Requirements:  
Attach your plots, Simulink Model and MATLAB codes. Please label your plots.

**Problem 1**: (Matlab Basic Commands)  
a) **[1 point]**: Use MATLAB to plot the signal, \( x(t) = 4 \cos(5\pi t - \pi/4) \) where the time, \( t \), ranges from 0 to 1, varying by 0.01.

**Problem 2**: (Simulink-Building a Model)  
a) **[1 point]**: Build a model for the following mathematical model:
\[ \dot{v} = \frac{1}{1000} (f(t) - 50v) \]
where \( f(t) \) is the step input of 500 at \( t = 0 \).

b) **[0.5 point]**: Assume initial conditions are zero. Set the stop time to 120 and simulate the model. Plot the output. (Please label your plot).

**Problem 3**: (Simulink-Creating Subsystems)  
a) **[1.5 points]**: Given the following two equations:
\[ \begin{align*}
\dot{x}_1 &= -2x_1 + x_2 + f(t) \\
\dot{x}_2 &= \frac{1}{2} (-x_2 + x_1)
\end{align*} \]
where \( f(t) = 5 \sin t \). Build a model for the above equations and incorporate “subsystem blocks” to simplify the model.

b) **[1 points]**: Assume all initial conditions are zero. Set the stop time to 50 and simulate the model. Plot the both outputs on the same plot, i.e. \( x_1 \) Vs Time and \( x_2 \) Vs Time.

**Problem 4**: (Control System Toolbox-Model for LTI System)  
Given the transfer function, \( G_1(s) \) is as follow:

\[ G_1(s) = \frac{4s + 3}{s^2 + 5s + 6} \]
a) **[0.5 point]**: Use `zpk` command on \( G_1(s) \) to create Zero-pole-gain model (ZPK).

b) **[0.5 point]**: Use Matlab command to convert the Zero-pole-gain model in Problem 4(a) to state space model.

c) **[1 point]**: Given that \( G_2 = \frac{2s + 1}{3s^2 + 2s + 4} \). Find the new transfer function for \( G_1 \times (1 + G_1 G_2)^{-1} \).

**Problem 5**: (Control System Toolbox-Transient Response)

a) **[1 point]**: Find the step response for the following mathematical model:

\[
H(s) = \frac{Y(s)}{X(s)} = \frac{1}{1000s + 50}
\]

where the step input, \( x(t) = 10u(t) \).

b) **[0.5 point]**: Generate the Bode plot for the mathematical model in Problem 5(a).

c) **[1.5 point]**: Use this command: \( G(s) = \text{feedback}(500 * H(s),1) \) to compute the new transfer function, \( G(s) \). Simulate the step response with the step input, \( x(t) = 10u(t) \). Then, generate the Bode plot for \( G(s) \).