Code: 9A14403 **R09**

B.Tech II Year II Semester (R09) Supplementary Examinations May/June 2017

FLUID MECHANICS & HEAT TRANSFER

(Mechatronics)

Time: 3 hours Max. Marks: 70

All questions carry equal marks

(A total of five questions are to be answered with at least two questions from each part)

All questions carry equal marks

Heat transfer data book is permitted in the examination hall.

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PART - A

1 (a) Define surface tension. Also derive the expression for pressure intensity for a case of hollow bubble of radius r.

(b) An open tank contains water up to a depth of 2 m and above it an oil of specific gravity 0.9 for a depth of 1.2 m. Find the pressure intensity at the interface of the two liquids and at the bottom of the tank.

2 (a) Define stream line, path line, streak line and stream tube.

(b) An orifice meter with orifice diameter 15 cm is inserted in a pipe of 30 cm diameter. The pressure difference measured by a mercury oil differential manometer on the two sides of the orifice meter gives a reading of 50 cm of mercury. Find the rate of flow of oil of specific gravity 0.9 when the coefficient of discharge of the orifice meter = 0.64.

3 A pipe line 300 mm in diameter and 3200 m long is used to pump up 50 kg per second of an oil whose density is 950 kg/m^3 and whose kinematic viscosity is 2.1 stokes. The centre of the pipe line at the upper end is 40 m above than that at the lower end. The discharge at the upper end is atmospheric. Find the pressure at the lower end and draw the hydraulic gradient and the total energy line.

4 A Kaplan turbine runner is to be designed to develop 9100 kW. The net available head is 5.6 m. If the speed ratio = 2.09, flow ratio = 0.68, overall efficiency = 86% and the diameter of the boss is 1/3 the diameter of the runner, find the diameter of the runner, its speed and the specific speed of the turbine.

PART – B

5 (a) What are the different modes of heat transfer? Give their governing equations along with mechanism.

(b) Using Fourier heat conduction equation, derive the heat rate equation for conduction through a homogeneous slab.

6 (a) Using 'Dimensional analysis' prove that for forced convection heat transfer for flow through circular pipes $Nu = f(R_e, P_r)$.

(b) Explain the non-dimensional Prandtl number using boundary layer concept.

7 (a) Explain how radiation heat exchange takes place between two blackbodies. Derive the relevant equations. State assumptions, if any.

(b) Explain the concept of shape factor. Give its importance in radiation heat transfer.

8 (a) For a heat exchanger, show that: $R_d = \frac{1}{U_{design}} - \frac{1}{U_{clean}}$

(b) Explain the working principle of a heat pipe using a schematic diagram.

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