

# CBCS SCHEME

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 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)

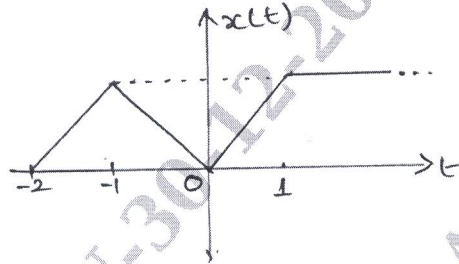


Fig.Q1(i)

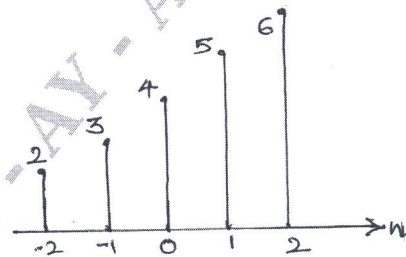


Fig.Q1(ii)

- 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  $y(t) = \frac{dx(t)}{dt}$ .  
i) Find the resulting output  $y(t)$  of the differentiator ii) Find the energy of  $y(t)$ . (05 Marks)

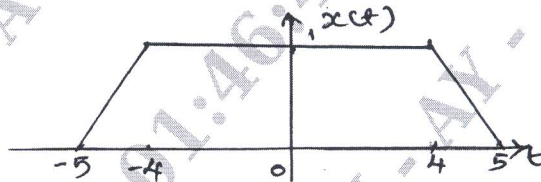


Fig.Q1(c)

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

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

$$= 0; \text{ elsewhere}$$

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

(08 Marks)

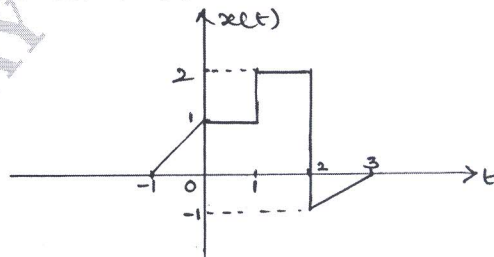


Fig.Q2(b)

**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. State 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

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

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

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

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

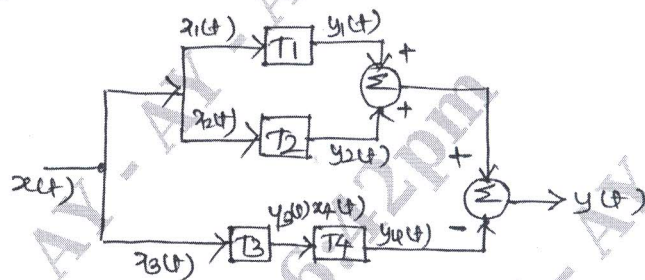


Fig.Q5(a)

(04 Marks)

b. Determine whether the following systems defined by their impulse response are causal, memoryless 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)  $y(t) = x(t - t_0) \xrightarrow{\text{FT}} Y(j\omega) = e^{-j\omega t_0} X(j\omega)$

ii)  $-jtx(t) \xrightarrow{\text{FT}} \frac{d}{d\omega} X(j\omega).$

(06 Marks)

- b. Find the DTFT of the following signals :

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

ii)  $x(n) = \left(\frac{1}{2}\right)^n \{u(n+3) - u(n-2)\}.$

(10 Marks)

**OR**

- 8 a. Find the 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)

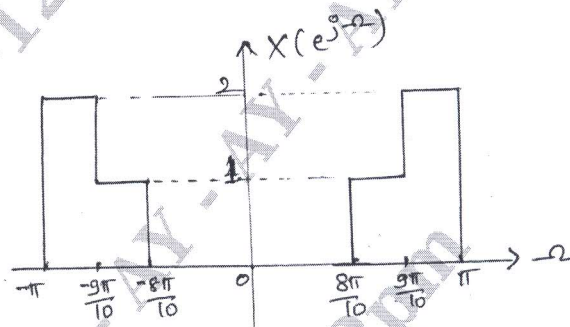


Fig.Q8(c)

**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.

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

(06 Marks)

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

$$x(n) = u(n)$$

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

Find :

- Transfer function
- Impulse response
- Is the system stable?
- Is the system causal?

(10 Marks)

\*\*\* 3 of 3 \*\*\*