S.E. Sem III CBSGS
Mechanical Engg.
Thermodynamics

18/5/2016
3 pm to 6 pm

QP Code : 30595

(3 Hours)

[Total Marks : 80]

N. B. : (1) Question No. **1** is **compulsory**
(2) Solve any **three** questions from remaining **five** questions
(3) Assume suitable data
(4) Use of Mollier Chart and Steam Table is permitted

Q1) Answer any **Four** of the following : [20]

a) Prove that Energy is a property of the system.
b) What is cut-off ratio. Discuss its effect on the thermal efficiency of diesel engine.
c) Define Joule- Thompson coefficient and Explain its significance.
d) State and Explain Maxwell Equations.
e) Define COP for refrigerator and heat pump. Derive relation between them.

Q2) a) State and derive Steady flow energy equation and apply it to a boiler, condenser. [08]

b) Steam flows into a turbine, at a flow rate of 5000 kg/hr. The turbine develops a power of 550KW. The heat loss from the casing of the turbine and bearings is negligible.
(i) Find the change in enthalpy across the turbine, if the inlet velocity is negligible and exit velocity is 360 m/s and the change in potential energy is negligible.
(ii) Find the change in enthalpy across the turbine, if the velocity at entry is 66m/s and inlet pipe is 3m above the exit pipe [12]

Q3) a) State and prove Carnot theorem. [08]

b) A reversible heat engine operates with two environments. In the first, it draws 12000 kW from a source at 400°C and in the second, it draws 25000 kW from a source at 100°C. In both the operations, the engine rejects heat to a thermal sink at 20°C. Determine the operation in which the engine delivers more power [12]

Q4) a) Derive an expression for efficiency of Dual cycle. [08]

b) In an air standard Diesel cycle, the conditions at the beginning of the compression stroke are 300K and 1 bar. The air is compressed to a pressure of 50 bar and then fuel is injected such that 20kJ of energy is added per mole of air. Determine the compression ratio, the cut-off ratio and thermal efficiency of the cycle, if c_p of air is 3.5 times the gas constant R. [12]

Q5) a) Explain equivalency of Kelvin-Planck and Clausius Statement [08]

b) 1.5 kg of gas flows through gas turbine unit from its initial pressure and temperature 600 kN/m^2 and 1300 K respectively and exhausts at a pressure of 102 kN/m^2 and a temperature of 600 K to the atmosphere. The atmospheric pressure and temperature are 100 kN/m^2 and 298K. Calculate availability at the entrance to the gas turbine and exhaust of the gas turbine. [12]

Q6) a) Explain
(i) Dry Saturated Steam (ii) Sensible heat of water
(iii) Total Enthalpy of Steam (iv) Dryness Fraction [08]

b) In a Rankine cycle, the maximum pressure of steam supplied is 6 bar. The dryness fraction is 0.9. The exhaust pressure is 0.7 bar. Find the theoretical work done and Rankine efficiency. [12]