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Fourth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Signals and Systems

Time: 3 hrs.   Max. Marks: 80

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

Module-1

1 a. Sketch the even and odd parts of the signals shown in Fig.Q1(i) and (ii)   **(08 Marks)**
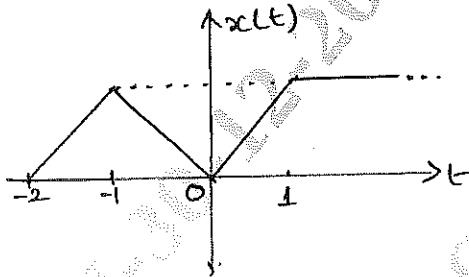

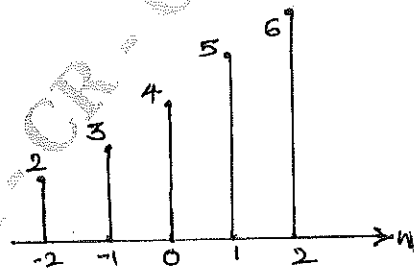Fig.Q1(i)   Fig.Q1(ii)

   b. Determine whether the following signal is periodic or not if periodic find the fundamental period. $x(t) = \sin^2(4t)$.   **(03 Marks)**

   c. The trapezoidal pulse x(t) shown in Fig.Q1(c) is applied to a differentiator is $y(t) = \dfrac{dx(t)}{dt}$.

   i) Find the resulting output y(t) of the differentiator   ii) Find the energy of y(t).   **(05 Marks)**

Fig.Q1(c)

OR

2 a. Determine whether the following systems are memoryless, causal, time invariant, linear and stable. i) $y(t) = x(t^2)$ ii) $y(n) = \log_{10}(|x(n)|)$.   **(08 Marks)**

   b. i) A continuous time signal x(t) is shown in Fig.Q2(b) sketch $y(t) = [x(t) + x(2-t)] u(1-t)$.
       ii) Sketch the signal : $x(n) = 1; -1 \le n \le 3$
$$= \tfrac{1}{2} \; ; n = 4$$
$$= 0; \text{elsewhere}$$

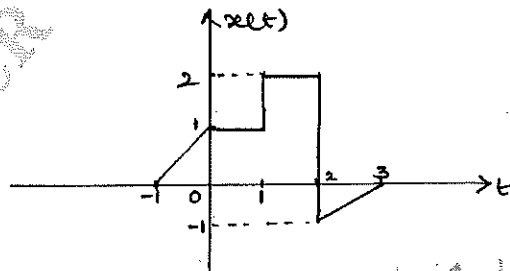   Sketch : i) $2x(2n)$ ii) $\tfrac{1}{2}x(n) + \tfrac{1}{2}(-1)^n x(n)$.   **(08 Marks)**

Fig.Q2(b)

Module-2

3 a. Prove the following :

   i) $x(t) * u(t) = \int_{-\infty}^{t} x(\tau) \, d\tau$

   ii) $x(n) * [h_1(n) * h_2(n)] = \{x(n) * h_1(n)\} * h_2(n)$. (08 Marks)

   b. Compute the convolution sum of $y(n) = \beta^n u(n) * \alpha^n u(n)$; $|\beta| < 1$ and $|\alpha| < 1$. (08 Marks)

OR

4 a. Sate and prove the associative and commutative properties of convolution integral. (08 Marks)

   b. Compute the convolution integral of $x(t) = e^{-2t}u(t)$ and $h(t) = u(t + 2)$. (08 Marks)

Module-3

5 a. A system consists of several subsystems connected as shown in Fig.Q5(a). Find the operator T relating x(t) to y(t) for the subsystem operators given by

