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**BIME-023**

# DIPLOMA – VIEP– MECHANICAL ENGINEERING (DMEVI)

## Term-End Examination

00574 **June, 2017**

## BIME-023 : ENGINEERING THERMODYNAMICS

*Time : 2 hours* *Maximum Marks : 70*

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

**1.** Choose the correct answer. *7×2=14*

(a) Which of the following is an extensive property of a thermodynamic system ?

(i) Pressure

(ii) Volume

(iii) Temperature

(iv) Density

(b) The latent heat of vaporisation at critical point is

(i) Less than zero

(ii) Greater than zero

(iii) Equal to zero

(iv) None of the above

(c) A control volume refers to

(i) a specified mass

(ii) an isolated system

(iii) a fixed region in space

(iv) a closed system

(d) The Second law of thermodynamics defines

(i) Internal energy

(ii) Enthalpy

(iii) Entropy

(iv) Temperature

(e) A frictional heat engine can be 100% efficient only if its exhaust temperature is

(i) Zero Kelvin

(ii) 0°C

(iii) Equal to the inlet temperature

(iv) All of the above

(f) Availability function is expressed as

(i) $a = (u + p_0 dV + T_0 dS)$

(ii) $a = (du + p_0 dV - T_0 dS)$

(iii) $a = (u + p_0 V + T_0 S)$

(iv) $a = (u + p_0 V - T_0 S)$

(g) Rankine cycle comprises of

(i) two isentropic processes and two constant pressure processes

(ii) two isentropic processes and two constant volume processes

(iii) two isentropic processes and two isothermal processes

(iv) two isothermal processes and two constant pressure processes

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

(a) Define and explain a thermodynamic system. Differentiate between various types of thermodynamic systems and give examples of each of them.

(b) 0·25 kg of air at a pressure of 1·4 bar occupies 0·15 $m^3$ and from this condition it is compressed to 14 bar pressure according to the law $pV^{1.25} = C$.

Determine :

(i) Change of internal energy

(ii) Work done

(iii) Heat transfer

Take the value of $C_p$ = 1·005 kJ/kg°C and $C_v$ = 0·718 kJ/kg°C.

(c) Derive the steady flow energy equation for an open system. State the assumptions made.

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

(a) Establish the equivalence of Kelvin-Planck and Clausius statements.

(b) Explain the working of Carnot cycle for reversible heat engine.

(c) 0·05 $m^3$ of air at a pressure of 8 bar and 280°C expands to eight times its original volume and the final temperature after expansion is 25°C. Calculate the change in entropy of air during the process. Assume $C_p$ = 1·005 kJ/kg K and $C_v$ = 0·718 kJ/kg K.

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

(a) Describe with a neat sketch, throttling calorimeter and explain how dryness fraction of steam is determined.

(b) Find the enthalpy and entropy of steam when the pressure is 20 bar and the steam has the following conditions :

(i) Dry saturated

(ii) Superheated having a temperature of 350°C.

(c) Two boilers, one with a superheater and the other without a superheater, are delivering equal quantities of steam into a common main. The pressure in the boiler and the main is 20 bar. The temperature of the steam from a boiler with a superheater is 350°C and the temperature of the steam in the main is 250°C. Determine the quality of the steam supplied by the other boiler. Take specific heat of superheated steam as 2·25 kJ/kg K.

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

(a) 2 kg of an ideal gas expands adiabatically from pressure 600 kPa and temperature 350°C to 100 kPa. Find the final temperature of the gas, work done and heat transfer.

(b) Discuss the effect of superheat and inlet pressure on the performance of Rankine cycle with the help of T-S diagram.

(c) In a steam power cycle, the steam supply is at 15 bar and dry saturated. The condenser pressure is 0·4 bar. Calculate the Rankine cycle efficiency.