



JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Regular), April-May 2015

B. Tech (Mechanical Engineering), Semester IV

Roll No.....

ME 408 : Heat Transfer

Time: 3 hours

Max. Marks: 100

Instructions to students:

1. Do not write anything other than your roll number on question paper.
2. Assume suitable data wherever required and mention it clearly.
3. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.

Q.1A	Objective type multiple choice questions (7 questions @ 1 mark)	7
i.	Which of the following is the case of heat transfer by radiation (i) blast furnace (ii) heating of building (iii) cooling of parts in furnace (iv) heat received by a person from fireplace (v) all of the above.	
ii.	Heat transfer takes place as per (i) zero th law of thermodynamics (ii) first law of thermodynamics (ii) II nd law of thermodynamics (iv) Kirchoff's and Stephen's law	
iii.	Cork is a good insulator because it has (i) free electrons (ii) atoms colliding frequency (iii) low density (iv) porous body (v) all	
iv.	Which of the following is a case of steady state heat transfer (i) IC engine (ii) air preheaters (iii) heating of buildings in winter (iv) none	
v.	Pick up wrong case. Heat flowing from one side to other depends directly on (i) Face area (ii) time (iii) thickness (iv) temp. diff. (v) thermal conductivity	
vi.	Metals are good conductors of heat because (i) their atoms collide frequently (ii) their atoms are relatively far apart (iii) they contain free electrons (iv) they have high density (v) all	
vii.	Boris has an effective surface area of 1.9 m ² . He generates heat at a constant rate of 120W. By how much will his putting on a thick (5mm) snowsuit raise his skin temperature? (snowsuit conductivity = 0.04 W/m-°C (i) 9.9 °C (ii) 8.9 °C (iii) 7.9 °C (iv) 6.9 °C (v) 5.9 °C	
viii.	Define conduction, convection and radiation, perfectly.	1+1+1
Q.2	Short answer type questions (4 questions @ 2.5 marks)	10
i.	How are Fourier's law and Ohm's law similar?	
ii.	State of effect of impurities on the thermal conductivity of a metal.	
iii.	Define and elaborate effectiveness of Fin.	
iv.	Wien's displacement law, elaborate.	
Q.3	Derive the expression of velocity distribution and mass flow rate for laminar film condensation on a flat plate. Write all assumptions.	10
Q.4A	Explain condensation and its types in detail.	05
Q.4B	Discuss various forms of boiling.	05



Q.5A	An electric wire of 1.25mm diameter and 250mm long is laid horizontally and submerged in water at 7 bars. The wire has an applied voltage 2.2 V and carries a current of 130 amps. If the surface of the wire is maintained at 200°C, make calculations for the heat flux and boiling heat transfer coefficient.	05
Q.5B	In a food processing plant, a brine solution is heated from -12 °C to -65 °C in a double pipe parallel flow heat exchanger by water entering at 35 °C and leaving at 20.5 °C at the rate of 9 kg/min. Determine the heat exchanger area for overall heat transfer coefficient of 860 W/m ² K. For water C _p =4186 J/kg-K.	05
Q.6A	List the salient features of a black body radiation. Calculate the radiant flux density from a black body at 500 °C. If the emitted radiated energy is to be doubled, to what temperature surface of the black body needs to be raised?	05
Q.6B	A woman informs an engineer that she frequently feels cooler in the summer when standing in front of an open refrigerator. The engineer tells her that she is only imagining things as there is no fan inside the refrigerator to blow air over her. A lively argument ensues. Whose side of the argument do you take? Why?	05
	OR	
Q.6B	Suppose you have a choice between a straight triangular or rectangular fin constructed of aluminum with a base thickness of 3.0mm. The convection coefficient is 50 W/m ² ·°C. Select the fin for least weight for a given heat flow.	05
Q.7	A X-flow heat exchanger is used to heat an oil in the tubes (c=1.9 kJ/kg·°C) from 15 °C to 85 °C. Blowing across the outside of the tubes is steam which enters at 130 °C and leaves at 110 °C with a mass flow of 5.2 kg/s. the overall heat transfer coefficient is 275 W/m ² ·°C and for steam (c=1.86 kJ/kg·°C). Calculate the surface area of heat exchanger.	10
	OR	
Q.7	Exhaust gases (C _p =1.12 kJ/kg.K) flowing through a tubular heat exchanger at the rate of 1200 kg/hr are cooled from 400 °C to 120 °C. The cooling is affected by water (C _p =4.18 kJ/kg.K) that enters the system at 10 °C & @ 1500 kg/hr. If the overall heat transfer coefficient is 500 kJ/m ² -hr-deg, what HE area is required to handle the load for (a) parallel flow and (b) counter flow arrangement?	10
Q.8A	Define the effectiveness of fin? How to increase the effectiveness of fin? What happens if ε _{fin} = 1, ε _{fin} < 1 and ε _{fin} > 1	10
Q.9A	Show physical significance of Following non-dimensional numbers: Nu (Nusselt Number), Gr (Grashof Number) and Pr (Prandtl Number), Re (Reynold Number) and St (Stanton Number)	10
Q.9B	Two large parallel plates with emissivity (ε) = 0.5 each, are maintained at different temperatures and are exchanging heat only by radiation. Two equally large radiation shields with surface emissivity 0.05 are introduced in parallel to the plates. Find percentage reduction in net radiative heat transfer.	10
	OR	
Q.9B	Derive general heat conduction equation in Cartesian co-ordinates. Also deduce the equation for (i) Steady state conduction (ii) No heat sources (iii) No heat source and steady state condition (iv) One dimensional heat conduction equation without heat generation under steady state	10