CBCS SCHEME

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15AE54

Fifth Semester B.E. Degree Examination, Dec.2018/Jan.2019
Aircraft Structures - I

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing one full question from each module.

Module-1

1 a. Explain stress tensor and stress concentration factor. **(06 Marks)**

b. A point in a body is subjected to tensile stresses 100MPa and 70MPa along two mutually perpendicular directions. The point is also subjected to shear stress of magnitude 50MPa. Determine:

i) Normal stress and shear stress acting on a plane which is at an angle of 120° with reference to the 100MPa stress plane

ii) Magnitude of principal stress and maximum and minimum shear stresses

iii) Orientation of the principal planes

iv) Normal stress on the planes of maximum and minimum shear stresses. **(10 Marks)**

OR

2 a. Explain maximum shear stress theory and maximum strain energy theory. **(06 Marks)**

b. At a certain position along one member with diameter'd' the loading is found to consist of shear force of 10kN together with an axial tensile load of 20kN. If the elastic limit in tension of the material is 270MN/m^2 and factor of safety of 4, estimate the magnitude of 'd' required according to

i) Maximum principal stress theory

ii) Maximum shear strain energy theory. Take Poisson's ratio as 0.283. **(10 Marks)**

Module-2

3 a. A mass of 50kg drops through 25mm at the centre of a 250mm long simply supported beam. The beam has a square cross section and yield strength of 400MN/m^2. Take Young's modulus as 207000 MN/m^2 and factor of safety 2. Determine the dimension of the cross section of beam. **(08 Marks)**

b. Discuss how stress concentration can be reduced in structural components subjected to different loading cases. **(08 Marks)**

OR

4 a. A circular bar of 500mm length is supported freely at its two ends. It is acted upon by a central concentrated cyclic load having a minimum value of 20kN and a maximum value of 50kN. Determine the diameter of bar by taking a factor of safety of 1.5, size effect of 0.85, surface finish factor of 0.9, stress concentration factor of 1. Given ultimate strength = 650MPa, yield strength = 500MPa and endurance strength = 350MPa. **(08 Marks)**

b. Show, how the modified Goodman diagram is constructed, for

i) axial and bending stresses and

ii) torsional shear stresses. **(08 Marks)**

Module-3

5 a. Explain the four basic flight loading conditions with neat sketches. **(08 Marks)**

b. The aircraft shown in Fig Q5b(i) weighs 135kN and has landed such that at the instant of impact the ground reaction on each main under carriage wheel is 200kN and its vertical velocity is 3.5m/s. If each under carriage wheel weighs 2.25kN and is attached to Oelo strut as shown in Fig Q5b(ii), calculate the axial load and bending moment in the strut ; the strut may be assumed to be vertical. Determine also the shortening of the strut when the vertical velocity of the aircraft is zero. Finally calculate the shear force and bending moment in the wing at the section AA if the wing, outboard of this section, weighs 6.6kN and has its C.G 3.05m from AA.

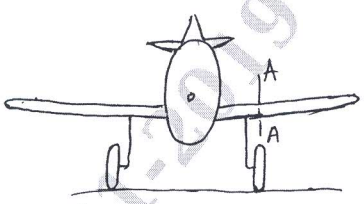

Fig Q5b(i)

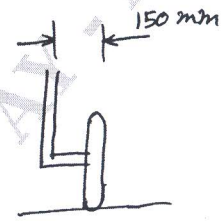

Fig Q5b(ii) **(08 Marks)**

OR

6 a. What are the desirable properties of aircraft materials? **(04 Marks)**

b. Write a note on Aluminum alloys. **(06 Marks)**

c. Write a note on Titanium alloys. **(06 Marks)**

Module-4

7 a. Define: plane stress, plane strain and principle stress. **(06 Marks)**

b. Derive the equations of compatibility for strain in three dimensional system. **(10 Marks)**

OR

8 a. What are statistically determinate and indeterminate structures? give examples. **(06 Marks)**

b. Calculate the reactions at the support for the beam shown in Fig Q8(b). Using Laypersons' 3 moment theorem. **(10 Marks)**

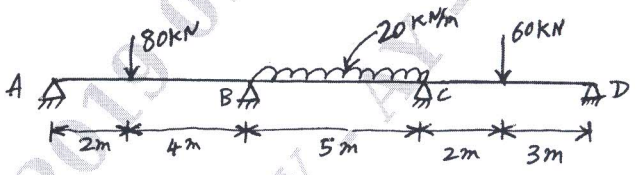

Fig Q8(b)

Module-5

9 a. A solid steel shaft of diameter 160mm and length is subjected to a torque of 45kN-m. If G = 80GPa, determine the strain energy stored in the shaft. **(06 Marks)**

b. A simply supported beam of span 'ℓ' has an overhang of length 'a' on the left. The vertical load 'w' is applied at the end of the overhang. Calculate the deflection of the point of application of the load Castigliano's first theorem. **(10 Marks)**

OR

10 a. Derive an equation for critical buckling load of a column with the end condition, one fixed and the other free. **(08 Marks)**

b. Arrive at an equation for central deflection for a column with initial curvature. **(08 Marks)**

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