CBCS SCHEME

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17AE43

Fourth Semester B.E. Degree Examination, July/August 2021
Aircraft Propulsion

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions.***

1 a. With a neat diagram, explain the working principle of four stroke CI engine. **(10 Marks)**
b. Compare the advantages of Gas Turbine engines over reciprocating engines. **(10 Marks)**

2 a. What is meant by Boundary layer? Explain boundary layer separation with figure. **(10 Marks)**
b. Discuss classification of aircraft power plants. Explain principle of aircraft propulsion with an example. **(10 Marks)**

3 a. Explain performance characteristics of Turbojet, Turboprop and Turbo Engines. **(12 Marks)**
b. With suitable assumptions, derive an expression for Momentum thrust. **(08 Marks)**

4 a. Derive an equation of thrust for a propulsive device and explain the factors affecting thrust. **(12 Marks)**
b. Define with relevant equations :
i) Thrust power ii) Propulsive efficiency and iii) Overall efficiency. **(08 Marks)**

5 a. What are Over expanded and Under expanded nozzle? Explain. **(03 Marks)**
b. What do you mean by Thrust Reversal? Explain the different types of Thrust Reversal's with a sketch. **(07 Marks)**
c. A supersonic wind tunnel setting chamber expands air (or) Freon – 21 through a nozzle from a pressure of 10 bar to 4 bar in the test section. Calculate the stagnation temperature to be maintained in the setting chamber to obtain a velocity of 500m/s in the test section for
i) Air , $C_p = 1.025$ kJ/kg K , $C_V = 0.735$ kJ/kg K.
ii) $F_7 21$, $C_p = 0.785$ kJ/kg K , $C_V = 0.67$ kJ/kg K.
What is the Test section Mach number in each case? **(10 Marks)**

6 a. Derive an expression for Minimum area ratio in terms of external deceleration ratio with usual notations. **(10 Marks)**
b. With the help of neat sketch, explain the process of Shock Swallowing in a variable geometry supersonic inlet. **(10 Marks)**

7 a. Explain the principle of operation of centrifugal compressor. **(10 Marks)**
b. A centrifugal compressor has to deliver 35kg of air per second, the impeller is 76cm diameter revolving at 11,500 rpm with an adiabatic efficiency of 80%. If the pressure ratio is 4.2:1 estimate the probable axial width of the impeller at the impeller tip if the radial velocity is 120 m/s. The inlet conditions are 1 bar and 47^0C. **(10 Marks)**

8 a. Explain the performance characteristics of axial flow compressor. **(10 Marks)**
b. An axial flow air compressor of 50% reaction design has blades with inlet and outlet angles of 45^0 and 10^0 respectively. The compressor is to produce a pressure ratio of 6:1 with an overall isentropic efficiency of 0.85 when inlet static temperature is out the compressor. Assuming a value of 200 m/s for blade speed find the number of stages required if the work done factor is i) Unity ii) 0.87 for all stages. **(10 Marks)**

9 a. Describe the process of Combustion in a gas turbine and explain classification of Combustion chamber, with neat diagram. **(10 Marks)**

b. List the factors affecting burner performance. Explain the effect of operating variables in Burner performance. **(10 Marks)**

10 a. Discuss the classification of Turbines, with a neat diagram explain :
i) Single stage turbines ii) Multi stage turbines. **(10 Marks)**

b. Gas at 7 bar & 300^0C expands to 3 bar in an impulse turbine stage. The nozzle angle is 70^0 with reference to the exit direction. The rotor blades have equal inlet and outlet angle and the stage operates with optimum blade speed ratio. Assuming that the isentropic efficiency of the nozzles is 0.9 and that the velocity at entry to the stage is negligible, deduce the blade angle used and the mass flow required for this stage to produce 75kw.
Take C_p = 1.15 kJ/kg – K. **(10 Marks)**

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