Code No: NR211401 **NR**

II B.Tech I Semester Supplementary Examinations, November 2006
THERMODYNAMICS & FLUID MECHANICS
(Common to Mechatronics and Production Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. A certain thermometer is calibrated using the ice and steam point as fixed points, at temperature 0^0 and 100^0 respectively. The function of the thermometric substance is taken as t = a log $_e$ X + b instead of the usual linear function t = aX + b. Show that the new scale is given by t = 100 $\{\log_e(X/X_i)/\log_e(X_s/X_i)\}$ [16]

2. At the inlet to a certain nozzle the enthalpy of the fluid passing is 2800kJ/kg and velocity is 60m/s. At the discharge end the enthalpy is 2768 kJ/kg. The nozzle is horizontal and there is negligible heat loss from it. Find [16]
   (a) Velocity at the exit
   (b) Mass flow rate if inlet area is $0.1m^2$ and specific volume at inlet is $0.187m^3/kg$ and
   (c) Exit area of the nozzle if the specific volume at the exit of the nozzle is $0.498m^3/kg$.

3. A heat pump working on the reversed Carnot cycle takes in heat from a reservoir at 5^0C and delivers heat to a reservoir at 60^0C. The heat pump is driven by a reversible heat engine which, receives heat from a reservoir at 840^0C and rejects heat to a reservoir at 60^0C. the reversible heat engine also drives a machine that absorbs 30 kW. If the heat pump extracts 17kJ/s from the 5^0C reservoir, determine [16]
   (a) the rate of heat supply from 840^0C source, and
   (b) the rate of heat rejection to the 60^0C sink.

4. (a) A pressure vessel has a volume of 1 m^3 and contains air at 1.4 MPa, 175^0 C. The air is cooled to 25^0C by heat transfer to the surroundings at 25^0C. Calculate the availability in the initial and final states and the irreversibility for the process. Assume for air Cp= 1.005 kJ/kg.K and R = 0.287kJ/kg.K. [8]
   (b) What is third law of thermodynamics? State its significance. [8]

5. (a) Show the ideal Rankine cycle with three stages of reheating on a T-s diagram. Assume the turbine inlet temperature is the same for all stages. How does the cycle efficiency vary with the number of reheat stages? [8]
   (b) Steam is produced at 19.5MPa, 560^0C. The condenser pressure is 2.5kPa. Assume ideal conditions in the turbine and neglect the pump work. Determine the thermal efficiency. [8]

6. (a) Define fluid surface tension property . What are its examples? [6]

   (b) The velocity distribution in a viscous flow over a plate is given by u = 4y - y^2 where u is velocity at distance y from the plate. If the coefficient of dynamic viscosity is 1.5 Pa.sec, determine the shear stress at y=0 and at y=2. [10]

7. (a) What can be the type of flow in a river during the period of heavy rainfall ? Give reasons. [8]

   (b) The velocity vector in an incompressible flow is given by
   V = (6xt +yz^2)i + (3t +xy^2)j + (xy -2xyz-6tz)k
   Verify whether the continuity equation is satisfied. Determine the acceleration vector at a point A(1,1,1) and at t= 1. [8]

8. (a) State and prove Bernoulli's theorem. Mention its limitations. [8]

   (b) An oil of specific gravity 0.84 flows through a uniform diameter pipe at the rate of 375 lit/sec. The energy head losses are 25 N-m/N per km length of the pipe. Find the slope of the hydraulic grade and total energy lines and the power lost per km of pipe. [8]

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