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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
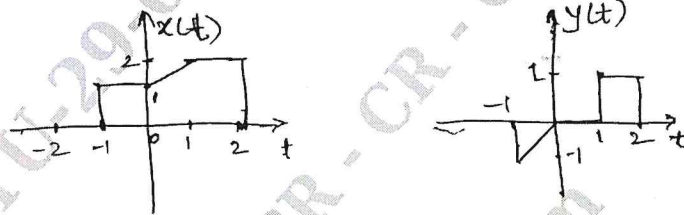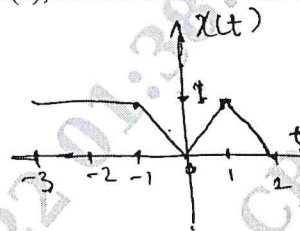   i) $x(t-2) + y(1-t)$ ii) $x(t) - y(t+2)$. **(08 Marks)**

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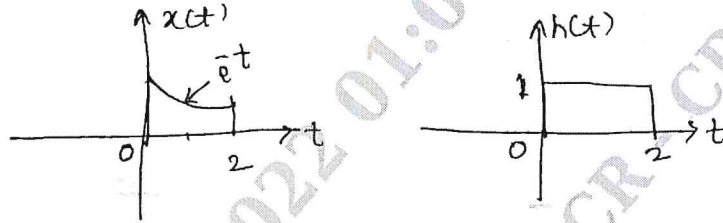   ii) Evaluate $y(t) = x(t) * h(t)$, if $x(t)$ & $h(t)$ are as shown in Fig. Q4(b(ii)). **(12 Marks)**

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)**
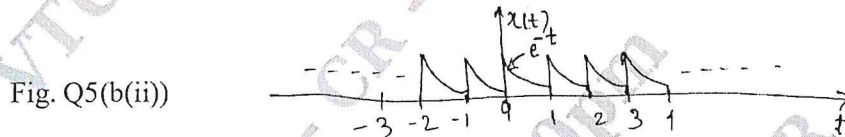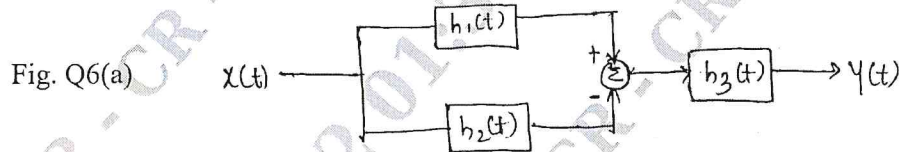
Fig. Q5(b(ii))

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)**
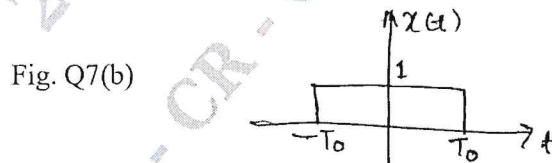   b. Find F.T. of the signal shown in Fig. Q7(b). **(06 Marks)**

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) $X(jw) = \dfrac{1}{2 + j(w-3)}$ ii) $X(jw) = e^{-j3w}\dfrac{1}{jw+2}$ (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

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

OR

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

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

    b. Find the Inverse Z - transform.

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

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

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