

1. A cube 3 m on an edge has its lower half of specific gravity  $S = 1.35$  and upper half of  $S = 0.65$ . It is submerged into a two-layered fluid, the lower  $S = 1.25$  and the upper  $S = 0.85$ . Determine the height (m) of top of the cube above the interface of these two fluids. (20%)
2. If 800 L/s of water flows through an 60-cm-diameter pipeline that contains a horizontal  $90^\circ$  bend and the pressure at the entrance to the bend is 150 kPa, determine the force components, parallel and normal to the approach velocity, required to hold the bend in place. Neglect losses. (20%)
3. The torque delivered by a water turbine depends upon discharge  $Q$ , head  $H$ , specific weight  $\gamma$ , angular velocity  $\omega$ , and the efficiency  $e$ . Determine the form of equation for torque by using the Dimensional Analysis. (20%)
4. A trapezoidal brick-lined channel ( $n = 0.016$ ) must carry  $50 \text{ m}^3/\text{s}$  a distance of 9 km with a head loss of 6 m. The bottom width is 5 m and has side slopes of 1 horizontal to 1 vertical. What is the velocity (m/s)? (20%)
5. (1). For  $\mathbf{q} = i(x + 2y) + j(3y + 4z) + k(5x^2 + 6y^2 + 7z^2)$ , find the components of rotation at (1, 2, 3). (10%)  
(2). The two-dimensional stream function for a flow is  $\psi = 2 + 3x - 5y + 9xy$ . Find the velocity potential  $\phi$ . (10%)