Q1. (20 Marks)	Choose the correct option for following questions. All the Questions are compulsory and carry equal marks (2 marks Each)
1.	Upto the critical radius of insulation
Option A:	Convection heat loss will be less than conduction heat loss
Option B:	Heat flux will decrease
Option C:	Added insulation will increase heat loss
Option D:	Added insulation will decrease heat loss
2.	In which one of the following materials, is the heat energy propagation minimum due to conduction heat transfer?
Option A:	Lead
Option B:	Copper
Option C:	Water
Option D:	Air
3.	Convective heat transfer, in which heat is transferred by movement of warmed matter is described by
Option A:	Fourier's law
Option B:	Newton's law of cooling
Option C:	Fick's law
Option D:	Stefan's Boltzmann Law
4.	Heat transfer occurs by natural convection because change in temperature causes difference in _____
Option A:	viscosity
Option B:	density
Option C:	thermal conductivity
Option D:	heat capacity
5.	The rate of heat transfer is -----in film wise condensation.
Option A:	Less
Option B:	More
Option C:	Same as that of dropwise condensation.
Option D:	Negligible
6.	A body that reflects all the incident thermal radiations is called a
Option A:	Opaque body
Option B:	Gases
Option C:	Black body
Option D:	Specular body
7.	In shell and tube heat exchangers, what is the use of straight tie rods?

Option A:	to fix the tube sheet in position
Option B:	to fix the tubes in position
Option C:	to hold baffle in space
Option D:	to account for thermal strain
8.	Which of the following is the most common type of baffle used in industrial shell and tube heat exchanger?
Option A:	75 % cut segmental baffle
Option B:	25 % cut segmental baffle
Option C:	Orifice baffle
Option D:	Disk and doughnut baffle
9.	Evaporation by thermo compression is results in the _____
Option A:	Saving of steam
Option B:	Realization of multiple effect economy in a single effect
Option C:	Saving of process material
Option D:	Low capacity
10.	Rate of evaporation decreases as _____
Option A:	Temperature increases
Option B:	Humidity of surrounding air increases
Option C:	Heat transfer area increases
Option D:	Atmospheric pressure decreases

Q2 (20 Marks)	Solve any Four Questions out of Six (05 marks each)
A	Derive for critical thickness for the insulation applied over hallow cylinder.
B	Significance of Biot Number, Grashoff Number, Prandtl Number and Reynolds Number.
C	Explain Boiling regimes in pool boiling
D	State the laws of radiation
E	Explain Working Construction of Shell and tube heat exchanger with its diagram, advantages and disadvantages.
F	Explain Boiling Point Elevation

Q3 (20 Marks)	Solve any Two Questions out of Three (10 marks each)
A	A 300mm O.D. pipe is covered with two layers of insulation (k_1=0.105 W/m K and k1=0.105 W/m K). The better insulating material is on the outside and is 40 mm thick. The other insulating material is of 50 mm thickness. The inner and outer surface temperatures of the insulation are 623K and 323K. Find (i) The heat loss per metre length (ii) The heat loss per square metre of the outer insulation surface. (iii) The temperature of the surface between the two layers of insulation.
B	Air stream at 300 K is moving at a velocity of 0.3 m/s across a 100 W electric bulb at 400 K. If the bulb is approximated by a 60 mm diameter sphere, calculate the heat transfer rate and the percentage of power lost owing to convection. The physical properties of air at the film temperature of 350 K are:

	$\nu = 2.08 \times 10^{-5}$ m²/sec, $k = 0.03$ W/m K, $P_r = 0.697$
C	A surface condenser was designed for a condensation rate of 50 Kg vapour per hour. It contained 100 tubes of 10mm outside diameter and of 1m length. The tubes are arranged in a 10 x 10 array. By mistake, the condenser is installed in the vertical position (tubes vertical) instead of in the horizontal position (tubes horizontal) for which position it was designed. What would be the condensation rate in the vertical position?

Q4 (20 Marks)	Solve any Two Questions out of Three (10 marks each)
A	Explain with neat diagram feed arrangement in Evaporator.
B	Derive design equation for Counter heat exchanger "$Q = U.A.\Delta T_{lm}$".
C	A double pipe heat exchanger is made up of inner tube 37.5 mm I.D, 44.8 mm O.D and outer tube 72.7 mm O.D and 5.1 mm wall steel pipe, has an effective heating surface of 2.4 m² based on outer surface of inner pipe. This exchanger has a scale deposit on heating surface with a dirt factor of 4.8x 10⁻⁴ hr. m² °C / Kcal. It is proposed to use this exchanger to preheat benzene from an initial temperature of 20 °C by means of hot water which will enter the exchanger at 88 °C. Benzene will flow through the annulus at the rate of 5500 Kg/hr and the hot water will flow through the tube at 6250 Kg/hr. Determine the temperature of benzene if counter current flow is used. Thermal conductivity of steel is 39.312 Kcal/hr m °C. Data: |	Viscosity	Thermal Conductivity Kcal/hr m °C	Heat Capacity Kcal/Kg °C	Density Kg/m³
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Water	0.80	0.550	1.0	970
Benzene	0.57	0.138	0.4	860	