

Pop Quiz

Fall, 2007

Course: 414.311A

1. Let define a vector $\vec{x}_i = (x_i, y_i, z_i)$ on a 3-D space.

(1) What is magnitude of \vec{x}_i ?

(2) Write a vector $\vec{x}_1 \bullet \vec{x}_2$ where \bullet indicates vector dot product.

(3) Write a vector $\vec{x}_1 \times \vec{x}_2$ where \times indicates vector cross product.

2. Let's consider the gradient in a 3-D space, s.t.

$$\nabla = \frac{\partial}{\partial x} i + \frac{\partial}{\partial y} j + \frac{\partial}{\partial z} k$$

where (i,j,k) indicates unit vectors in the Cartesian coordinate.

(1) Find ∇F if $F = \sin(ax) + \cos(by) + cz$

(2) Find $\nabla \vec{F}$ if $\vec{F} = (\cos(ax), \sin(by), cz)$.

3. Describe the following terms:

(1) ideal fluid

(2) Newtonian flow

(3) Vorticity

(4) Velocity potential

(5) Streamline, Streakline, and pathline

(6) Added mass

4. In a 2-D fluid domain, Write the following equations. Use your own definition as needed.

- Laplace equation

- Bernoulli's equation

- Navier-Stokes equation

5. Define the following transformation:

(1) Laplace Transformation

(2) Fourier Transformation

6. A 5-kg ball is attached on a spring.

(1) Without any motion of the ball, it is observed that the spring is stretched 0.1-m. Find the spring constant.

(2) The spring is stretched a little bit more and released. Then the spring shows a regular oscillation. What is the period of oscillation that you can observe?