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Total No. of Pages : 02

Total No. of Questions : 09

B.Tech.(AE) (2011 Onwards) (Sem.-3)

APPLIED THERMODYNAMICS

Subject Code : BTAE-302

Paper ID : [A1115]

Time : 3 Hrs.

Max. Marks : 60

INSTRUCTIONS 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**Q1. Write briefly :**

- a) List four applications of compressed air.
- b) What is polytropic efficiency?
- c) What is the difference in the working principle of positive displacement compressors and dynamic compressors?
- d) Draw the p-V diagram for a double stage reciprocating compressor with and without inter cooling.
- e) What is the function of a diffuser in a centrifugal compressor?
- f) Why the blades of an axial flow compressor are of airfoil section?
- g) Explain the terms slip factor and power input factor as applied to centrifugal compressor.
- h) List four advantages of gas turbines over I.C engines.
- i) Write briefly the applications of a gas turbine.
- j) What is the working principle of jet propulsion?

SECTION-B

- Q2. What is volumetric efficiency of a reciprocating air compressor? Derive an expression for the volumetric efficiency of a single stage air compressor.
- Q3. With the help of a neat sketch discuss the working of a roots blower.
- Q4. A centrifugal compressor delivers 16.5 kg/s of air with a total head pressure ratio 4:1. The speed of the compressor is 15000 *r.p.m.* Inlet total head temperature is 20°C, slip factor is 0.9, power input factor is 1.04 and isentropic efficiency is 80%. Calculate (i) Overall diameter of the impeller (ii) Power input.
- Q5. State the merits and demerits of closed cycle gas turbine over open cycle.
- Q6. Discuss the working principle of a Turboprop engine with a neat sketch.

SECTION-C

- Q7. A two stage single acting reciprocating compressor takes in air at the rate of 0.2m³/s. The intake pressure and temperature of air are 0.1 MPa and 16° C. The air is compressed to a final pressure of 0.7 MPa. The intermediate pressure is optimum with perfect inter cooling. The compression index is 1.25 for both the stages and the compressor runs at 600 *r.p.m.* Neglecting the clearance, determine :
- the intermediate pressure
 - the power required to drive the compressor
 - the rate of heat rejection in the intercooler.

Take $C_p = 1.005 \text{ kJ/kg-K}$, $R = 0.287 \text{ kJ/kg-K}$

- Q8. In a simple gas turbine plant air enters the compressor at 15°C and at the rate of 16 kg/s. The unit has a pressure ratio of 6:1 and the maximum cycle temperature is 610°C. The isentropic efficiency of compressor and turbine are 80% and 82% respectively. Determine the power output in kilowatts of an electric generator geared to the turbine.

Take $C_p = 1.005 \text{ kJ/kg-K}$, $\gamma = 1.4$. for the compression process and take $C_p = 1.11 \text{ kJ/kg-K}$, $\gamma = 1.33$ for the expansion process.

- Q9. What is degree of reaction of an axial flow compressor? Show that the blades are symmetrical for 50% reaction.