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NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA**(An Autonomous Institute Affiliated to AKTU, Lucknow)****B.Tech****SEM: IV - THEORY EXAMINATION (2022-2023)****Subject: Fluid Mechanics & Fluid Machines****Time: 3 Hours****Max. Marks: 100****General Instructions:****IMP:** Verify that you have received the question paper with the correct course, code, branch etc.

1. This Question paper comprises of **three Sections -A, B, & C.** It consists of Multiple Choice Questions (MCQ's) & Subjective type questions.
2. Maximum marks for each question are indicated on right -hand side of each question.
3. Illustrate your answers with neat sketches wherever necessary.
4. Assume suitable data if necessary.
5. Preferably, write the answers in sequential order.
6. No sheet should be left blank. Any written material after a blank sheet will not be evaluated/checked.

SECTION A**20****1. Attempt all parts:-**

- 1-a. If there is bucket full of oil and bucket full of water and you are asked to lift them, which one of the two will require more effort given that volume of buckets remains same? (CO1) 1
- (a) Oil bucket
(b) Water bucket
(c) Equal effort will be required to lift both of them
(d) None of the mentioned
- 1-b. Which of the following is a type of fluid based on viscosity? (CO1) 1
- (a) Real Fluid
(b) Ideal Fluid
(c) Newtonian Fluid
(d) All of the mentioned
- 1-c. When is air assumed to be incompressible? (CO2) 1
- (a) At low speed

- (b) At high speed
(c) Independent of its speed
(d) None of the mentioned
- 1-d. The velocity of a point in a flow is... (CO2) 1
(a) along the streamline
(b) tangent to the streamline
(c) along the pathline
(d) tangent to the pathline
- 1-e. A liquid flows through two similar pipes 1 and 2. If the ratio of their flow velocities $V_1 : V_2$ be 2:3, what will be the ratio of the head loss in the two pipes? (CO3) 1
(a) 3:2
(b) 9:4
(c) 0.085
(d) 4:09
- 1-f. The laminar boundary layer is a ... (CO3) 1
(a) Smooth flow
(b) Rough flow
(c) Uniform flow
(d) Random flow
- 1-g. Specific speed of reaction turbine is between? (CO4) 1
(a) 5 and 50
(b) 10 and 100
(c) 100 and 150
(d) 150 and 300
- 1-h. What is the SI unit of impulse? (CO4) 1
(a) N/m
(b) N/m^2
(c) N.s
(d) Kg.m
- 1-i. With the increase in load, Energy in the turbine... (CO5) 1
(a) Decreases
(b) Increases

- (c) Remains same
- (d) Independent
- 1-j. Centrifugal pumps transport fluids by converting... (CO5) 1
 - (a) Kinetic energy to hydrodynamic energy
 - (b) Hydrodynamic energy to kinetic energy
 - (c) Mechanical energy to kinetic energy
 - (d) Mechanical energy to Hydrodynamic energy

2. Attempt all parts:-

- 2.a. Explain vapor pressure and cavitation. (CO1) 2
- 2.b. What are the factors to the determined when viscous fluid flows through the circular pipe? (CO2) 2
- 2.c. What is meant by stability of a floating body? (CO3) 2
- 2.d. What is breaking jet in Pelton wheel turbine? (CO4) 2
- 2.e. Differentiate pump and turbine. (CO5) 2

