ELEN30012 SIGNALS AND SYSTEMS
Semester 2 Exam 2019
Numerical Answers

Question 1
(a) Linear (b) not time-invariant (c) $h(t) = tu(t)$ (d) $r(t) = \frac{1}{6}t^3 u(t)$

(e) $y(t) = \begin{cases} 0, & 0 \le t < 1 \\ \frac{(t-1)^2}{2}, & 1 \le t < 3 \\ 2t - 4, & t \ge 3 \end{cases}$

Question 2
(a) $F(\omega) = \frac{1}{1+j\omega}$ (b) $|F(\omega)| = \frac{1}{\sqrt{1+\omega^2}}$, $\underline{/F(\omega)} = -\tan^{-1}(\omega)$

(d) $|F_1(\omega)| = |F(\omega)|$, $\underline{/F_1(\omega)} = \underline{/F(\omega)} - \omega$

Question 3
(a) $X(\omega) = \pi \sum_{k=-\infty}^{k=\infty} \delta(n + \frac{\pi}{2} - 2\pi k) + \delta(n - \frac{\pi}{2} - 2\pi k)$

(b) $Y(\omega) = \pi \sum_{k=-\infty}^{k=\infty} \delta(n - \frac{\pi}{2} - 2\pi k)$, $y[n] = \frac{1}{2} e^{\frac{j\pi n}{2}}$

Question 4
(c) (i) $V_1(z) = \frac{1}{8z^6 - 2z^5 - z^4}$ (ii) $V_2(z) = \frac{1}{(8z^2 - 2z - 1)^2}$ (iii) $V_3(z) = \frac{-2z + 16z^2}{(8z^2 - 2z - 1)^2}$

Question 5
(b) (i) $X_1 = -2 + j2$ (ii) $x[0] = -1$, $x[1] = 0$.

Question 6
(a) MIMO (b) unstable (c) P exists (e) $x[1] = \begin{bmatrix} 0 \\ -3 \end{bmatrix}$, $x[2] = \begin{bmatrix} -1.5 \\ 4.5 \end{bmatrix}$

(f) $v[0] = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$, $v[1] = \begin{bmatrix} -2 \\ 0 \end{bmatrix}$. Note: there are other correct answers.

Question 7
(a) $\zeta = 0$, $\omega_n = 3$ (b) marginally stable (c) no dominant poles
(d) undamped (e) $y(t) = \frac{1}{9}(1 - \cos(3t))u(t)$