SE - SEM-III - Mechanical - TD (old)

20/5/15

(OLD COURSE)
(3 Hours)

QP Code : 4535

[Total Marks: 100]

N.B. (1) Question No. 1 is **compulsory.**
(2) Attempts any **four** questions from remaining **six** questions.
(3) Draw **neat sketches** wherever necessary.
(4) Use of steam table, gas table and Mollier chart are **permitted.**
(5) **Assume** suitable data if necessary.

1 Answer any **five:** 20
(a) Explain intensive and extensive properties with examples.
(b) What is cut-off ratio? How does it affect the thermal efficiency of diesel cycle?
(c) Define point function and path function with examples.
(d) State Zeroth law of thermodynamics. What is its significance?
(e) Define: (i) Equivalent evaporation and (ii) Factor of Evaporation
(f) Draw T-s diagram of Otto cycle and Diesel cycle.

2 (a) Air at a temperature of 20 °C passed through a heat exchanger at a velocity of 40 m/s where its temperature is raised to 820 °C. It is then enters a turbine with same velocity of 40 m/s and expands till the temperature falls to 620 °C. On leaving the turbine, the air is taken at a velocity of 55 m/s to a nozzle where it expands until the temperature has fallen to 510 °C. If the air flow rate is 2.5 kg/s, calculate: 14
(i) Rate of heat transfer to the air in the heat exchanger.
(ii) The power output from the turbine assuming no heat loss.
(iii) The velocity at exit from the nozzle, assuming no heat loss.

(b) Define: 6
(i) Availability
(ii) Dead state
(iii) Effectiveness.

3 (a) For the same compression ratio and heat supplied compare Otto, Diesel and Dual cycle with the help of P-v and T-s diagram. 8
(b) A Rankine cycle operates between the pressure 15 bar and 0.01 bar. The initial degree of superheat is 100 °C. Assuming isentropic efficiency of expansion 85 %, calculate: 12
(i) Pump work
(ii) Actual turbine work
(iii) Thermal efficiency.

4 (a) A fluid flows under steady state through a C-D nozzle, prove that: 10

$$\frac{dA}{A}=\frac{dV}{V}\left(M^2-1\right)$$

(b) What is Joule – Thompson coefficients? What conclusions can be drawn from a given values of this coefficients. 6
(c) State and prove Carnot theorem. 4

5 (a) Air at 20 °C and 1.05 bar occupies 0.025 m^3. The air is heated at constant volume until the pressure is 4.5 bar and then cooled at constant pressure back to original temperature. Sketch the process on T-s and P-v diagram and calculate: 8
(i) The heat flow from air.
(ii) The net entropy change.

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(b) A rigid cylinder of volume 0.028 m^3 contains steam at 80 bar and 350 °C. The cylinder is cooled until the pressure is 50 bar. Calculate: 8
(i) The state of steam after cooling.
(ii) The amount of heat rejected by the steam.

(c) Discuss the effect of variation of back pressure on the performance of C-D nozzle. 4

6 (a) In an engine working on Dual cycle, the temperature and pressure at the beginning of the cycle are 90°C and 1 bar respectively. The compression ratio is 9. The maximum pressure is limited to 68 bar and total heat supplied per kg of air is 1750 KJ. Determine: 10
(i) Pressure and temperature at all salient points.
(ii) Air standard efficiency.
(iii) Work done per cycle.

(b) A normal shock wave is standing in a C-D nozzle where Mach number is 2. If the pressure and density before shock are 26.5 KN/m^2 and 0.413 kg/m^3 respectively. Determine: 10
(i) Pressure, temperature and density after shock.
(ii) Velocity before and after shock.
(iii) Stagnation pressure before and after shock.
(iv) Strength of shock.

7 Write short notes on any **four:** 20
(a) Rayleigh and Fanno line.
(b) Methods of improving Rankine cycle efficiency.
(c) Principle of increase of entropy.
(d) Clausius inequality
(e) Brayton Cycle.
