B.Tech. Civil (Construction Management) / B.Tech. Civil (Water Resources Engineering) B.Tech. (Aerospace Engineering)

Term-End Examination

00358

December, 2013

ET-201(B) : ENGINEERING THERMODYNAMICS

Time : 3 hours *Maximum Marks : 70*

Note : *Answer **seven** questions in all . Question no **1** is **compulsory**. Use of Steam table and scientific calculator is **allowed**.*

1. Choose the correct answer from the given four alternatives for the following objective type questions : **10x1=10**

(a) Torr is a unit of :

(i) temperature (ii) pressure

(iii) volume (iv) energy

(b) Which of the following is not an extensive property ?

(i) Volume (ii) Pressure

(iii) Energy (iv) Entropy

(c) A thermodynamic cycle is impossible if :

(i) $\phi \frac{dQ}{T} < 0$ (ii) $\phi \frac{dQ}{T} = 0$

(iii) $\phi \frac{dQ}{T} > 0$ (iv) $\phi\, dS > 0$

(d) An iso-entropic process :

(i) is always reversible

(ii) Is always adiabatic

(iii) need not be adiabatic or reversible

(iv) is always frictionless.

(e) In a refrigerator plant, if the condenser temperature increases, the power input to the compressor will :

(i) decrease

(ii) increase

(iii) remain the same

(iv) be unpredictable.

(f) Match List-I with List- II and select the answer from the code given below

List -I (Equipment in arefrigerator system)	List - II (purpose)
(A) Compressure	(1) Enthalpy remains constant
(B) Evaporator	(2) Enthalpy increases
(C) Throttle value	(3) Enthalpy increases but pressure remains constant
(D) Condenser	(4) Enthalpy decreases but pressure remains constant.

Code :

(i) (A)-(1), (B)-(2), (C)-(3), (D)-(4)

(ii) (A)-(4), (B)-(3), (C)-(2), (D)-(1)

(iii) (A)-(2), (B)-(3), (C)-(1), (D)-(4)

(iv) (A)-(3), (B)-(1), (C)-(4), (D)-(2)

(g) In a vapour compression system, the working fluid is superheated vapour at entrance to :

(i) evaporator (ii) condenser

(iii) compressor (iv) expansion value

(h) When a liquid boils at constant pressure, the following parameter increases :

(i) temperature

(ii) latent heat of vaporization

(iii) kinetic energy

(iv) entropy

(i) During a general polytropic expansion process characterised by pv^n=constant, the work done is equal to :

(i) $p_1v_1 - p_2v_2$

(ii) $p_1v_1 \ ln\left(\frac{v_2}{v_1}\right)$

(iii) $\frac{p_1v_1-p_2v_2}{n-1}$

(iv) $\frac{p_1v_1-p_2v_2}{n+1}$

(j) A mixture of gases expands from 0.03 m^3 to 0.06 m^3 at constant pressure of 1 MPa, and absorbs 84 kJ of heat during the process. The change in internal energy of the mixture is :

(i) 30 kJ (ii) 54 kJ

(iii) 84 kJ (iv) 114 kJ

2. (a) Distinguish between the term 'change of state', 'path' and 'process'. Also explain a 'thermodynamic cycle'. **2x5=10**

(b) A platinum resistance thermometer has a resistance of 2.8 ohm at 0°C and 3.8 ohm at 100°C. Calculate the temperature when the resistance indicated is 5.8 ohm.

3. (a) A mass of gas is compressed in a quasi - static process from 80 kPa, 0.1m^3 to 0.4 MP_a, 0.03 m^3. Assuming that the pressure and volume are related by pv^n = constant, find the work done by the gas system. **2x5=10**

(b) If a gas of volume 6000 cm^3, and at pressure of 100 kPa is compressed quasistatically according to PV^2 = constant until the volume becomes 2000 cm^3, determine the final pressure and the work transfer.

4. (a) A stationary mass of gas is compressed without friction from an initial state of 0.3 m^3 and 0.105 MP_a to a final state of 0.15 m^3 and 0.105 MP_a, the pressure remaining constant during the process. There is a transfer of 37.6 kJ of heat from the gas during the process. How much does the internal energy of the gas change ? **2x5=10**

(b) A domestic refrigerator is loaded with food and the door closed. During a certain period the machine consumes 1KW of energy and the internal energy of the systems drops 5000 kJ. Find the net heat transfer for the System.

5. (a) In a cyclic process, heat transfers are +14.7 kJ, −25.2 kJ, −3.56 kJ, and +31.5 kJ. What is the net work for this cyclic process ? **2x5=10**

(b) State and explain the Kelvin - Planck statement of the second law of thermodynamics.

6. (a) Define the COP of a refrigerator. What is a heat pump ? How does it differ from a refrigerator ? **2x5=10**

(b) Show that the COP of a heat pump is greater than the COP of a refrigerator by unity.

7. (a) A refrigeration plant for a food store operates as a reversed Carnot heat engine cycle. The store is to be maintained at a temperature of $-5°C$, and the heat transfer from the store to the cycle is at the rate of 5 KW. If heat is transferred from the cycle to the atmosphere at a temperature of 25°C, calculate the power required to drive the plant. **2x5=10**

(b) A heat pump provides 3×10^4 kJ/h to maintain a dwelling at 23°C on a day when the outside temperature is 0°C. The power input to the heat pump is 4kW. Determine the COP of the heat pump and compare it with the COP of a reversible heat pump operating between the reservoirs at the same two temperatures.

8. A reversible power cycle is used to drive a reversible heat pump cycle. The power cycle takes in Q_1 heat units at T_1 and rejects Q_2 at T_2, The heat pump abstracts Q_4 from the sink at T_4 and discharges Q_3 at T_3. Prove that **10**

$$\frac{Q_4}{Q_1} = \frac{T_4(T_1 - T_2)}{T_1(T_3 - T_4)}.$$

9. (a) Find the enthalpy, entropy, and volume of steam at 1.4 MP_a, 380°C. **2x5=10**

(b) What do you understand by triple point ?

10. (a) What are the four basic components of a steam power plant ? Explain with the help of block diagram. **2x5=10**

(b) What is the effect of reheat on
(i) the specific output,
(ii) the cycle efficiency, and
(iii) Steam rate, of a steam power plant ?
