IX. (a) Describe the physical mechanism of convection. How is the convection heat transfer coefficient related to this mechanism? (6)

(b) Define the bulk temperature. How is it used? (4)

(c) A 20mm diameter tube is maintained at constant wall temperature of 90°C. Water enters the tube at 40°C and leaves at 60°C. If the entering velocity is 3 m/s, calculate the length of tube necessary to accomplish the heating. (10)

OR

X. (a) Differentiate between LMTD and NTU methods for design of heat exchanges. (4)

(b) Derive the expression for LMTD for parallel flow heat exchanges. (6)

(c) Hot water at 90°C flows through a 50mm ID, 60 mm OD horizontal steel pipe [k = 54 W/m°C] and is exposed to atmospheric air at 20°C. The water velocity is 0.25 m/s. Calculate the overall heat transfer coefficient for this situation, based on the outer area of pipe. (10)

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B.TECH. DEGREE III SEMESTER (SUPPLEMENTARY) EXAMINATION IN MECHANICAL ENGINEERING (CAD/CAM)
JUNE 2001

ME

ME 304 THERMODYNAMICS AND HEAT TRANSFER

(1995 Admissions)

Time: 3 Hours Maximum Marks: 100

I. (a) Explain the following:
- (i) Continum
- (ii) System
- (iii) State
- (iv) Process (10)

(b) A fluid is contained in a cylinder piston arrangement that has a paddle that imparts work to the fluid. The atmospheric pressure is 760mm of Hg. The paddle makes 10,000 revolutions during which the piston moves out 0.8 m. The fluid exerts a torque of 1.275 Nm on the paddle. What is net work transfer, if the piston is 0.6m diameter? (10)

OR

II. (a) Explain Kelvin-Plank's and Clausins statements. What is PMMZ? (8)

(b) The work and heat transfer in a system in a process **A** are 20 KJ and 16 KJ. Another process **B** between the same end conditions involves a heat transfer of 9 KJ. Calculate the work transfer in the process **B**. Show first law of Thermodynamics is valid for the cyclic process in this case. (6)

(c) The heat engine is supplied with 278 kJ/sec of heat at a constant temperature of 283°C and heat rejection takes place at 5°C. There are two cases of heat rejection of 208 kJ/sec and 139 kJ/sec. Classify which of the results reported a reversible and an irreversible cycle. (6)

(Turn over)

II. (a) Draw the P-V and T-S diagram for carnot cycle and derive the expression for efficiency in terms of compression ratio. (8)

(b) An engine working on Otto-cycle has a volume of $0.5m^3$, pressure 1 bar and temperature 27°C at the beginning of the compression stroke. At the end of the compression stroke the pressure is 10 bar. 200 kJ of heat are added during constant volume heating process. Calculate the pressures, temperatures and volumes at salient points in the cycle. Also find the percentage clearance, efficiency, net work per cycle and mean effective pressure. If the number of working cycles per minute is 200, find the ideal power developed by the engine. Assume the cycle is reversible. (12)

OR

V. (a) Derive the expression for the efficiency of a constant pressure air cycle. (8)

(b) Draw the T-S diagram for water and show the variation of entropy with temperature when ice at 0°C is heated to steam at 150°C under 1 atm pressure. (8)

(c) Explain the modified Rankine cycle taking into account the effect of bleeding. (4)

(a) Derive the general three dimensional heat conduction equation in cartesian co-ordinates. (10)

(b) A hot steam pipe having an inside surface temperature of 250°C has an inside diameter of 80 mm and a wall thickness of 5.5 mm. It is covered with a 90mm layer of insulation having $k = 0.5$ W/m°C, followed by a 40mm layer of insulation having $k = 0.25$ W/m°C. The outside temperature of the insulation is 20°C. Calculate the heat lost per meter of, length. Assume $k = 47$ W/m°C for the pipe. (10)

OR

Contd.....3.

VI. (a) What is meant by thermal resistance? (4)

(b) Discuss the mechanism of thermal conduction in gases and solids. (6)

(c) A composite wall is formed of a 25 mm copper plate, a 3.2 mm layer of asbestos, and a 50 mm layer of fiber glass. The wall is subjected to an overall temperature difference of 560°C. Calculate the heat flow per unit area through the composite structure. (10)

VII. (a) How does thermal radiatioan differ from other types of electro-magnetic radiation? (5)

(b) What is Stefan-Boltzmann law? Explain. (5)

(c) Two perfectly black parallel planes 1.2 by 1.2 m are separated by a distance of 1.2 m. One plane is maintained at 800K and the other at 500K. The planes are located in a large room whose walls areat 300K. What is the net heat transfer between the planes? (10)

OR

VIII. (a) Briefly explain the following terms:

(i) Emissive power
(ii) Absorptivity
(iii) Emissivity
(iv) Radiation shields (10)

(b) A 1m diameter cylinder, 1m long is maintained at 800K and has an emissivity of 0.65. Another cylinder, 2m in diameter and 1 m long, encloses the first cylinder and is perfectly insulated. Both cylinders are placed in a large room maintained at 300K. Calculate the heat lost by the inner cylinder. (10)

Contd.....4.