PAPER ID-311114

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B.TECH.
(SEM III) THEORY EXAMINATION 2020-21
FLUID MECHANICS & FLUID MACHINES

Time: 3 Hours ***Total Marks: 100***

Note: 1. Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt *all* questions in brief. 2 x 10= 20

a.	Define viscosity and give its unit.
b.	Define compressibility. How it is related to bulk modulus?
c.	Write down only the condition for stability of floating body by mentioning relative positions of M and G.
d.	Define Froude number and weber number.
e.	At what distance r from the center of a pipe of radius R does the average velocity occur in laminar flow?
f.	Differentiate between laminar, turbulent and transient flow.
g.	What do you mean by Equipotential line?
h.	Write the difference between Eulerian and Lagrangian approach.
i.	What will be the total % of work saved by fitting the air vessel? Explain.
j.	What is the purpose of priming in a centrifugal pump?

SECTION B

2. Attempt any *three* of the following: 10 x 3 = 30

a.	The velocity distribution in the pipeline is given by the relation $u= 2y – y^2$ Where u denotes the velocity at a distance y from the solid boundary. Calculate (i) Shear stress at the wall, (ii) Shear stress at 0.5 cm from the wall and (iii) Total resistance for a 2 cm diameter pipe over a length of 100 m. Assume coefficient of viscosity 0.4 poise.
b.	Drive the continuity equation for steady Irrotational flows in Cartesian co-ordinate for incompressible fluids.
c.	With the help of diagram explain streamline, equipotential lines and flownet. Prove that equipotential line and streamline intersect each other orthogonally.
d.	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 runner. Find the diameter of runner, its speed and specific speed of turbine.
e.	Define specific speed of centrifugal pump and derive the expression for it.

SECTION C

3. Attempt any *one* part of the following: 10 x 1 = 10

(a)	Write about Venturimeter. Derive the expression for rate of flow of fluid through Venturimeter.
(b)	A pipeline conducts water from a reservoir to a power house, the elevation of which is 200 m lower than that of surface of reservoir. The water is discharged through a nozzle with a jet velocity of 60 m/s and at nozzle exit the jet has a diameter of 20 cm. Make calculation for the power of jet and the power lost in friction between the reservoir and jet.

Roll No: | | | | | | | | | | | | | |

4. Attempt any *one* part of the following: 10 x 1 = 10

(a)	The velocity component in a two dimensional incompressible flow field are expressed as $u = y^3/3 + 2x - x^2y$; $v = xy^2 - 2y - x^3/3$ (i) Determine the velocity and acceleration at point (1, 3) (ii) Is the flow physically possible? If so obtain an expression for the stream function.
(b)	The resulting force F of a supersonic plane during flight can be considered as dependent upon the length of the aircraft l, velocity V, air viscosity μ, air density ρ, and bulk modulus of air K. Express the functional relationship between these variables and the resisting force.

5. Attempt any *one* part of the following: 10 x 1 = 10

(a)	Determine the displacement thickness, momentum thickness and shape factor of the following velocity profiles in the boundary layer on a flat plate. $u/U_0 = (y/\delta)^{1/m}$ where u is the velocity at a height y above the surface and U_0 is the free stream velocity.
(b)	Describe the phenomenon of boundary layer separation.

6. Attempt any *one* part of the following: 10 x 1 = 10

(a)	A Pelton turbine running at 720 rpm uses 300 kg of water per second. If the head available is 425 m determine the hydraulic efficiency. The bucket deflects the jet by 165°. Also find the diameter of the runner and jet. Assume Cv = 0.97 and φ = 0.46, Blade velocity coefficient is 0.9.
(b)	With the help of neat sketch explain the working of Francis turbine.

7. Attempt any *one* part of the following: 10 x 1 = 10

(a)	A single acting reciprocating pump run at 50 rpm delivers 0.01 m^3/s of water. The diameter of the piston is 200 mm and stroke length 400mm. Determine the (i) Theoretical discharge of the pump (ii) Coefficient of discharge (iii) Slip and percentage slip of the pump.
(b)	Explain the following (i) Function of volute casing and diffuser of a centrifugal pump. (ii) Cavitation in centrifugal pump.