CBCS SCHEME

USN | | | | | | | | | | **18AE61**

Sixth Semester B.E. Degree Examination, June/July 2024

Aircraft Performance

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Derive the necessary equations which describes the translational and rotational motion of an airplane. **(10 Marks)**

b. With neat graph derive an expression for power required and condition for minimum power required. **(10 Marks)**

OR

2 a. With neat graph derive an expression for thrust required and condition for minimum thrust required. **(12 Marks)**

b. The Bede BD-5J is a very small single seat home built jet airplane which became available in the early 1970's. The data for BD-5J are as follows :
Wing span 17ft,
Wing plan form area = $37.8 ft^2$,
Gross weight at takeoff = 960ℓb,
fuel capacity = 55 gal,
Power plant = one French – built micro-turbo TRS 18 turbojet engine with maximum thrust at sea level of 202 ℓb and specific fuel consumption of 1.3 ℓb/ ℓb.h. The drag polar is $C_D = 0.02 + 0.62 C_L^2$. Calculate the maximum velocity at sea level. [Take $E_\infty = 0.002377$ slug/ft^3]. **(08 Marks)**

Module-2

3 a. Deduce an expression for equation of motion for rate of climb. **(10 Marks)**

b. With the graphical approach, derive an expression for time to climb, and also draw the hodograph diagram. **(10 Marks)**

OR

4 a. By using force and velocity diagram of gliding flight, obtain the equilibrium velocity also the flight path. **(10 Marks)**

b. Consider the Gulfstream IV flying at 30,000ft. Assume a total loss of engine thrust. Calculate the minimum glide path angle, maximum range covered over the ground, corresponding equilibrium glide velocity at 30,000ft and at sea level. **(10 Marks)**

Module-3

5 Derive the three aerodynamic relations which are important for static performance of aircraft and deduce as following statement :

$$V_{(C_L^{3/2}/C_D)_{max}} : V_{(C_L/C_D)_{max}} : V_{(C_L^{1/2}/C_D)_{max}} = 0.76:1:1.32$$ **(20 Marks)**

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

OR

6 a. Derive Brequet Range equation and state that the maximum range fo jet airplane occurs when airplane is flying at $(C_L^{1/2} / C_D)_{max}$. (12 Marks)

b. Derive the endurance for propeller driven airplane and state the maximum conditions. (08 Marks)

Module-4

7 a. Obtain an expression for S_g and S_a in the takeoff performance analytically. (14 Marks)

b. With a neat diagram theoretically describe the intermediate segments of ground roll take off performance. (06 Marks)

OR

8 a. What is the touchdown zone of a runway? How do you calculate the approach distance and flare distance during landing. (10 Marks)

b. What is meant by ground effects? How do you calculate the ground roll distance in landing performance? (10 Marks)

Module-5

9 a. Obtain an expression for minimum turn radius. (13 Marks)

b. Obtain the turning rate of an aircraft during pull-up and pull-down maneuver. (07 Marks)

OR

10 a. With the help of neat diagram, explain v-n diagram. (13 Marks)

b. Explain the limitations of pull-up and push-over. (07 Marks)

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