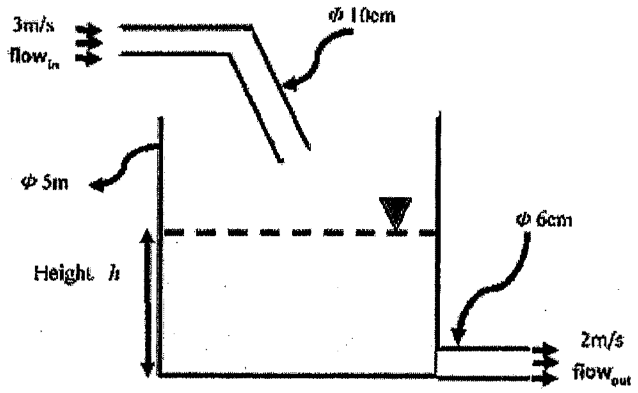
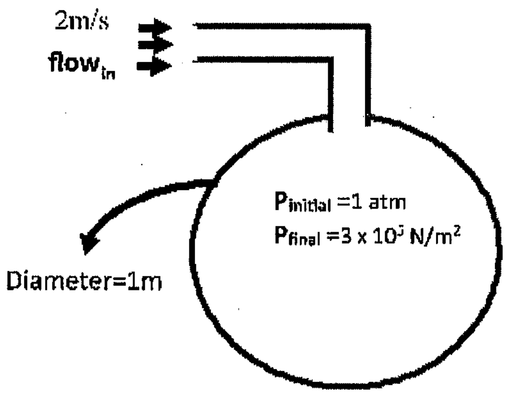
Ref. No. Ex/PE/PE/H/T/422E/2025

B.E. POWER ENGG. 4^{TH} YEAR 2^{nd} SEMESTAR EXAM-2025

SUBJECT: ***Advanced topics in Fluid Mechanics(HONS.)***

Time: Three Hours **Full Marks 100**

<table>
<tr><th>Sl No.</th><th>Questions</th><th>Marks</th></tr>
<tr><td>1.
(CO1)</td><td>(i) State Reynolds Transport Theorem and describe its purpose.
(ii) water storage tank of diameter 5 meter is fed by a pipe of diameter 10cm & drained by a pipe of 6 cm diameter. Water enters at a uniform speed of 3 m/s & leaves at 2 m/s. Find the rate at which the water level in the tank rises.


(iii) Spherical tank of diameter 1 meter filled with air at 1 atm pressure. It is fed by a pipe of diameter 2 cm at 2m/s rate. The inlet pressure is 3×10^5 N/m^2. Temperature of the tank is 300k which is also same with pipe temperature. Find the time required to fill the tank upto the pressure of 3×10^5 Pa.

</td><td>3+10
+12
=25</td></tr>
<tr><td>1.
OR</td><td>(i) What are the differences between a tensor and a vector? Give examples
(ii)Show that the skew-symmetric matrix is a vector.
(iii) Show the rotation of fluid elements is half of vorticity from translation and deformation of fluid elements with diagram.</td><td>3+2+20
=25</td></tr>
</table>

[Turn over

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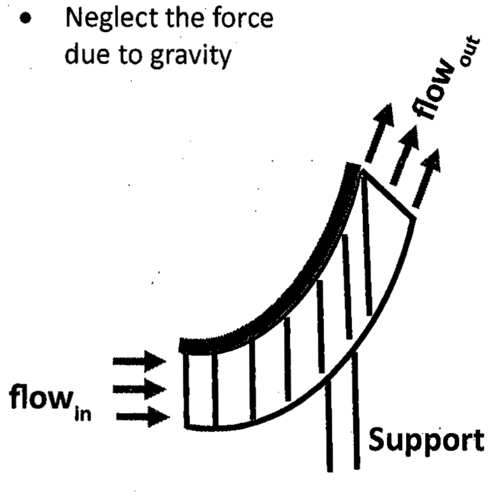
SUBJECT: ***Advanced topics in Fluid Mechanics(HONS.)***

Time: Three Hours **Full Marks 100**

Sl No.	Questions	Marks
2. (CO2)	(i) A two-dimensional velocity field is given by $u = -Ky/(x^2+y^2)$ and $v = -Kx/(x^2+y^2)$. Comment on the flowing features of the flow field: (1) Is the flow steady or unsteady? (2) Is the flow compressible or incompressible? (3) Is the flow rotational or irrotational? (4) What is the shear strain rate in the flow at a location (1,1)? (ii) A fluid is flowing at a constant flow rate of Q through a divergent pipe having inlet and outlet diameters of D1 and D2, respectively., and a length of L. Assuming the velocity to be axial and uniform at any section, show that the accelerations at the inlet and outlet of the pipe are given by $-\frac{32(D_2-D_1)Q^2}{\pi^2 D_1^5 L}$ and $-\frac{32(D_2-D_1)Q^2}{\pi^2 D_2^5 L}$, respectively.	12+13 = 25
3. (CO3)	Starting from the continuity and momentum equations for a steady, incompressible laminar fully developed flow between a pair of fixed, parallel pates, separated by a distance H, deduce the velocity profile. Show the zero shear stress plane. Consider that the flow is subjected to an axial pressure gradient $G = -dp/dx$. Show that the average velocity is 2/3rd the maximum velocity.	25
4. (CO4)	(i) State how the conservation of mass and momentum equations in the differential forms can be deduced using RTT (ii) A jet of diameter 1 cm impinges on a stationary vane with a support which deflects it by 60o angle. The jet velocity remains constant throughout the flow over the vane. Find the force exerted by the jet on the vane and the support. • The pressure is constant • Neglect the force due to gravity 	15+10 = 25
4. **OR**	i) Describe the Stokes' First problem. ii) State the governing differential equation and the underlying assumptions and impose the appropriate boundary condition.	12+13 = 25