Problem A :

Given: An LTIC system specified by the equation

$$(D^2 + 5D + 6)y(t) = (D + 1)f(t)$$

Find:

i. Find the characteristic polynomial, characteristic equation, characteristic roots, and characteristic modes of this sytem.

ii. Find $y_0(t)$, the zero-input component of the response $y(t)$ for $t \geq 0$, if the initial conditions are $y_0(0) = 2$ and $\dot{y}_0(0) = -1$.

Problem B :

Given: An LTIC system specified by the equation

$$(D^2 + 4D + 4)y(t) = Df(t)$$

Find:

i. Find the characteristic polynomial, characteristic equation, characteristic roots, and characteristic modes of this sytem.

ii. Find $y_0(t)$, the zero-input component of the response $y(t)$ for $t \geq 0$, if the initial conditions are $y_0(0) = 3$ and $\dot{y}_0(0) = -4$.

Problem C :

Given: An LTIC system specified by the equation

$$D(D+1)y(t) = (D+2)f(t)$$

Find:

i. Find the characteristic polynomial, characteristic equation, characteristic roots, and characteristic modes of this sytem.

ii. Find $y_0(t)$, the zero-input component of the response $y(t)$ for $t \geq 0$, if the initial conditions are $y_0(0) = 0$ and $\dot{y}_0(0) = 1$.

Problem D :

Given: An LTIC system specified by the equation

$$(D^2 + 9)y(t) = (3D + 2)f(t)$$

Find:

i. Find the characteristic polynomial, characteristic equation, characteristic roots, and characteristic modes of this sytem.

ii. Find $y_0(t)$, the zero-input component of the response $y(t)$ for $t \geq 0$, if the initial conditions are $y_0(0) = 0$ and $\dot{y}_0(0) = 6$.

Problem E :

Given: An LTIC system specified by the equation

$$(D+1)(D^2+5D+6)y(t) = Df(t)$$

Find:

i. Find the characteristic polynomial, characteristic equation, characteristic roots, and characteristic modes of this sytem.

ii. Find $y_0(t)$, the zero-input component of the response $y(t)$ for $t \geq 0$, if the initial conditions are $y_0(0) = 2$, $\dot{y}_0(0) = -1$, and $\ddot{y}_0(0) = 5$.

Problem 2.1 :

Given: For each of the following systems

a. $y(t) = 3x(t-1)$

b. $y(t) = tx(t)$

c. $\frac{dy}{dt} + y(t-1) = x(t)$

f. $y(t) = \int_t^\infty x(\tau)d\tau$

g. $y(t) = \int_t^{2t} x(\tau)d\tau$

Find: Specify whether or not the system is: (i) linear and/or (ii) time-invariant.

Problem 2.2 :

Given: For each of the following systems

a. $y(t) = 3x(t) + 1$

b. $y(t) 3 \sin(t) x(t)$

c. $\frac{dy}{dt} + t y(t) = x(t)$

d. $\frac{dy}{dt} + 2y(t) = 3\frac{dx}{dt}$

f. $y(t) = \int_0^\tau x(\tau) d\tau$

Find: Specify whether or not the system is: (i) linear and/or (ii) time-invariant.