

$$128 + 4 = 132$$

SHAHEED BHAGAT SINGH STATE TECHNICAL CAMPUS, FEROZEPUR

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Total number of pages: [ 2 ]

Total number of questions: 06

B.Tech. ME 4<sup>th</sup> Sem

## Applied Thermodynamics-II

Subject Code: BTME 404 A/404 (RC/RP)

Paper ID: M/18

(2011 batch onwards)

Time allowed: 3 Hrs

Max Marks: 60

- All questions are compulsory
- Assume any missing data
- Use of steam tables and mollier diagram etc. is allowed.

### PART A (2×10)

Q. 1. Short Answer Questions:

All COs

- What is effect of clearance volume on volumetric efficiency of a reciprocating air compressor?
- What do you understand by term slip factor?
- Define the term Isothermal efficiency. How it differs from Isentropic efficiency.
- How will you compare open cycle and closed cycle gas turbines?
- What is utility of heat exchanger?
- What are applications of jet propulsion systems?
- Discuss the utility of steady flow energy equation in compressors.
- What is effect of friction on the work done in a compression process?
- What is meant by multistage compression? What are its advantages?
- What do you mean by term surging and choking?

### PART B (8×5)

Q. 2. How will you classify the air compressors? Enlist the applications of each COa type of air compressor.

OR

What do you mean by thermodynamic analysis of compressor? How will you COa apply flow energy equation for analysis of a compressor?

Q. 3. What are relative merits/ demerits of centrifugal air compressor with rotary COb axial flow air compressor. Air at temperature of 300K flows in a centrifugal compressor running at 18000 r.p.m. The other relevant data is as follows: Isentropic total heat efficiency = 0.76 ; outer diameter of blade tip = 550 mm ; slip factor = 0.82, Calculate:

- The temperature rise of the air passing through the compressor
- Static pressure ratio

Assume that the absolute velocities of air at the inlet and exit of the compressor are same. Assume,  $C_p = 1.005 \text{ kJ/kg K}$

OR



Discuss the construction and working a positive displacement type rotary COB compressor with the help of a neat sketch. Describe its salient features and analysis its working.

- Q. 4. What are effects of different operating variables on the thermal efficiency of COC open cycle gas turbine? Discuss, also illustrate various methods to improve the thermal efficiency of open cycle gas turbine.

OR

Air is drawn in a gas turbine until at  $15^\circ\text{C}$  and 1.01 bar and pressure ratio is COC 7.1. The compressor is driven by H.P. turbine and L.P. turbine drives the separate power shaft. The isentropic efficiencies of compressor, H.P. and L.P. turbines are 0.82, 0.85 and 0.85 respectively. If the maximum cycle temperature is  $610^\circ\text{C}$ . Calculate:

- Pressure and temperature of gases entering the power turbine
- Net power developed by the unit per kg/s mass flow rate.
- Work ratio
- Thermal efficiency of the unit.

Neglect the mass of fuel and assume;

$C_{ps} = 1.005 \text{ kJ/Kg K}$  and  $\gamma = 1.4$  ; for compression process

$C_{pg} = 1.15 \text{ kJ/Kg}$  and  $\gamma = 1.3$  ; for combustion and expansion processes

- Q. 5. What is working principle of Jet propulsion? Discuss the different methods of COD jet propulsion by enlisting their relative merits and demerits.

OR

What are the various performance characteristics of different propulsion COD systems? Explain in brief.

- Q. 6. An air compressor takes in air at 1 bar and  $20^\circ\text{C}$  and compresses it according to law  $PV^{1.2} = \text{constant}$ . It is then delivered to a receiver at a constant pressure COE of 10 bar. Assuming  $R = 0.287 \text{ kJ/kgK}$ , Determine :

- Temperature at the end of compression
- Work done and heat transferred during the compression per kg of air.

OR

A single acting two stage compressor with complete intercooling delivers COE 10.5 kg/min of the air at 16 bar. The suction occurs at 1 bar and  $27^\circ\text{C}$ . The compression and expansion processes are reversible, If polytropic index  $n = 1.3$ . Make the calculations for :

- Power required to drive the compressor
- Isothermal efficiency
- Heat transferred in the intercooler, if the compressor runs at 440 rpm

If the Clearance ratios for LP and HP cylinders are 0.04 and 0.06 respectively, Calculate the swept volume and clearance volume for each cylinder.