stress is 60 MN/m^2.What will be the maximum instantaneous stress developed if the same weight has been dropped through a height at 25mm. (Take E =210 GN/m^2). (7)

Q.5(a) A beam is loaded as shown in Fig. Q5.

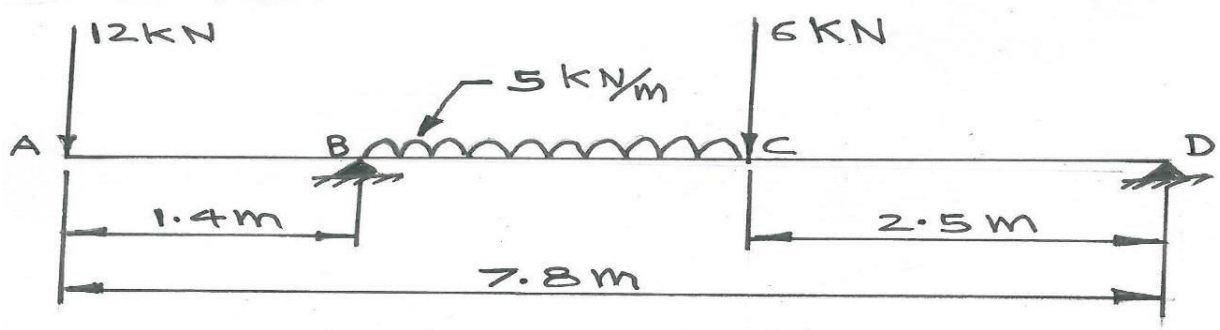

fig. Q5 (a,b)

Calculate Each of the following: (a) Draw SFD and BMD, (5+5)
(b) The position of the point of contra flexure from the left hand side of the beam. (4)

Q6 (a) A 1m long steel tube of internal diameter 80mm, 2mm thick has closed ends and is subjected to internal pressure of $3MN/m^2$. If Modulus of Elasticity E = 200 GN/m^2 and Poisson's ratio μ = 0.3, compute increase in volume of tube. (7)

Q6(b) A spherical shell having 1250mm diameter is manufactured by using 5mm thick plates. It is filled with fluid under pressure of magnitude

1.5MN/m^2 determine surface stress, surface strain, change in diameter and volume, Take E = 200 GN/m^2, Poisson's ratio μ = 0.25. (7)

Q7 (a) A rectangular beam 300mm wide is simply supported over a span of 8m. It carries an uniformly distributed load of 30 KN/m over its entire length. Calculated the depth of the cross section of the beam if the maximum bending stress induced in the beam is not to exceed 120 MN/m^2. (7)

(b) A rectangular column is having a cross section 220 mm wide and 40 mm thick. It is subjected to an axial pull of 250 KN at an eccentricity of 10 mm in the plane which bisects the thickness. Determine the maximum and minimum stresses set up in the section. (4+3)

Q8 (a) A hollow shaft having an internal diameter 40% of its external diameter, transmits 562.5 KW at 100rpm. Determine the external diameter of the shaft if the twist in a length of 2.5m should not exceed 1.3^0. Assuming that the maximum torque=1.25 times the mean torque, G= 90 GN/m^2. (7)

(b) A valve is fitted with two close coiled springs fitted in parallel, each of same material and with same free length. The outer spring has 14 coils, mean diameter 120mm and wire diameter 8mm. The inner spring has 20coils of wire diameter 5mm. Each spring is to have the same shear stress when the springs are compressed. Calculate EACH of the following:
(a) the mean coil diameter of innerspring, (4)
(b) the stiffness of the combined springs, (3)
Note: Modules of rigidity for spring material = 70 GN/m^2.

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