1. (15%) Find, if possible, an equation of a plane that contains the following given points: (0, 1, 0); (0, 1, 1) and (1, 3, -1).

2. (20%) For the given matrix

$$A=\begin{pmatrix} 0 & -1 & 0 \\ -1 & -1 & 1 \\ 0 & 1 & 0 \end{pmatrix}$$

(a) Find the eigenvalues.
(b) Find the corresponding eigenvectors.
(c) Are the eigenvectors orthogonal?
(d) If yes, find the orthonomal eigenvectors.

3. (15%) Use the Stokes' theorem to evaluate

$$\oint_C z^2 e^{x^2} dx + xy^2 dy + \tan^{-1} y dz$$

Where C is the circle given by $x^2+y^2=9$, Z=0

4. (20%) Using boundary conditions
$u(0)=1$, $v(1)=0$,
find the solutions $u(x)$ and $v(x)$, $0 \le x \le 1$, to the following systems of ordinary differential equations (ODEs) of (a) and (b)

(a) $\begin{cases} \dfrac{du}{dx} = -2u \\ \dfrac{dv}{dx} = -v \end{cases}$ (b) $\begin{cases} \dfrac{du}{dx} = u - v \\ \dfrac{dv}{dx} = v - u \end{cases}$

5. (30%) Starting each time from initial conditions

$$z(x,0)=\cos x, \quad -\infty < x < \infty,$$

find the solutions $z(x,t)$ to the following partial differential equations (PDEs) of (a), (b) and (c):

(a) $\dfrac{\partial z}{\partial t} + 2\dfrac{\partial z}{\partial x} = 0$

(b) $\dfrac{\partial z}{\partial t} + 2\dfrac{\partial z}{\partial x} = z$

(c) $\dfrac{\partial z}{\partial t} - 4\dfrac{\partial^2 z}{\partial x^2} = 0$

(d) Draw your solutions to a)-c) at representative times t_0, t_1, t_2.