B. Tech. Sem - III (Mechanical Engg.) (2014 COURSE) (CBCS) :
WINTER - 2018
SUBJECT : FLUID MECHANICS

Day: Wednesday
Date: 28/11/2018

W-2018-2312

Time: 10.00 AM TO 01.00 PM
Max. Marks: 60

N.B.:

1) All questions are **COMPULSORY**.
2) Figures to right indicate **FULL** Marks.
3) Assume suitable data if necessary.

Q.1 **a)** With the help of neat sketches define following types of fluid flow: **(05)**
i) One, two & three dimensional flow
ii) Laminar and turbulent flow
Also give suitable examples for each type of flow.

b) What do you understand by a flow net? **(05)**
What are different methods to generate flow nets?
Explain any one method with the help of a neat sketch.

OR

Q.2 **a)** What are stream lines, streak lines and path lines? **(05)**
Explain them with the help of neat sketches and suitable examples.

b) The velocity components in a fluid flow are given by: **(05)**
$u = 2xy \quad \& \quad v = a^2 + x^2 - y^2$
i) Show that the flow is possible
ii) Derive the relation for stream function.

Q.3 **a)** What is Archimedes' principle? **(05)**
Derive an expression for Archimedes' principle.

b) An annual plate 2 m external diameter and 1 m internal diameter with its greatest and least depths below the surface being 1.5 m and 0.75 m respectively. Calculate the magnitude, direction & location of the force acting upon one side plate due to water pressure. **(05)**

OR

Q.4 **a)** What are the three conditions of equilibrium developed when a submerged or a floating body is given a slight angular displacement? **(05)**

b) What is total pressure & centre of pressure? **(05)**
How is magnitude and direction of total pressure on a curved surface calculated?

Q.5 **a)** Derive an expression for differential from of Euler's equation of motion. **(05)**
Reduce this equation to ideal Bernoulli's equation between two points in a flowing fluid.

b) Derive an expression for discharge over a rectangular notch in terms of head of water over crest of the notch. **(05)**

OR

Q.6 **a)** With the help of a neat sketch as per IS-2952 (1964) explain construction and working of an orifice meter. **(05)**
Why is coefficient of discharge of an orifice meter much smaller than that of venturimeter?

P.T.O.

b) The following data refers to an orifice meter attached to a pipe through which oil is flowing: **(05)**

Diameter of the pipe: 300 mm
Diameter of the orifice: 150 mm
Reading of the differential manometer: 500 mm of Hg column
Specific gravity of the oil: 0.9
Coefficient of discharge of the meter: 0.64

Determine the rate of flow of oil through the orifice meter.

Q.7 **a)** How is Computational Fluid Dynamics (CFD) methodology helpful in analysis of fluid flow problems? **(05)**

b) With the help of a neat sketch explain the concept of the development of lift on an airfoil. **(05)**

OR

Q.8 **a)** In case of a laminar flow show that the pressure gradient in the direction of flow is equal to the shear gradient in the direction normal to the direction of flow. **(05)**

b) What is drag? **(05)**
Give detailed classification of drag with the help of suitable examples.

Q.9 **a)** The water levels in the two reservoirs 'A' and 'B' are 104.5 m and 100 m respectively above the datum. From 'A' and 'B' there are two connections to point 'D' *viz.* 'AD' and 'BD'. At point 'D', pressure is 98.1 kN/m^2 gauge and height is 83.5 m above datum. Another pipe connects 'D' to another tank 'C'. What will be the height of water level in 'C' assuming the same value of friction coefficient (f) = 0.0075 for all pipes. Take. The diameters of the pipes AD, BD and CD are 300 mm, 450 mm, 600 mm respectively and their lengths are 240 mm, 270 mm, 300 mm respectively. **(08)**

b) What is water hammer in pipes? **(02)**

OR

Q.10 **a)** What are major and miner energy losses in pipes? **(05)**
Give relationships for calculation of them.

b) In a pipe of 300 mm diameter and 800 mm length, an oil of specific gravity 0.8 is flowing at the rate of 0.45 m^3/s. Find: **(05)**

i. Head loss due to friction
ii. Power required to maintain the flow

Take kinematic viscosity of the oil as 0.3 Stoke.

Q.11 **a)** For a turbulent flow through circular pipe, give velocity distribution. **(05)**
Why the nature of velocity profiles is different in both laminar as well as turbulent flows?

b) What do you understand by model analysis? **(05)**
Give advantages and applications of model testing.

OR

Q.12 **a)** Define the following terms related to development of boundary layer on a flat plate: Free stream velocity; Laminar boundary layer; Turbulent boundary layer; Laminar sub-layer; Critical Reynolds' number **(05)**

b) What are the dimensionless numbers used in model analysis? **(05)**
Explain any two dimensionless numbers with their relationships and their physical significance.

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