



CBCS SCHEME

21AE52

Fifth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025 Aircraft Propulsion

Time: 3 hrs.

Max. Marks: 100

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

Module-1

- 1 a. With the help of PV and TS diagram, explain the cycle analysis of jet engine. (12 Marks)
- b. Derive an expression for steady flow energy equation for compressible flow machines with usual notation. (08 Marks)

OR

- 2 a. With the help of a neat schematic and PV and TS diagram explain the working principle of a four stroke diesel engine. (10 Marks)
- b. What are the advantages of gas turbine engines over reciprocating engine? (06 Marks)
- c. Define the following :
 - i) Stagnation velocity of sound
 - ii) Stagnation pressure. (04 Marks)

Module-2

- 3 a. With the help of a neat schematic diagram, explain the working principle of a turbojet engine. Also give the advantages and disadvantages. (12 Marks)
- b. A turbojet power plant uses avocation Kerosene having a calorific value of 43 MJ/kg. The fuel consumption is 0.18 kg-N/hr when the thrust is 9 kN. The aircraft velocity is 500 m/s the mass of air passing through the compressor is 27 kg/s. Calculate the air fuel ratio and overall efficiency. (08 Marks)

OR

- 4 a. With the help of neat sketch explain the working principle of an after burner. (06 Marks)
 - b. Define a propeller and explain the different types of propellers. (06 Marks)
 - c. The diameter of the propeller of an aircraft is 2.5m. It files at a speed of 500 kmph at an altitude of 8000 m. For a flight to jet speed ratio of 0.75, determine :
 - i) The flow rate of air through the propeller
 - ii) The thrust produced
 - iii) Specific thrust
 - iv) Specific impulse
 - v) The thrust power
- Take at $Z = 8000$ m, air density $\rho = 0.525 \text{ kg/m}^3$. (08 Marks)

Module-3

- 5 a. With the help of a neat sketch, explain the method of shock swallowing using variable area inlet. (08 Marks)
- b. Explain with a neat sketch the operation of subsonic inlet under various flow speed condition. (06 Marks)
- c. Air ($\gamma = 1.4$, $R = 287.43 \text{ J/kg } ^\circ\text{K}$) enters a straight axis symmetric duct at 300 K, 3.45 bar and 150 m/s and leaves it at 277 K, 2.058 bar and 260 m/s. The area of cross section at entry is 500 cm^2 . Assuming adiabatic flow, determine :
- Stagnation temperature
 - Maximum velocity
 - Mass flow rate
 - Area of cross section at exit. (06 Marks)

OR

- 6 a. With the help of a neat diagram explain “
- Over expanded nozzle
 - Under expanded nozzle. (10 Marks)
- b. With the help of neat diagram, explain the different modes of inlet operations. (05 Marks)
- c. Derive an expression for diffuser efficiency. (05 Marks)

Module-4

- 7 a. With a neat sketch explain the working principles of centrifugal compressor. (10 Marks)
- b. An axial flow air compressor of 50% reaction design has blades with inlet and outlet angles of 45° and 10° respectively. The compressor is to produce a pressure ratio of 6 : 1 with an overall isentropic efficiency of 0.85 when inlet static temperature is 37°C . The blade speed and axial velocity are constant through compressor. Assuming a value of 200 m/s for blade speed, find the number of stages required if the work done factor is :
- unity
 - 0.87 for all stages. (10 Marks)

OR

- 8 a. Explain performance characteristics of axial compressor with a graph. (10 Marks)
- b. Differentiate axial flow compressor and centrifugal compressor. (05 Marks)
- c. A centrifugal compressor has to deliver 35 kg air per second. The impeller is 76 cm diameter revolving at 11500 rpm with an adiabatic efficiency of 80%. If the pressure ratio is 4.2 : 1 estimate the probable axial width of the impeller tip if the radial velocity is 120 m/s. The inlet conditions are 1 bar and 47°C . (05 Marks)

Module-5

- 9 a. With the help of neat sketch, explain the working of radial turbine. (10 Marks)
- b. Discuss the various important factors affecting combustion chamber design. (10 Marks)

OR

- 10 a. Explain the various methods used in turbine blade cooling. (08 Marks)
- b. Describe various losses in turbine. (08 Marks)
- c. Write a note on impact of pollutants in combustion chamber. (04 Marks)
