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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Third Semester, B.E. - Electronics and Communication Engineering

Semester End Examination; Dec. - 2019

Signals and Systems

Time: 3 hrs *Max. Marks: 100*

***Note**: Answer **FIVE** full questions, selecting **ONE** full question from each unit.*

UNIT - I

1 a. A continuous signal $x(t)$ is shown in Fig. 1(a). Sketch and label each of the following: 8

(i) $x(t-2)$

(ii) $x(2t)$

(iii) $x(t/2)$

(iv) $x(-t)$

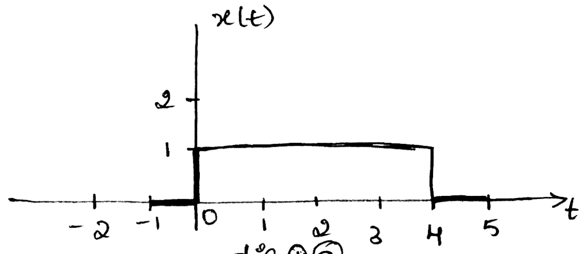

fig 1(a)

b. Identify whether the following signals are energy or power signals? Also find its corresponding value. 8

i) $x_1(n) = \cos(\pi n)$; $-4 \le n \le 4$
$= 0$; otherwise

ii) $x_2(n) = \cos(\pi n)$; $n \ge 0$
$= 0$; otherwise

c. Find the even and odd components of the signal $x(t) = \cos(t) + \sin(t) + \sin(t)\cos(t)$ 4

2 a. Determine whether the given signals are periodic. Determine the fundamental period, if periodic, 8

i) $x(t) = e^{i(\pi t - 1)}$

ii) $x(t) = \cos 2t + \sin 3t$

iii) $x(n) = \cos\left(\dfrac{\pi n^2}{8}\right)$

iv) $x(n) = \sum_{K=-\infty}^{\infty} \left\{ \delta(n-3k) + \delta(n-k^2) \right\}$

b. For the following system, illustrate whether the system is linear, time invariant, memory, stable and causal. 8

i) $y(n) = x(n - n_d)$

ii) $y(n) = \log_{10}\left(|x(n)|\right)$

iii) $y(t) = x\left(t/2\right)$

iv) $y(n) = x(n) \sum_{K=-\infty}^{\infty} \delta(n-2k)$

c. Define unit impulse in continuous time and discrete time and explain its importance. 4

UNIT - II

3 a. Prove the following identities, 10

i) $x(t) * \delta(t) = x(t)$

ii) $x(t) * \delta(t - t_0) = x(t - t_0)$

iii) $x(t) * u(t) = \int_{-\infty}^{t} x(\tau)\, d\tau$

iv) $x(t) * u(t - t_0) = \int_{-\infty}^{t - t_0} x(\tau)\, d\tau$

b. An LTI system is characterized by $h(n) = \left(3/4\right)^n u(n)$. Compute the output of the system at time, $n = 5, -5, 10$, when input $x[n] = u[n]$. 10

4 a. Determine the output of the system given by the differential equation with initial condition as 10

$$\frac{d^2y(t)}{dt}+\frac{5dy(t)}{dt}+4y(t)=\frac{dx(t)}{dt}$$

$y(0)=0;\frac{dy(t)}{dt}\Big|_{t=0}=1$ and $x(t)=e^{-2t}u(t)$

b. Implement the equations given below in direct form I and II structure, 10

i) $y(n)-\frac{1}{4}y(n-1)+\frac{1}{8}y(n-2)=x(n)+\frac{1}{2}x(n-2)$ ii) $\frac{d^2y(t)}{dt^2}+\frac{5dy(t)}{dt}+4y(t)=\frac{dx(t)}{dt}$

UNIT - III

5 a. Evaluate the DTFS representation for the signal $x(n)=\sin\frac{4\pi}{21}n+\cos\frac{10\pi}{21}n+1$. Sketch magnitude and phase spectra. 10

b. State and prove Convolution Property using Fourier series definition. 10

6 a. Determine the FS representation for the signal $x(t)=\cos 4t+\sin 8t$. 5

b. Consider the signal $x(n)=2+2\cos\frac{\pi}{4}n+\cos\frac{\pi}{2}n+\frac{1}{2}\cos\frac{3\pi}{4}n$ 10

i) Determine and sketch its power density spectrum.

ii) Evaluate the power of the signal.

c. State and prove Linearity Property using FS definition. 5

UNIT - IV

7 a. State Sampling theorem. Explain Over Sampling and Under Sampling. 10

b. Using frequency differentiation property find inverse Fourier transform of, 6

$$X(jw)=\frac{jw}{(2+jw)^2}$$

c. Find the Nyquist rate for the signal, i) $x_1(t)=\sin c(200t)$ ii) $x_2(t)=\sin c^2(200t)$ 4

8 a. Find D.T.F.T for the given signal, i) $x(n)=\alpha^n u(n);|\alpha|<1$ ii) $x(n)=(-1)^n u(n)$ 10

b. State and prove Parseval's theorem using DTFT definition. 10

UNIT - V

9 a. Find the Z-transform of, 10

i) $x(n)=-\alpha^n u(-n-1)$. Specify its ROC.

ii) $x(n)=-u(-n-1)+\left(\frac{1}{2}\right)^n u(n)$. Determine ROC and analyze pole zero plot.

b. Find the inverse Z-transform using partial fraction expansion method, 10

$$x(Z)=\frac{Z^3+Z^2+\frac{3}{2}Z+\frac{1}{2}}{Z^3+\frac{3}{2}Z^2+\frac{1}{2}Z}$$ ROC: $|Z|<\frac{1}{2}$

10 a. A causal LTI system is described by the difference equation, 10

$y(n)=y(n-1)+y(n-2)+x(n-1)$

i) Determine the system function H(z) and plot the corresponding ROC.

ii) Determine the impulse response of the system.

b. Solve the difference equation $y(n)+3y(n-1)=x(n)$ with $x(n)=u(n)$ and the initial condition $y(-1)=1$ using Z-transform method. 10

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