

CBCS SCHEME

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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 flies 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)

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.

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 difference 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. Different 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)
