(c) Explain working of 4-stroke petrol engine with proper sketch. Also draw P-V diagram of Otto-Cycle.

(d) What amount of heat would be required to produce 5 kg of steam at a pressure of 6 bar and temperature of 260° C from water at 30°C? Take specific heat of water as 4.18 kJ/kg-K.

—x—





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NME303

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 140312

Roll No. | | | | | | | | | | |

# B.Tech. (Semester-III)

## SPL. THEORY EXAMINATION, 2014-15

## THERMODYNAMICS

*Time : 2 Hours]* *[Total Marks : 50*

**Note:** Attempt all questions. All questions carry equal marks. Assume any data missing suitably. Symbols have their usual meaning.

1. Attempt any two of the following: 5×2=10

(a) Define the following:

(i) Reversible process and irreversible process

(ii) Point function and path function

(iii) PMM-1

(b) Derive work done for $PV^n$ = Constant. An insulated rigid tank contains 0.6 $m^3$ of air at 12 bar pressure and 150° C. This air is allowed to expand by relation $PV^{1.4}$ = Constant up to 1 bar. Find maximum work that can be obtained.

(c) A process following the law $PV^n$ = constant. Prove that, for this process heat transfer is given by $\left[\frac{\gamma-n}{\gamma-1}\right]\left[\frac{P1V1-P2V2}{n-1}\right]$ and hence prove that specific heat for this process is given by $\left[\frac{n-\gamma}{n-1}\right]C_v$.

2. Attempt any two of the following: 5×2=10

(a) A reversible heat engine operating between the thermal reservoirs at 600°C and 40°C is used-to drive a reversible refrigerator for which the temperature limits are 40°C and –20°C. The engine absorbs 2000 KJ of energy as heat from the reservoir at 600°C and the net output work from the engine refrigerator system is 410 kJ. Make calculations for the heat extracted from the refrigerator cabinet and the net heat rejected to the reservoir at 40°C.

(b) A gas flows steadily through a rotary adiabatic compressor. The gas enters the compressor at a temperature of 16°C, a pressure of 100 kPa, and an enthalpy of 391.2 kJ/kg. The gas leaves the compressor at a temperature of 245°C, a pressure of 0.6 MPa, and an enthalpy of 534.5 kJ/kg. Then evaluate the external work done per unit mass of gas when the gas velocity at entry is 80 m/s and at exit is 160 m/s.

(c) State Kelvin Planck and Clausius statements. Prove that the two statements are equivalent.



3. Attempt any three of the following: 5×3=15

(a) Calculate the change in entropy when 0.2 $m^3$ of air at 1 bar and 60°C is compressed to 0.06 $m^3$ according to the law $PV^{1.3}$ = Constant. Take R = 0.287 kJ/kg-K and adiabatic index is 1.4.

(b) Define available energy, unavailable energy and second law efficiency.

(c) What do you mean by entropy? State and prove the principle of increase of entropy.

(d) If a perfect gas having unit mass undergoes change of state from 1 to 2 then show that the change of entropy is:

$$S_2 - S_1 = c_v \ln(P_2/P_1) + c_p \ln(V_2/V_1)$$

4. Attempt any three of the following: 5×3=15

(a) Plot ideal Rankine Cycle on P-v and T-s diagram. If 1 kg of steam at 20 bar and 360°C expands in a steam turbine to 1 bar. It is then condensed in a condenser to saturated water. The pump feed water to boiler. Assume ideal Rankine cycle and determine:

(i) Net work done

(ii) Rankine efficiency

(b) What do you mean by quality of steam? Explain combination type calorimeter for dryness fraction measurement.