SECTION B

30

3. Answer any five of the following:-

- 3-a. The diameters of a pipe at section 1 is 10 cm and at section 2 is 15 cm. Find the discharge through the pipe if the velocity of water flowing through the pipe at section 1 is 5 m/s. Also determine the velocity at section 2. (CO1) 6
- 3-b. Determine the intensity of shear of an oil having viscosity = 1 poise. The oil is used for lubricating the clearance between a shaft of diameter 10 cm and its journal bearing. The clearance is 1.5 mm and the shaft rotates at 150 r.p.m. (CO1) 6
- 3-c. Derive the equation of a streamline for a 2-D flow. Prove that the discharge between two streamlines is the difference in their stream function values. (CO2) 6
- 3-d. Water is flowing through a pipe having diameter 300 mm and 200 mm at the bottom and upper end respectively. The intensity of pressure at the bottom end is 24.525 N/cm and the pressure at the upper end is 9.81 N/cm . Determine the difference in datum head if the rate of flow through pipe is 40 lit/s. (CO2) 6
- 3.e. Find an expression for the discharge over a rectangular weir in terms of head of water over the crest of the weir. (CO3) 6
- 3.f. What is the difference between impulse turbine and reaction turbine? Explain with neat diagram. (CO4) 6
- 3.g. A centrifugal pump is to discharge $0.118 \text{ m}^3/\text{sec}$ at a speed of 1450 rpm 6

against a head of 25 m. The impeller diameter is 250 mm, its width at outlet is 50 mm and manometric efficiency is 75% . Determine the vane angle at the outer periphery of the impeller. (CO5)

SECTION C

50

4. Answer any one of the following:-

- 4-a. A 30 cm diameter pipe conveying water branches into two pipes of diameters 20 cm and 15 cm respectively. If the average velocity in the 30 cm pipe is 2.5 m/s, find the discharge in this pipe. Also determine the velocity in 15 cm pipe if the average velocity in 20 cm pipe is 2 m/s. (CO1) 10
- 4-b. Differentiate between : (i) Stream function and velocity potential function (ii) Stream line and streak line and (iii) Rotational and irrotational flows (CO1) 10

5. Answer any one of the following:-

- 5-a. Find the velocity and acceleration at a point (1, 2, 3) after 1 sec. for a three dimensional flow given by $u = yz + t$, $v = xz - t$, $w = xy$ m/s. (CO2) 10
- 5-b. State Bernoulli's theorem for steady flow of an incompressible fluid. Derive an expression for Bernoulli's equation from first principle and state the assumptions made for such a derivation. (CO2) 10

6. Answer any one of the following:-

- 6-a. A horizontal pipe line 40 m long is connected to a water tank at one end and discharges freely into the atmosphere at the other end. For the first 25 m of its length from the tank, the pipe is 150 mm diameter and its diameter is suddenly enlarged to 300 mm. The height of water level in the tank is 8 m above the centre of the pipe. Considering all losses of head which occur, determine the rate of flow. Take $f = .01$ for both sections of the pipe. (CO3) 10
- 6-b. A pipe line 60 cm diameter bifurcates at a Y-junction into two branches 40 cm and 30 cm in diameter. If the rate of flow in the main pipe is 1.5 m/s and mean velocity of flow in 30 cm diameter pipe is 7.5 m/s, determine the rate of flow in the 40 cm diameter pipe. (CO3) 10

7. Answer any one of the following:-

- 7-a. A jet of water having a velocity of 20 m/s strikes a curved vane, which is moving with a velocity of 10 m/s. The jet makes an angle of 20° with the direction of motion of vane at inlet and leaves at an angle of 130° to the direction of motion of vane an outlet. Calculate : (i) Vane angles, so that the water enters and leaves the vane without shock. (ii) Work done per second per unit weight of water striking (or work done per unit weight of water striking) the vane per second. (CO4) 10

- 7-b. What are unit quantities? Define the unit quantities for a turbine. Why are they important? (CO4) 10

8. Answer any one of the following:-

- 8-a. Find the rise in pressure in the impeller of a centrifugal pump through which water is flowing at the rate of 15 litre/s. The internal and external diameters of the impeller are 20 cm and 40 cm respectively. The widths of impeller at inlet and outlet are 1.6 cm and 0.8 cm. The pump is running at 1200 r.p.m. The water enters the impeller radially at inlet and impeller vane angle at outlet is 30° . Neglect losses through the impeller. (CO5) 10
- 8-b. Differentiate : (i) Between a single-acting and double-acting reciprocating pump, (ii) Between a single cylinder and double cylinder reciprocating pump. (CO5) 10

2022-23 Jan_June