3E1413

Roll No. : _____ Total Printed Pages : 4

# 3E1413

**B.Tech. (Sem. III) (Main/Back) Examination, January - 2012**
**Production & Industrial Engg.**
**3PI3 Engineering Thermodynamics (Common for ME/AE)**

Time : **3** Hours] [Total Marks : **80**
[Min. Passing Marks : **24**

***Instructions to Candidates :***

*Attempt any five questions selecting one question from each unit. All questions carry equal marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.*

Use of following supporting material is permitted during examination.
*(Mentioned in form No. 205)*

1. Steam table 2. Mollier chart

## UNIT – I

1 (a) Define a thermodynamic system. Explain its different types. 6

(b) What do you understand by property of a steam ? Distinguish bet$^{n}$ intensive and extensive properties with example. 4

(c) Explain vapour-liquid-solid phase equilibrium with diagram in pure substance. 6

**OR**

1 (a) Explain thermodynamic PVT surfaces. 6

(b) Describe Zeroth law of thermodynamics. 4

(c) A vessel of volume 0.04m$^3$ contains a mix of saturated water and saturated steam at a temp. of 250$^0$c. The mass of liquid is 9 kg. Find pr, mass, sp. volume, enthalpy, entropy and Internal energy. 8

## UNIT – II

2 (a) Give following statements of II Law of Thermodynamics -

(i) Clausius statement.

(ii) Kelvin-Plank statement.

6

(b) Gas from a cylinder of compressed helium is used to inflate an inelastic flexible balloon originally folded completely flat, to a volume of $0.6m^3$. If barometer read 760 mm Hg. what is the amount of workdone upon atmosphere by balloon ? Sketch the system before & after the processes.

6

(c) Briefly explain steady state processes.

4

**OR**

2 (a) State the First Law of Thermodynamics. Prove $Q = \Delta U + W$.

4

(b) Write down general energy equations for steady flow systems.

(i) Steam nozzle

(ii) Turbine.

4

(c) The properties of steam during a reversible constant pr. non flow process at p=1.6 bar change from $\vartheta_1 = 0.3m^3/kg$, $T_1 = 20°c$ to $\vartheta_2 = 0.55m^3/kg$, $T_2 = 260°c$ Sp. heat is given by $C_p = \left(1.5 + \frac{75}{\Gamma + 45}\right) KJ/kg°c$ where $T$ in $°c$.

Determine (per kg)

(i) Heat added

(ii) Work done

(iii) Change in Internal energy

(iv) Change in Enthalpy.

8

## UNIT – III

3 (a) Explain concept of available & unavailable energy. Derive expression for availability in non flow system. 5

(b) Explain Helm hortz and gibbs function. 5

(c) Prove Tds Equations in Thermodynamics. 6

**OR**

3 (a) Explain folloaing :
(i) Clayperon relation.
(ii) Jaule-Thomson Coefficient. 8

(b) Derive Maxwell relations and explain their importance in thermodynamics. 8

## UNIT – IV

4 (a) Explain briefly Jaule's cycle with the help of $p$-$v$ & $h$-$S$ diagrams and derive expression for ideal efficiency of Jaule cycle. 8

(b) The compression ratio of an ideal air standard diesel cycle is 15. The heat transfer is 1465 KJ/kg of air. Find the pressure and temperature at the end of each process and determine its cycle efficiency. What is Mean Effective Pressure of the cycle if the inlet conditions are 300 k & 1 bar. 8

**OR**

4 (a) Explain briefly the diesel cycle with $p$-$v$ & $T$-$S$ diagram and derive expression for efficiency. 8

(b) In an otto cycle, air at 1 bar and 290k is compressed isentropically untill the pr is 15 bar. The heat is added at const. volume until the pressure rises to 40 bar. Calculate air standard efficiency and the mean effective pressure for cycle. Take $C_v$=*0.717 KJ/kgk* & $R_v$=*8.317 KJ/kg* mole k. 8

## UNIT – V

5 (a) Explain with help of neat diagram "regenerative cycle". Derive expression for its thermal efficiency. 10

(b) Steam enters an engine at a pressure of 12 bar with $67^0$c of superheat. It is exhausted at a pressure of 0.15 bar & 0.95 dry. Find the drop in enthalpy of the steam. 6

**OR**

5 (a) Steam at a pressure of 10 bar & 0.95 dry. Expand iscentropically to a pressure of 4 bar. Determine final dryness fraction of steam, by (i) using steam tables, (ii) using Mollier chart. 8

(b) A simple rankine cycle works betⁿ 35 bar and 0.2 bar. The initial condition of steam being dry saturated. Calculate
(i) Cycle efficiency
(ii) Rankine efficiency
(iii) Work ratio
(iv) Steam consumption. 8

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