CBCS Scheme

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15EE54

Fifth Semester B.E. Degree Examination, Dec.2017/Jan.2018
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. Explain the classification of signals. **(06 Marks)**

b. Find the even and odd components of the signal $x(t) = (1 + t^3)\cos^3(10t)$. **(04 Marks)**

c. Sketch the signal $y(t) = [x(t) + x(2 - t)]\,u(1 - t)$, where x(t) is shown in Fig.Q1(c). **(06 Marks)**

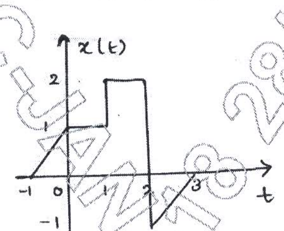

Fig.Q1(c)

OR

2 a. Find the overall operator the system $y(n) = \frac{1}{3}[x(n + 1) + x(n) + x(n - 1)]$. **(04 Marks)**

b. Find the average power of square wave show in Fig.Q2(b). **(07 Marks)**

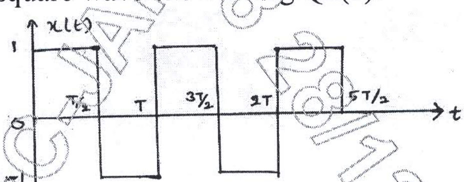

Fig.Q2(b)

c. Determine whether the system $y(t) = x\left(\frac{t}{2}\right)$ is, i) Linear ii) Time-invariant iii) Memory iv) Causal v) Stable. **(05 Marks)**

Module-2

3 a. A continuous time LTI system with unit impulse response, h(t)=u(t) and input $x(t) = e^{-at}u(t)$; $a > 0$. Find the output y(t) of the system. **(08 Marks)**

b. Find the step response for the LTI system represented by the impulse response $h(n) = (\frac{1}{2})^n u(n)$. **(04 Marks)**

c. Consider a continuous time LTI system is represented by the impulse response $h(t) = e^{-3t}u(t-1)$. Determine whether it is (i) Stable ii) Causal. **(04 Marks)**

OR

4 a. Solve the differential equation :

$$\frac{d^2y(t)}{dt^2} + 3\frac{dy(t)}{dt} + 2y(t) = 2x(t) \text{ with } y(0) = -1\ ;\ \left.\frac{dy(t)}{dt}\right|_{t=0} = 1 \text{ and } x(t) = \cos t\ u(t).$$ **(08 Marks)**

b. Draw the direct form I and II implementation for the difference equation :

$y(n) + \frac{1}{5}y(n-1) - y(n-3) = 2x(n-1) + 7x(n-2)$. **(08 Marks)**

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-3

5 a. Find the Fourier transform of $x(t) = \sum_{k=0}^{\infty} \alpha^k f(t - kT); |\alpha| < 1$. (06 Marks)

b. Find the inverse Fourier transform of $k(j\omega) = \dfrac{j\omega}{(2 + j\omega)^2}$. (04 Marks)

c. The impulse response of a continuous time LTI system is given by $h(t) = \dfrac{1}{RC} e^{-t/RC} u(t)$. Find the frequency response and draw its spectrum. (06 Marks)

OR

6 a. Find the frequency response and impulse response of the system having $y(t) = e^{-2t} u(t) + e^{-3t} u(t)$, for the input $x(t) = e^{-t} u(t)$. (08 Marks)

b. Find the frequency response and the impulse response of the system described by differential equation : $\dfrac{d^2 y(t)}{dt^2} + 3\dfrac{dy(t)}{dt} + 2y(t) = 4\dfrac{dx(t)}{dt} + x(t)$. (08 Marks)

Module-4

7 a. State and prove Parseval's theorem in discrete time domain. (06 Marks)

b. Find the DTFT of the signal $x(n) = a^{|n|}$; $|a| < 1$. (05 Marks)

c. Find the inverse DTFT of the signal, $x(e^{j\Omega}) = \dfrac{3 - \frac{1}{4} e^{-j\Omega}}{-\frac{1}{16} e^{-j2\Omega} + 1}$. (05 Marks)

OR

8 a. Find the impulse response of the system having output $y(n) = \frac{1}{4}\left(\frac{1}{2}\right)^n u(n) + \left(\frac{1}{4}\right)^n u(n)$ for the input $x(n) = \left(\frac{1}{2}\right)^n u(n)$. (08 Marks)

b. Obtain the difference equatin for the system with frequency response :

$$H(e^{j\Omega}) = 1 + \frac{e^{-j\Omega}}{\left(1 - \frac{1}{2} e^{-j\Omega}\right)\left(1 + \frac{1}{4} e^{-j\Omega}\right)}.$$ (08 Marks)

Module-5

9 a. Determine the z – transform of $x(n) = -u(-n-1) + (\frac{1}{2})^n u(n)$. Find the RoC and poles –zeros locations of x(z). (06 Marks)

b. Find the z – transform of $x(n) = n^2 (\frac{1}{2})^n u(n - 3)$ using appropriate properties. (04 Marks)

c. Find the inverse z-transform of x(z) using partial fraction method,

$$x(z) = \frac{1 + 2z^{-1} + z^{-2}}{1 - \frac{3}{2} z^{-1} + \frac{1}{2} z^{-2}};\ |z| > 1 \text{ as RoC.}$$ (06 Marks)

OR

10 a. A system has impulse response $h(n) = \left(\frac{1}{2}\right)^n u(n)$. Determine the input to the system if the output is given by, $y(n) = \left(\frac{1}{3}\right)^n u(n) + \frac{2}{3}\left(-\frac{1}{2}\right)^n u(n)$. (08 Marks)

b. Solve the following difference equation using z-transform,

$y(n) - \frac{3}{2} y(n-1) + \frac{1}{2} y(n-2) = x(n)$ for $n \ge 0$, with $y(-1) = 4$, $y(-2) = 10$ and $x(n) = \left(\frac{1}{4}\right)^n u(n)$ (08 Marks)