CBCS SCHEME

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21AE53

Fifth Semester B.E. Degree Examination, June/July 2024
Aero Structures

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Briefly explain :
i) Stress tensor
ii) Principal stresses
iii) Factor of safety. **(06 Marks)**

b. What are the codes and standards? **(06 Marks)**

c. A beam of uniform rectangular cross section is subjected to load as shown in Fig.Q1(c). The maximum bending stress in the beam should not exceed 80MPa. Find the width and depth of the beam if h = 2b.

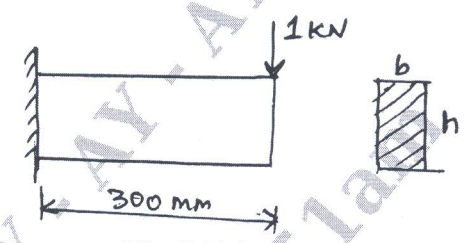

Fig.Q1(c) **(08 Marks)**

OR

2 a. Explain the Tresca's failure theory and Vonmises failure theory with relevant equations and yield surfaces. **(10 Marks)**

b. A steel shaft of yield strength 500MPa is tension and 264MPa in shear is subjected to a bending moment of 100Nm and a twisting moment of 160Nm. Determine the diameter of the shaft based :
i) Maxm normal stress theory.
ii) Maximum principal strain theory
iii) Maximum shear stress theory
iv) Maximum strain energy theory
v) Distribution energy theory.

(10 Marks)

Module-2

3 a. What is endurance limit? Discuss the modifying factors for endurance limit. **(10 Marks)**

b. A cantilever beam of span 800mm has rectangular Eruo section of depth 200mm. The free end of the beam is subjected to a transverse load of 1kN that drops on to it from a height of 40mm. Selecting C40 steel σ_y = 328.6MPa and factor of safety 3, determine the width of the rectangular cross section. **(10 Marks)**

OR

4 a. Formulate the expression for impact stress due to impact is bending. **(10 Marks)**

b. Explain :
i) S – N diagram
ii) Cumulative fatigue damage. **(10 Marks)**

Module-3

5 a. Discuss the various types of loads acting on an aircraft. **(05 Marks)**

b. An aircraft having a weight of 250kN and a tricycle under carriage lands at vertical velocity of 3.7m/s, such that the vertical and horizontal reactions on the main wheels are 1200kN and 400kN respectively; at this instant the noise wheel is 1.0m from the ground as shown in Fig.Q5(b). If the moment of inertia of the aircraft about its CG is 5.65×10^8 N s^2mm determine the inertia force on the aircraft, the time taken for its vertical velocity to become zero and its angular velocity at this instant.

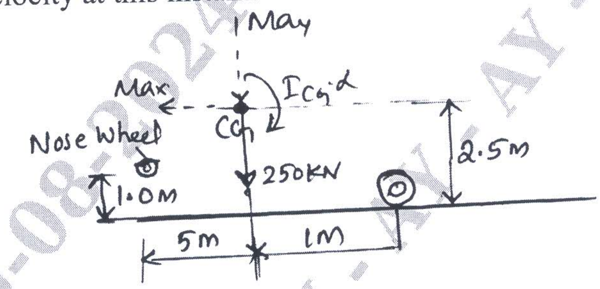

Fig.Q5(b) **(10 Marks)**

c. What is load factor? Derive an expression for load factor for correctly banked turn. **(05 Marks)**

OR

6 a. Discuss the desirable properties of materials for aircraft applications. **(06 Marks)**

b. A semi-aerobatic aircraft has reached its design diving speed of 185m/s in a dive inclined at 45° to the horizontal ground. If the maximum load factor for the aircraft is 5.5, determine the height at which the pull out the from dive must begin for straight and level flight to be achieved at 500m. **(06 Marks)**

c. Discuss the properties of Tifanium and Aluminium alloys used in aircraft applications. **(08 Marks)**

Module-4

7 a. Derive the equations of equilibrium is three dimension. **(10 Marks)**

b. Consider the displacement field :

$$u = [y^2 i \times 3yzj + (4 + 6x^2)k] \times 10^{-2}$$

What are the rectangular strain components at the point P(1, 0, 2). **(06 Marks)**

c. Explain plane stress condition with stress-strain equations and give examples. **(04 Marks)**

OR

8 a. Distinguish statically determinate and indeterminate structures. Give suitable example with sketches. **(10 Marks)**

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

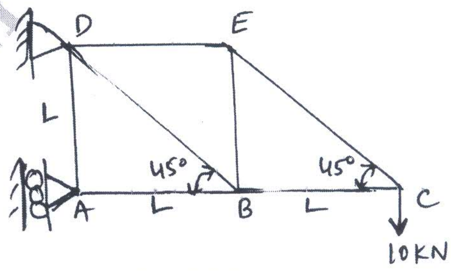

Fig.Q8(b) **(10 Marks)**

Module-5

9 a. State and prove Maxwell's reciprocal theorem. **(10 Marks)**

b. Using Cashtiglino's theorem determine the strain energy and deflection at free end of the cantilever beam shown in Fig.Q9(b).

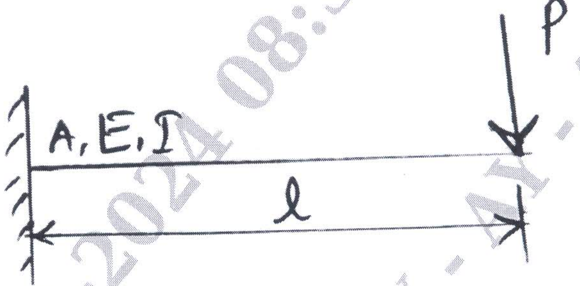

Fig.Q9(b) **(10 Marks)**

OR

10 a. Formulate the expression for Euler's buckling load for a column with both ends hinged. Also state assumptions. **(10 Marks)**

b. Determine the section of a cast iron hollow cylindrical column 3m long with both ends firmly built in, if it carries an axial load of 800kN. The ratio of internal diameter to external diameter is 5/8. Use a factor of safety = 4. Take σ_c = 550MPa Rankine constant for both ends hinged are = 1/1600. **(10 Marks)**

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