CBCS SCHEME

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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.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

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)**

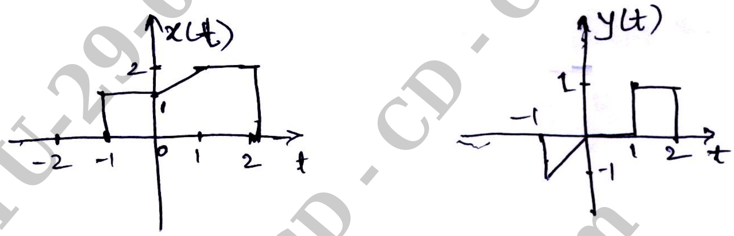


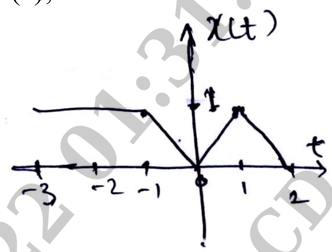
Fig. Q1(b)

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 of 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 $x(t) = e^{-1 + 1}$ 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)**

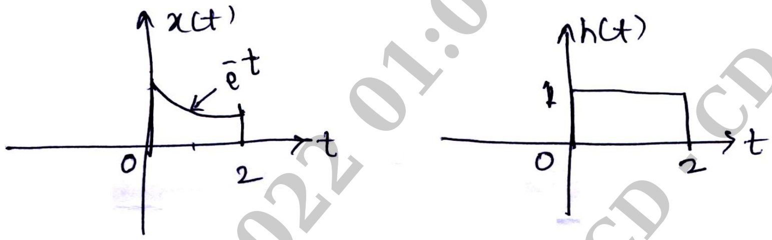


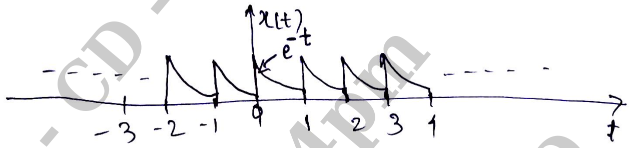
Fig. Q4(b(ii))

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)**

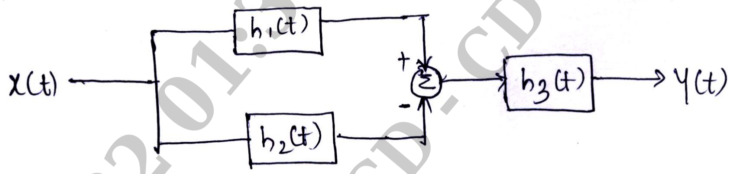
Fig. Q5(b(ii))



OR

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

Fig. Q6(a)



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)**

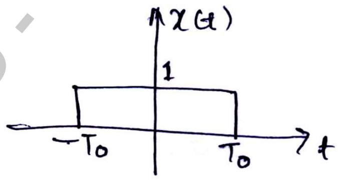
c. Obtain DTFS coefficients of x(n) if $\Omega_0 = 3\pi$.
   i) $x(n) = \sin 6\pi n$ ii) $x(n) = \cos 3\pi n + \sin 9\pi n$. **(06 Marks)**

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(jw) given below :
   i) $X(jw) = \dfrac{jw}{(jw)^2 + 5jw + 6jw}$ ii) $X(jw) = \dfrac{1 - jw}{1 + w^2}$ **(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.

i) $x(n) = (\frac{1}{2})^n u(n+2)$ ii) $x(n) = n \cdot a^n u(n)$. **(06 Marks)**

c. Obtain the signal x(t), if its Fourier transform is

i) $X(jw) = \frac{1}{2 + j(w-3)}$ ii) $X(jw) = e^{-j3w} \frac{1}{jw+2}$ **(08 Marks)**

Module-5

9 a. Find the Z – transform of the signals.

i) $x(n) = (\frac{1}{2})^n u(n) - (\frac{3}{2})^n u(-n-1)$ ii) $x(n) = (-\frac{1}{3})^n u(n)$. **(07 Marks)**

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

$$X(z) = \frac{z^2 - 3z}{z^2 - \frac{3}{2}z - 1} \quad |\tfrac{1}{2}| < |z| < |2|$$ **(07 Marks)**

OR

10 a. Use properties to find Z – transform of the following signals :

i) $x(n) = 3^n u(n-2)$ ii) $x(n) = n \sin\left(\frac{\pi}{2} n\right) u(n)$. **(08 Marks)**

b. Find the Inverse Z - transform.

i) $X(z) = \frac{1}{1 - \frac{1}{2} z^{-1}} + \frac{2}{1 - 2 z^{-1}} \quad |z| > |2|$.

ii) $X(z) = \frac{2 + z^{-1}}{1 - \frac{1}{2} z^{-1}} \; |z| < |\tfrac{1}{2}|$, Use Power Series Expansion method. **(12 Marks)**

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