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B. M. S. College of Engineering, Bengaluru - 560019

Autonomous Institute Affiliated to VTU

May 2023 Semester End Main Examinations

Programme: B.E. **Semester:**
Branch: Aerospace Engineering **Duration: 3 hrs.**
Course Code: 19AE3DCIAE **Max Marks: 100**
Course: Introduction to Aerospace Engineering **Date: 12.05.2023**

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may suitably assumed.

UNIT - I

1. a) Give an account of the development of aviation till the present day. **10**

   b) List out, with a sketch, and explain the various major parts of an airplane and their function. **10**

UNIT - II

2. a) Write a short note on Longitudinal Stability. **6**

   b) Explain clearly terms related to a typical airfoil with a sketch. **6**

   c) Consider a NACA 2412 airfoil with a chord of 0.64 m in an airstream at standard sea level conditions (density = 1.23 kg/m^3) with freestream velocity of 70 m/s. The lift per unit span is 1254 N/m. Calculate the angle of attack (α) and drag and moment about the quarter chord per unit span. **8**

   The coefficient of lift, drag and moment about the quarter chord for the airfoil for various angles of attack is as given below:

α (degrees)	C_L	C_D	C_m
0	0.25	0.0065	-0.05
4	0.65	0.007	-0.05
8	1.08	0.0112	-0.05
12	1.44	0.017	-0.05

OR

3. a) An aircraft has the following features: **8**

   Zero lift drag (CDo) = 0.022, Oswald efficiency (e)=0.85, Aspect ratio (AR) = 8.3, Mass (m)=6000 kg, area of wing (S) = 30 m^2.

   Determine the following: 1) Maximum lift to drag ratio 2) airspeed corresponding to the Maximum lift to drag ratio at sea level and 3) minimum thrust required for straight and level flight. Density at sea-level can be assumed as 1.226 kg/m^3.

b) What is the difference between lift and drag? Explain with neat sketch the forces acting on the aircraft in a steady level flight. **6**

c) Write a short note on Lateral Stability. **6**

UNIT - III

4. a) Explain briefly the semi-monocoque construction of a fuselage and wing structure of an aircraft with simple sketches. **8**

b) A square beam 20mmx20mm in section and 2m long is supported at the ends. The beam fails when a point load of 400N is applied at the centre of the beam. Find the maximum bending stress. **6**

What uniformly distributed load per meter length will break a cantilever of the same material 40mm wide, 60mm deep and 3m long?

Bending Stress = Bending Moment * depth/2 * 1/Area Moment of Inertia.

c) State the advantages of aluminum which makes it suitable for aircraft industry. **6**

UNIT – IV

5. a) An aircraft cruises at an Equivalent Speed (V_{eas}) of 100 m/s at an altitude (h) of 4000 m above the sea-level. The outside air temperature (T_o) is 262.15 °K. The speed of sound at this altitude (a_s) is 324.57 m/s. At ISA conditions the Lapse rate (L) is 0.0065°K/m, the temperature (T_o) is 288.15°K at sea-level, R = specific gas constant for air = 287.05 J/(kg K), atmospheric pressure (P_o) = 101325 Pa and density as 1.226 kg / m^3 **8**

b) Write a brief note about the Life Support Systems on an aircraft. **6**

c) Give a brief account of the navigation aids available in a modern-day aircraft. **6**

OR

6. a) An aircraft cruises at a True air Speed (V_{TAS}) of 258.427 m/s at an altitude (h) of 9000 m above the sea-level. The speed of sound at this altitude (a_s) is 303.79 m/s. At ISA conditions the Lapse rate (L) is 0.0065 K/m, the temperature (T_o) is 288.15 K at sea-level, atmospheric pressure (P_o) = 101325 Pa and density as 1.226 kg / m^3. **8**

i) Calculate the air pressure P_s at the altitude of 9,000 m above sea-level.

ii) Calculate the air density ρ_s at the altitude of 9,000 m above sea-level.

iii) Calculate the equivalent airspeed: V_{eas}.

iv) Calculate the Mach number: M

b) Define De-icing and Anti-icing and write some methods applied to prevent / remove ice formed. **6**

c) Write an account of the various utilities serviced by the Environmental Control System. **6**

UNIT - V

7.	a)	Write an account about the improvement in the materials used for airframe construction and the advancement in manufacturing methods stating what these advancements have resulted in.	**10**
	b)	Describe briefly how an aircraft can be made crashworthy and draw a sketch to illustrate the concept.	**5**
	c)	Give an account of some of the major National Aerospace Programs that are presently in progress in India and mention some of the major Public and Private Sector industries which are involved in these programs.	**5**

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