CBCS SCHEME

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17AE54

Fifth Semester B.E. Degree Examination, Aug./Sept.2020
Aircraft Structures – I

Time: 3 hrs. Max. Marks: 100

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

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Explain stress concentration factor and stress tensor. **(04 Marks)**

b. An element is subjected to stresses as shown in Fig.Q1(b). Determine :
- i) Normal stress and shear stress acting on a plane which is at an angle of 120° with reference to 100MPa stress plane
- ii) Magnitude of principal stresses and maximum and minimum shear stresses
- iii) Orientations of principal planes and maximum and minimum shear planes
- iv) Normal stress on the planes of maximum and minimum shear stresses.

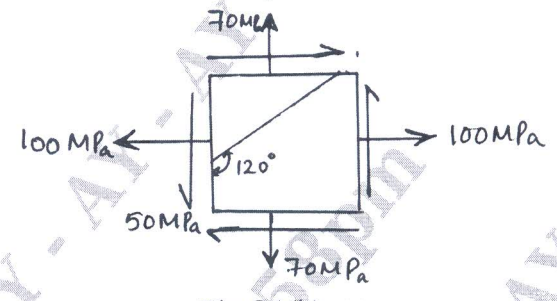

Fig.Q1(b) **(08 Marks)**

c. A 45mm diameter cost rod is subjected to an axial compressive load of 55kN and a torsional moment of 300Nm as shown in Fig.Q1(c). Determine the maximum and minimum normal stresses and shear stresses.

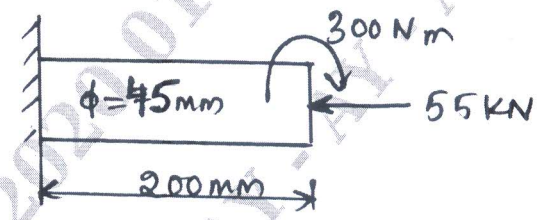

Fig.Q1(c) **(08 Marks)**

OR

2 a. Write a short note on codes and standards. **(04 Marks)**

b. A steel shaft of yield strength 500MPa in tension and 264MPa in shear is subjected to a bending moment of 100N-m and twisting moment of 160N-m. determine the required diameter of the shaft based on :
- i) Maximum principal stress theory
- ii) Treasca's theory
- iii) Maximum strain energy theory
- iv) Distortion energy theory. Take E = 2.1 $\times 10^5$MPa, Poisson's ratio = 0.298 and factor of safety = 2. **(12 Marks)**

c. Briefly explain the various methods to mitigate stress concentration. **(04 Marks)**

Module-2

3 a. What is impact stress? Derive an equation for impact stress due to axial impact. **(08 Marks)**

b. A cantilever beam of span 800mm has rectangular cross section of depth 200mm. The free end of the beam is subjected to a transverse load of 1kN that drops on to if from a height of 40mm. Selecting C40 steel, $\sigma_y = 328.6$MPa, E = 206.8GPa, Factory of safety = 3. Determine the width of rectangular cross section. **(06 Marks)**

c. What is endurance limit? Briefly discuss the factors affecting the endurance limit. **(06 Marks)**

OR

4 a. Derive Soderberg's criteria for fatigue design. **(08 Marks)**

b. A steel shaft made of SAE1045 steel oil quenched is subjected to a repeated bending moment of 500Nm and a reversed twisting moment of 600Nm. Determine the diameter of the shaft based on factor of safety 1.8 according to :

i) Maximum principal stress theory
ii) Tresca's criterion
iii) Vonmises criterion.

Take $\sigma_{uit} = 662$MPa, $\sigma_{yp} = 425$MPa, $\sigma_{en} = 365$MPa, $\tau_{yp} = 241$MPa. Load correction factor for bending and Torsion is 0.9 and 0.5 respectively. Take surface correction factor = size correction factor = 0.85. **(12 Marks)**

Module-3

5 a. With a neat sketch explain V-n diagram. **(10 Marks)**

b. Briefly discuss the different types of loads coming on various parts of an aircraft. **(06 Marks)**

c. Write a short note on safe life and fail safe structures. **(04 Marks)**

OR

6 a. Briefly explain Grifith's theory and basic modes of crack growth. **(08 Marks)**

b. Write a short note on aluminum alloys used in aircraft components. **(06 Marks)**

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

Module-4

7 a. Briefly explain state of stress at a point. **(04 Marks)**

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

c. Briefly explain plane stress and plain strain condition with relevant equations and examples. **(06 Marks)**

OR

8 a. Differentiate statically determinate and indeterminate structures. **(08 Marks)**

b. Check the determinacy of the truss shown in Fig.Q8(b). Also compute the member forces.

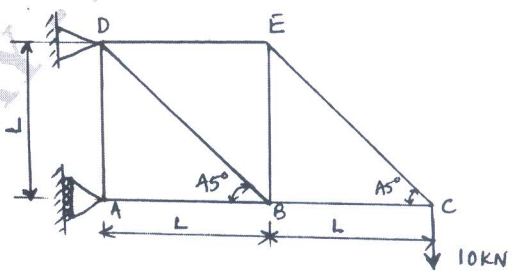

Fig.Q8(b) **(12 Marks)**

Module-5

9 a. Derive an expression for strain energy due to torsion with usual notations. **(06 Marks)**

b. State and explain Castiglino's theorem. Determine the total strain energy and free and deflection for the beam shown in Fig.Q9(b).

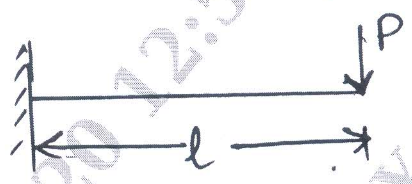

Fig.Q9(b) **(08 Marks)**

c. State and prove Maxwell's reciprocal theorem. **(06 Marks)**

OR

10 a. Drive the expression for Euler's buckling load for a column with both ends hinged. **(08 Marks)**

b. Write a short note on :
   i) Limitations of Euler's theory
   ii) South-well plot. **(04 Marks)**

c. A hollow cast iron column whose outside diameter is 200mm and thickness of 20mm is 4.5m long and is fixed at both ends. Calculate safe load by Rankine's formula using a factor of safety of 2.5. Find the ratio of Euler's to Rankine's loads. Take $E = 1 \times 10^5$MPa and Rankine constant $= \frac{1}{1600}$ and crushing stress $\sigma_c = 550$MPa. **(08 Marks)**

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