國立交通大學九十一學年度碩士班入學考試試題

科目名稱：流體力學(172)　　考試日期：91 年 4 月 20 日 第 2 節

系所班別：土木工程學系　　組別：丙組一般生　　第 1 頁,共 1 頁

＊作答前,請先核對試題、答案卷（試卷）與准考證上之所組別與考試科目是否相符!!

1. Consider an unsteady, one-dimensional velocity field: $\vec{v}(x,t) = t(1+\beta x)\hat{i}$, where β is a constant.

   (a) [5%] Is the fluid incompressible or compressible?

   (b) [5%] If the density of the fluid ρ is uniform but unsteady, find the density such that the flow conserves mass. Assume that the density $\rho = \rho_0$ is a constant at $t = 0$.

   (c) [5%] Following a Lagrangian fluid particle moving in the flow field, what is the change rate of the density?

   (d) [5%] For the fluid particle locating at $x = 0$ initially, find an expression for the position of the particle as a function of time.

   (e) [5%] What is the acceleration of a fluid particle moving in the velocity field?

   (f) [5%] Write down the differential equation that governs the momentum conservation of the flow field.

   (g) [5%] What is the pressure gradient (dp/dx) of the flow field, if the dynamic viscosity of the fluid μ is a constant?

2. [15%] The wind shear stress acting on the surface of a lake τ is assumed to be a function of the wind speed U, the density ρ and the kinematical viscosity ν of the air, and the characteristic height of the water-surface roughness d. Use dimensional analysis with U, ρ and ν as the repeating parameters to find the non-dimensional groups. Discuss your result.

3. [30%] Consider the laminar flow of an incompressible fluid past a flat plate located at $y = 0$. The boundary layer velocity profile is approximated as $u = Uy/\delta$ for $0 \leqq y \leqq \delta$ and $u = U$ for $y > \delta$, where U is the velocity outside the boundary layer, δ is the boundary layer thickness, and y is the vertical distance from the plate. Determine the shear stress by using the momentum integral equation.

4. [20%] Water on the horizontal apron of the 30-m-wide spillway has a depth of 0.2 m and a velocity of 6 m/s. Determine the depth after the jump and the power dissipated within the jump.