SE (SEM-III) (REV-2012) (CBSGS) [MECHANICAL ENGG] COMMON WITH AUTOMOBILE ENGG SEM-III (CBSGS)

27/11/15 3:00 PM to 6:00 PM

QP Code : 5103

THERMODYNAMICS

(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 **Five** of the following : [20]

a) State the first law of thermodynamics for the Closed system undergoing a cycle.
b) Explain Zeroth Law of Thermodynamics.
c) Show that entropy is property of system.
d) Define Availability and Unavailability.
e) Define COP for refrigerator and heat pump. Derive relation between them.
f) Define (i) Dryness Fraction (ii) Sensible heat of water (iii) Latent heat of vapourisation (iv) Superheated Steam

Q2) a) State the Kelvin Planck and Clausius statement and establish the equivalence of both for Second law of Thermodynamics. [08]

b) One kg of dry saturated steam undergoes an isentropic expansion process from 10 bar to 1 bar. Determine the final condition of steam and the work done when the expansion takes place.
(i) In a cylinder fitted with a piston
(ii) In a turbine [12]

Q3) a) State and derive Steady flow energy equation and apply it to a boiler, condenser, nozzle and turbine. [08]

b) Liquid Octane C_8H_{18} at 25^oC is used as fuel. Air used is 150% of theoretical air and is supplied at 25^oC. Assume a complete combustion and the product leaves the combustion chamber at 1600K. Calculate heat transfer per kg mole of fuel. Use the following data [12]

Substance	h_f^o (MJ/Kmole)	h_{298K} (MJ/Kmole)	h_{1600K} (MJ/Kmole)
C_8H_{18}	-250	-	-
O_2	-	8.68	52.96
N_2	-	8.67	50.57
H_2O (gas)	-241.8	9.9	62.75
CO_2	-393.5	9.36	76.95

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

b) A mass of air initially at $206^{o}C$ is at a pressure of 7bar and has a volume of $0.03m^3$ The air is expanded at constant pressure to $0.09m^3$, a polytropic process with n = 1.5 is then carried out, followed by a constant temperature process which completes the cycle. All the processes are reversible. Sketch the cycle on pressure-volume diagram and find the heat received and heat rejected in the cycle.
Take R = 0.287 KJ/KgK, C_v = 0.713 KJ/KgK [12]

Q5) a) Explain Maxwell relations. [04]

b) Explain Clausius – Clapyeron Equation [04]

c) An engine working on the Otto Cycle is supplied with air at 0.1MPa and $35^{o}C$. The compression ratio is 8. Heat supplied is 2100 KJ/Kg. Calculate the maximum pressure and temperature of the cycle, the cycle efficiency and mean effective pressure. [12]

Q6) a) Explain
(i) Combustion
(ii) Enthalpy of Formation
(iii) Enthalpy of Combustion
(iv) Adiabatic flame temperature [08]

b) A reversible engine receives heat from two thermal reservoir maintained at constant temperatures of 750K and 500K. The engine develops 100KW and rejects 3600KJ/min of heat to a heat sink at 250K. Determine the heat supplied by each thermal reservoir and thermal efficiency of the engine. [12]