

		Marks
Group A (Answer any two)		
1 (a)	How does viscosity of fluids change with temperature and why?	2
(b)	A 2.2 cm wide gap between two vertical plane surfaces is filled with an oil of specific gravity 0.85 and dynamic viscosity 20 poise. A metal plate 1.2 m x 1.2 m x 0.2 cm thick and weighting 45 N is placed midway in the gap. Find the force required, if the plate is to be lifted up with a constant velocity of 0.15 m/s.	10
(c)	Find percentage reduction in volume of water if pressure increases by 10^4 kN/m ² over atmospheric pressure of 1.013 bar. Take Bulk Modulus $K = 2.19$ GN/m ² .	3
2 (a)	A trapezoidal plate measuring 3m at the top edge and 4m at the bottom edge is immersed in water with the plan making an angle 45° to the free surface of water. The top and the bottom edges lie at 1m and 2m respectively from the surface. Determine the hydrostatic force on the plate.	9
(b)	A 20-cm-diameter, 60-cm-high vertical cylindrical container is partially filled with 50-cm-high liquid whose density is 850 kg/m ³ . The cylinder is rotated at a constant speed. Determine the rotational speed at which the liquid will start spilling from the edges of the container.	6
3(a)	With suitable sketch derive an expression to determine the metacentric height of a floating body.	6
(b)	A block of wood of specific gravity 0.7 floats in water. Determine the metacentric height of the block, if the size is 2m X 1m X 0.8m.	9
Group B (Answer any two)		
4 (a)	A fluid field is given by $\vec{V} = 4x^3 y\hat{i} - 10x^2 y\hat{j} + 3t\hat{k}$ m/s. Find the velocity and acceleration of a fluid particle at point (1, 2, 3) when $t=2$ sec.	10
(b)	A conical converging pipe converges uniformly from 0.4 m diameter to 0.2 m diameter over a length of 2 m. Find the local and convective acceleration at the middle of the diffuser for (a) constant flow rate of 50 l/s and (b) flow rate varies uniformly from 50 l/s to 100 l/s in 5 sec and the time of interest is 2 sec. Velocity at any cross section is uniform.	10
5 (a)	Deduce the Euler equation for a flow along a streamline and from there deduce the Bernoulli's equation.	10
(b)	A centrifugal pump draws water steadily from a reservoir through vertical 30 cm diameter suction pipe and discharges into a horizontal pipe of 25 cm diameter. Suction pressure at entry of pump is -0.4 bar (g) and discharge pressure is 2.8 bar(g). Distance between the gauges is 1.5m. Flow rate is 0.1 m ³ /s. Compute power required to run the pump.	10
6 (a)	Water is to be transported at a rate of 2 m ³ /s in uniform flow in an open channel whose surfaces are asphalt lined. The bottom slope is 0.001. Determine the dimensions of the best cross section if the shape of the channel is (a) rectangular and (b) trapezoidal	10

Time: Three Hours

Full

Marks 100

(b)	Derive Darcy-Weisbach equation to determine the major head due to pressurized flow of a fluid through a conduit	10
Group C		
7.(a)	Derive the velocity of sound wave for compressible fluid when the process is assumed as isentropic	7
(b)	A supersonic plane flies at 1800 km/hr at an altitude above sea level where the pressure and temperature of air at that altitude be 80 kPa and -10°C . Calculate the pressure, temperature and density at stagnation point at the nose of the plane. Take $R=287 \text{ J/kg K}$, and $\gamma=1.4$. Also find the Mach angle.	8
Group D (Answer any one)		
8 (a)	A jet of water is striking at the centre of a single semicircular curved vane with a velocity ' V ' while the vane is moving with velocity ' u ' in the direction of jet. Show that maximum efficiency of the vane will be 0.592.	7
(b)	A jet of 4 cm in diameter having a velocity of 30 m/s strikes tangentially at one edge on a wheel which deflects the jet through an angle of 120° . Calculate the thrust on the vane when i) the axis of symmetry is horizontal and ii) the tangent at the inlet tip is horizontal.	8
9.(a)	With a neat sketch of a venturimeter (label properly showing different angles) deduce the relation of determining the volume flow rate through it	08
(b)	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 30cm. The loss in head is 0.2 times the kinetic head of the pipe. Find flow rate through the pipe.	07