

**University of Mumbai**  
**Examinations Summer 2022**  
**Program: Mechanical Engineering**

Curriculum Scheme: **R 2016**  
 Course Code: **MEC503**  
 Time: 3hour

Examination: **TE (Sem.V)**  
 Course Name: **Heat Transfer**  
 Max. Marks: 80

Q1.	<b>Choose the correct option for following questions. All the Questions are compulsory and carry equal marks</b>
1.	The coefficient of thermal conductivity is defined as
Option A:	Quantity of heat transfer per unit area per one degree drop in temperature
Option B:	Quantity of heat transfer per one degree temperature drop per unit area
Option C:	Quantity of heat transfer per unit time per unit area
Option D:	Quantity of heat transfer per unit time per unit area per one degree temperature drop per unit length
2.	Conduction is a process of heat transfer from
Option A:	A hot body to a cold body, in a straight line, without affecting the intervening medium
Option B:	One particle of the body to another without the actual motion of the particles
Option C:	One particle of the body to another by the actual motion of the heated particles
Option D:	None of the above
3.	When the thickness of insulation on a pipe exceeds the critical value
Option A:	the heat flow rate decreases
Option B:	the heat flow rate increases
Option C:	the heat flow rate remains constant
Option D:	None of the above
4.	“The ratio of the emissive power and absorptive power of all bodies is the same and is equal to the emissive power of a perfectly black body”, This statement is known as
Option A:	Planck’s law
Option B:	Stefan’s law
Option C:	Kirchhoff’s law
Option D:	Black body law
5.	With regard to “ Fouling factor” which of the following statements is correct?
Option A:	It is used when a liquid exchangers heat with a gas
Option B:	It is used only in case of Newtonian fluids
Option C:	It is dimensionless
Option D:	It is virtually a factor of safety in heat exchanger design
6.	Dropwise condensation usually occurs on
Option A:	Glazed surface
Option B:	Smooth surface
Option C:	Oily surface
Option D:	Coated surface
7.	The free convection heat transfer is significantly affected by
Option A:	Reynolds number
Option B:	Grashoff number
Option C:	Prandtl number
Option D:	Stanton number
8.	Critical radius of a hollow cylinder is defined as:
Option A:	Inner radius which would give maximum heat flow
Option B:	Outer radius which would give minimum heat flow

Option C:	Outer radius which would give maximum heat flow
Option D:	None of the above
9.	For a radiation shield which of the following parameters should be highest?
Option A:	Emissivity
Option B:	Reflectivity
Option C:	Absorptivity
Option D:	Transmissivity
10.	In a shell and tube heat exchanger, the corrosive liquid is normally passed through
Option A:	Tube side
Option B:	Shell side
Option C:	Either of the above
Option D:	None of the above

<b>Q2</b>	<b>Solve any Four out of Six 5 marks each</b>
A	What do you mean by Fouling in heat exchanger?
B	Differentiate between dropwise and filmwise condensation.
C	Derive the equation of critical thickness of insulation
D	Define intensity of radiation. Explain is solid angle?
E	Explain hydrodynamic and thermal boundary layer
F	What is Fin? What are the various types of fins?

<b>Q3</b>	<b>Solve any Two Questions out of Three 10 marks each</b>
A	A wall of a furnace is made up of inside layer of silica brick 120mm thick covered with a layer of magnesite brick 240 mm thick. The temperature at inside surface of silica brick wall and outside surface of magnesite brick wall are 725°C and 110°C respectively. The contact thermal resistance between the two walls at the interface is 0.0035°C/W per unit wall area. If thermal conductivities of silica and magnesite bricks are 1.7W/m.K and 5.8W/m°C, calculate: i)The rate of heat loss per unit area of walls, ii)The temperature drop at interface.
B	A heat exchanger is constructed from 4cm O.D. tube to cool 6kg/s of liquid from 65°C to 40°C using 6 kg/s of water at 10°C. Assuming the specific heat of liquid as 3.6kJ/kg.K. and overall heat transfer based on the outer tube area as 567W/m <sup>2</sup> . K. Determine the heat transfer surface area required for the following arrangement: -i) Parallel flow, ii) Counter flow.
C	A standard cast iron pipe (inner diameter=50mm and outer diameter=55mm) is insulated with magnesium insulation (k=0.02W/m.K). Temperature at the interface between the pipe and insulation is 300°C. The allowable heat loss through the pipe is 600W/m length of pipe for the safety; the temperature of the outside surface of insulation must not exceed 100°C. Determine minimum thickness of insulation required.

<b>Q4.</b>	<b>Solve any Two Questions out of Three 10 marks each</b>
A	An egg with mean diameter of 4cm and initially at 20°C is placed in a boiling water pan for 4min and found to be boiled to the consumers taste. For how long should a similar egg for same consumer be boiled when taken from refrigerator at 5°C? Take the following properties for egg: k=10W/m.K, ρ=1200kg/m <sup>3</sup> , C <sub>p</sub> =2kJ/kg. K and h=100W/m <sup>2</sup> . K. Use lump theory.
B	The net radiation from the surfaces of two parallel plates maintained at temperature T <sub>1</sub> and T <sub>2</sub> is to be reduced by 79 times. Calculate the number of screens to be placed between the two surfaces to achieve this reduction in heat exchange. Assuming the emissivity of screens as 0.05 and that of the surfaces as 0.8.
C	With the help of dimensional analysis method prove that for free convection Nu=constant ×(Gr.) <sup>m</sup> ×(Pr) <sup>n</sup>