1) a) Does $lim_{(x,y)\to(0,0)} \frac{y^2 sin^2 x}{x^4+y^4}$ exist? Why?

b) Find the absolute maximum and minimum values of $f(x,y) = x^4 + y^4 - 4xy + 2$ on the set $D = \{(x,y): 0 \le x \le 3,\ 0 \le y \le 2\}$.

2) a) Evaluate the integral $\int_0^1 \int_x^1 e^{\frac{x}{y}} dydx$.

b) Evaluate the integral $\int_0^1 \int_y^{\sqrt{2-y^2}} (x+y)dxdy$ in two different ways (Once using rectangular coordinates and once using polar coordinates).

3) a) If $u = (2,0,3)$ and W is the subspace of R^3 of dimension 2 which is generated by the vectors $v_1 = (1,2,0)$ and $v_2 = (1,1,1,)$, then find $Proj_W u$ and $Proj_{W^T} u$.

b) Let $p_1 = 1 - x + x^2$ and $p_2 = 2 + 2x - x^2$ be two vectors in the space P_2 of all polynomials with real coefficients and degree less than or equal to 2. On P_2 define the inner product $< f, g > = \int_{-1}^{1} f(x)g(x)dx,\ f, g \in P_2$. Find $\|p_1\|$ and $d(p_1, p_2)$.

4) a) Find the distance between the point $P(1,1,1)$ and the plane passing through the points $P_1(1,-1,1)$, $P_2(2,-1,0)$, $P_3(-1,2,4)$.

b) Find a basis for the kernel of the linear operator $T: R^3 \to R^3$ defined by

$$T(x,y,z) = (x - 2y + 3z, -3x + 6y + 9z, -2x + 4y - 6z).$$

Also find $T(1,1,1)$ and determine whether T is one to one or onto.

5) Find a matrix P that orthogonally diagonalizes $A = \begin{bmatrix} 6 & 2\sqrt{3} \\ 2\sqrt{3} & 7 \end{bmatrix}$ and determine $P^{-1}AP$.

Then use the results to calculate A^5.