Model Answer key.
Paper: T3425 - T.E. (Instrumentation & control)
Sem V. CBSGS.
T05505 . Signals & systems   QP.Code: 23855

Q. ① ⓐ

① $F\{a_1 x_1(t) + a_2 x_2(t)\} = a_1 X_1(j\Omega) + a_2 X_2(j\Omega)$

② If $F[x(t)] = X(j\Omega)$ then
$F\{x(t-t_0)\} = e^{-j\Omega_0 t} X(j\Omega)$.

③ $F\{x(at)\} = \frac{1}{|a|} X\left(\frac{j\Omega}{a}\right)$

④ $F\{x(-t)\} = X(-j\Omega)$

⑤ $F\{x^*(t)\} = X^*(-j\Omega)$

⑥ $F\left\{\frac{d}{dt}(x(t))\right\} = j\Omega X(j\Omega)$

ⓑ consider $x(t) = x_e(t) + x_o(t)$

$\therefore x^2(t) = x_e^2(t) + 2x_e(t)\cdot x_o(t) + x_o^2(t)$

$\int_{-\infty}^{\infty} x^2(t) = \int_{-\infty} x_e^2(t) + 2x_e(t)\cdot x_o(t) + x_o^2(t)\, dt$

$\int_{-\infty}^{\infty} x_e(t)\cdot x_o(t)\, dt = 0$

$\therefore$ we get $\int_{-\infty}^{\infty} x^2(t)\, dt = \int_{-\infty} x_e^2(t)\, dt + \int_{-\infty}^{\infty} x_o^2(t)\, dt$

ⓒ $$y_1(n) = \begin{bmatrix} 2 & 0 & 1 & 1 \\ 1 & 2 & 0 & 1 \\ 1 & 1 & 2 & 0 \\ 0 & 1 & 1 & 2 \end{bmatrix} \begin{bmatrix} 1 \\ -2 \\ 0 \\ 1 \end{bmatrix}$$

$$y_1(n) = \begin{bmatrix} 3 \\ -2 \\ -1 \\ 0 \end{bmatrix}$$ $\Rightarrow$ convolution

(d) Initial value $x(0) = \lim_{s\to\infty} sX(s)$

$$\lim_{s\to\infty} \cancel{s} \cdot \frac{0.8}{\cancel{s}(s^2+0.6s+0.2)} = \frac{0.8}{1+0} = \underline{0}$$

final value $x(\infty) = \lim_{s\to 0} sF(s)$

final value $= \underline{4}$

(e) $x(t) = \mathrm{sgn}(t) = 1 \,;\, t>0$
$\qquad\qquad\qquad\quad = -1 \,;\, t<0.$

$$X(j\Omega) = \frac{2}{j\Omega}$$

Q.2

(a) $$H(s) = \frac{Y(s)}{X(s)} = \frac{1}{s^2-s-6}$$

$$h(t) = \frac{1}{5} e^{3t} u(t) - \frac{1}{5} e^{-2t} u(t)$$

step response $\Rightarrow$ $$y(t) = -\frac{1}{6} u(t) + \frac{1}{15} e^{3t} u(t) + \frac{1}{10} e^{-2t} u(t)$$

(b) (i)