CBCS SCHEME

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21AE52

Fifth 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. Give general classification of powerplants used in an aircraft. **(06 Marks)**

b. Illustrate the principles of aircraft propulsion. **(04 Marks)**

c. Draw a schematic diagram of a gas turbine engine. Explain its components and their functions. **(10 Marks)**

OR

2 a. With the help of a schematic diagram, write the working of a four stroke petrol engine. Draw the P-V and T-S diagram. **(12 Marks)**

b. Write the advantages of gas turbine engine over reciprocating engine. **(08 Marks)**

Module-2

3 a. With a neat sketch, explain blade element theory and criteria for blade selection. **(10 Marks)**

b. Write short notes on the following :

(i) Variable pitch propeller.

(ii) Momentum theory of propeller. **(10 Marks)**

OR

4 a. With the help of a schematic diagram, explain the working principle and performance characteristics of a Turbojet engine. **(10 Marks)**

b. The absolute jet exit velocity from a jet engine is 2800 m/s and the forward flight velocity is 1400 m/s. Calculate the propulsive efficiency. **(04 Marks)**

c. List the different methods of thrust augmentation, with the help of a relevant sketch explain an afterburner. **(06 Marks)**

Module-3

5 a. Write the purpose of inlet in gas turbine engine. Explain the operation of subsonic inlets under various operating conditions. **(08 Marks)**

b. Explain with neat sketches shock swallowing supersonic inlets. **(04 Marks)**

c. Air ($\gamma = 1.4$, $R = 287.43$ J/kg K) enters a straight axis symmetric 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) Maximum velocity (ii) Mass flow rate. **(08 Marks)**

OR

6 a. Explain flow conditions in a convergent-divergent (C-D) nozzle for varying back pressure conditions. Show pressure variation and formation of shock with the help of sketches. **(10 Marks)**

b. Write short notes on:

(i) Over expanded and Under damped nozzle.

(ii) Ejector and variable area nozzle.

(iii) Thrust reversal. **(10 Marks)**

Module-4

7 a. Draw a neat diagram and explain the working of a centrifugal compressor for a gas turbine engine. What are its advantages and disadvantages. (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, 1 bar
Impeller dia : 75 cm
If the slip factor is 0.92, what is the compressor efficiency? (10 Marks)

OR

8 a. Define Degree of reaction and derive an expression for the same with usual notations for an axial flow compressor. (08 Marks)

b. Enumerate the process of surging and stalling in an axial flow compressor. (04 Marks)

c. Determine the stage efficiency, η_s and work done factor Ω of an axial flow compressor, if the actual pressure ratio developed was 1.35 and actual temperature rise was 30 K. 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. (08 Marks)

Module-5

9 a. Describe the process of combustion in a gas turbine engine. With neat sketch, explain different zones of combustion. (10 Marks)

b. With the help of relevant sketches, explain flame tube cooling and flame stabilization. (10 Marks)

OR

10 a. Draw the variation of pressure and velocity in a Reaction Turbine and explain the operating principle. (08 Marks)

b. Describe the different methods of turbine blade cooling with relevant sketches. Also explain the effect of cooling air on turbine performance. (12 Marks)

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