Ref No Ex/Prod/T/ 224/2017 (Old)

B.E. PRODUCTION ENGINEERING SECOND YEAR SECOND SEMESTER (Old)-2017

FLUID SYSTEMS THREE HOURS FULL MARKS 100

Answer Any five Questions

1(a) State and explain Newton's law of viscosity. (8)

(b) A 0.15 m diameter vertical cylinder rotates concentrically inside another cylinder of diameter 0.15 m . Both cylinders are 0.25 m high. The space between the cylinders is filled with a liquid. If torque of 12 Nm is required to rotate the inner cylinder at 100 rpm , determine the viscosity of the fluid. (8)

(c) Define kinematic viscosity and also state its unit in M K S system (4)

2(a) A main pipe having 15 cm diameter branches into two pipes . One of the branch pipes has a diameter of 8 cm whereas other has 4 cm . The flow in the larger diameter branch pipe is three fourth of the main pipe and remaining is discharged through the smaller diameter branch pipe. If the average velocity of flow in any one of the pipes , main or branch does not exceed 3.5 m/sec , find the rate of flow and velocities of the main pipe as well as branch pipes. (8)

(b) Mathematically prove that stream line and velocity potential line are mutually perpendicular to each other. (7)

(c) The velocity components in a two dimensional fluid flow are :
$u=2xy$ and $v = b^2 + x^2 - y^2$
Is the flow rotational or ir-rotational ? (5)

3(a) Obtain an expression for the discharge when fluid flows through a horizontal pipe with the help of a venture-meter .Assume specific gravity of the fluid is less than that of manometer fluid used in venture meter. (8)

(b) A pipe bend placed in a horizontal plane tapers from 200 mm diameter at inlet to 150 mm diameter at the outlet as shown in fig 1. Water flows from 200 mm diameter to 150 mm diameter at the rate of 0.45 m^3 / s . The pressures at inlet and outlet are 40 KN / m^2 and 23 KN/ m^2 respectively. Determine the magnitude and direction of resultant force on the bend. (8)

(c) State the assumptions of Bernoulli's equation (4)

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4(a) In a lubricated journal bearing, the rotating journal is supported by a thin film of oil. It is judged that resisting torque T depends on load on the bearing W ,dynamic viscosity of oil μ , rotational speed N, diameter of the journal D, length of the bearing L and clearance between the journal and bearing C. Using Buckingham's PI (π) theorem express T in terms of dimensionless parameters. (10)

(b) Define Reynolds number and show it is a dimensionless number (5)

(c) What are repeating variables ? State the criterions for the selection of repeating variables (5)

5(a) Prove that shear stress gradient is equal to pressure gradient for viscous laminar flow. (5)

(b) Derive Hagen-Poiseuille equation. (8)

(c) Derive the expression of time of emptying a cylindrical vessel by a orifice that is placed at the bottom of the vessel. (7)

6(a) Prove that the pressure rise in the impeller of a centrifugal pump is

$$(V_1^2 + U_2^2 - V_{f2}^2 \operatorname{cosec}^2\beta_2) / 2g$$

where V_1 , absolute velocity at inlet ; U_2 , peripheral velocity at outlet ; V_{f2} , velocity of flow at outlet ; β_2 , outlet vane angle (10)

(b) The impeller of a centrifugal pump is of 30 cm diameter and 5 cm width at the periphery , and has blades whose tip angles incline 60° backward. The pump delivers 17m^3 / min and impeller rotates at 1000 rpm. Assuming that the pump is designed to admit radially , calculate (i) speed and direction of water as it leaves the impeller (ii) torque exerted by the impeller on the water (iii) shaft power required. Assume mechanical and hydraulic efficiencies are 95% and 75% respectively. Neglect the leakage loss. (8)

(c) Define specific speed of centrifugal pump (2)

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7(a) State the major differences of Impulse Turbine and Reaction Turbine (4)

(b) Define the specific speed of a turbine. Hence prove that

$N_s = NP^{1/2} / H^{5/4}$

Where N_s = Specific speed of a turbine
N = Rotational speed
P = Power
H = Head (8)

(c) At a particular power station , a single jet Pelton wheel turbine produced 23080 KW under a head of 1770 m while running at 750 r p m . Calculate (i) jet diameter (ii) mean diameter of the bucket. Assume co-efficient of velocity and speed ratio are 0.97 and 0.46. Overall efficiency is 85% . (8)

8(a) With the help of neat sketch explain the working principle of VANE PUMP. (5)

(b) With the help of neat sketch explain briefly the working principle of ROTARY type direction control valve. (5)

(c) Describe with neat sketch the working principle of WALL ATTACHMENT and INTERACTIVE JET type fluid logic element. (6)

(d) Explain NAND and FLIP-FLOP logic states with the help of turbulence amplifier.. (4)

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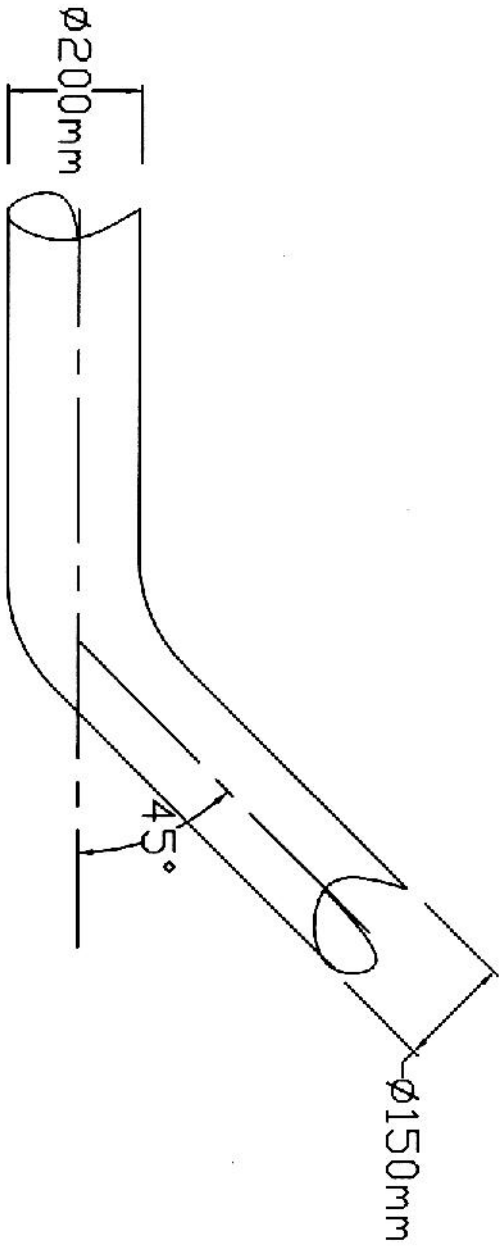

Fig 1