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INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

(Dundigal-500043, Hyderabad)

B.Tech IV SEMESTER END EXAMINATIONS (REGULAR) - JULY 2022

Regulation:UG20

FLIGHT MECHANICS

Time: 3 Hours

(AERONAUTICAL ENGINEERING)

Max Marks: 70

Answer ALL questions in Module I and II

Answer ONE out of two questions in Modules III, IV and V

(NOTE: Provision is given to answer TWO questions from among one of the Modules III / IV / V)

All Questions Carry Equal Marks

All parts of the question must be answered in one place only

MODULE – I

1. (a) Explain forces and moments that act on an aircraft. Differentiate between aerodynamic force and propulsive force. [BL: Understand| CO: 1|Marks: 7]
- (b) A high-speed aircraft is flying at Mach 0.95 in a standard atmosphere at 30,000ft. Determine:
 - i) True airspeed
 - ii) Indicated airspeed on a incompressible calibrated airspeed indicator
 - iii) Indicated airspeed on a compressible calibrated airspeed indicator
 - iv) Equivalent airspeed

[BL: Apply| CO: 1|Marks: 7]

MODULE – II

2. (a) Classify the different methods to calculate cruise performance. Compare different methods with its advantages and disadvantages. [BL: Understand| CO: 2|Marks: 7]
- (b) Solve the maximum range an aircraft can cruise at an altitude of 15km, if its usable fuel weight is 130kN. The thrust specific fuel consumed is 0.65 N per hour per Newton thrust
[BL: Apply| CO: 2|Marks: 7]

MODULE – III

3. (a) Develop an expression for maximum rate of climb and angle of attack for propeller driven airplane. [BL: Apply| CO: 3|Marks: 7]
- (b) An aircraft is in steady level flight at sea level at speed of 100 m/s. The pilot causes his aircraft to enter a horizontal, correctly banked circle of 100 m radius keeping the same angle of incidence. The engine thrust is altered as necessary. Then the pilot brings the aircraft out of the turn without altering the angle of incidence and thrust and allows it to climb. Estimate the rate of climb, if at that incidence, the L/D ratio is 8. [BL: Apply| CO: 3|Marks: 7]
4. (a) An airplane propelled by propeller engine in on cruise phase of flight. Explain how to optimize cruising performance. [BL: Understand| CO: 4|Marks: 7]
- (b) Airplane has a wing loading of 2400 N/m^2 and its drag equation is $C_D = 0.016 + 0.055 C_L^2$, calculate its maximum lift/drag ratio, the minimum drag speed and the lift/drag ratio at a speed of 100m/s. [BL: Apply| CO: 4|Marks: 7]

MODULE – IV

5. (a) Make use of the equations of motion of an aircraft undergoing lateral maneuver or level turn and derive an expression for radius of turn. [BL: Apply| CO: 5|Marks: 7]
- (b) An aeroplane having weight of 1500 kg is turning at a speed of 200 km/hr and bank angle of 50° . Obtain the centrifugal force, lift and radius of turn. [BL: Apply| CO: 5|Marks: 7]
6. (a) Build an expression for turn radius and turn rate for pull up and pulldown maneuver. [BL: Apply| CO: 5|Marks: 7]
- (b) While flying at 130 km/hr at 3000m ($\rho = 0.000890 \text{ slugs}/ft^3$) an airplane weighs 9000N makes a 90° turning in 15 seconds, maintaining the same incidence and altitude. The wing loading is $100N/m^2$ at a given speed and the (L/D) ratio is 10. Calculate the radius of turn, the load factor in the turn and the thrust power required. [BL: Apply| CO: 5|Marks: 7]

MODULE – V

7. (a) Illustrate the factors considered for air safety and requirements to meet the landing performance. Explain the phenomenon of discontinued landing with neat sketches. [BL: Understand| CO: 6|Marks: 7]
- (b) Calculate the total landing distance for our Gulfstream-like airplane at standard sea level, assuming that (for conservatism) the landing weight is the same, as the takeoff gross weight of 73,000 lb. Assume that no thrust reversal is used, and that the runway is dry concrete with a brakes-on value of $\mu_r = 0.4$. The approach angle is 3° . [BL: Apply| CO: 6|Marks: 7]
8. (a) Explain the process of landing of an aircraft through a diagram indicating the landing path and landing distance. Describe the calculation of approach distance and flare distance [BL: Understand| CO: 6|Marks: 7]
- (b) Summarize the following:
- i) Fuel planning and Reserve fuel
 - ii) Maximum takeoff weight determination. [BL: Understand| CO: 6|Marks: 7]

