



# CBCS SCHEME

18AE43

## Fourth 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. Derive an expression for steady flow energy equation for compressible flow machines with usual notation. (10 Marks)
- b. Define stagnation state and stagnation enthalpy. Derive an expression for stagnation temperature. (10 Marks)

OR

- 2 a. With the help of PV and TS diagram, explain the cycle analysis of jet engine. (12 Marks)
- b. List the advantages and disadvantages of turbo prop engine. (08 Marks)

### Module-2

- 3 a. Explain the operating principle of a turbofan engine with a neat diagram. Also give the advantages and disadvantages. (12 Marks)
- b. A turbojet power plant uses aviation kerosene having a calorific value of 43mJ/kg. The fuel consumption is 0.18kg/hr-N, when the thrust is 9kN. The aircraft velocity is 500m/s the mass of air passing through the compressor is 27kg/s. Calculate the air fuel ratio and overall efficiency. (08 Marks)

OR

- 4 a. Briefly explain different types of propeller. (10 Marks)
- b. The diameter of the propeller of an aircraft is 2.5m. It files at a speed of 500kmph at an altitude of 8000m. 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 powerTake at  $z = 8000\text{m}$  air density  $\rho = 0.525\text{kg/m}^3$ . (10 Marks)

### Module-3

- 5 a. Derive a relation for minimum area ratio  $\left(\frac{A_{\max}}{A_i}\right)$  in terms of external deceleration  $(V_i/V_a)$ . (10 Marks)
- b. List the major design considerations for the inlets. (05 Marks)
- c. Differentiate subsonic and supersonic inlets. (05 Marks)

OR

- 6 a. Discuss the various types of thrust reversal system with suitable sketch. (10 Marks)
- b. Derive an expression for diffuser efficiency. (05 Marks)
- c. Explain Ejector nozzle with a sketch. (05 Marks)

**Module-4**

- 7 a. With a neat sketch explain working principle of centrifugal compressor. (10 Marks)  
b. An axial flow air compressor of 50% reaction design has blades with inlet and outlet angle of  $45^\circ$  and  $10^\circ$  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  $37^\circ\text{C}$ . The blade speed and axial velocity are constant through compressor. Assuming a value of 200m/s for blade speed, find the number of stages required if the work done factor is :  
i) Unity ii) 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 35kg of air per second. The impeller is 76cm diameter revolving at 11500rpm 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 120m/s. The inlet conditions are 1 bar and  $47^\circ\text{C}$ . (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 method 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 chambers. (04 Marks)

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