Indian Maritime University

(A Central University, Govt of India)

Mar/Apr'26 SE

Programme Name: B Tech (Marine Engineering)

Semester: V

Subject Code: UG11T4509

Subject Name: Heat Transfer & Marine Heat Exchangers

Date: 13.03.2026	Max Marks: 70
Duration: 03 Hrs	Pass Marks: 35

General Instructions

(i) All Sections (A, B & C) are to be attempted.
(ii) Options, if any, are specified in respective section.
(iii) Heat Transfer Data Handbook can be used.

Section A

Ten MCQs/Fill in the Blanks of 01 Mark each – Choose the correct answer as applicable.

1. The non-dimensional Grashoff number is considered in which of the following heat transfer?
a) Forced convection heat transfer
b) Free convection heat transfer
c) Conduction heat transfer
d) Radiation heat transfer

2. The overall coefficient of heat transfer is used in problems of
a) Conduction
b) Convection
c) Radiation
d) Conduction & Convection

3. For the same heat transfer Q and same overall heat transfer coefficient Uo, surface area required for cross flow operation is always
a) less than LMTD for parallel flow
b) more than LMTD for parallel flow
c) same as LMTD for parallel flow
d) unpredictable

4. Reynold's number gives the relation between_____
a) Inertial forces and gravitation forces
b) Inertial forces and viscous forces

c) Inertial forces and buoyancy forces
d) Gravitation forces and buoyancy forces

5. The emissivity of the body at a particular temperature is numerically equal to its absorptivity for radiant energy from body at the same temperature is called –
a) Wien's law
b) Kirchhoff's law
c) Stefan-Boltzmann law
d) Newton's law of cooling

6. Up to the critical radius of insulation,
a) Heat flux will decreases
b) added insulation will increase the heat loss
c) added insulation will decrease the heat loss
d) convective heat loss will be less than conduction heat loss

7.Effectiveness of the fin is defined as____
a) The ratio of fin heat transfer rate to the heat transfer rate that would exist without a fin.
b) The ratio of heat transfer rate that would exist without a fin to the fin heat transfer rate.
c) The ratio of actual heat transferred by fin to the maximum heat transferrable by fin.
d) The ratio of fin heat transfer rate to the maximum heat transferable by pin fin.

8.What is the unit of thermal conductivity (k) in the International System of units (SI)?
a)Watts (W)
b)Watts per square meter-Kelvin (W/m^2K)
c)Watts per meter-Kelvin ($W/m \cdot K$)
d)Watts per Kelvin (W/K)

9. The emissive power of a black body, according to Stefan-Boltzmann, is proportional to____
a) Fourth power of the absolute temperature
b) Seventh power of the absolute temperature
c) Eighth power of the absolute temperature
d) Stefan-Boltzmann constant

10.For heat exchangers, TEMA stands for
a) Tubular Exchanger Manufactures Association
b) Thermal Exchanger Manufactures Association
c) Tubular Equipment Manufacturers Association
d) Thermal Equipment Manufacturers Association

Section B

Five Questions of 02 Marks each

11. Define LAMBERT'S COSINE law.
12. Define Nusselt Number and Reynolds number.
13. Define velocity boundary layer thickness in fluid flow.
14. Draw temperature profile of Counter Flow and Parallel Flow Heat Exchanger
15. Mention the importance of critical radius of insulation.

Section C

Seven Questions of 10 Marks each of which any 05 questions to be answered.

16. Derive the heat diffusion equation in Cartesian co-ordinates (10marks)

17. a) Calculate the heat transfer from a 60W incandescent bulb at 115^0 C to ambient air at 25^0 C. Assume the bulb as a sphere of 50mm diameter. Also find percentage of power lost by free convection. The correlation is given as :

$Nu = 0.60(Gr.Pr)^{1/4}$ (6 marks)

b) Describe any 4 dimensionless numbers considered in free convection. (4marks)

18. Draw the TEMA standard heat exchanger with channel and removable cover, one object pass, and outside packed floating head (AEP) and mention the various parts. (10marks)

19. a) Derive an expression for LMTD in Parallel Flow Heat Exchangers. (6marks)
b) Prove that the temperature distribution in a plane wall is linear. (4marks)

20. Air at 20°C, at a pressure of 1 bar is flowing over a flat plate at a velocity of 3 m/s. if the plate maintained at 60°C, calculate the heat transfer per unit width of the plate. Assuming the length of the plate along the flow of air is 2m.

21. A composite wall consists of three layers of thicknesses 300 mm, 200mm and 100mm with thermal conductivities 1.5, 3.5 and is W/m K respectively. The inside surface is exposed to gases at 1200°C with convection heat transfer coefficient as 30W/m2K. The temperature of air on the other side of the wall is 30°C with convective heat transfer coefficient 10 Wm2K. If the temperature at the outside surface of the wall is 180°C, calculate the temperature at other surface of the wall, the rate of heat transfer and the overall heat transfer coefficient. (4+3+3=10 Marks)

22.a) Define Wein's displacement law and Intensity of radiation (4marks)

b) Assuming the Sun to be a black body emitting radiation with maximum intensity at $\lambda = 0.49$ μm, Calculate the following:
i) The surface temperature of the sun (3marks)

ii) The heat flux at the surface of the sun (3marks)

TMI IMU <tmi-imu@tmi.tolani.edu>

Clarification - UG11T4509 - Section C - Q No 21 - 13.03.2026 - AN - reg.

1 message

[redacted]

Fri, Mar 13, 2026 at 3:58 PM

Dear Sir/Madam,

Please refer to the subject cited above and read Q No 21 as follows:

*Q No 21 - A composite wall consists of three layers of thicknesses 300 mm, 200 mm and 100 mm with thermal conductivities 1.5, 3.5 and **15** W/m K respectively. The inside surface is exposed to gases at 1200°C with convection heat transfer coefficient as 30 W/m²K. The temperature of air on the other side of the wall is 30°C with convective heat transfer coefficient 10 W/m²K. If the temperature at the outside surface of the wall is 180°C, calculate the temperature at the other surface of the wall, the rate of heat transfer and the overall heat transfer coefficient.*

Thanks & Regards,

[redacted]