CBCS SCHEME

USN | | | | | | | | | | |

15EC44

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 ON`E 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)**

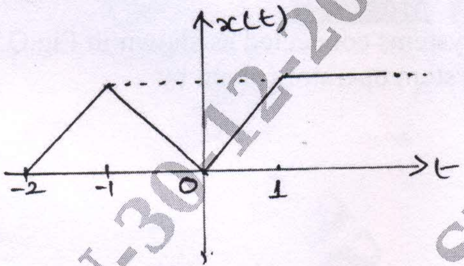

Fig.Q1(i)

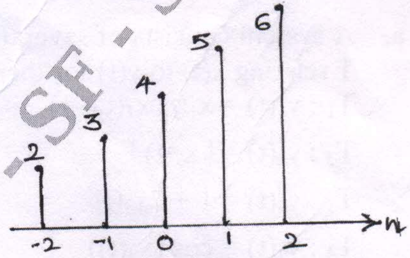

Fig.Q1(ii)

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 $y(t) = \frac{dx(t)}{dt}$.

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

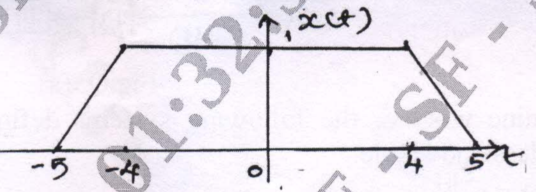

Fig.Q1(c)

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 : $x(n) = 1; -1 \le n \le 3$

$= \frac{1}{2}\ ;\ n = 4$

$= 0;$ elsewhere

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

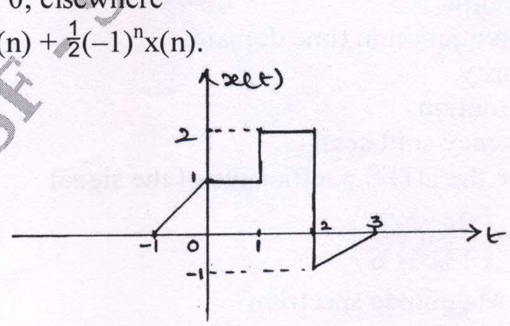

Fig.Q2(b)

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

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

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

$T_3 : y_3(t) = 1 + 2x_3(t)$

$T_4 : y_4(t) = \cos(x_4(t))$

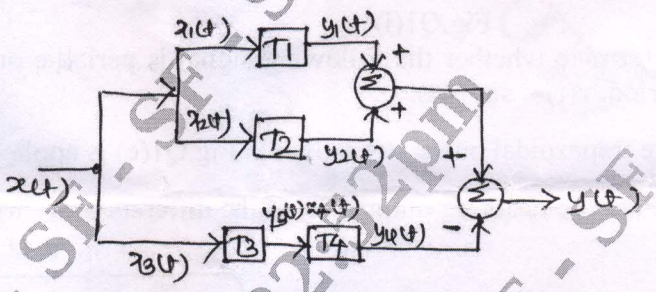

Fig.Q5(a) **(04 Marks)**

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) $-jtx(t) \xleftrightarrow{FT} \frac{d}{d\omega} X(j\omega)$. **(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)**

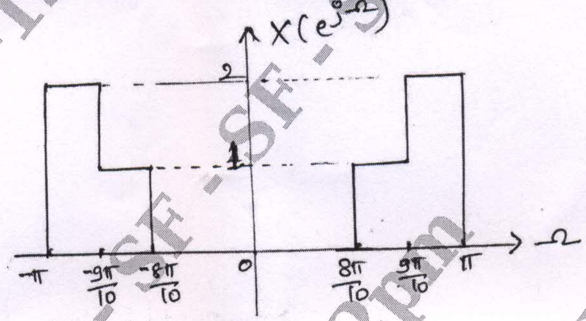

Fig.Q8(c)

Module-5

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

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

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

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

OR

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

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