3E1633

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3E1633

B.Tech .III Semester (Old Back) Examination -2014

Mechanical Engg.

3ME3A Engg. Thermodynamics

Common to 3AN3, 3PI3A and 3AE3A

Time : 3 Hours **Maximum Marks : 80**
Min. Passing Marks : 24

Instructions to Candidates:

*Attempt any **five** questions, selecting **one** question from each **unit**. All questions carry **equal** marks. (Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.)*

Use of following supporting material is permitted must be stated clearly.

1. ***Steam table*** *2.* ***Mollier chart***

Unit - I

1. a) List the important processes for closed system and derive the equation for workdone of polytropic process. **(6)**

b) Four kg of water is placed in an enclosed volume of 1 m^3. Heat is added until the temperature is 150^{0}C. Find the

i) Pressure

ii) Mass of vapor and

iii) Volume of vapor **(10)**

OR

1. a) Write the Steady flow energy equation for a single stream entering and a single stream leaving a control volume and explain the various terms in it. **(6)**

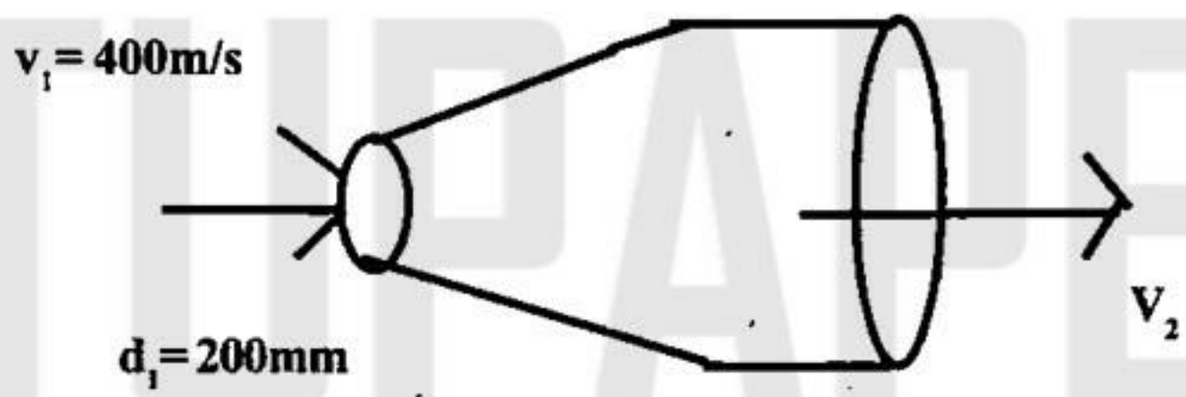
b) Air flows through the supersonic nozzle shown in figure. The inlet conditions are 7kpa and 420°C. The nozzle exit diameter is adjusted such that the exiting velocity is 700m/s. Calculate

i) The exit temperature

ii) The mass flow rate and

iii) The exit diameter.

Assume the adiabatic quasi-equilibrium flow **(10)**



Unit - II

2. a) Give the Kelvin-Plank and Clausius statements of the second law of thermodynamics **(6)**

b) Air is contained in an insulated, rigid volume at 20°C and 200 kpa. A paddle wheel, inserted in the volume, does 720 kJ of work on the air. If the volume is $2m^3$, calculate the entropy increase assuming constant specific heats. **(10)**

OR

2. a) Show that the COP of a heat pump is greater than the COP of refrigerator by unity. **(6)**

b) Two kg of water at 80°C are mixed adiabatically with 3kg of water at 30°C in a constant pressure process of 1 atmosphere. Find the increase in the entropy of the total mass of water due to the mixing process (C_p of water= 4.187 kJ/KgK) **(10)**

Unit - III

3. a) Derive Maxwell's equations **(6)**

b) Derive $C_p - C_v = -T\left(\frac{\partial P}{\partial V}\right)_T \left(\frac{\partial V}{\partial T}\right)_P^2$ **(10)**

OR

3. a) What is Joule-Thomson Coefficient? Determine the joule-Thomson coefficient for ideal gas **(6)**

b) Derive Clapeyron equation. **(10)**

Unit - IV

4. a) For the same compression ratio and heat rejection, which cycle is most efficient: Otto, Diesel or Dual? Explain with P-V and T-S diagrams. **(6)**

b) In an air standard Otto cycle the compression ratio is 7, and compression begins at 35^0C, 0.1 Mpa. The maximum temperature of the cycle is 1100^0C.Find

i) The heat supplied per kg of air.

ii) The work done per kg of air.

iii) The cycle efficiency. **(10)**

OR

4. a) Plot the efficiency of the air standard otto cycle as a function of the compression ratio for compression ratios from 4 to 16 **(6)**

b) Derive an expression for optimum intermediate pressure in multistage compression with intercooling between stages. **(10)**

Unit - V

5. a) Explain with neat sketch the Rankine cycle. **(6)**

b) A steam power plant is operating on the simple ideal Rankine cycle. Steam enters the turbine at 3Mpa and 350^0C and is condensed in the condenser at a pressure of 75kpa. Determine the thermal efficiency of this cycle. **(10)**

OR

5. a) Draw the ideal Rankine cycle on P-V, T-S and h-s diagram. **(6)**

b) A steam power plant is proposed to operate between the pressure of 10kpa and 2Mpa with a maximum temperature of 400^0C. Determine the thermal efficiency of power plant. **(10)**