

COLLEGE OF ENGINEERING, PUNE

2011-2012

End Semester Examination (Autumn)

Basic Mechanical Engineering

Programme: F.Y. B. Tech

Branch: (Electrical Group)

Duration: 3.00 Hrs

Date: 26/11/2011

Max. Marks: 50

Instructions: 1. **Answer any FIVE questions.** 2. Illustrate your answer with neat sketches wherever necessary. 3. Assume suitable standard data, if necessary. 4. Figures to the right indicate full marks. 5. Use of non-programmable electronic calculator and steam table is permitted.

- Q.1 a** (i) State Kelvin-Plank's and Clausius statement of Second Law of Thermodynamics. 2
 (ii) Complete the following table and rewrite: 2

Process	Work done	Heat supplied
Isothermal	$p_1 v_1 \ln \left(\frac{v_2}{v_1} \right)$	
Polytropic		$\frac{\gamma-n}{\gamma-1} \times \frac{mR(T_1 - T_2)}{n-1}$
Adiabatic		

(iii) 'In isochoric process all the heat supplied to the gas is utilised in increasing the internal energy of the gas.' Justify this statement. 1

- b** Steam is leaving from a 4 liter pressure cooker whose operating pressure is 150 kPa, through an exit opening of cross-sectional area of 8 mm². It is observed that the amount of liquid in the cooker has decreased by 0.6 liters in 40 minutes after the steady operating conditions are established. Determine (a) the mass flow rate of the steam and exit velocity, (b) the total and flow energies of the steam per unit mass, and (c) the rate at which energy is leaving the cooker by the steam. 5
 Assume: Flow is steady and initial startup period is discarded. Saturation conditions exist within the cooker at all times.

OR

- b** The power output of an adiabatic steam turbine is 5MW. The inlet and exit conditions of the steam are: 5
 Inlet: $P_1 = 2 \text{ MPa}$, $T_1 = 400^\circ\text{C}$, $V = 50 \text{ m/s}$, $z_1 = 10 \text{ m}$
 Outlet: $P_2 = 15 \text{ kPa}$, $x_2 = 0.9$, $V = 180 \text{ m/s}$, $z_2 = 6 \text{ m}$
 Determine:
 (i) Change in enthalpy, kinetic energy and potential energy.
 (ii) The work done per unit mass of the steam flowing through the turbine.
 (iii) The mass flow rate of the steam.

- Q.2 a** Explain in detail with neat sketch the Household refrigerator. Write the state of refrigerant at inlet and out let of each component of the system. 5
b (i) What is critical point? What are the values of Critical point of water? 2
 (ii) What is the temperature of the steam which is at 12 bar and having the Enthalpy (h) is 2900 kJ/kg. Also find its specific volume of steam. What will be the dryness fraction if the enthalpy is 2340kJ/kg. (Assume Cp of steam = 2.1 kJ/kgK) 3

Extract of Steam table;

P, bar	T _{sat} , °C	Specific Vol m ³ /kg		Specific Enthalpy, kJ/kg		
		v _f	v _g	h _f	h _{fg}	h _g
12	188	0.001139	0.16321	798.4	1984.3	2782.7

- Q.3 a** A composite wall consists of 1.5mm thick steel sheet and 10mm plywood sheet separated by 2mm thick glass-wool in between. Calculate the rate of heat flow per m² if the temperatures on the steel sheet and plywood sides are 25 °C and -15 °C respectively. Also calculate the interface temperatures 5

- b Define thermal conductivity. How does it vary w.r.t change in temperature for metals, nonmetals, liquids and gases? 3
- c Define critical radius of insulation. Write its significance. 2
- Q.4 a A simple U-tube manometer containing mercury is connected to a pipe in which a fluid of specific gravity 0.8 is flowing. The other end of the manometer is open to atmosphere. Find the vacuum pressure in pipe, if the difference of mercury level in the two limbs is 40 cm and the height of fluid in the left from the center of pipe is 15 cm below. 4
- b Define the following. 3
 - i) Specific weight
 - ii) Specific gravity
 - iii) Dynamic viscosity
- c State Pascal's law 1
- d What is Reynolds's number. Write its importance in fluid flow. 2
- Q.5 a What are the various types of Drives? With neat sketch explain belt drives. Also state the limitations and advantages of them. 5
- b What are keys? List the various types. Sketch at least three 5
- OR**
- b Classify bearings. Describe with neat sketch Bush -Bearing. How it is different than Solid Journal Bearing. 5
- Q.6 a List different applications of solar energy? 2
- b How the Wind mills are classified? 2
- c State any two advantages and disadvantages of Geothermal Energy 2
- c Explain with neat sketch KVIC Bio Gas Plant. 4
- OR**
- c Write a short note on Ocean Thermal Energy System 4