Problem 1  Let \( f(x) = \sin x \).

(a) Find the Taylor series generated by \( f(x) \) at \( x = \frac{\pi}{2} \).

(b) If you approximate \( f(x) = \sin x \) using the Taylor polynomial of order 4 centered at \( x = \frac{\pi}{2} \), what is a (reasonable) bound for the error when \( \left| x - \frac{\pi}{2} \right| < 1 \)?
Problem 2  Let $u = (0,1,1)$ and $v = (1,1,0)$.

(a) Find $\text{proj}_v u$.

(b) What is the angle between $u$ and $v$?

Problem 3  Find a parametric equation for the line segment joining the two points $P(2,1,-3)$ and $Q(0,-1,4)$.
Problem 4 Let $M$ be the plane passing through the three points $P = (2, 0, 0)$, $Q = (0, 2, 0)$, and $R = (0, 0, 2)$.

(a) What is the equation for $M$?

(b) What is the distance from the origin to $M$?
Problem 5  Find a parametric equation for the line which is the intersection of the two planes $x + 2z = 1$ and $x + y - z = 0$. 
Problem 6  A particle moves with position at time \( t \) given by

\[
\mathbf{r}(t) = 4t \mathbf{i} + (\cos 3t) \mathbf{j} + (\sin 3t) \mathbf{k}.
\]

(a) Find the velocity, acceleration, speed, and direction of the particle at all times \( t \).

(b) Find a parametric equation for the tangent line to the curve at \( t = 0 \).
Problem 7  A particle moves in space with acceleration at time $t$ given by

$$a(t) = (-\cos t)i + e^t j + 2k.$$  

We also know that at $t = 0$ the particle started from position $(0, 0, 0)$, with initial velocity $v(0) = k$.

(a) Find the particle’s velocity vector as a function of $t$.

(b) Find the particle’s position vector as a function of $t$. 

6