

**GUJARAT TECHNOLOGICAL UNIVERSITY****BE – SEMESTER – IV • EXAMINATION – WINTER 2017****Subject Code:142501****Date: 14/11/2017****Subject Name: Heat Power Engineering****Time: 02.30PM 05.00PM****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1** (a) Write general equation for steady flow process and show how this equation can be applied to reciprocating compressor, steam nozzle and water turbine. **07**
- (b) State the limitations of first law of thermodynamics. State and explain Kelvin-Planck statement of second law of thermodynamics. **07**
- Q.2** (a) What do you understand by the term entropy? State and prove the Clausius theorem. **07**
- (b) A domestic gas cylinder initially empty is filled by 14.2 kg gas from large reservoir, the enthalpy of entering gas is 630 kJ/kg. After filling, the gas cylinder has pressure 11 bar, enthalpy 760 kJ/kg and specific volume 0.047 m<sup>3</sup>/kg. Calculate the heat received by the cylinder from the surrounding. **07**
- OR**
- (b) A reversible heat engine absorbs heat from two thermal reservoirs at constant temperature of 800 K and 550 K, rejects heat to a reservoir at 300 K. Calculate the thermal efficiency and heat supplied by each thermal reservoirs when the engine produces 80kW and rejects 55 kJ/s to heat sink. **07**
- Q.3** (a) Explain the Otto cycle with help of P-v Diagram. Derive an expression for the air standard efficiency for Otto cycle. **07**
- (b) Explain Brayton cycle with schematic diagram. Also draw the T-s and P-v diagram for the same. Derive equation of efficiency for the ideal Brayton cycle. **07**
- OR**
- Q.3** (a) What is the function of steam nozzle? Explain different types of steam nozzle with neat sketch. **07**
- (b) What do you understand by compounding of steam turbine? Why is it required? Explain the velocity compounding of steam turbine with neat sketch indicating variation of pressure and velocity across stages. **07**
- Q.4** (a) Explain construction and working of single stage reciprocating compressor. State various application of compressed air. **07**
- (b) Justify the need of multistaging of reciprocating compressor. With suitable assumptions, derive the expression for the optimum value of the intercooler pressure in a two stage reciprocating air compressor. **07**
- OR**
- Q.4** (a) What is the principle of jet propulsion? State advantages and disadvantages of jet propulsion. **07**
- (b) Draw Schematic diagram of open and close cycle gas turbine. State Advantages of close cycle over open cycle gas turbine. **07**
- Q.5** (a) Explain vapour compression refrigeration system with schematic diagram. State its relative merits over air refrigeration cycle. **07**

- (b) How air-conditioning differ from refrigeration? Explain following psychometric process and show process on psychometric chart. **07**
- (i) Sensible Heating and Cooling
  - (ii) Humidification and dehumidification

**OR**

- Q.5** (a) Explain the following **07**
- (1) Fourier's law of heat conduction
  - (2) Newton's law of cooling
  - (3) Stefan Boltzmann's law of radiation
- (b) A plane wall is 15 cm thick of surface area  $4.5 \text{ m}^2$ . Thermal conductivity of the wall is  $9.5 \text{ W/mK}$ . The inner and outer surface temperatures of the wall are maintained at  $150^\circ\text{C}$  and  $45^\circ\text{C}$  respectively. Determine **07**
- (i) Heat flow rate across the wall
  - (ii) Temperature gradient in the heat flow direction and
  - (iii) Temperature of surface at 5 cm and 10 cm away from the inner surface.

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