This question paper contains 3 printed pages

7015

Your Roll No

M.Tech. / II Sem. **J**

NUCLEAR SCIENCE AND TECHNOLOGY

Paper NST–606— Applied Thermodynamics

Time : 3 hours *Maximum Marks* 70

(Write your Roll No on the top immediately on receipt of this question paper.)

Attempt all the questions.

Answer briefly and according to the marks allotted for each question.

Use steam table where it is necessary.

1 (*a*) Show that the internal energy of the following systems is a function of Temperature only:

(I) an ideal gas

(II) an incompressible substance

substance is a function of temperature only

(b) Why would we use an intercooler between compressor stages?

(c) What is reheat cycle? Mention two benefits of a reheat cycle

(d) Two kg water at 200 kPa with a quality of 25% has its temperature raised to 250^{0}C in a constant pressure process. What is the change in enthalpy?

(e) Discuss Mollier diagram and its significances in thermodynamic process

(4+4+4+4+4) Marks

2. (a) Calculate volume, enthalpy, internal energy and entropy of 5 kg of steam at 0.8 MPa pressure under following conditions:

(I) Dry and saturated

(II) Wet stream having wetness of 37 %

(III) Superheated steam at 250^{0}C **(2+2+2) Marks**

(b) The pressure at the end of compression of a steam engine having a compressor ratio 5 is 0.6 MPa. If the pressure and temperature at 0.15 of stroke were 0.1 MPa and 70^{0}C respectively, find the law of compression and the value of final temperature **(6$\frac{1}{2}$ Marks)**

OR

(a) Explain the principle of boilers and mention the types of boilers. Discuss the locomotive boilers **(1+1+4) Marks**

Turn over

(b) Derive the Euler and Bernoulli equation from Steady Flow Energy Equation (S F E E) for steady flow system What is the difference between the work for non-flow and flow process? Show with the help of PV diagram ?

(3+2+1 $\frac{1}{2}$) Marks

3. (a) What is a heat exchanger? Derive the heat transfer rate for parallel flow heat exchanger? Why are counter flow heat exchangers superior to parallel flow heat exchanger?

(2+5+2) Marks

(b) Use the formulae and steam table to find the relative humidity and specific humidity corresponding to 25^0C dry bulb and 21^0C wet bulb temperature **(3 $\frac{1}{2}$)Marks**

4 (a) A diesel engine has a state before compression of 95 kPa, 290 K, and a peak pressure of 6000 kPa a maximum temperature of 2400 K Find the volumetric compression ratio and the thermal efficiency

(4 $\frac{1}{2}$) Marks

(b) Explain the vapour compression cycle with the help of T-s and p h diagrams Explain the effect of superheat and subcooling on this cycle Derive the expression for C OP

or

A fluid undergoes a reversible adiabatic compression according to the law pv^n constant Determine the change in enthalpy internal energy and entropy, and the heat transfer and work transfer during this process

(8) Marks

5. Consider a steam turbine power plant operating near critical pressure, as shown in Fig 1 As a first approximation, it may be assumed that the turbine and the pump processes are reversible and adiabatic Neglecting any changes in kinetic and potential energies, calculate

(a) The specific turbine work output and the turbine exit state

(b) The pump work input and enthalpy at the pump exit state

(c) The thermal efficiency of the cycle $(4+4+4\frac{1}{2})$

Marks

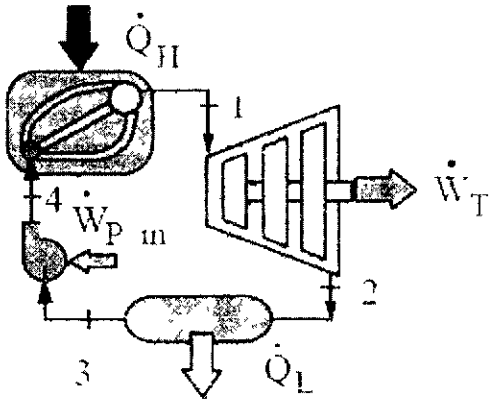

Fig 1

$P_1 = P_4 = 20$ MPa

$T_1 = 700\ ^\circ C$

$P_2 = P_3 = 20$ kPa

$T_3 = 40\ ^\circ C$