CBCS SCHEME

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18AE43

Fourth Semester B.E. Degree Examination, Dec.2023/Jan.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 energy equation in steady flow for compressible flow machines with usual notation. **(10 Marks)**

b. Explain the working principle of tubo jet engines with a neat sketch and write the advantages and disadvantages. **(10 Marks)**

OR

2 a. Desirable the working principle of 4 stroke petrol engine with a neat diagram. **(10 Marks)**

b. Compute the indicated mean effective pressure and efficiency of a Joule cycle if the temperature at the end of combustion is 2000k and the temperature and pressure before compression is 350k and 1 bar. The pressure ratio is 1.3. Assume $C_P = 1.005$kJ/kg k. **(10 Marks)**

Module-2

3 a. Enlist the theories used in design of propellers. Explain advanced blade element theory of propeller. **(10 Marks)**

b. Define thrust. Prove that $F = m_i[(1 + t)c_j - c_i)]$. **(10 Marks)**

OR

4 a. List the methods of thrust augmentation. Explain about afterburner. **(10 Marks)**

b. Discuss the performance characteristics of turbojet engine. **(10 Marks)**

Module-3

5 a. What is meant by boundary layer? Explain in detail about boundary layer separation. **(10 Marks)**

b. Explain the process of shock swallowing in a variable geometer supersonic inlet. **(10 Marks)**

OR

6 a. Write short notes on :
i) Thrust reverser and thrust vectoring with neat sketch
ii) Nozzle choking. **(10 Marks)**

b. Describe over expanded and under spaded nozzles with the help of neat sketch. **(10 Marks)**

Module-4

7 a. Draw a schematic diagram, explain the principle operation of a centrifugal compressor. **(10 Marks)**

b. A centrifugal compressor has an inlet eye 15cm diameter. The impeller revolves at 20,000 rpm and the inlet air has an axial velocity of 107m/s, inlet stagnation temperature 294k and inlet pressure 1.03kg/cm^2. Determine :
i) Theoretical angle of the blade at this point
ii) Mach number of the flow at the tip of the eye. **(10 Marks)**

OR

8 a. Define degrees of reaction ad derive an expression for the same of axial flow compressor. **(10 Marks)**

b. Air at a temperature of 290k enters a ten stage axial flow compressor at the rate of 3kg/s. The pressure ratio is 6.5 and the isentropic efficiency is 90%, the compression process being adiabatic. The compressor has symmetrical blades. The axial velocity of 110m/s is uniform across the stage and the mean blade speed of each stage is 180m/s. Determine the direction of the air at entry to and exit from the rotor and the station blades and also the power given to the air. Assume $C_p = 1.005$kJ/kg k and $\gamma = 1.4$. **(10 Marks)**

Module-5

9 a. Explain the process of combustion in a gas turbine. **(10 Marks)**

b. Brief the flame stabilizing zone with the help of diagram. **(10 Marks)**

OR

10 a. 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 the turbine is 85%. All the stages are to have a nozzle outlet angle 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 required. Assume $C_p = 1.15$kJ/kg k, $\gamma = 1.333$ and optimum blade speed ratio. **(10 Marks)**

b. Explain the thermodynamics of radial turbines with neat h – s diagram. **(10 Marks)**

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