BMET- 302

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

Odd Semester Examination, 2019-20
B.Tech-Mechanical Engineering (Semester-3rd)
BASIC THERMODYNAMICS

Time: 3:00 hrs. **Max. Marks: 100**

Total no. of printed pages: 2

Note: All questions are compulsory:

Q.1 Attempt any four of the following **4×5=20**

a) Explain 1st law of thermodynamics and give its limitations.

b) Explain equivalence of kelvin- Planck and Clausius statement.

c) Explain the adiabatic process. Derive an expression for the work done during the adiabatic process.

d) A system contains 0.15 m^3 of air at 4 bar and 423 K. a reversible adiabatic expansion takes place till the pressure falls to 1 bar. The air is then heated at constant pressure till enthalpy increase by 67 KJ. Determine the total work done.
If these processes are replaced by a single reversible polytropic process giving the same work between the same initial and final states, determine the index of expansion. Take C_p=1.009 KJ/KgK.

e) What are the limitations of first law of thermodynamics? How does second law of thermodynamics help to overcome these limitations?

f) What do you mean by property? Distinguish between intensive and extensive properties.

Q.2 Attempt any four of the following **4×5=20**

a) Explain the expansion process. What is the difference between throttling process and a free expansion process?

b) What is PMM –I? Why it is impossible?

c) Show the equivalence of two statements of second Law of thermodynamics.

d) What do you understand by the degree of superheat and degree of subcooling?

e) An ideal gas of mass 0.25 kg has a pressure of 3 bar, a temperature of 80^0C and a volume of 0.07 m^3. The gas undergoes an irreversible adiabatic process to a final pressure of 3 bar and a final volume of 0.10 m^3, during which the work done on the gas is 25KJ. Evaluate C_p and C_v of the gas and increase in entropy of the gas.

f) Define available and unavailable energy.

P.T.O.

Q.3 Attempt any two of the following **2×10=20**

a) Derive the Maxwell relation and explain their importance in thermodynamics.

b) Explain joule Kelvin effect with a neat sketch of throttling process. Prove that joule Thomson coefficient $\mu = 0$ for an ideal gas.

c) 2 kg of air at 500 KPaand 80°C expands adiabatically in a closed system until its volume is doubled and its temperature becomes equal to that of surroundings. The surroundings is at 100 KPa and 5°C.Determine the following:

i. The maximum work
ii. The actual work
iii. Irreversibility

Q.4 Attempt any two question **2×10=20**

a) Derive the first and second TDS equations, and derive the expression for the difference in heat capacities.

b) A Carnot cycle works with isentropic compression ratio of 5 and isothermal expansion ratio of 2. The volume of air at the beginning of the isothermal expansion is 0.3 m^3. If the maximum temperature and pressure is limited to 550 K and 21 bar, determine:(1) minimum temperature in the cycle: (2) thermal efficiency of the cycle: (3) pressure at all salient points(4) change of entropy during the isothermal expansion.(5) work done per cycle.(6) mean effective pressure.

c) Using Steam Table, find the enthalpy of 1 kg of steam at 12 bar when,

i. steam is dry saturated,
ii. steam is 22% wet and
iii. superheated to 250°C

Q.5 Attempt any two question **2×10=20**

a) Derive the relation for air standard efficiency of Diesel cycle. Also show the cycle on P-V and T-S diagram.

b) Explain Carnot cycle and derive the relation for its efficiency.

c) An ideal Otto cycle has compression ratio of 8.0.The initial conditions are 1 bar and 27°C. Heat added during constant volume process is 1050KJ/Kg. Find

i. maximum temperature of cycle
ii. Air standard efficiency
iii. Work done per Kg of air.