1187

Code : 9ME-42

Register Number | | | | | | | |

IV Semester Diploma Examination, April/May 2013

THERMAL ENGG. – I

Time : 3 Hours] **[Max. Marks : 100**

(1) Section – I is Compulsory.

(2) Answer any **two** full questions from Sections – **II, III & IV**.

SECTION – I

1. (a) Fill in the blanks with appropriate word/words : **5 × 1 = 5**

(i) When neither mass nor energy is allowed to cross the boundary of a system, it is then called _____.

(ii) The general law of expansion or compression is $PV^n = C$, the process is said to be hyperbolic if n is equal to _____.

(iii) In an Otto cycle heat is added at _____.

(iv) The amount of heat absorbed to evaporate 1 kg of water from its _____ saturation temperature without change of temperature is called _____.

(v) The equation for Rankine efficiency is _____.

(b) Differentiate between intensive and extensive properties of a system. Give three examples for each. **5**

SECTION – II

2. (a) Define the terms : (i) System (ii) State (iii) Cycle (iv) Enthalpy (v) Entropy. **5**

(b) Define heat and work. Are these quantities a path function or point function ? Explain. **5**

[Turn over

(c) A reversible engine is supplied with heat from two constant temperature sources at 900 K and 600 K and rejects heat to a constant temperature sink at 300 K. The engine develops work equivalent to 90 kJ/s and rejects heat at the rate of 56 kJ/s. Estimate the heat supplied by each source. 5

3. (a) Derive an equation $C_P - C_V = R$. 5

(b) A mass of 2.25 kg of nitrogen occupying 1.5 m^3 is heated from 25 °C to 200 °C at a constant volume. Calculate the initial and final pressures of the gas. Take universal gas constant as 8314 J/kg mol. K. The molecular mass of nitrogen is 28. 5

(c) Explain free expansion process. 5

4. (a) Derive an equation $PV^{\gamma} = C$. 7

(b) A quantity of gas has a volume of 0.14 m^3, pressure of 0.15×10^6 N/m^2 and a temperature of 100 °C. If the gas is compressed at a constant pressure until its volume becomes 0.112 m^3, determine (i) the temperature at the end of compression (ii) work done in compressing the gas (iii) decrease in internal energy (iv) Heat given out by the gas. 8

SECTION – III

5. (a) What are the advantages of gaseous fuels ?

(b) Draw a neat sketch of the apparatus used for determining the calorific value of solid and liquid fuels. Explain the procedure.

(c) Write Dulongs formula to calculate HCV of the fuel.

6. (a) Derive an equation for the Air standard efficiency of an Otto cycle.

(b) In an Otto cycle, the temperature at the beginning and end of the isentropic compression are 316 K and 596 K respectively. Determine the Air Std. efficiency and the compression ratio. Assume $\gamma = 1.4$.

raw the PV and T-S diagrams of a dual combustion cycle. Show all the rocesses. 6

5 , diesel engine has a compression ratio of 15. Heat addition at constant ressure takes place at 10% of the stroke. Find the Air standard efficiency of he engine. Take $\gamma = 1.4$ for air. 5

5 Explain reversible process. What are the conditions for reversibility of a 4

SECTION – IV

5 With the help of temperature vs. heat diagram, explain the formation of 5 team. 5

A sample of 1 kg of steam at a pressure of 15 bar exists in the following two onditions : 10

7 i) Wet steam with dryness fraction 0.8

ii) Superheated steam with a temperature of 215 °C.

Determine the following properties in each case :

a) Enthalpy

8 b) Volume

c) Entropy

d) External work

3 e) Internal energy

Take the specific heat of superheat as 2.3 kJ/kg.K. Neglect the volume of 9 vater.

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Derive an equation for the work done, change in internal energy and heat 10 ransferred during the constant temperature process as applied to wet steam. 9

Steam at 10 bar and 0.9 dryness is throttled to a pressure of 2 bar. Using steam table, evaluate the final dryness fraction. Estimate the change of 5 ntropy during this process. 6

10. (a) State the limitations of a Carnot cycle.

(b) Explain the modified Rankine cycle with the help of PV and T-S diagram

(c) In a Carnot cycle the upper and lower limits of temperature corresponds t steam pressure of 28 bar and 0.15 bar respectively. Dry saturated steam supplied to the engine. Calculate :

(i) Dryness fraction of steam at the beginning of isentropic compressio

(ii) Heat supplied per kg of steam

(iii) Work done per kg of steam

(iv) Carnot cycle efficiency
