1. Please draw a figure of control volume applied to fluid flowing over one side of a flat plate and derive the equation for the growth of the turbulent boundary layer and for shear stress along a smooth flat based on one-seven-power law proposed by Prandtl. (20%)

2. Please draw a figure and determine the momentum correction factor for laminar flow in a round tube. (20%)

3. Please draw a figure and derive the equations of both conjugate depths y2 = f(y1) and head loss h_L = g(y1, y2) for the hydraulic jump in a horizontal rectangular channel. (20%)

4. A pump with a shaft input of 9.7 kW and an efficiency of 73% is connected in a waterline carrying 0.2 cubic meters per second. The pump has a 160-mm-diameter suction line and a 125-mm-diameter discharge line. The suction line enters the pump 1 meter below the discharge line. For a suction pressure of 67 kilo Newtons per square meter, calculate the pressure at the discharge flange and the rise in the hydaulic grade line across the pump. (20%)

5. A flow rate of 15 cubic meters per second water exits at a depth of 1.4 meter in a rectangular channel 5.6 meters wide. Find the critical depth, specific energy, Froude number, F + M, and conjugate depth. (20%)