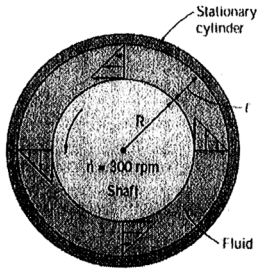
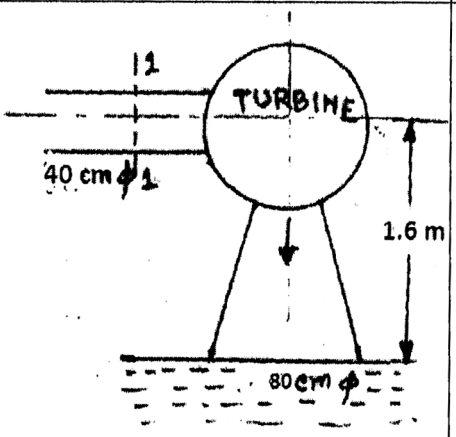
Ref. No. **Ex/PE/PC/B/T/214/2024**

B.E. POWER ENGG. 2ND YEAR 1st SEMESTAR EXAMINATION, 2024

SUBJECT: ***Fluid Mechanics***

Time -3 hours **Full Marks 100**

	CO1 (20 Marks)	**Marks**
1.(a)	In the stress vs strain rate curve show the nature of different kind of fluids.	6
(b)	The viscosity of a fluid is to be measured by a viscometer constructed of two 40-cm-long concentric cylinders The outer diameter of the inner cylinder is 12 cm, and the gap between the two cylinders is 0.15 cm. The inner cylinder is rotated at 300 rpm, and the torque is measured to be 1.8 N.m. Determine the viscosity of the fluid 	10
(c)	Define co-efficient of volume expansion coefficient. It is observed that the density of an ideal gas decreases by 10 percent when compressed isothermally from 10 atm to 11 atm. Determine the percent decrease in density of the gas if it is compressed isothermally from 100 atm to 101 atm OR A spherical water drop of 1 mm in diameter splits up in air into 64 smaller drops of equal size. Find the work required in splitting up the drop. The surface tension coefficient of water in air = 0.073 N/m.	2+2 4
	CO2 (24 Marks)	
2 (a)	A fluid field is given by $\vec{V} = (4 + xy + 2t)\hat{\imath} + 6x^3\hat{\jmath} + (3xt^2 + z)\hat{k}$ m/s. Find the velocity and acceleration of a fluid particle at point (4, 4, -4) when t=3 sec.	10
(b)	A 40 cm diameter pipe (penstock) supplies water steadily to a turbine at 0.18 MN/m^2. The water leaves the turbine with a pressure of –0.025 MN/m^2 through a 80 cm pipe (draft tube). A vertical distance of 1.6 m separates the centers of pipe at sections where measurement have been made. Calculate the power developed by the turbine for water if 0.30 m^3 of water passes through the arrangement per second. (Considering no loss in the turbine) 	8
(c)	Deduce Darcy-Weisbach equation	6
OR (c)	What do you mean by major loss and minor loss in a pipe flow? A right angled V-notch is employed to measure the discharge. Estimate the flow rate if the head (H±dH) measured above the still is given as (0.2±0.01) m. take C_d=0.60	2+4
	CO3 (22 marks)	
3(a)	Deduce Chezy equation. What do you mean by conveyance? OR Derive the conditions for the most economic trapezoidal channel.	8

[Turn over

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Time -3 hours **Full Marks 100**

(b)	With a neat sketch of a venturimeter, deduce the expression of obtaining the flow rate of a fluid through a pipe. OR Find the discharge of water flowing through a pipe of 30 cm diameter placed in an inclined position where a venturimeter of throat diameter 15 cm has been inserted. The difference of pressure between the main and the throat is measured by a liquid of sp gr. 0.6 in an inverted U-tube, which gives a reading of 40cm. The loss in head is 15% the kinetic head of the pipe. Find flow rate through the pipe.	8
(c)	State the factors that affects the velocity of sound through a fluid Estimate the Mach number and the velocity of a projectile when a Mach one of Mach angle $\pi/6$ radian is observed at an altitude where temperature is 275K. If the Mach angle is estimated within $\pm 4°$, determine the error in velocity. Take R=287 J/kg K, and γ=1.4.	3 5
	CO4 (16 marks)	
4 (a)	The pressure drop ΔP in a pipe of diameter D and length l depends on the density of the fluid ρ, viscosity of the fluid μ, mean velocity of the fluid V and average height of protrusion ε. Show that the pressure drop can be expressed as $\Delta P = \rho V^2 f\left(\frac{l}{D}, \frac{\mu}{\rho VD}, \frac{\varepsilon}{D}\right)$	10
(b)	The flow rate over a spillway is 120 m^3/s. What is the maximum length scale factor for a dynamically similar model if a flow rate of 0.75 m^3/s is available in the laboratory? On a part of such a model a force of 2.8 N is measured. What is the corresponding force on the prototype spillway? (Viscosity and surface tension effects are here negligible.)	6
	CO5 (18 marks)	
5 (a)	A three stage centrifugal pump has 30 cm diameter impellers with 1.5 cm width at outlet. The velocity at the inlet is radial. The vanes are curved back at angle of 25° to the tangent at the outlet and occupy 10% of outlet area while running at 950 rpm. The pump delivers 42 liters of water per second with 90% manometric efficiency and 80% overall efficiency. **Calculate** the head generated by the pump and input power. OR A centrifugal pump is required to deliver 50 liter of water per second to an open tank at a height of 30 m through a 100m long pipe of 15 cm diameter. The inlet losses of head in the suction pipe are estimated to be 0.35 meter. Assuming overall efficiency of 70% **determine** the power required to drive the pump. Take f=0.6 for pipe.	10
(b)	A jet of water is striking at the center of a flat plate with a velocity 'V' while the plate is moving with velocity 'u' in the direction of jet. With the help of a neat sketch, determine the maximum efficiency of the vane. What will be the maximum efficiency (jet striking at center) for series of semicircular vanes mounted on a wheel? OR With a neat sketch of velocity vector diagram of a centrifugal impeller, deduce the expression of Euler Head.	8