Streamlines and Stream Functions Consider the two-dimensional, steady-state flow of an incompressible fluid. The general continuity equation sirplilies as follows: Stezd -slnle cuxide ut nrual derivaive clar uM Iflell culcek HuL OlLx Equalle CEcau\* AW-alleMiIeal Ilutd Is (cuyesslok Thus, any velocity field that describes physically possible Lwo-dimensional, steady-state flow of an incompressible fluid must satisly Eq: (1.1) As an example consider the following velocity field thal supposedly deseribes the Lwo- dimensional, sleady-stale llow ofan mncompressible luid: V-UX and Vy =VjJ Is it physically possible\_ i.e. des this velocity lield salisly continuity? If noL, can mnodified so that continuity salisfied? For the velocity field satisfy continuity; it Iust satisfy the continuity equation sitplified for the appropriate conditions- In this case; Eq (1.1) To check this\_ subslilute the given velocity equations into Eq: (E.)as follows: av , (Ujx) (Vy)-Ua+V,+5 Since the equation does nOt equal zero\_ this velocity field does not satisly continuity for Steady- stale , dimensional flow ofan incompressible fluid. However; it will satisfy continuity if V, U;. Thus, the following velocity field will satisly continuity: V=Uj\* and One way t0 visualize this flow is [0 sketch the velocity field as forest of little atrows in An X-y each showing the direction and the magnitude of the velocity point in the flow field However; for incompressible. steady-state\_ Iwo-dimensional flow there another tool that helps visualize the flow. This tool KIOWn as the streamline line' in the flow field that is everywhere tangent t0 the veloeity- Because streamnline always tangent Lo the velocily at every point along ILs length\_ lhere can be nO flow aeross streamline\_ The mathemalical equalion that describes the streamline in any flow is called stream function To develop the equation for streamline we must firSt describe the direction of the velocity at any point in the flow. Atany pOint in the flow field, the direction of the velocity at any point can be described in lers of the and components 0f velocity- The slope of a line thal is tangent t0 the velocity vector al pomt (1W) grd