(3 Hours) **Max. Marks: 80**

NB:

1) Question No 1 is compulsory.
2) Attempt any three out of remaining five questions.
3) Figures to the right indicate full marks.
4) Assume suitable data if required.
5) Use of steam Table and moiller chart permitted.

Q.1 a Attempt the following (Any five) 20

i) Define a thermodynamic system. Differentiate between open system, closed system and an isolated system.
ii) Define reversible and irreversible process.
iii) What is the perpetual motion machine of the first kind and second kind?
iv) Prove that entropy is a property of a system.
v) Define availability, unavailability and irreversibility.
vi) What is cut-off ratio? State its significance?
vii) 2 kg of steam is at12 bar and 0.85 dry, determine its enthalpy and specific volume.

Q.2 a Explain the First Law of Thermodynamics as referred to closed systems undergoing a cyclic change and undergoing process. 06

b Air at 1.02bar,22°C,initially occupying a cylinder volume of 0.015m^3 Compressed reversibly and adiabatically by a piston to a pressure of 6.8bar,calculate (i)The final temperature; (ii)the final volume; (iii)the work done. 06

c At the inlet to a certain nozzle, the enthalpy of the fluid passing is 2800 kJ/kg and the velocity is 50 m/s. At the discharge end, the enthalpy is 2600 kJ/kg. The nozzle is horizontal and there is negligible heat loss from it. 08
(a) Find the velocity at exists from the nozzle.
(b) If the inlet area is 900cm^2 and the specific volume at inlet is 0.187m^3/kg, find the mass flow rate.
(c) If the specific volume at the nozzle exit is 0.498 m^3/kg, find the exit area of the nozzle.

Q.3 a Define point function and path function. 04

b State Kelvin-Planck and Clausis statement of second law of thermodynamics and prove its equivalence. 08

c Two Carnot engines work in series between the source and sink temperatures of 550 K and 350 K.If both the engines develop equal power determine the intermediate temperature. 08

Q.4 a Describe the working of a Carnot cycle and derive an expression for the efficiency of the reversible heat engine. 06

b State and prove Clausius inequality. 08

c A heat engine receives reversibly 420 kJ/cycle of heat from a source at327°C, and rejects heat reversibly to a sink at 27°C. There are no other heat transfers. For each of the three hypothetical amounts of heat rejected, in (a), (b), and (c) below, compute the cyclic integral of dQ /T from these results show which case is irreversible, which reversible, and which impossible: 06
(a) 210 kJ/cycle rejected
(b) 105 kJ/cycle rejected
(c) 315 kJ/cycle rejected

Q.5 .

a Derive an expression for the efficiency of Otto cycle. 08

b In a steam turbine steam at 20 bar, 360°C is expanded to 0.08 bar. It then enters a condenser, where it is condensed to saturated liquid water. The pump feeds back the water into the boiler. Assume ideal processes; find per kg of steam the network and the cycle efficiency. 12

Q.6 a . Explain the Reheat and Regeneration method to improve the efficiency of the Rankine cycle. 06

b An engine with 200 mm cylinder diameter and 300 mm stroke works on theoretical Diesel cycle. The initial pressure and temperature of air used are 1 bar and 27°C.The cut-off is 8% of the stroke. Determine: 10
(i)Pressures and temperatures at all the points.
(ii)Theoretical air standard efficiency.
(iii)Mean effective pressure.

c State the Zeroth law of thermodynamics.What is its significance? 04
