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Total No. of Questions : 09

B.Tech.(AE) (2012 to 2017) (Sem.–3)

APPLIED THERMODYNAMICS

Subject Code : BTAE-302

M.Code : 54110

Time : 3 Hrs. Max. Marks : 60

INSTRUCTION TO CANDIDATES :

1. **SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.**
2. **SECTION-B contains FIVE questions carrying FIVE marks each and students have to attempt any FOUR questions.**
3. **SECTION-C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.**

SECTION-A

1. Write briefly :

a. Briefly classify various types of compressors.

b. What is the effect of clearance volume on volumetric efficiency of a reciprocating compressor?

c. What are centrifugal compressors?

d. What is degree of reaction?

e. Define the term stage efficiency.

f. Explain the concept of overall efficiency.

g. What is the principle of jet propulsion?

h. What is dual turbine system?

i. Name various commonly used propellant.

j. What is work ratio?

SECTION-B

2. Using steady flow energy equation establish the relationship for work done by compressor.

3. A reciprocating air compressor has four stage compression with 5 m^3/min of air being delivered at 160 bar when initial pressure and temperature are 1 bar, 25°C. Compression occur polytropically following polytropic index of 1.25 in three stages with perfect intercooling between stages. For the optimum intercooling conditions determine the intermediate pressures and the work required for driving compressor.

4. Compare the rotary and reciprocating compressors on various aspects.

5. Discuss the phenomena surging, choking and stalling in reference to centrifugal compressors.

6. Compare the centrifugal compressors with axial compressors.

SECTION-C

7. A jet propulsion engine has compressor with pressure ratio 4 and compressed air enters into combustion chamber where combustion occurs so as to yield temperature of 500°C at turbine inlet. Actual temperature at inlet to combustion chamber is 10% more than that of isentropic compressor temperature rise. Exhaust from turbine is expanded up to atmospheric pressure of 1 bar. The ambient temperature is 285 K. Determine,

   a. power required to drive compressor.

   b. air fuel ratio if calorific value of fuel is 43100 k/kg .

   c. static thrust developed per kg of air per second.

8. A gas turbine unit receives air at 1 bar, 300 K and compresses it adiabatically to 6.2 bar. The compressor efficiency is 88%. The fuel has a heating value of 44186 kJ/kg and the fuel-air ratio is 0.017 kg fuel/kg of air. The turbine internal efficiency is 90%. Calculate the work of turbine and compressor per kg of air compressed and thermal efficiency, for products of combustion cp = 1.147 kJ/kg K, γ = 1.33.

9. In a reciprocating air compressor, the air is compressed at the rate of 4 m^3/min at 1 bar 27°C up to the pressure of 8 bar following index of compression as 1.2. The compression occurs in two stages with intercooling at optimum intercooler pressure and perfect intercooling. Compare the work input required if the same compression occurs in single stage. Also compare the work input if same compression occurs in two stages with imperfect intercooling up to 30°C at the optimum intercooling pressure. Consider Cp = 1.0032 kJ/kg K and R = 0.287 kJ/kg-K.

NOTE : Disclosure of Identity by writing Mobile No. or Making of passing request on any page of Answer Sheet will lead to UMC against the Student.