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NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA

(An Autonomous Institute Affiliated to AKTU, Lucknow)

B.Tech

SEM: IV - CARRY OVER THEORY EXAMINATION - SEPTEMBER 2022

Subject: Fluid Mechanics & Fluid Machines

Time: 3 Hours Max. Marks: 100

General Instructions:

1. The question paper comprises three sections, A, B, and C. You are expected to answer them as directed.
2. Section A - Question No- 1 is 1 mark each & Question No- 2 carries 2 mark each.
3. Section B - Question No-3 is based on external choice carrying 6 marks each.
4. Section C - Questions No. 4-8 are within unit choice questions carrying 10 marks each.
5. 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. When a fluid is subjected to resistance, it undergoes a volumetric change due to (CO1) 1

(a) Cohesion

(b) Strain

(c) Compressibility

(d) Adhesion

1-b. What is fluid mechanics? (CO1) 1

(a) Study of fluid behaviour at rest

(b) Study of fluid behaviour in motion

(c) Study of fluid behaviour at rest and in motion

(d) None of the mentioned

1-c. The characteristic of Ideal fluid are (CO2) 1

(a) compressible

(b) viscid

(c) Inviscid, Incompressible

(d) Shear stress has a constant, non zero value

1-d. The streamlines of the particles in a flow are recorded. If the streamline distribution remain the same even after sometime, what type of flow can it be? (CO2) 1

(a) steady

(b) unsteady

(c) uniform

(d) non-uniform

1-e. The frictional resistance for fluids in motion is (CO3) 1

(a) proportional to the velocity in laminar flow and to the square of the velocity in turbulent flow

(b) proportional to the square of the velocity in laminar flow and to the velocity in turbulent flow

(c) proportional to the velocity in both laminar flow and turbulent flow

(d) proportional to the square of the velocity in both laminar flow and turbulent flow

1-f. Reynolds number defined as? (CO3) 1

(a) Ratio of pressures in the inlet to the outlet of a pipe

(b) The product of velocity of the flow and the diameter of the pipe, divided by the kinematic viscosity of fluid

(c) The product of density of the fluid, velocity of the flow and the diameter of the pipe, divided by the dynamic viscosity of fluid

(d) Ratio of inertia force to viscous force

1-g. Impulse turbine is generally fitted at (CO4) 1

(a) At the level of tail race

(b) Above the tail race

(c) Below the tail race

(d) About 2.5mts above tail race to avoid cavitations.

1-h. The impulse equation is defined as (CO4) 1

(a) $F\Delta t = m\Delta v$

(b) $F\Delta t = mu$

(c) $F\Delta t = mT$

(d) $F\Delta t = mRT$

1-i. Internal cavitation in pump occurs due to (CO5) 1

(a) Drag force

(b) Cyclic stress

(c) Shock waves

(d) Flow speed

1-j. The fluid coming into the centrifugal pump is accelerated by (CO5) 1

(a) Throttle

(b) Impeller

(c) Nozzle

(d) Governor

2. Attempt all parts:-

2.a. Define mass density and specific weight. (CO1) 2

2.b. Explain hydraulic gradient line and total energy line. (CO2) 2

2.c. What is meant by water hammer? (CO3) 2

2.d. What is the function of draft tube? (CO4) 2

2.e. What is the need for priming in reciprocating pump? (CO5) 2

SECTION B 30

3. Answer any <u>five</u> of the following:-

3-a. Two large plate surfaces are 2.4 cm apart. The space between the surfaces is filled with glycerine. What force is required to drag a very this plate of 0.5 m^2 area between two large plate surfaces at a speed of 0.6 m/s if, (a) the this plate is in the middle of the two plate surfaces, (b) the thin plate is at a distance of 0.8 cm from one plate surface. Take dynamic viscosity of glycerine as 8.1 x 10^{-1} N s /m^2 (CO1) 6

3-b. What is Surface Tension? Give the mathematical expression of surface tension for a soap bubble and water droplet? (CO1) 6

3-c. What is the relationship between equipotential line and line of constant stream function at the point of intersection ? (CO2) 6

3-d. If for a 2-D potential flow, the velocity potential is given by $\Phi = x(2y - 1)$. Determine the velocity at the point P(4, 5). Determine also the value of stream function at the point P. (CO2) 6

3.e. Find the loss of head due to friction and power required to pump an oil of specific gravity 0.85 and absolute viscosity 1.5 poise through a 25 cm diameter and 10 km long pipe laid at a slope of 1 in 200. The rate of flow of oil is 0.022 m^3 /s. (CO3) 6

3.f. Draw main characteristic curves and operating characteristic curves for hydraulic turbines. 6

(CO4)

3.g.	What is a reciprocating pump? Describe the principle and working of a reciprocating pump with a neat sketch. (CO5)	6

SECTION C 50

4. Answer any <u>one</u> of the following:-

4-a.	What do you understand by gauge and vacuum pressure? State and prove the Pascal's law. Also give its practical applications. (CO1)	10
4-b.	Explain hydrostatic law. An open tank contains water up to 1m depth and height of oil of specific gravity 0.8 above water is 60cm. Find the pressure at (i) At the bottom of tank (ii) At the interface of water and oil and (iii).At 80 cm from the free surface? (CO1)	10

5. Answer any <u>one</u> of the following:-

5-a.	The velocity components in a two-dimensional flow field for an incompressible fluid are expressed as $u = y^3/3 + 2x - x^2y$, $v = xy^2 - 2y - x^3/3$. Show that these functions represent a possible case of an irrotational flow. Obtain an expression for stream function and velocity potential. (CO2)	10
5-b.	Find the form of equation for discharge Q through a sharp edged triangular notch; assuming Q depends upon the central angle α of the notch, head H, gravitational acceleration 'g' and on the mass density ρ, viscosity μ and surface tension σ of the fluid. (CO2)	10

6. Answer any <u>one</u> of the following:-

6-a.	Derive an expression for head loss in power transmission through pipes. (CO3)	10
6-b.	A pipe of diameter 300 mm and length 3500 m is used for the transmission of power by water. The total head at the inlet of the pipe is 500 m. Find the maximum power available at the outlet, if the value of friction factor = 0.006. (CO3)	10

7. Answer any <u>one</u> of the following:-

7-a.	Show that in case of jet striking the series of flat plates mounted on wheel periphery, the efficiency will be maximum when tangential velocity of wheel is half of the jet. (CO4)	10
7-b.	Describe working and constructional features of Pelton turbine. Also explain different efficiencies of the turbine.(CO4)	10

8. Answer any <u>one</u> of the following:-

8-a.	Define Manometric head and Manometric efficiency, mechanical efficiency and overall efficiency of a centrifugal pump. A single acting reciprocating pump, running at 50 rpm delivers 0.00736 m3/s of water. The diameter of the piston is 200 mm and stroke length 300 mm. The suction and delivery heads are 3.5 m and 11.5 m respectively. Determine, (i)	10

Theoretical discharge (ii) Coefficient of discharge (iii) Percentage slip of the pump (iv) Power required to run the pump. (CO5)

8-b. A centrifugal pump having outer diameter equal to two times the inner diameter and running at 1000 rpm works against a total head of 40 m. the velocity of flow through the impeller is constant and equal to 2.5 m/s. The vanes are set back at angle of 40^0 at outlet. If the outer diameter of the impeller is 500 mm and width at outlet is 50 mm, determine: (a) Vane angle at inlet (b) Work done by impeller on water per second and (c) Manometric efficiency. (CO5) 10