

**GUJARAT TECHNOLOGICAL UNIVERSITY****BE - SEMESTER-III • EXAMINATION – WINTER 20L13****Subject Code: 133401****Date: 26-11-2013****Subject Name: Thermodynamics and Thermal Engineering****Time: 02.30 pm - 05.00 pm****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)** Explain first law of thermodynamics. Also, Derive mathematical statement of the first law of thermodynamics for steady state flow process. **07**

**(b)** Define thermodynamics and its related basic terminologies such as system, surrounding, state, process and also explain scope of thermodynamics. **07**

**Q.2 (a)** Explain in details Otto cycle with neat sketch. **07**

**(b)** State and explain various statements of second law of thermodynamics. Also, discuss third law of thermodynamics in brief. **07**

**OR**

**(b)** Explain PVT behavior of pure substances with the help of PT and PV diagrams. **07**

**Q.3 (a)** Describe in brief vaporization and evaporation and difference between vapour(steam) and Gas **07**

**(b)** Define any seven: **07**

- i. Dryness fraction
- ii. Wetness fraction
- iii. Enthalpy of Dry saturated steam
- iv. Enthalpy of superheated steam
- v. Specific volume of super-heated steam
- vi. Saturation Temperature
- vii. Sensible heat
- viii. Latent heat

**OR**

**Q.3 (a)** Explain in details thrust rocket motor theory. **07**

**(b)** Distinguish between reversible and irreversible processes. **07**

**Q.4 (a)** Describe the factors (properties) affecting the choice of a refrigerant. **07**

**(b)** Carnot refrigeration cycle absorbs heat at 270 K and rejects heat at 300 K. **07**

(a) Calculate the coefficient of performance of this refrigeration cycle.

(b) If the cycle is absorbing 1130 kJ/min at 270 K, how many kJ of work is required per second.

(c) If the Carnot heat pump operates between the same temperatures as the above refrigeration cycle, what is the coefficient of performance?

(d) How many kJ/min will the heat pump deliver at 300 K if it absorbs 1130 kJ/min at 270 K?

**OR**

**Q.4 (a)** Describe the basic principle of air conditioning along with a labeled diagram **07**

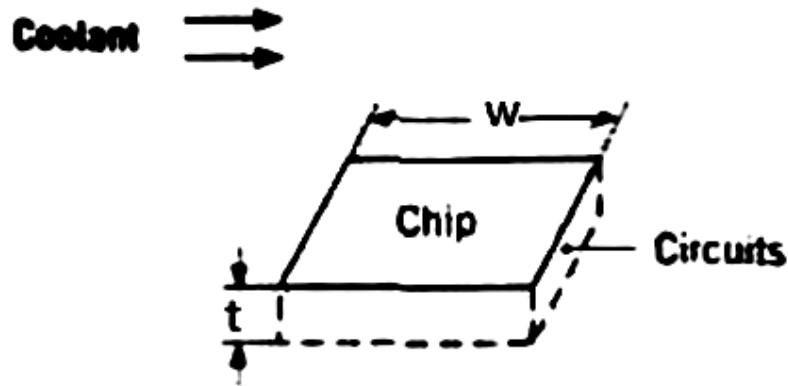
**(b)** What is psychrometry? Explain the principles of psychrometry? **07**

**Q.5 (a)** Explain the basics of convective heat transfer and its equation with the help of a neat diagram. **07**

- (b) A composite wall is made up of two slabs with outermost surface temperatures maintained at  $(T_1)$   $1300^\circ\text{C}$  and  $(T_3)$   $115^\circ\text{C}$ . The first slab has a thickness of 500 mm ( $L_1$ ) and thermal conductivity ( $K_1$ ) of  $1.4\text{W/m K}$  and the thickness and the thermal conductivity ( $K_2$ ) of the second slab are 161 mm ( $L_2$ ) and  $0.35\text{W/m K}$ , respectively. Calculate the conduction heat transfer through this composite wall per square metre and the temperature of the surfaces in contact. 07

OR

- Q.5 (a) Explain the basics of radiation mode of heat transfer and its equation with the help of a neat diagram. 07
- (b) A square silicon chip ( $k = 150\text{W/m. K}$ ) is of width  $w = 5\text{ mm}$  on a side and of thickness  $t = 1\text{mm}$ . The chip is mounted in a substrate such that its side and back surfaces are insulated, while the front surface is exposed to a coolant. If 4 W are being dissipated in circuits mounted to the back surface of the chip, what is the steady-state temperature difference between back and front surfaces? Assume steady-state conduction, One-dimensional conduction in the chip and neglect heat loss from back and sides. 07



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