CBCS SCHEME

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17AE54

Fifth Semester B.E. Degree Examination, Feb./Mar. 2022
Aircraft Structures - I

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. What are codes and standards? Explain. **(04 Marks)**

b. Briefly explain : i) Stress tensor ii) Factor of safety. **(06 Marks)**

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

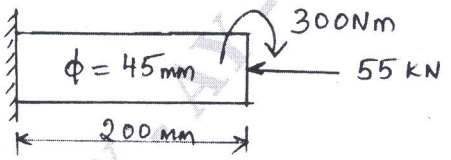

Fig.Q1(c) **(10 Marks)**

OR

2 a. What is stress concentration? How to mitigate the stress concentration? **(06 Marks)**

b. Briefly explain the following failure theories
i) Maximum shear stress theory ii) Distortion energy theory. **(06 Marks)**

c. A steel shaft of yield strength 500MPa in tension and 264 MPa is shear is subjected to a bending moment of 100Nm and a twisting moment of 160Nm. Determine the required diameter of the shaft based on :
i) Maximum principal stress theory
ii) Maximum strain energy theory
iii) Distortion energy theory.
Take $E = 2.1 \times 10^5$ MPa, Poison's ratio = 0.298 and factor of safety = 2. **(08 Marks)**

Module-2

3 a. Derive an expression for impact stress due to axial impact load. **(08 Marks)**

b. A hammer of 4kN strikes the mid span of a simply supported beam of span AM. The beam has a depth of 200mm and a width of 100mm. Determine the height through which the hammer can be allowed fall if the maximum stress is the beam is limited to 100MPa. The modulus of elasticity of beam material is 206GPa. **(06 Marks)**

c. Briefly discuss the endurance strength modification factors. **(06 Marks)**

OR

4 a. Briefly explain the SN diagram for a ferrous material. **(08 Marks)**

b. A steel shaft made of SAE 1045 steel oil quenched is subjected to a repeated bending moment of 500Nm and a reversed turning moment of 600Nm. Determine the diameter of the shaft based on a factor of safety 1.8 according to :
i) Maximum principal stress theory ii) Tresca's criterion iii) Vonmises criterion.
Take $\sigma_{\mu f} = 662$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. Briefly discuss the various types of loads coming on aircraft. **(08 Marks)**

b. What are the types of titanium used in aircraft and give their properties. **(06 Marks)**

c. Briefly discuss the post specific function of aircraft structure. **(06 Marks)**

OR

6 a. Write a note on aluminum alloys used is aircraft components. **(08 Marks)**

b. With a neat sketch explain V-n diagram. **(08 Marks)**

c. State and write an expression of Griffith's failure theory. **(04 Marks)**

Module-4

7 a. Define :

i) Plane stress

ii) Plane strain

iii) Principal stress. **(06 Marks)**

b. Derive equilibrium equations for three dimensional stress systems. **(10 Marks)**

c. Explain state of stress at a point. **(04 Marks)**

OR

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

b. State and prove Claperon's three moment equation. **(12 Marks)**

Module-5

9 a. State and prove Castiglino's theorem. Using Castiglino's theorem determine the deflection at the free end of a cantilever subjected to a point load at its free end. **(08 Marks)**

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

c. Derive an expression for strain energy due to bending. **(06 Marks)**

OR

10 a. Briefly discuss :

i) Failure modes of columns

ii) Limitations of Euler's theory

iii) Southwell plot. **(10 Marks)**

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

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