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18EC45

Fourth Semester B.E. Degree Examination, July/August 2022
Signals and Systems

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 a. Differentiate between Energy and Power signals. Identify whether $u(t)$ is energy or power signals. Compute its energy / power. (08 Marks)
- b. Given the signals $x(t)$ & $y(t)$ in the Fig. Q1(b), sketch
 - i) $x(t - 2) + y(1 - t)$
 - ii) $x(t) - y(t + 2)$. (08 Marks)

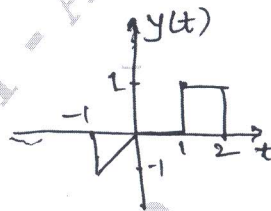
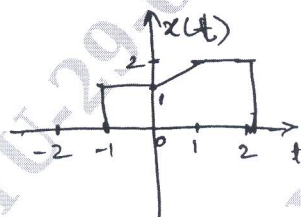


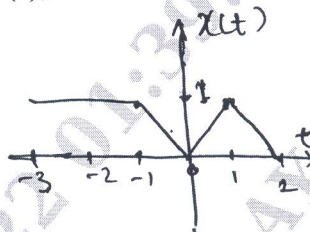
Fig. Q1(b)

- c. Sketch the signal $Z(t) = r(t + 2) - r(t + 1) - 2u(t) + u(t - 1)$. (04 Marks)

OR

- 2 a. For the signal shown in Fig. Q2(a), sketch its Even and Odd components. (06 Marks)

Fig. Q2(a)



- b. Identify whether the following signals are periodic or not? If Periodic what is the period of it?
 - i) $x(t) = \cos \sqrt{2} t + \sin 2 \pi t$
 - ii) $x(t) = \cos 8 \pi t$
 - iii) $x(n) = \sin \frac{\pi}{6} n + \sin \frac{\pi}{3} n$. (08 Marks)
- c. Sketch the signals : i) $u(t - 2) - 2u(t) + u(t + 2)$ ii) $e^{-2t} \{u(t) - u(t - 2)\}$. (06 Marks)

Module-2

- 3 a. Check whether the following system is linear, time variant, causal, static and stable. $Y[n] = 2x[1 - n] + 2$. (08 Marks)
- b. Compute the following convolutions :
 - i) $y(t) = x(t) * h(t)$, where $x(t) = u(t + 2)$ and $h(t) = e^{-2t} u(t)$.
 - ii) $y(t) = x(t) * h(t)$, where $x(t) = e^{-1+t}$ and $h(t) = u(t)$. (12 Marks)

OR

- 4 a. The system is described by the differential equation

$$\frac{dy(t)}{dt} = 2x(t) + \frac{d}{dt} x(t).$$
 State whether this system is linear, time variant, causal and static. (08 Marks)

- b. i) Evaluate $y(n) = x(n) * h(n)$, if $x(n) = \alpha^n u(n)$ $\alpha < 1$ & $h(n) = u(n)$.
 ii) Evaluate $y(t) = x(t) * h(t)$, if $x(t)$ & $h(t)$ are as shown in Fig. Q4(b(ii)). (12 Marks)

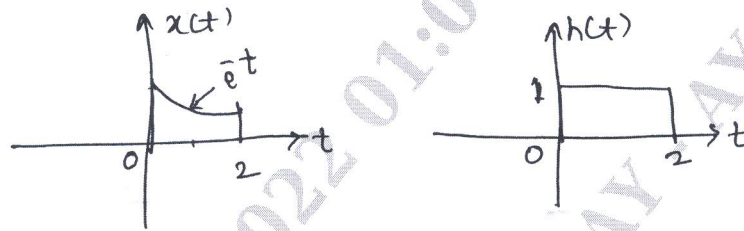


Fig. Q4(b(ii))

Module-3

- 5 a. Impulse responses of the various systems are described below. Identify whether these systems are memoryless, causal and stable.
 i) $h(n) = 2\delta(n)$ ii) $h(t) = e^{-2t} u(t+2)$ iii) $h(t) = 2 \{u(t) - u(t-2)\}$. (10 Marks)
 b. Obtain the Fourier representations of the signals :
 i) $x(n) = \cos 2\pi n + \sin 4\pi n$ with $\Omega_0 = 2\pi$ ii) $x(t)$ shown in Fig. Q5(b(ii)). (10 Marks)

