USN

Fifth Semester B.E. Degree Examination, Dec.2018/Jan.2019
Signals and Systems

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

PART – A

1 a. Define a signal and a system with examples. **(04 Marks)**

b. Sketch the following signal and determine even and odd components.

$$x(n) = (1, \underset{\uparrow}{2}, 0, 1, 2)$$

(06 Marks)

c. Find the total energy of the signal :

$$x(t) = A \;;\; -\frac{T}{2} \le t \le \frac{T}{2}$$
$$= 0 \;;\; \text{otherwise}$$

(04 Marks)

d. Check whether the following signals are periodic or not. If periodic determine their fundamental period.

(i) $x(t) = \cos t + \sin\sqrt{2}\, t$

(ii) $x(n) = \cos(\pi + 0.2n)$ **(06 Marks)**

2 a. Determine whether the system given below is (i) memoryless (ii) Causal (iii) Time invariant (iv) Linear (v) stable

$$y(t) = e^{-x(t)}$$

(06 Marks)

b. Find the response of an L.T.I. system with impulse response $h(n) = \alpha^n u(n)$ for an input signal $x(n) = \beta^n u(u)$; $|\alpha| < 1$ and $|\beta| < 1$. When (i) $\alpha \ne \beta$ and (ii) $\alpha = \beta$. **(10 Marks)**

c. Find the step response for the system whose impulse response $h(t) = t\ u(t)$. **(04 Marks)**

3 a. The impulse response of a system is $h(t) = e^{2t} u(t-1)$. Check whether the system is (i) stable (ii) causal (iii) memoryless. **(06 Marks)**

b. The differential equation of the system is given as, $\frac{d^2y(t)}{dt^2} + \frac{3dy(t)}{dt} + 2y(t) = x(t)$ with $y(0) = 1$, $\left.\frac{dy(t)}{dt}\right|_{t=0} = 1$

Determine total response of the system for an input $x(t) = u(t)$. **(08 Marks)**

c. Draw the direct form-I and direct form-II realizations for the system

$$y(n) - \frac{1}{2}y(n-1) + \frac{1}{4}y(n-2) = x(n) + 2x(n-1)$$

(06 Marks)

4 a. State and prove the following properties of discrete time fourier series:

(i) Parseval theorem

(ii) Time shift **(10 Marks)**

b. Find the fourier series co-efficients for the periodic signal x(t) with period, 2 sec given by $x(t) = e^{-t}$; for $-1 \le t \le 1$. **(10 Marks)**

PART – B

5 a. State and prove the following properties of continuous time fourier transform :
(i) Convolution (ii) Linearity (10 Marks)

b. Find the fourier transform of the following :
$x(t) = \sin(\pi t)\, e^{-2t}\, u(t)$ (05 Marks)

c. Find the inverse fourier transform of $X(w) = \dfrac{jw + 12}{(jw)^2 + 5jw + 6}$ (05 Marks)

6 a. Find the DTFT of the following signals :
(i) $x(n) = \left(\frac{1}{2}\right)^n u(n-2)$
(ii) $x(n) = u(n) - u(n-6)$
(iii) $x(n) = 2^n u(-n)$ (10 Marks)

b. Obtain the frequency response and impulse response of the system having the output y(n) for the input x(n) as given below:
$x(n) = \left(\frac{1}{2}\right)^n u(n)$
$y(n) = \frac{1}{4}\left(\frac{1}{2}\right)^n u(n) + \left(\frac{1}{4}\right)^n u(n)$ (10 Marks)

7 a. State and prove the following properties of z-transform: (08 Marks)
(i) Initial value theorem
(ii) Differentiation in z-domain

b. Find the Z.T. of the following and sketch the R.O.C.S.
(i) $x(n) = a^{n-1} u(n)$
(ii) $x(n) = \left(\frac{1}{2}\right)^n u(n) + 2^n u(-n-1)$ (06 Marks)

c. Find the inverse z-transform of $X(z) = \dfrac{z^2 - 3z}{z^2 + \frac{3}{2}z - 1}$ using partial fraction expansion method, ROC : $\frac{1}{2} < |z| < 2$. (06 Marks)

8 a. A causal discrete time LTI system is described by
$$y(n) - \frac{3}{4}y(n-1) + \frac{1}{8}y(n-2) = x(n)$$
where x(n) and y(n) are the input and output of the system respectively.
(i) Determine the system function H(z)
(ii) Find the impulse response h(n)
(iii) Find the stability of the system (12 Marks)

b. Solve the following difference equation for the given initial conditions and input.
$$y(n) - \frac{1}{9}y(n-2) = x(n-1)$$
with $y(-1) = 0$, $y(-2) = 1$ and $x(n) = 3\,u(n)$. Use unilateral z-transformation. (08 Marks)

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