SUBJECT CODE NO:- P-15
FACULTY OF ENGINEERING AND TECHNOLOGY
S.E.(MECH/PROD) Examination MAY/JUNE-2016
Thermodynamics - I
(Revised)

[Time:Three Hours] **[Max Marks:80]**

N.B i) Q.No.1 and 6 are compulsory.
ii) Solve any three questions from each section.
iii) Use of steam tables is permitted.
iv) Assume suitable data, if required.

Section A

Q.1 Solve any five. 10

i) State any three assumption of steady flow process.
ii) What are limitations of I^{ST} law of thermodynamics?
iii) Derive the equation for Nozzle from S.F.EE.
iv) Prove that $COP_{HP}=COP_R+1$.
v) What do you mean by heat reservoir? Explain HTR & LTR.
vi) Represent constant temperature process on P-V and T.S diagrams.
vii) What do you mean by "available energy".

Q.2 a) Derive steady flow energy equation on time basis. 06

b) Air flow steadily at the rate of 0.5 Kg/sec through an air compressor, entering at 7m.sec velocity, 100kpa pressure and 0.95 m^3 /kg volume and leaving at 5m/sec, 700 kpa and 0.19 m^3 /kg. The internal energy of the air leaving is 90 kj/kg greater than that of the air entering. Cooling water in compressor jackets absorb heat at the state of 50kw. 09

a) Compute the rate of shaft work input to the air in kw.
b) Find the ratio of inlet pipe diameter to outlet pipe diameter to outlet pipe diameter.

Q.3 a) Prove the Carnot theorem that "The efficiency of a irreversible heat engine is always less then the efficiency of a reversible energy operating between the same two thermal reservoir". 06

b) A heat pump working on the Carnot cycle takes in heat from a reservoir of 5^0c and deliver heat to a reservoir at 60^0c. The heat pump is driven by a reversible heat engine which take in heat from a reservoir at 840^0c and reject heat to a reservoir at 60^0c . The reversible heat engine also drives a machine that consume 30kw. If heat pump extracts 17kj/sec from 5^0c reservoir determine. 09

i) Rate of heat supply from 840^0c source.
ii) The rate of heat rejection to sink at 60^0c.

Q.4 a) State and explain the "principle of increase of entropy". 08

b) State and explain "Clausius theorem". 07

Q.5 Write short note in any three. 15

i) Concept of flow work.
ii) P M M-II
iii) Available and unavailable energy.
iv) Thermodynamic temperature scale.

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Section B

Q.6 Solve any five. 10

i) What are the limitations of Carnot cycle?
ii) Write short note on mean effective pressure.
iii) Define wet steam and superheated steam.
iv) What are different phases of pure substance state the process of phase transformation bases on heat supplied or rejected?
v) State the devices used for determining dryness fraction of steam.
vi) Define fuel and its types.
vii) What do you mean by stoichiometric air?

Q.7 a) Derive an expression for mean effective pressure of diesel cycle. 07

b) An engine working on Otto cycle in which upper and lower temperature limits of T_3 and T_1 . If the maximum work per kg of air is to be done, show that the intermediate temperature is given by $T_2=T_4=\sqrt{T_1 \times T_3}$. 08

Q.8 a) Derive an expression for enthalpy of wet steam. 04

b) Steam at 8 bar and 250^0c is flowing at the rate of 1.5 kg/sec passes through a pipe caring wet steam at 8 bar and 0.98 dry. After adiabatic mixing the flow rate is 2.8 kg/sec. Determine condition of steam after mixing. The mixture is further expanded in a nozzle isentropic ally to a pressure of 4 bars. Determine velocity of steam leaving nozzle. 11

Q.9 a) Write short note on. 06
" Bomb calorimeter"

b) An engine working on Otto cycle is supplied with at 1.bar and 30^0c, the compression ratio is 7.5. Heat supplied is 2200kj/kg. Calculate the maximum pressure, temperature of the cycle, cycle efficiency and mean effective pressure. 09

Q.10 Write short note on (any three) 15

a) Compression of Otto, diesel and dual cycle on the basis of same compression ratio.
b) Higher calorific value and lower calorific value.
c) Triple point.
d) Separating and throttling calorimeter.