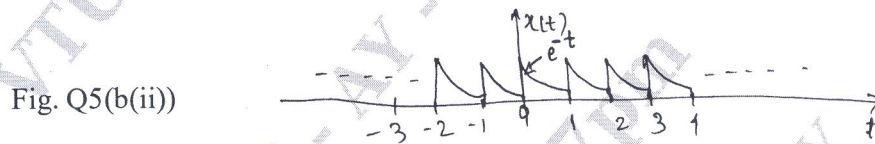
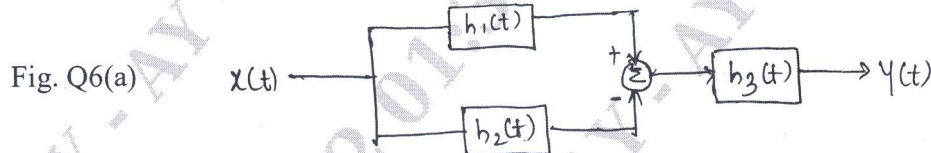


Fig. Q5(b(ii))

OR

- 6 a. Find the overall impulse response of the system shown in Fig. Q6(a). (08 Marks)



where $h_1(t) = u(t+1)$, $h_2(t) = u(t-2)$, $h_3(t) = e^{-3t} u(t)$.

- b. State and prove time shift property of Fourier Series. (06 Marks)
 c. Obtain DTFS coefficients of $x(n)$ if $\Omega_0 = 3\pi$. (06 Marks)
 i) $x(n) = \sin 6\pi n$ ii) $x(n) = \cos 3\pi n + \sin 9\pi n$.

Module-4

- 7 a. State and prove Convolution property of DTFT. (06 Marks)
 b. Find F.T. of the signal shown in Fig. Q7(b). (06 Marks)

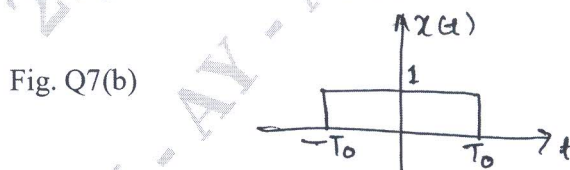


Fig. Q7(b)

- c. Find the time domain signal $x(t)$ if its F.T. $X(j\omega)$ given below :

i) $X(j\omega) = \frac{j\omega}{(j\omega)^2 + 5j\omega + 6j\omega}$ ii) $X(j\omega) = \frac{1-j\omega}{1+\omega^2}$ (08 Marks)

OR

- 8 a. State and prove Parseval's theorem for Fourier transform. (06 Marks)
- b. Using properties, find the DTFT of the signals. (06 Marks)
- i) $x(n) = (\frac{1}{2})^n u(n+2)$ ii) $x(n) = n \cdot a^n u(n)$.
- c. Obtain the signal $x(t)$, if its Fourier transform is (08 Marks)
- i) $X(j\omega) = \frac{1}{2 + j(\omega - 3)}$ ii) $X(j\omega) = e^{-j3\omega} \frac{1}{j\omega + 2}$

Module-5

- 9 a. Find the Z - transform of the signals. (07 Marks)
- i) $x(n) = (\frac{1}{2})^n u(n) - (\frac{3}{2})^n u(-n-1)$ ii) $x(n) = (-\frac{1}{3})^n u(n)$.
- b. State and prove differentiation in the Z - domain property of Z - transform. (06 Marks)
- c. Use Partial fraction expansion to find the inverse Z - transform of (07 Marks)
- $$X(z) = \frac{z^2 - 3z}{z^2 - \frac{3}{2}z - 1} \quad \left| \frac{1}{2} \right| < |z| < |2|$$

OR

- 10 a. Use properties to find Z - transform of the following signals : (08 Marks)
- i) $x(n) = 3^n u(n-2)$ ii) $x(n) = n \sin\left(\frac{\pi}{2}n\right) u(n)$.
- b. Find the Inverse Z - transform. (12 Marks)
- i) $X(z) = \frac{1}{1 - \frac{1}{2}z^{-1}} + \frac{2}{1 - 2z^{-1}} \quad |z| > |2|$.
- ii) $X(z) = \frac{2 + z^{-1}}{1 - \frac{1}{2}z^{-1}} \quad |z| < \left|\frac{1}{2}\right|$, Use Power Series Expansion method.
