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CBCS SCHEME

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21AE52

Fifth Semester B.E./B.Tech. Degree Examination, June/July 2025
Aircraft Propulsion

Time: 3 hrs. Max. Marks: 100

Note: *1. Answer any FIVE full questions, choosing ONE full question from each module.*
2. Use of thermodynamic data land book is permitted.

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Sketch and explain a two stroke SI engine. **(10 Marks)**
b. Explain with neat diagram open cycle gas turbine power plant. **(10 Marks)**

OR

2 a. Sketch and explain a pulse jet engine. **(10 Marks)**
b. An aircraft is flying at Mach no. 3 at an altitude where $P_a = 8.5$ kN/m^2; $T_a = 220$ K. The jet engine powering it has maximum operating temperature as 240 K. considering. Considering the engine an ideal engine compute :
i) Thermal efficiency (overall)
ii) Propulsive efficiency
iii) Specific impulse (specific impulses). **(10 Marks)**

Module-2

3 a. Explain momentum theory with necessary equations. **(10 Marks)**
b. Explain advanced blade element theory. **(10 Marks)**

OR

4 a. How jet engine thrust can be augmented? Explain. **(10 Marks)**
b. Discuss performance characteristics of turbojet engine. **(10 Marks)**

Module-3

5 a. Discuss external flow near subsonic inlet. **(10 Marks)**
b. What is starting problem in supersonic inlets? Explain. **(10 Marks)**

OR

6 a. What is meant by underexpanded and overexpnaded nozzles? **(10 Marks)**
b. What is meant by nozzle chocking? Explain. **(10 Marks)**

Module-4

7 a. Sketch and explain the working of centrifugal compressor. Draw the velocity triangles for impeller entry and exit. **(10 Marks)**

b. A centrifugal compressor has an impeller with 21 vanes (radial exit shape), a vaneless diffuser and no inlet guide varies. At entry P_{01} = 100 KPa and T_{01} = 300 K.

i) For operating mass flow of 2.3 kg/s, the impeller tip speed of 500m/s and mechanical efficiency of 96% compute the power required to drive the compressor

ii) For an diffuser exit velocity of 100 m/s and total to total efficiency of 82%,. Compute the stagnation and static pressures at diffuser exit. **(10 Marks)**

OR

8 a. Derive an expression for degree of reaction for axial flow compressors with appropriate velocity triangles. **(10 Marks)**

b. An axial flow compressor operates at 288 K with 88% efficiency and produces a pressure ratio of 4.0 for a mass flow of 3 kg/s.

i) If the temperature raise per stage must be equal but not more than 25 K calculate the number of stages required and pressure ratio of the first and last stages

ii) If the absolute velocity at the entry to the last stage is 165 m/s at an angle of $\alpha_1 = 20°$, work done factor = 0.83, velocity diagram is symmetrical and the mean diameter is 0.18 m, compute the rotor speed rps and last stage blade length. **(10 Marks)**

Module-5

9 a. How combustion chambers are classified? Explain. **(10 Marks)**

b. What is flame stabilization in a combustion chamber how it is done in a flame holder? **(10 Marks)**

OR

10 a. How a 2D analysis for axial flow turbine is done? Explain. **(10 Marks)**

b. A radial inward flow turbine with rater nozzle ring operates with following parameters : Mass flow = 2 kg/s, P_{01} = 400 KPa, T_{01} = 1100 K P_{02} = 099 P_{01}, nozzle exit angle $d_2 = 70°$, polytrophic efficiency $\eta_{poly} = 0.85$, Rotor maximum diameter D = 0.4m, $V_{2r} = E_{a3}$, hub/Tip radius ratio at exit = 0.4 T_{03} = 935 K [Use $\gamma = 1.33$, R = 287 kJ/kg k, $C_p = 1.158$ kJ/kg K]. Compute the following :

i) Rotor tip speed, rotational speed, and rpm of the rotor

ii) Mach number, velocities, rotor width at tip and relative total temperature T_{02} – red. **(10 Marks)**

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