CBCS SCHEME

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18SM42

Fourth Semester B.Tech. Degree Examination, July/August 2022
Fluid Mechanics and Heat Transfer

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Define the following terms and write their units.
i) Weight density ii) Specific gravity iii) Newton's law of viscosity iv) Surface tension v) Capillarity **(10 Marks)**

b. The dynamic viscosity of an oil, used for lubrication between a shaft and sleeve is 6 poise. The shaft in of diameter 0.4m and rotate at 190rpm. Calculate the power lost in the bearing for a sleeve length of 90mm. The thickness of the oil film is 1.5mm. **(10 Marks)**

OR

2 a. Define the following terms :
i) Pascal's law ii) Hydrostatic law iii) Centre of pressure
iv) Velocity Potential function v) Stream function. **(10 Marks)**

b. The pressure intensity at a point in a fluid is given as 3.924 N/cm^2. Find the corresponding height of fluid when the fluid is (i) water (ii) oil of specific gravity 0.9. **(05 Marks)**

c. The velocity potential function is given by $\phi = 5(x^2 - y^2)$ calculate the velocity components at the point (4, 5). **(05 Marks)**

Module-2

3 a. Define Reynold's equation of motion, Navier – Stokes equation and Euler's equation of motion. **(06 Marks)**

b. Obtain Bernoulli's equation of motion from Euler's equation and list the assumption made in derivation of Bernoulli's equation. **(04 Marks)**

c. Water is flowing through a pipe having diameter 300mm and 200mm at the bottom and upper end respectively. The intensity of pressure at the bottom end is 24.525N/cm^2 and the pressure at the upper end 9.81 N/cm^2. Determine the difference in datum head if the rate of flow through pipe is 40Lps. **(10 Marks)**

OR

4 a. Explain development of boundary layer with rest to fluid flowing over a flat plate. **(05 Marks)**

b. Define displacement thickness, momentum thickness and energy thickness for the flow over flat plate. Also write the expression for the same. **(06 Marks)**

c. A fluid of viscosity 0.7Ns/m^2 and specific gravity 1.3 is flowing through a circular pipe of diameter 100mm. The maximum shear stress at the pipe wall is given as 196.2N/m^2. Find
i) Pressure gradient ii) The average velocity iii) Reynolds number of the flow. **(09 Marks)**

Module-3

5 a. Explain three modes of heat transfer with their basic laws. **(06 Marks)**

b. Explain the three types of boundary conditions used in analysis of heat conduction problems. **(06 Marks)**

c. A 3mm thick metal plate having K = 98.6W/mk is exposed to vapour at 100ºC on one side and cooling water at 30ºC on the opposite side. The heat transfer coefficients are 14200W/m^{2}ºC on vapour side and 2325 W/m^{2}ºC on water side. Determine the rate of heat transfer and drop in temperature at each side of the plate. **(08 Marks)**

OR

6 a. Define the following terms :
(i) Critical thickness of insulation
(ii) lumped parameter analysis
(iii) Fin effectiveness
(iv) Fin efficiency
(v) Steady state heat conduction. **(10 Marks)**

b. Explain the significance of Biot and Fourier number. **(04 Marks)**

c. Define variable thermal conductivity. Obtain the expression for variable thermal conductivity applying into Fourier law of heat conduction. **(06 Marks)**

Module-4

7 a. Explain the three types of boundary conditions applied in Finite difference representation. **(08 Marks)**

b. Define the following terms :
(i) Kirchhoff's law
(ii) Wein displacement law
(iii) Planck's law
(iv) Radiation shield
(v) Emissivity
(vi) Intensity of radiation. **(12 Marks)**

OR

8 Explain the following :
(i) Spectrum of electromagnetic radiation
(ii) Concept of black body
(iii) Irradiation
(iv) View factor
(v) Radiation exchange between parallel plates. **(20 Marks)**

Module-5

9 a. Explain the physical significance of
(i) Reynolds number
(ii) Grashof number
(iii) Prandtl number
(iv) Nussult number
(v) Stanton number. **(10 Marks)**

b. Obtain an empirical expression in terms of dimensionless numbers for forced convection heat transfer. **(10 Marks)**

OR

10 a. With a neat sketch, explain the different regimes of pool boiling. **(08 Marks)**

b. Explain briefly different modes of condensation. **(06 Marks)**

c. Classify heat exchangers based on heat transfer process, constructional features and flow arrangement. **(06 Marks)**

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