OR

Determine the amount of heat which should be supplied to 2 kg of water at 25°C to convert it into steam at 5 bar and 0.9 dry.

Unit - V

5. a) Draw a neat sketch of Otto cycle and indicate all the processes on it.

   b) Define air standard efficiency.

   c) Derive an expression for the efficiency of Diesel cycle.

   d) An engine of 250 mm bore and 375 mm stroke works on Otto cycle. The clearance volume is 0.00263 m^3. The pressure and temperature are 1 bar and 50°C. If the maximum pressure is limited to 25 bar, find the following :

      i) The air standard efficiency of the cycle

      ii) The mean effective pressure for the cycle

   Assume the ideal conditions.

OR

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 :

i) Pressure and temperatures at all salient points,

ii) Air standard efficiency,

iii) Mean effective pressure.

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Roll No .....

AE/AU/IP/IEM/ME/PR - 304

B.E. III Semester

Examination, December 2015

Thermodynamics

Time : Three Hours

Maximum Marks : 70

Note: i) Answer five questions. In each question part A, B, C is compulsory and D part has internal choice.

ii) All parts of each question are to be attempted at one place.

iii) All questions carry equal marks, out of which part A and B (Max. 50 words) carry 2 marks, part C (Max. 100 words) carry 3 marks, part D (Max. 400 words) carry 7 marks.

iv) Except numericals, Derivation, Design and Drawing etc.

Unit - I

1. a) Define the characteristic gas constant and write its units.

   b) State Boyle's law for an ideal gas.

   c) State and explain the first law of thermodynamics.

   d) It is proposed to compress 5 kg of CO_2 from an initial state of 20 bar and 15°C to a final state of 80 bar pressure. If the compression is done in a reversible adiabatic manner, find the final temperature, the work transfer, and the change of internal energy. Treat CO_2 as a perfect gas and take $\gamma = 1.27$.

OR

A steam turbine operates under steady flow conditions receiving steam at the following state :

Pressure 15 bar; internal energy 2700 kJ/kg; specific volume 0.17 m^3/kg and velocity 100m/s.

The exhaust of steam from the turbine is at 0.1 bar with internal energy 2175 kJ/kg, specific volume 15 m^3/kg and velocity 300 m/s. The intake is 3 meters above the exhaust. The turbine develops 35kW and heat loss over the surface of turbine is 20 kJ/kg. Determine the steam flow rate through the turbine.

Unit - II

2. a) Write Kelvin-Planck and Clausius statements of second law of thermodynamics.

   b) Define and explain entropy.

   c) Derive an expression for efficiency of Carnot cycle.

   d) A rigid cylinder containing 0.005 m^3 of nitrogen (molecular mass 28) at 1 bar and 290 K is heated reversibly until the temperature becomes 360 K. Determine the heat supplied and entropy change. Assume nitrogen to be perfect gas and take $\gamma = 1.4$.

OR

An engine working on Carnot cycle absorbs Q_1 units of heat from a source at T_1 and rejects Q_2 units of heat to a sink at T_2. Because of imperfect heat transfer, the maximum (θ_1) and minimum (θ_2) absolute temperatures attained during the cycle are give by

$\theta_1 = T_1 - KQ_1$ and $\theta_2 = T_2 + KQ_2$; Where K is a constant.

Show that efficiency of the plant is given by $\eta = 1 - \frac{T_2}{T_1 - KQ_1}$.

Unit - III

3. a) Define compressibility factor.

   b) State the law of corresponding states.

   c) Write a short note on generalized compressibility chart.

   d) Set up a T ds relation in the following form

   $T\,ds = c_p\,dT = \beta\,\upsilon\,T\,dp$

   Where β is the coefficient of volume expansion. The other symbols have their usual meanings.

OR

One kg-mol of oxygen at 350 K undergoes a reversible non-flow isothermal expansion and the volume increases from 0.06 m^3/kg to 0.15 m^3/kg. Using Van der Waal's equation of state, calculate the final pressure and the work done during the process. How does this value for work compare with that obtained by using ideal gas equation of state?

Unit - IV

4. a) What is triple point?

   b) Explain dryness fraction of steam.

   c) Describe with a neat sketch a separating and throttling calorimeter for measuring dryness fraction of steam.

   d) Steam enters an engine at a pressure 10 bar absolute and 400°C. It is exhausted at 0.2 bar. The steam at exhaust is 0.9 dry. Find :

      i) Drop in enthalpy;

      ii) Change in entropy