BME-052

DIPLOMA IN MECHANICAL ENGINEERING (DME) / ADVANCED LEVEL CERTIFICATE COURSE IN MECHANICAL ENGINEERING (DMEVI / ACMEVI)

Term-End Examination

December, 2015

BME-052 : BASICS OF THERMAL ENGINEERING

Time : 2 hours   *Maximum Marks : 70*

*Note : Attempt **all** questions. Internal choices are given. All questions carry equal marks. Use of scientific calculator and steam tables is permitted.*

1. Choose the correct alternative for the following objective type questions : 7×2=14

    (a) Which of the following is the basis of temperature measurement ?

        (i) Zeroth law of thermodynamics

        (ii) First law of thermodynamics

        (iii) Second law of thermodynamics

        (iv) Law of stable equilibrium

(b) The Kelvin temperature of a system can be measured by a

(i) mercury-in-glass thermometer

(ii) thermocouple

(iii) constant-volume gas thermometer

(iv) resistance thermometer

(c) Heat transferred to a closed stationary system at constant volume is equal to

(i) work transfer

(ii) increase in internal energy

(iii) increase in enthalpy

(iv) None of the above

(d) Which of the following does *not* change during a throttling process ?

(i) Enthalpy

(ii) Entropy

(iii) Volume

(iv) Pressure

(e) Match List 1 with List 2 and choose the correct answer from the code :

	List 1		List 2
	(Law of thermodynamics)		(Defines)
(A)	First	I.	Internal energy
(B)	Second	II.	Temperature
(C)	Zeroth	III.	Entropy

	A	B	C
(i)	I	II	III
(ii)	II	III	I
(iii)	III	I	II
(iv)	I	III	II

(f) If the thermal efficiency of a Carnot engine is 1/5, the COP of a Carnot refrigerator is

(i) 5

(ii) 4

(iii) 6

(iv) 3

(g) The entropy of a system

(i) can never decrease

(ii) can never increase

(iii) may increase or decrease

(iv) will always remain constant

2. Answer any *two* of the following questions : 2×7=*14*

   (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 ?

   (b) A mass of gas is compressed from 80 kPa, 0·1 m^3 to 0·4 MPa, 0·03 m^3. Assuming that the pressure and volume are related by

$$pv^n = \text{constant},$$

   find the work done by the gas system.

   (c) A stationary mass of gas is compressed without friction from an initial state of 0·3 m^3 and 0·105 MPa to a final state of 0·15 m^3 and 0·105 MPa, 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 ?

3. Answer any *two* of the following questions : 2×7=*14*

   (a) Explain Clausius' statement of the second law of thermodynamics.

   (b) Define Entropy. What are the causes of entropy increase ?

(c)   Steam initially at 1·5 MPa, 300°C expands reversibly and adiabatically in a steam turbine to 40°C. Determine the ideal work output of the turbine per kg of steam.

4.   Answer any *two* of the following questions :   *2×7=14*

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

(b)   A rigid vessel of volume 0·86 m³ contains 1 kg of steam at a pressure of 2 bar. Evaluate the specific volume, temperature, dryness fraction, internal energy and enthalpy of steam.

(c)   What is the effect of regeneration on the specific output and cycle efficiency of a steam power plant ?

5.   Write   short   notes   on   any   *four*   of   the
following : $4×3\frac{1}{2}=14$

(a)   Nozzles

(b)   Impulse Turbine

(c)   Cooling Towers

(d)   Black Body

(e)   Stefan-Boltzmann Law

(f)   Geothermal Energy