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17AE43

**Fourth Semester B.E. Degree Examination, July/August 2022**  
**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. Describe the working of four stroke petrol engine with neat sketch. Draw its P-V and T-S diagram. (10 Marks)  
b. Write the principle of aircraft propulsion and explain about types of air craft power plants with neat sketch. (10 Marks)

OR

- 2 a. Derive an expression for specific work output and thermal efficiency in terms of pressure ratio and temperature ratio for simple gas turbine cycle with neat sketch of P-V and T-S diagram. (12 Marks)  
b. Compare the advantages and disadvantages of gas turbine engines and reciprocating engines. (08 Marks)

**Module-2**

- 3 a. Explain different types of propeller and write the propeller Nomenclature with neat sketch. (10 Marks)  
b. Derive the expression for momentum thrust with suitable assumptions. (10 Marks)

OR

- 4 a. Write about the methods of thrust augmentation by various methods and explain. (12 Marks)  
b. The effective Jet exit velocity from a jet engine is 2700m/s. Forward flight velocity is 1350m/s and mass flow rate is 78.6 kg/s. Find :  
i) Thrust ii) Thrust power iii) Propulsive efficiency. (08 Marks)

**Module-3**

- 5 a. Explain briefly about thrust reversal and its types. (08 Marks)  
b. Air Enters a straight symmetric duct at 300K, 150m/s and 3.45bar. It leaves at 277K, 260m/s and 2.058 bar. Area of cross section at entry is 500cm<sup>2</sup>. Assume the flow is adiabatic and conditions for air.  
Determine :  
i) Stagnation temperature  
ii) Maximum velocity  
iii) Mass flow rate  
iv) Area of cross-section at exit. (08 Marks)  
c. Write about over-expanded and under-expanded nozzle with sketch. (04 Marks)

OR

- 6 a. Explain about :  
i) Thrust reversal and thrust vectoring (12 Marks)  
ii) Engine back pressure control. (08 Marks)  
b. Derive the expression for minimum area ratio in terms of external deceleration ratio. (08 Marks)

**Module-4**

- 7 a. With neat sketch explain the parts of centrifugal compressor and its operation. (10 Marks)
- b. A centrifugal compressor under test gave the following data :
- |                              |                  |
|------------------------------|------------------|
| Speed                        | = 11,500 rev/min |
| Inlet total heat temperature | = 21°C           |
| Outlet total hat pressure    | = 4 bar          |
| Inlet total head pressure    | = 1 bar          |
| Diameter of impeller         | = 75cm           |
| Slipfactor                   | = 0.92.          |
- Find the compressor efficiency. (10 Marks)

**OR**

- 8 a. Describe the basic principle of operation of axial flow compressor with relevant sketch. Also explain the main characteristics of axial flow compressor. (10 Marks)
- b. Derive degree of reaction and derive the expression for degree of reaction of an axial flow compressor. (10 Marks)

**Module-5**

- 9 a. Explain about the types of combustion chamber and compare its advantages and disadvantages with neat sketch. (10 Marks)
- b. Explain about :
- Flame tube cooling
  - Combustion chamber geometry. (10 Marks)

**OR**

- 10 a. Explain about types of turbine blade cooling with neat sketch. (10 Marks)
- b. A multistage gas turbine is to be designed with impulse stages and is to operate with an inlet pressure and temperature of 6 bar and 900K and an outlet pressure of 1 bar. The isentropic efficiency of turbine is 85%. All the stages are having nozzle outlet angel of 75° and equal outlet and inlet blade angles. Mean blade speed of 250m/s and equal inlet and outlet gas velocities. Estimate the maximum number of stages. Take  $\gamma = 1.33$ ,  $C_p = 1.15$  kJ/kg-k and optimum blade speed ratio. (10 Marks)

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