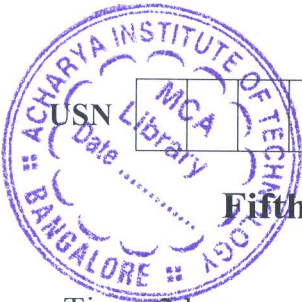


CBCS SCHEME

21AE52



Fifth Semester B.E. Degree Examination, June/July 2024 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. Give general classification of powerplants used in an aircraft. (06 Marks)
- b. Illustrate the principles of aircraft propulsion. (04 Marks)
- c. Draw a schematic diagram of a gas turbine engine. Explain its components and their functions. (10 Marks)

OR

- 2 a. With the help of a schematic diagram, write the working of a four stroke petrol engine. Draw the P-V and T-S diagram. (12 Marks)
- b. Write the advantages of gas turbine engine over reciprocating engine. (08 Marks)

Module-2

- 3 a. With a neat sketch, explain blade element theory and criteria for blade selection. (10 Marks)
- b. Write short notes on the following : (10 Marks)
 - (i) Variable pitch propeller.
 - (ii) Momentum theory of propeller.

OR

- 4 a. With the help of a schematic diagram, explain the working principle and performance characteristics of a Turbojet engine. (10 Marks)
- b. The absolute jet exit velocity from a jet engine is 2800 m/s and the forward flight velocity is 1400 m/s. Calculate the propulsive efficiency. (04 Marks)
- c. List the different methods of thrust augmentation, with the help of a relevant sketch explain an afterburner. (06 Marks)

Module-3

- 5 a. Write the purpose of inlet in gas turbine engine. Explain the operation of subsonic inlets under various operating conditions. (08 Marks)
- b. Explain with neat sketches shock swallowing supersonic inlets. (04 Marks)
- c. Air ($\gamma = 1.4$, $R = 287.43$ J/kg 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 (i) Maximum velocity (ii) Mass flow rate. (08 Marks)

OR

- 6 a. Explain flow conditions in a convergent-divergent (C-D) nozzle for varying back pressure conditions. Show pressure variation and formation of shock with the help of sketches. (10 Marks)
- b. Write short notes on:
 - (i) Over expanded and Under damped nozzle.
 - (ii) Ejector and variable area nozzle.
 - (iii) Thrust reversal. (10 Marks)

Module-4

- 7 a. Draw a neat diagram and explain the working of a centrifugal compressor for a gas turbine engine. What are its advantages and disadvantages. (10 Marks)
- b. A centrifugal compressor under test gave the following data :
 Speed : 11,500 rev/min
 Inlet total head temperature : 21 °C
 Outlet and inlet total head pressure : 4 bar, 1 bar
 Impeller dia : 75 cm
 If the slip factor is 0.92, what is the compressor efficiency? (10 Marks)

OR

- 8 a. Define Degree of reaction and derive an expression for the same with usual notations for an axial flow compressor. (08 Marks)
- b. Enumerate the process of surging and stalling in an axial flow compressor. (04 Marks)
- c. Determine the stage efficiency, η_s and work done factor Ω of an axial flow compressor, if the actual pressure ratio developed was 1.35 and actual temperature rise was 30 K. The blade inlet and outlet angles are 47° and 15° respectively. The peripheral and axial velocities are 225 m/s and 180 m/s respectively. (08 Marks)

Module-5

- 9 a. Describe the process of combustion in a gas turbine engine. With neat sketch, explain different zones of combustion. (10 Marks)
- b. With the help of relevant sketches, explain flame tube cooling and flame stabilization. (10 Marks)

OR

- 10 a. Draw the variation of pressure and velocity in a Reaction Turbine and explain the operating principle. (08 Marks)
- b. Describe the different methods of turbine blade cooling with relevant sketches. Also explain the effect of cooling air on turbine performance. (12 Marks)

* * * * *