Student Exam No._____

GANPAT UNIVERSITY

B. Tech. Sem. III (Mechanical Engineering)

CBCS Regular Examination November – December-2013

2ME305- Engineering Thermodynamics

Time: 3 Hours **Total Marks: 70**

Instruction:
1. Attempt *all questions.*
2. *Don't write anything on the question paper.*
3. *Use of non programmable scientific calculator is permitted.*
4. *Allow steam table.*

SECTION I

Que. – 1 **(a)** State the First Law of Thermodynamics and prove that for a non-flow process, it leads to the energy equation $Q = \Delta U + W$. **4**

(b) Define 'internal energy' and prove that it is a property of a system. **4**

(c) Explain the following statements of second law of thermodynamics. **4**
(*i*) Clausius statement
(*ii*) Kelvin-Planck statement

OR

Que. – 1 **(a)** A gas undergoes a thermodynamic cycle consisting of the following processes: **7**
(i) Process 1-2 : Constant pressure p= 1.4 bar, V1=0.028m^3,W_{12}=10.5 KJ,
(ii) Process 2-3 : Compression with PV=Constant, $U_3=U_2$,
(iii) Process 3-1: Constant volume, $U_1-U_3=-26.4$ KJ.
There are no significant changes in kinetic energy and potential energy.
(a) Draw the cycle on a P-Diagram.
(b) Determine the net work for the cycle in KJ.
(c) Determine the heat transfer for process 1-2.
(d) Show that $\sum Q_{cycle}=\sum W_{cycle}$

(b) Explain Entropy change in an irreversible process. **5**

Que. – 2 **(a)** Explain the concept of available and unavailable energy. When does the system become dead? **6**

(b) What is the Heat Pump? How does it differ from a Refrigerator? Show the COP of a heat pump is greater than COP of a refrigerator by unity. **5**

OR

Que. – 2 **(a)** Write down the general energy equation for a steady flow system and simplify when applied to the following systems: **6**
(*i*) Centrifugal water pump (*ii*) Reciprocating air compressor
(*iii*) Steam nozzle (*iv*) Steam turbine

(b) For an engine operating on air standard Otto cycle, the clearance volume is 10% of the swept volume. The specific heat ratio of air is 1.4. The air standard cycle efficiency is? **5**

Que. – 3 (a) With the help of P-V and T-S diagrams, show that for the same maximum pressure and heat input and compare diesel, dual and Otto cycle. 6

(b) What do you mean by the term 'Entropy'? Derive expressions for entropy changes for a reversible process (for a system) in the following cases : 6

(i) When heat is added to the system

(ii) When heat is rejected from the system

SECTION II

Que. – 4 (a) Derive the air standard efficiency of diesel engine and explain the effect of Cut-off ratio on performance of engine. 4

(b) A reversible heat engine operated between 600°C and 400 °C this engine drive, a reversible refrigerator operated between 40°C & −18°C still there net work out of 370 KJ. While heat received by engine 2100KJ. Find cooling effects of refrigerator (desire effects) 8

OR

Que. – 4 (a) Find the Irreversibility associated with the expansion process of air through a very small opening in a pipe from pressure 8 bar, temperature 600K to a pressure of 1.2 bars, assume: Air to an Ideal gas, temperature of surrounding 298K. 8

(b) Draw the following cycles on P-v and T-s diagram 4

(a) STERLING CYCLE (b) OTTO

(b) DIESEL (d) DUAL CYCLE

Que. – 5 (a) Derive the Maxwell relations and explain their importance in thermodynamics. 6

(b) Using Maxwell relation derive the following **Tds** equation 5

$$Tds = c_p\,dT - T(\partial v/\partial T)_p\,dp$$

OR

Que. q– 5 (a) What does the Joule-Thomson coefficient represent? Check Joule-Thomson coefficient of Ideal gas. 7

(b) For a steady flow process from state 1 to state 2 enthalpy change from h_1= 400KJ/Kg, h_2=100KJ/Kg, S1=1.1KJ/Kg-K, S_2=0.71KJ/Kg-K, To=300K, find the change in AE. 4

Que. – 6 (a) What do you mean by 'Clausius inequality'? 4

(b) What is Availability? 4

(c) State the limitations of first law of thermodynamics. 2

(d) What is difference in polytropic and isentropic process? 2

END OF PAPER