

- (12%) Explain what are Eulerian description and Lagrangian description in fluid mechanics?
- (12%) Explain the streamline, streakline and pathline? What condition(s) of the flow that these three lines coincide together?
- (20%) A steady, 2-D, incompressible flow exists between two fixed plane surface spaced at a distance  $b$  apart. (1) Determine the velocity profile ( $u$  and  $v$ ) from the Navier-Stokes equations after simplification (10%). (2) Determine the stream function for the flow (5%). (3) Also determine is this flow irrotational (5%)?
- (30%) For an incompressible, inviscid fluid flow passing a circular cylinder of radius  $a$ , assume the velocity field around the cylinder is  $v_r = U(1 - \frac{a^2}{r^2})\cos\theta$  and  $v_\theta = -U(1 + \frac{a^2}{r^2})\sin\theta$ . (1) Determine the velocity distribution on the surface of the cylinder when  $r = a$ . (10%) (2) Apply the Bernoulli equation to determine the pressure distribution along the cylinder surface. (10%) (3) Using the total derivation, determine the acceleration of the flow field around the cylinder. (10%) (Note that you should use the cylindrical coordinates)
- (26%) (1) For a given vortex sheet where  $U(y) = U_0, y \geq 0$ ;  $U(y) = 0, y < 0$ , is this flow unstable? Explain your reasons (8%). (2) What are the matching conditions for solving this linear instability problem (10%)? (3) From the Rayleigh's equation, find the dispersion equation of this problem (8%).