IX. (a) Explain the mechanism of heat flow by natural convection. (8)

(b) Define effectiveness of a heat exchanger. (4)

(c) Derive the effectiveness - NTU relationship for a parallel flow heat exchanger. (8)

OR

X. (a) Define:

(i) Reynold's number
(ii) Prandtl number
(iii) Nusselt number (6)

(b) Air enters a cooler at 115°C and at 3 bar and is brought to 45°C by passing through tubes of 10mm inner diameter surrounded by water which enters the cooler at 15°C and leaves at 30°C. Assuming the heat exchanger is counter flow, find the mean temperature difference. If the air velocity in the tube is limited to 6.5m/sec. find the length of the tube required. Neglect the tube resistance and assume water side heat transfer coefficient as 200W/m²-K

Take the following properties of air at mean temperatures:

Density , $\rho = 2.87\ Kg/m^3$

Specific heat, $C_p = 1005\ J/Kg-K$

Thermal conductivity, K = 0.03 W/m-K

Kinematic viscosity, $\nu = 20.92 \times 10^{-6}\ m^2/sec$

Absolute viscosity, $\mu = 20.92 \times 10^{-6}\ Kg/m-s$ (14)

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BTS 165 (I)

B.TECH. DEGREE III SEMESTER (SUPPLEMENTARY) EXAMINATION IN MECHANICAL ENGINEERING (CAD/CAM) JUNE 2002

ME 304 THERMODYNAMICS AND HEAT TRANSFER

(1995 Admissions)

ME

Time: 3 Hours Maximum Marks: 100

I. (a) Explain the following:

(i) Thermodynamic system
(ii) Thermodnyamic Equilibrium
(iii) Zeroth law of thermodynamics
(iv) Joule-Thomson effect. (12)

(b) An engine cylinder has a piston of area 0.12m² and contains gas at a pressure of 1.5MPa. The gas expands according to a process which is represented by a straight line on a pressure-volume diagram. The final pressure is 0.15MPa. Calculate the work done by the gas on the piston if the stroke is 0.3m. (8)

OR

II. (a) Derive the steady flow energy equation. How this equation is applicable to turbine and compressor? (10)

(b) State and prove Carnot's theorem. (10)

III. (a) Derive the Tds equations. (10)

(b) Explain the Rankine cycle showing it on P - V and T - S diagrams. Obtain an expression for efficiency of the cycle. (10)

OR

IV. (a) Explain the Diesel cycle and obtain an expression for the air standard efficiency of the cycle. (10)

(b) The following information is available about an engine working on Diesel cycle:

Maximum cycle temperature	= 1890 K
Heat supplied	= 860 KJ/Kg
Ambient conditions	= 1 bar, 300 K

Determine the compression ratio, cut off ratio, maximum pressure and air standard efficiency. (10)

V. (a) Obtain the Fourier conduction equation in polar co-ordinates. (10)

(b) A furnace wall is made up of three layers, one of fire brick, one of insulating brick and one of red brick. The inner and outer surfaces are at 870°C and 40°C respectively. The respective co-efficients of thermal conductivities of the layers are 1, 0.12 and 0.75 W/m-K and the thickness are 22cm, 7.5cm and 11cm. Assuming close bonding of the layers at their interfaces, find the rate of heat loss per square metre per hour and the interface temperatures. (10)

OR

VI. (a) A conical cylinder of length L and radii R_1 and R_2 $(R_1 < R_2)$ is fully insulated along the outer surface. The surface of R_1 is maintained at temperature T_1 and surface R_2 is maintained at temperature T_2 $(T_1 > T_2)$. Considering the heat flow along the axis of the cylinder find the expression for heat flow through the conical cylinder. Take the thermal conductivity as K. (12)

Contd.....3.

(b) Determine the loss of heat through the wall of a rotating sphere shaped boiling pan with an inner diameter of 1.5m and wall thickness 20cm. Inner surface temperature is 200°C and that of the outer surface is 50°C. The equivalent thermal conductivity is 0.12W/m-K. Also find the heat flux. (8)

VII. (a) State and prove Kirchoff's law of radiation. (6)

(b) Explain:

(i) Black body
(ii) Stefan Boltzmann law. (6)

(c) Determine the heat lost by radiation per metre length of 8 cm diameter pipe at 300°C if -

(i) located in a large room with red brick walls at a temperature of 27°C.
(ii) enclosed in a 16cm diameter red brick conduit at a temperature of 27°C.

Emissivity of steel pipe = 0.79
Emissivity of brick conduit = 0.93 (8)

OR

VIII. (a) Explain:

(i) Emissive power
(ii) Planck's law
(iii) Grey body
(iv) Emissivity (12)

(b) Estimate the net radiant interchange per square metre for two very large planes at temperatures 500°C and 300°C respectively. Assume that the emissivity of hot and cold planes are 0.8 and 0.6 respectively. (8)

Contd.....4.