

**DIPLOMA IN MECHANICAL ENGINEERING
(DMEVI)**

Term-End Examination 02239

June, 2012

BIME-023 : ENGINEERING THERMODYNAMICS

Time : 2 hours

Maximum Marks : 70

Note : All questions are compulsory. Use of calculator is permitted. Use of steam table is also allowed.

1. Choose the correct answer from the given four alternatives : **7x2=14**
- (a) A thermodynamic system refers to
- (i) any defined region in space.
 - (ii) a specified mass in fluid flow
 - (iii) a specified region of constant volume
 - (iv) a prescribed and identifiable quantity of matter.
- (b) A system and its environment put together constitute.
- (i) an adiabatic system
 - (ii) an isolated system
 - (iii) a segregated system
 - (iv) a homogeneous system.

- (c) The value of an extensive property essentially depends on.
- (i) mass or extend of the system
 - (ii) interaction of system with its surroundings.
 - (iii) path followed by the system in going from one state, to another.
 - (iv) nature of boundaries, rigid or flexible.
- (d) Which of the following statements does not represent the essence of first law of thermodynamics ?
- (i) heat input to a system equals the net work done plus change in internal energy.
 - (ii) the sum of heat and work effects will be zero if the system undergoes a cycle.
 - (iii) heat input cannot be more than the work output.
 - (iv) for an isolated system, energy remains constant.
- (e) A paddle wheel used for stirring a liquid contained in a tank supplied 5000 KJ of work and during the stirring operation the tank lost 1500 KJ of heat to the surroundings. If the tank and liquid are considered as a system, the change in its internal energy will be
- (i) 1500 KJ
 - (ii) 3500 KJ
 - (iii) 5000 KJ
 - (iv) 6500 KJ

(f) During a general polytropic expansion process characterised by $pv^n = \text{constant}$, the work done is equal to :

(i) $p_1v_1 - p_2v_2$

(ii) $p_1v_1 \log_e \frac{v_2}{v_1}$

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

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

(g) With the increase in pressure

(i) the boiling point of water decreases and enthalpy of evaporation increases

(ii) the boiling point of water increases and enthalpy of evaporation decreases

(iii) both the boiling point of water and the enthalpy of evaporation decreases

(iv) both the boiling point of water and the enthalpy of evaporation increases.

2. Answer *any two* of the following : 2x7=14
- (a) Define an Isolated system. What is a thermodynamic cycle ? Define 'change of state', 'path', and 'process'.
- (b) One mole of an ideal gas at 1.0 MPa and 300 K is heated at constant pressure till the volume is doubled and then it is allowed to expand at constant temperature till the volume is doubled again. Calculate the work done by the gas.
- (c) The temperature 't' on a thermometric scale is defined in terms of properly X by the relation $t = a \ln X + l$
When 'a' and 'l' are constants. The values of X are found to be 2 and 6 at the ice point and the steam point respectively. Determine the temperature corresponding at a reading of X equal to 2.57 on the thermometer.
3. Answer *any two* of the following : 2x7=14
- (a) What is the zeroth law of thermodynamics ? What is an ideal gas ? What is the difference between universal gas constant and characteristic gas constant ?
- (b) Define efficiency of a heat engine, COP of a refrigerator, and COP of a heat pump, and show that
- $$\text{COP}_{\text{heat pump}} = 1 + \text{COP}_{\text{refrigerator}}$$

(c) 5 kg of an ideal gas is compressed adiabatically from pressure 120 KPa and temperature 260 K to a final pressure of 460 KPa. Find

- (i) Work done,
- (ii) Heat added or rejected,
- (iii) Change in internal energy.

For gas $C_p = 1 \text{ KJ/Kg-K}$, $C_v = 0.71 \text{ KJ/Kg-K}$.

4. Answer *any two* of the following : 2x7=14

- (a) Explain Clausius inequality.
- (b) The temperature of the freezer of a domestic refrigerator is maintained at -16°C whereas the ambient temperature is 35°C . If the heat leaks into the freezer at a continuous rate 2 KJ/sec, what is the minimum power required to pump out this heat leakage from freezer, continuously ?
- (c) The work output and heat input for process. A are 30 KJ and 15 KJ respectively. Another process B between the same end conditions involves a heat transfer 12 KJ. Determine the change in internal energy involved and work done during process B. Show that if a cycle is formed using process A and B, the given data follows the First law of thermodynamics.

5. Answer *any two* of the following : 2x7=14

- (a) What is the main characteristics of the triple point ? What is the meaning of saturated liquid, saturated vapour, and super heated vapour ?
 - (b) A steam power plant working on Rankine cycle, has a steam supply pressure of 20 bar and condenser pressure of 0.5 bar. If the initial condition of supply steam is dry and saturated, calculate the Carnot and Rankine efficiency of the cycle. Neglect pump work.
 - (c) What are the advantages of liquid and gaseous fuels over solid fuels ?
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