Reg. No.



MANIPAL INSTITUTE OF TECHNOLOGY

(A constituent unit of MAHE, Manipal)

III SEMESTER B.TECH. (AERONAUTICAL ENGINEERING) END SEMESTER EXAMINATIONS, NOV/DEC 2018

SUBJECT: AIRCRAFT STRUCTURES [AAE 2101]

REVISED CREDIT SYSTEM (24/12/2018)

Time: 3 Hours

MAX. MARKS: 50

Instructions to Candidates:

- ✤ Answer ALL the questions.
- Missing data **IF ANY** may be suitable assumed and clearly mentioned.
- A suspended bar system consists of two cross-sections as shown in Fig. 1. (2) Initially its lower surface is 0.8 mm above the ground surface. Determine the reaction of the lower support and the stresses in each section when a load of 40 kN is applied as shown. Take E= 205 GPa.



1B. The stresses on two mutually perpendicular planes through a point in a body are 120 MPa and 30 MPa both tensile along with a shear stress of 60 MPa, as shown in Fig. 2. Determine: the magnitude and direction of principal stresses stating whether the stress condition is uniaxial or biaxial, the planes of maximum shear stress and the normal and shear stresses on the planes of maximum shearing stress.



Fig. 2

1C. A cantilever of 14 m span carries loads of 6 kN, 4 kN, 6 kN and 4 kN at 2 m, 4 (5) m, 7 m and 14 m respectively from the fixed end. It also has a uniformly distributed load of 2 kN/m run for the length between 4 m and 8 m from the fixed end. Draw the SFD and BMD along with the line diagram of the arrangement.

2A. A cast iron beam of I-section as shown in Fig. 3 is simply supported on a (5) span of 5 m. If the tensile stress is not to exceed 20 N/mm², find the safe uniformly distributed which the beam can carry and the maximum compressive stress.





- 2B. Using double-integration method derive a relation for slope and deflection at the supports for a simply supported beam with an eccentric load acting at a distance 'a' from the left end.
- **3A.** Calculate the Euler's critical load for a strut of T-section, as shown in Fig. 4. (3) The strut is 3 m long and built-in at both the ends. Take $E = 2 \times 10^5 \text{ N/mm}^2$.



3B. Mention the relationship between effective length and actual length of a (2) column when a) both the ends are fixed b) when on end is hinged and the other fixed.

- 3C. A simply supported beam has its supports 8 m apart at A and B. It carries a UDL of 6 kN/m between A and B starting from 1 m and ending at 5 m from A. The end B of the beam has an overhang of 1 m and at the free end a concentrated load of 8 kN is applied. Determine the slope and deflections at each point. Take E= 2x10⁵ N/mm².
- **4A.** Derive the equation for bending stress for an un-symmetric beam (05)
- 4B. Part of a wing section is in the form of the two-cell box shown in Fig. 5 in (05) which the vertical spars are connected to the wing skin through angle sections all having a cross sectional area of 300 mm². Idealize the section into an arrangement of direct stress carrying booms and shear stress only carrying panels suitable for resisting bending moments in a vertical plane. Position the booms at the spar/skin junctions.



5 The doubly symmetrical fuselage section shown in Fig.6 has already been (10) idealized into an arrangement of direct stress carrying booms and shear stress carrying skin panels; the boom areas are all 150 mm². Calculate the direct stresses in the booms and the shear flows in the panels when the section is subjected to a bending moment of 100 kN m

