CBCS SCHEME

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17AE43

Fourth Semester B.E. Degree Examination, Aug./Sept.2020
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. With the help of PV and TS diagram, explain the cycle analysis of Jet engine. **(12 Marks)**

b. Derive an expression for steady flow energy equation for compressible flow machines with usual notation. **(08 Marks)**

OR

2 a. With the help of a neat schematic and PV and TS diagram, explain the working principle of a four stroke diesel engine. **(10 Marks)**

b. What are the advantages of gas turbine engines over reciprocating engine? **(06 Marks)**

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

Module-2

3 a. Explain the working principle of a turbojet engine with the help of a neat schematic, PV and T-S diagram. What are its advantages and disadvantages? **(12 Marks)**

b. A turbojet power plant uses aviation kerosene having a calorific value of 43 MJ/kg. The fuel consumption is 0.18 kg-N/hr, when the thrust is 9 kN. The aircraft velocity is 500 m/s the mass of air passing through the compressor is 27 kg/s. Calculate the air-fuel ratio and overall efficiency. **(08 Marks)**

OR

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

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

c. The diameter of the propeller of an aircraft is 2.5m. It flies at a speed of 500 kmph at an altitude of 8000m. For a flight to get 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 power.
Take at Z = 8000m, air density $\rho = 0.525$ kg/m^3 **(08 Marks)**

Module-3

5 a. With the help of a neat sketch explain the method of shock swallowing using variable area inlet. **(08 Marks)**

b. Explain with a neat sketch the operation of subsonic inlet under various flow speed conditions. **(06 Marks)**

c. Air ($\gamma = 1.4$, R = 287.43 J/kg °K) enters a straight axisymmetric 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) Stagnation temperature (ii) Maximum velocity (iii) Mass flow rate (iv) area of cross section at exit. **(06 Marks)**

OR

6 a. With the help of a neat sketch explain
(i) Over expanded nozzle (ii) Under expanded nozzle. **(12 Marks)**

b. With the help of neat diagram, explain the different modes of inlet operations. **(08 Marks)**

Module-4

7 a. Describe the essential parts of a centrifugal compressor, with the help of a neat sketch. Explain the principle of operation. **(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 and 1 bar. Impeller diameter = 75 cm. If the slip factor is 0.92, what is the compressor efficiency? **(10 Marks)**

OR

8 a. Define and derive an expression for degree of reaction of an axial flow compressor. **(10 Marks)**

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

c. Derive an expression for compressor efficiency in centrifugal compressor. **(04 Marks)**

Module-5

9 a. Explain different types of combustion chambers used in gas turbine engine. Briefly discus their advantages and disadvantages. **(10 Marks)**

b. Explain the following :
(i) Flame tube cooling
(ii) Use of Cheaper fuels
(iii) Pollution **(10 Marks)**

OR

10 a. With the help of a neat sketch, explain the working of a single stage reaction turbine. **(06 Marks)**

b. Explain the different methods of cooling turbine blades with relevant sketch. **(06 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 900 K 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 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/kg °K and optimum blade speed ratio. **(08 Marks)**

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