CBCS Scheme

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15AE43

Fourth Semester B.E. Degree Examination, June/July 2018
Aircraft Propulsion

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Briefly explain the principles of aircraft propulsion. Name different types of aircraft power plants. **(06 Marks)**

b. With the help of a neat schematic and P-V and T-S diagram, explain the working principle of a four stroke diesel engine. **(10 Marks)**

OR

2 a. Derive an expression for specific work output and thermal efficiency in terms of pressure ratio and temperature ratio for a simple gas turbine cycle with the help of a schematic diagram, P-V and T-S diagrams. **(08 Marks)**

b. What are the advantages of gas turbine engines over reciprocating engines? **(04 Marks)**

c. Define the following :
i) Stagnation velocity of sound
ii) Stagnation pressure. **(04 Marks)**

Module-2

3 a. Define a propeller and explain the different types of propellers. **(06 Marks)**

b. List the three theories used in the design of propellers. Explain blade element theory in brief. **(06 Marks)**

c. The effective jet exit velocity from a jet engine is 2700 m/s. The forward flight velocity is 1350 m/s and the air flow rate is 78.6 kg/s. Calculate:
i) thrust ii) thrust power and iii) propulsive efficiency. **(04 Marks)**

OR

4 a. With the help of a neat sketch explain the working principle of an after burner. **(06 Marks)**

b. Explain the working principle of a 'TURBOJET' engine with the help of a neat schematic, P-V and T-S diagram. What are its advantages and disadvantages? **(10 Marks)**

Module-3

5 a. Explain the function and operation of a diffuser with relevant sketches. **(06 Marks)**

b. With the help of a neat sketch explain the method of shock swallowing using variable area inlet. **(05 Marks)**

c. Air ($\gamma = 1.4$, $R = 287.43$ J/kg°k) enters a straight axisymmetric duct at 300K, 3.45 bar, and 150 m/s and leaves it at 277K, 2.058 bar and 260m/s. The area of cross section at entry is 500 cm^2. Assuming adiabatic flow, determine : i)Stagnation temperature ii) maximum velocity iii) mass flow rate iv) area of cross section at exit. **(05 Marks)**

OR

6 a. Write short notes on :
i) Thrust reversing and thrust vectoring
ii) Engine back pressure control. **(08 Marks)**

b. With the help of a neat sketch explain over – expanded and under-expanded nozzles. **(08 Marks)**

Module-4

7 a. Describe the essential parts of a centrifuged compress, with the help of a neat sketch. Explain the principle of operation. **(08 Marks)**

b. A centrifuged 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, and 1 bar, impeller dia = 75cm. If the slip factor is 0.92, what is the compressor efficiency? **(08 Marks)**

OR

8 a. Explain the process of surging and stalling in an axial flow compressor. **(06 Marks)**

b. Define and derive an expression for degree of reaction of an axial flow compressor. **(06 Marks)**

c. Determine the stage efficiency η_S and work done factor Ω of an axial flow compressor, if the actual pressure retro developed is 1.35 and actual temperature rise is 30K. 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. **(04 Marks)**

Module-5

9 a. Explain different types of combustion chambers used in gas turbine engines. Briefly discuss their advantages and disadvantages. **(08 Marks)**

b. Write short notes on :
i) Flame tube cooling
ii) Combustion chamber geometry. **(08 Marks)**

OR

10 a. With the help of a neat sketch, explain the working of a single stage reaction turbine. **(05 Marks)**

b. Explain the different methods of cooling turbine blades with relevant sketch. **(05 Marks)**

c. 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 bar of 1 bar. The isentropic efficiency of the turbine is 85%. All the stages are to have a nozzle outlet angle of 75° and equal outlet and inlet blade angles. Mean baled speed of 250 m/s and equal inlet and outlet gas velocities. Estimate the maximum number of stages. Take $\gamma = 1.33$, $C_p = 1.15$ kJ/kgK and optimum blade speed ratio. **(06 Marks)**

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