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BIME-023

DIPLOMA – VIEP– MECHANICAL ENGINEERING (DMEVI)

Term-End Examination

December, 2016

00992

BIME-023 : ENGINEERING THERMODYNAMICS

Time : 2 hours *Maximum Marks : 70*

Note : *Attempt **five** questions in all. Question no. 1 is **compulsory**. All questions carry equal marks. Scientific calculator is allowed. Assume missing data, if any. Use of steam table is permitted.*

1. Answer the following questions by choosing the best answer out of the four alternatives : *7×2=14*

(a) The first law of thermodynamics for steady flow

(i) Accounts for all energy entering and leaving a control volume

(ii) Is an energy balance for a specific mass of fluid

(iii) Is an expression of the conservation of linear momentum

(iv) Is restricted in its application to perfect gases

(b) For any reversible process, the change in entropy of the system and surroundings is

(i) Zero

(ii) Unity

(iii) Negative

(iv) Positive

(c) If the temperature of the source is increased, the efficiency of the Carnot engine

(i) Decreases

(ii) Increases

(iii) Does not change

(iv) Depends on other factors

(d) With an increase in the pressure

(i) Enthalpy of dry saturated steam increases

(ii) Enthalpy of dry saturated steam decreases

(iii) Enthalpy of dry saturated steam remains the same

(iv) Enthalpy of dry saturated steam first increases and then decreases

(e) The thermal efficiency of theoretical Otto cycle

(i) Increases with increase in compression ratio

(ii) Increases with increase in isentropic index

(iii) Does not depend on pressure ratio

(iv) Follows all the above

(f) Cetane number of the fuel used commercially for diesel engines in India is in the range of

(i) 80 – 90

(ii) 60 – 80

(iii) 60 – 70

(iv) 40 – 45

(g) Availability function is expressed as

(i) $a = (u + p_0V - T_0S)$

(ii) $a = (u + p_0dV + T_0dS)$

(iii) $a = (du + p_0dV - T_0dS)$

(iv) $a = (u + p_0V + T_0S)$

2. (a) What is thermodynamic property ? Discuss different properties with respect to intensive and extensive properties. *6*

(b) A vessel of cylindrical shape is 50 cm in diameter and 75 cm high. It contains 4 kg of gas. The pressure measured with a manometer indicates 620 mm of Hg above the atmosphere when the barometer reads 760 mm of Hg. Determine

(i) the absolute pressure of the gas in the vessel in bar, and

(ii) the specific volume and density of the gas. *8*

3. (a) Stating first law of thermodynamics, prove that for a non-flow process, it leads to the energy equation $Q = \Delta U + W$. *6*

(b) 0·3 kg of nitrogen gas at 100 kPa and 40°C is contained in a cylinder. The piston is moved compressing nitrogen until the pressure becomes 1 MPa and the temperature becomes 160°C. The work done during the process is 30 kJ. Calculate the heat transferred from the nitrogen to the surroundings. C_v for nitrogen = 0·75 kJ/kg-K. *8*

4. (a) State the limitations of the first law of thermodynamics. Also define Heat engine, Refrigerator and Heat pump. *8*

(b) A reversible engine receives its heat from a mixture of water vapour and liquid under atmospheric pressure and rejects 44·10 kJ of heat per hour to a mixture of ice and liquid water under atmospheric pressure. Find out the power delivered by the engine in HP. Take atmospheric pressure = 1·013 bar. *6*

5. (a) Define availability function. How are the concepts of entropy and unavailable energy related to each other ? *6*

(b) What do you understand by thermodynamics of combustion ? Differentiate between proximate and ultimate analysis of fuel. *8*

6. (a) Explain how the dryness fraction of steam can be determined experimentally. *6*

(b) Determine the amount of heat, which should be supplied to 2 kg of water at 25°C to convert it into steam at 4·5 bar absolute and 0·9 dry. *8*

7. (a) What is air standard efficiency ? How is it different from actual efficiency ? Also discuss the difference between air standard cycles and actual cycles. *6*

(b) What is an ideal Rankine cycle ? Showing it on PV and TS diagram find out its thermal efficiency. *8*
