USN | | | | | | | | | | | 15EE54

Fifth Semester B.E. Degree Examination, Dec.2018/Jan.2019
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. Distinguish between
   i) Continuous and Discrete time signals
   ii) Even and Odd signals
   iii) Periodic and Non-periodic signals
   iv) Deterministic and Random signals
   v) Energy and Power signals. **(10 Marks)**

b. Determine and sketch the even and odd parts of the signal shown in Fig Q1(b)

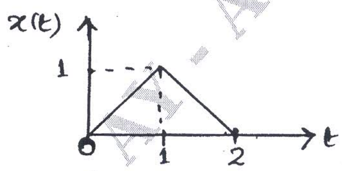

Fig Q1(b) **(06 Marks)**

OR

2 a. Determine whether the following signals are periodic, if periodic determine the fundamental period i) $x(t) = \cos 2t + \sin 3t$ ii) $x[n] = \cos\left(\frac{n\pi}{5}\right) \sin\left(\frac{n\pi}{3}\right)$ **(08 Marks)**

b. Using convolution integral, determine and sketch output of LTI system whose input and impulse response is $x(t) = e^{-3t}\left[u(t) - u(t-2)\right]$ and $h(t) = e^{-t}u(t)$ **(08 Marks)**

Module-2

3 a. Determine the convolution sum of two sequences
$x[n] = \left\{\underset{\uparrow}{3}, 2, 1, 2\right\}$ and $h[n] = \left\{1, \underset{\uparrow}{2}, 1, 2\right\}$. **(08 Marks)**

b. Find the step response of an LTI system, if impulse responses are
i) $h(t) = t^2 u(t)$ ii) $h[n] = \left(\frac{1}{2}\right)^n u[n]$ **(08 Marks)**

OR

4 a. Find the output response of the system described by a differential equation
$\frac{d^2y(t)}{dt^2} + 6\frac{dy(t)}{dt} + 8y(t) = \frac{dx(t)}{dt} + 2x(t)$. The input signal $x(t) = e^{-t}u(t)$ and initial conditions are $y(0) = 2$, $\frac{dy(0)}{dt} = 3$. **(06 Marks)**

b. Draw the direct form I and direct form II implementation of the following differential equation. $\frac{d^2y(t)}{dt^2} + 3\frac{dy(t)}{dt} + 2y(t) = \frac{d^2x(t)}{dt^2} + \frac{dx(t)}{dt}$ **(06 Marks)**

c. Check whether the response of LTI system $y[n] = 2x[n+1] + 3x[n] + x[n-1]$ is causal and stable? **(04 Marks)**

Module-3

5 a. State and prove the following properties in continuous time Fourier transform i) Linearity ii) Time shift iii) Time differentiation. **(10 Marks)**

b. Find the Fourier Transformation of $x(t) = e^{-at}\, u(t),\ a > 0$. **(06 Marks)**

OR

6 a. Using partial fraction expansion and linearity to determine the inverse Fourier transform of

$$x(j\omega) = \frac{-j\omega}{(j\omega)^2 + 3j\omega + 2}$$ **(08 Marks)**

b. Find the frequency response and impulse response of the system described by the differential equation.

$$\frac{d^2y(t)}{dt^2} + 3\frac{dy(t)}{dt} + 2y(t) = 2\frac{dx(t)}{dt} + x(t)$$ **(08 Marks)**

Module-4

7 a. State and prove the following properties in Discrete time Fourier transform
i) Frequency shift ii) Parseval's theorem. **(10 Marks)**

b. Find DTFT of the following signal

i) $x[n] = \left(\frac{1}{2}\right)^{n+2} u[n]$ ii) $x[n] = 2(3)^n u[-n]$ **(06 Marks)**

OR

8 a. Using DTFT, find the total solution to the difference equation for discrete time $n \geq 0$.
$5y(n+2) - 6y(n+1) + y(n) = (0.8)^n u(n)$ **(08 Marks)**

b. Determine the difference equation description for the system with the following impulse response $h[n] = \delta[n] + 2\left(\frac{1}{2}\right)^n u(n) + \left(\frac{-1}{2}\right)^n u(n)$ **(08 Marks)**

Module-5

9 a. What is region of convergence? List any 5 properties of ROC. **(07 Marks)**

b. Find the z-transform and ROC of the signal $x[n] = -b^n u[-n-1]$ **(05 Marks)**

c. State and prove time shift property. **(04 Marks)**

OR

10 a. Determine the inverse z-transform of x(z)

$$x(z) = \frac{1}{1 - 1.5z^{-1} + 0.5z^{-2}} \text{ for ROC } |z| > 1;\ \frac{1}{2} < |z| < 1.$$ **(06 Marks)**

b. Consider a causal discrete time sequence whose output y(n) and x(n) are related by

$$y(n) - \frac{5}{6}y(n-1) + \frac{1}{6}y(n-2) = x(n)$$

i) Find its system function ii) Find its impulse response h[n]. **(10 Marks)**

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