   $T_1 : y_1(t) = x_1(t) \, x_1(t - 1)$

   $T_2 : y_2(t) = |x_2(t)|$

   $T_3 : y_3(t) = 1 + 2x_3(t)$
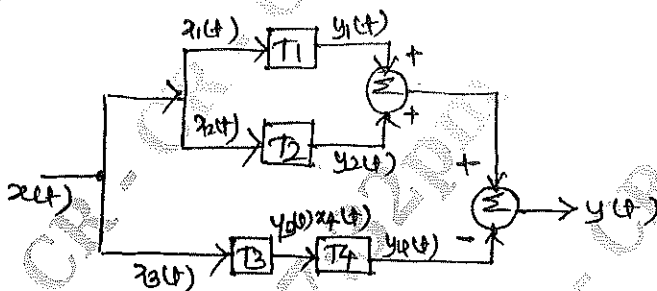
   $T_4 : y_4(t) = \cos(x_4(t))$

Fig.Q5(a) (04 Marks)

   b. Determine whether the following systems defined by their impulse response are causal, meoryless and stable.

   i) $h(t) = e^{-4|t|}$

   ii) $h(n) = (0.99)^n u(n + 3)$. (06 Marks)

   c. Evaluate the step response for the LTI system represented by the following impulse response

   i) $h(n) = e^{-t}u(t) * \delta(t - 2)$

   ii) $h(n) = (-1)^n \{u(n + 2) - u(n - 3)\}$. (06 Marks)

OR

6 a. State the following properties of CTFS :

   i) Time shift

   ii) Differentiation in time domain

   iii) Linearity

   iv) Convolution

   v) Frequency shift scaling. (06 Marks)

   b. Determine the DTFS coefficients of the signal

   $$x(n) = \cos\left(\frac{6\pi}{13}n + \frac{\pi}{6}\right)$$

   Draw : i) Magnitude spectrum

   ii) Phase spectrum. (10 Marks)

Module-4

7 a. State and prove the following properties :

    i) $y(t) = x(t - t_0) \xleftrightarrow{FT} Y(j\omega) = e^{-j\omega t_0} X(j\omega)$

    ii) $-jtx(t) \xleftrightarrow{FT} \dfrac{d}{d\omega} X(j\omega)$.   **(06 Marks)**

  b. Find the DTFT of the following signals :

    i) $x(n) = (-1)^n u(n)$

    ii) $x(n) = (\frac{1}{2})^n \{u(n + 3) - u(n - 2)\}$.   **(10 Marks)**

OR

8 a. Find he FT of the signal : $x(t) = te^{-2t} u(t)$.   **(06 Marks)**

  b. Find the FT of unit step function.   **(04 Marks)**

  c. Determine the signal x(n) if its spectrum is shown in Fig.Q8(c).   **(06 Marks)**
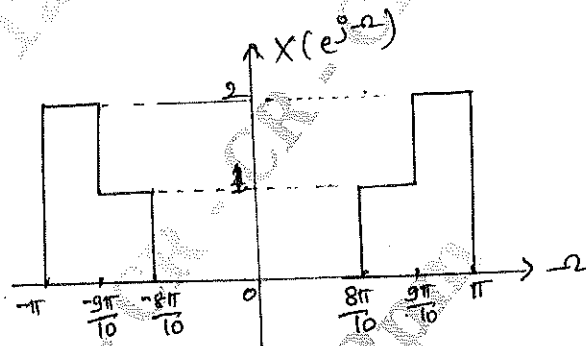

Fig.Q8(c)

Module-5

9 a. Explain properties of ROC with example.   **(06 Marks)**

  b. Determine the z-transform of the following signals.

    i) $x(n) = \left(\dfrac{1}{3}\right)^n \sin\left(\dfrac{\pi}{4}n\right) u(n)$

    ii) $x(n) = \left(\dfrac{1}{2}\right)^n \{u(n) - u(n - 10)\}$.   **(10 Marks)**

OR

10 a. Find the corresponding time domain signals corresponding to the following z-transform.

    $x(z) = \dfrac{z^2 - 3z}{z^2 + \frac{3}{2}z - 1}$; ROC ; $\dfrac{1}{2} < |z| < 1$.   **(06 Marks)**

  b. The input and output of on LTI system is given by

    $x(n) = u(n)$

    $y(n) = (\frac{1}{2})^{n-1} u(n + 1)$.

    Find :

    i) Transfer function

    ii) Impulse response

    iii) Is the system stable?

    iv) Is the system causal?   **(10 Marks)**