ANNA UNIVERSITY COIMBATORE

B.E. / B.Tech. DEGREE EXAMINATION – DECEMBER 2008

THIRD SEMESTER – MECHANICAL ENGINEERING

MC 301 ENGINEERING THERMODYNAMICS

Time: Three Hours **Maximum: 100 Marks**

(Use of Steam Table, Mollier Chart, Psychrometric Chart and Gas Tables are permitted)

PART A – (20 x 2 = 40 Marks)

Answer ALL Questions

1. Describe the concept of continuum.
2. Classify thermodynamic systems.
3. Distinguish between intensive properties and extensive properties.
4. State First law of thermodynamics.
5. What is PMM1 ?
6. What do you understand from Carnot cycle?
7. Define entropy
8. Entropy of the universe increases why?
9. Draw the PVT surface for Water.
10. Write the Vander Waal’s equation of state.
11. State Dalton’s law of partial pressure.
12. What is Joule Thomson effect?
13. Define (i) Dew Point Temperature (ii) Relative Humidity
14. Define By-Pass factor
15. What is the use of psychrometric chart?

16. What is wet bulb temperature?

17. Write the Energy and Momentum equation of compressible fluid flow.

18. Define the following (i) Mach Number (ii) Stagnation state.

19. What is Fanno Line. Show the Fanno line on h-S diagram.

20. What do you mean by critical pressure ratio of nozzle?

PART B – (5 x 12 = 60 Marks)

Answer Any FIVE Questions

21. During a given cycle, if the sum of all the heat transfer is – 170 kJ.The system completes 100 cycles per minute. Complete the following table and Compute the net rate of work output in kW.

Process	Q (kJ/min)	W(kJ/min)	ΔE (kJ/min)
1-2	0	2,170	-
2-3	21,000	0	-
3-4	-2,100	-	- 36,600
4-1	-	-	-

22. Air at a temperature of 15°C passes through a heat exchanger at a velocity of 30 m/s, where its temperature is raised to 800° C . It then enters a turbine with the same velocity of 30 m/s and expands until the temperature falls to 650°c. On leaving the turbine, the air is taken at a velocity of 60 m/s to a nozzle where it expands until the temperature has fallen to 500°C.If the air flow rate is 2 kg/s, calculate (a) the rate of heat transfer to the air in the heat exchanger, (b) the power output from the turbine assuming no heat loss, and(c) the velocity at exit from the nozzle, assuming no heat loss.

23. A reversible heat engine operates between two reservoirs at temperatures of 600^oC and 40^oC. The engine drives a reversible refrigerator which operates between reservoirs at temperatures of 40^oC and -20^oC. The heat transfer to the heat engine is 2000 kJ and the net work output of the combined engine refrigerator plant is 360 kJ. Evaluate the net heat transfer to the reservoir at 40^oC.

24. (a) A reversible heat engine during a cycle of operations draws 5 MJ from the 400 K reservoir and does 840 kJ of work. Find the amount and direction of heat interaction with other reservoirs. (8)

(b) Establish the inequality of Clausius (4)

25. Derive Maxwell's equations.

26. (a) Explain the significance of Joule-Thomson coefficient (6)

(b)Derive an expression for Clausius- Clapeyron equation. (6)

27. (a) An air conditioning system is designed under the following conditions:

Out door conditions – 30^o C DBT and 75% R.H

Required indoor conditions – 22^oC DBT and 70 % R.H.

Amount of free air circulated – 3.33 m^3/s.

Coil dew point temperature – 14^oC

The required condition is achieved first by cooling and dehumidification, and then by heating. Estimate (a) the capacity of the cooling coil in tones,(b) the capacity of the heating coil in kW,and (c) the amount of water vapour removed in kg/s. (8)

(b) Explain the following (i) Specific humidity,

(ii) Sensible heat load. (4)

28. A convergent –divergent nozzle has a throat area 500 mm^2 and an exit area of 1000mm^2.air enters the nozzle with a stagnation temperature of 360 K and a stagnation pressure of 1 MPa. Determine the maximum flow rate of air that the nozzle can pass, and the static pressure, static temperature, mach number, and velocity at the exit from the nozzle, if (a) the divergent section acts as a nozzle, and (b) the divergent section acts as a diffuser.

*********THE END*********