CBCS SCHEME

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17AE54

Fifth Semester B.E. Degree Examination, Jan./Feb. 2021
Aircraft Structures – I

Time: 3 hrs. Max. Marks: 100

Note:* 1. *Answer any FIVE full questions, choosing ONE full question from each module.
2. Use of machine design data hand book may be permitted.

Module-1

1 a. Explain the machine design. Write down the procedure of machine design. **(05 Marks)**

b. Explain Factor of Safety (FoS) and discuss the factors influencing FoS. **(05 Marks)**

c. A point in a structural member subjected to a plane stress as shown in Fig.Q1(c). Determine the following:
(i) Normal and Tangential stress on a plane inclined at 45°
(ii) Principal stress and their directions

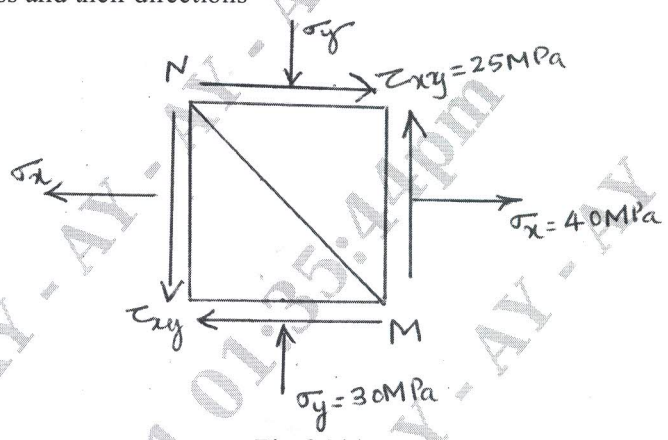

Fig.Q1(c) **(10 Marks)**

OR

2 a. Explain:
(i) Maximum Principal Stress Theory
(ii) Maximum Shear Stress Theory
(iii) Maximum Strain Energy Theory
(iv) Maximum Distortion Energy Theory **(12 Marks)**

b. A bar 50 mm diameter fixed at one end is subjected to a torsional load of 1 kN-m in addition to an axial pull of 15 kN. Determine the principal stress if the length of the shaft is 250 mm. **(08 Marks)**

Module-2

3 a. An unknown weight falls through 20 mm on to a collar rigidly attached to the lower end of a vertical bar 2m long and 500 mm^2 section. If the maximum instantaneous extension is 2 mm, what is the corresponding stress and the value of unknown weight? Take E = 200 GPa. **(10 Marks)**

b. Explain Endurance limit and derive Soderberg's relation for a member subjected to fatigue loading. **(10 Marks)**

OR

4 a. Write the effect of load factor, surface finish and size factor on endurance limit. **(10 Marks)**

b. Determine the diameter of a circular rod made of ductile material with a fatigue strength of σ_{en} = 265 MPa, tensile yield strength of 350 MPa. The member subjected to varying load from –300 kN to maximum of 700 kN and has a fatigue stress concentration factor = 1.8, F.O.S = 2. Take correction factors A = 0.85, B = 0.85, C = 1. Use Soderberg equation. **(10 Marks)**

Module-3

5 a. Explain load factor and different types of loads acting on Aircraft. **(06 Marks)**

b. Explain V-n diagram. **(06 Marks)**

c. An Aircraft having weight of 250 kN and a tricycle under carriage lands at a vertical velocity of 3.7 m/sec, such that vertical and horizontal reactions on the main wheels are 1200 kN and 400 kN, at this instant, the nose wheel is 1m from the ground, as shown in Fig.Q5(c). If the moment of inertia of the aircraft about its C.G is 5.65×10^8 N-sec^2-mm. Determine inertial forces of the aircraft. The time taken for its vertical velocity to become zero and its angular velocity at this instant.

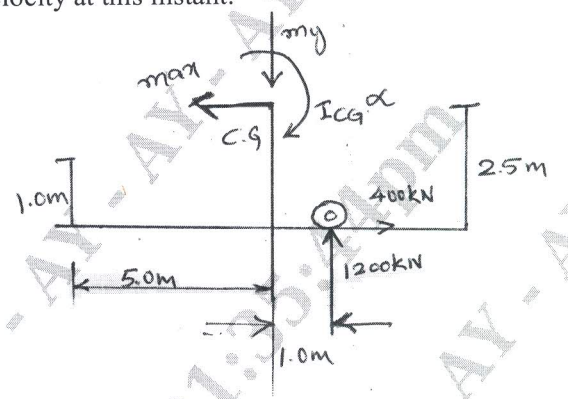

Fig.Q5(c) **(08 Marks)**

OR

6 a. Briefly explain the desirable properties of aircraft materials. **(08 Marks)**

b. What are the advantages and disadvantages of aluminium and titanium alloys? Also explain the composition, advantages of maraging steel. **(12 Marks)**

Module-4

7 a. Derive the equations of equilibrium in 3-D with a neat sketch. **(12 Marks)**

b. The state of stress at a point is given by

$\sigma_x = x^3yz + x^2y^2 \quad \tau_{xy} = x^2yz$

$\sigma_y = 3y^2z + yz \quad \tau_{yz} = xy^2z$

$\sigma_z = x^2y^2z^2 + xz \quad \tau_{zx} = xyz^2$

In the absence of body forces, determine the equilibrium conditions are satisfied or not at point (3, –4, 2). **(08 Marks)**

OR

8 a. Derive Clapeyron's 3-moment equation. **(10 Marks)**

b. Write notes on:

(i) Statically determinate structures

(ii) Statically indeterminate structures **(10 Marks)**

Module-5

9 a. State and explain "Maxwell's Reciprocal's theorem". **(10 Marks)**

b. State and prove Castigliano's first theorem in a beam subjected to a load system. **(10 Marks)**

OR

10 a. Derive the expression for crippling load for a column with both ends fixed and mention the assumptions made in Euler's-column theory. **(10 Marks)**

b. A 25 m long hollow circular column with inner diameter to outer diameter ratio is 0.8 is to carry a load of 136 kN. One end of the column is fixed and the other end is hinged. Determine the diameters of the column take σ_c = 320 MPa, $\alpha = \frac{1}{7500}$ for a material of column. FOS = 2.5. **(10 Marks)**

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