U.S.N

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

(An Autonomous Institution affiliated to VTU, Belgaum)

Fourth Semester, B.E. - Electrical and Electronics Engineering

Semester End Examination; June - 2016

Signals and Systems

Time: 3 hrs *Max. Marks: 100*

***Note**: i) Answer **FIVE** full questions, selecting **ONE** full question from each unit.*
ii) Assume suitably missing data if any.

UNIT - I

1 a. Determine whether the following signals are periodic. If it is periodic determine the fundamental period. 6

i) $x(t) = 2\sin\left(\frac{2}{3}\right)t + 3\cos\left(\frac{2\pi}{5}\right)t$ ii) $y(t) = 3\sin t + 5\cos\left(\frac{4}{3}\right)t$

b. Determine and sketch the even and odd components of the continuous-time signal, $x(t) = e^{-t}u(t)$. 6

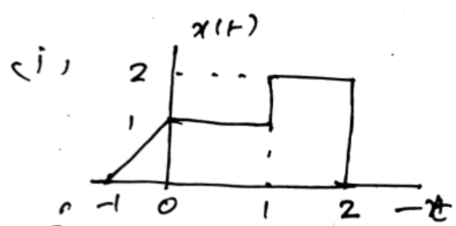
c. i) Show that the causality for a continuous-time linear system is equivalent to the following statement. For time t_o and any input $x(t)$ with $x(t) = 0$ for $t \leq t_0$, the output $y(t)$ is zero for $t \leq t_{0,}$ 8

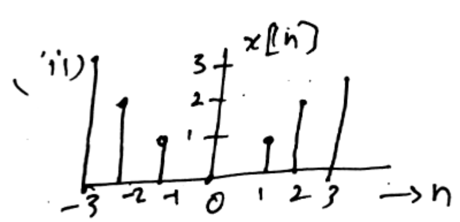
ii) Find a non linear system that is causal but does not satisfy this condition.

iii) Find a non linear system that satisfies this condition but is not causal.

2 a. Consider: $x(t) = 2\cos 2\pi\, t_o t$. Is it a power signal or Energy signal? 6

b. A continuous-time and discrets time signals are shown in the following figure. Sketch and label each of the following signals. 8





(a) $x(t)\,u(1-t)$ (a) $x[n]\,u[1-n]$

(b) $x(t)[u(t) - u(t-1)]$ (b) $x[n]\{u[n+2] - u[n]\}$

(c) $x(t)\,\delta\left(t - \frac{3}{2}\right)$ (c) $x[n]\,\delta(n-1)$

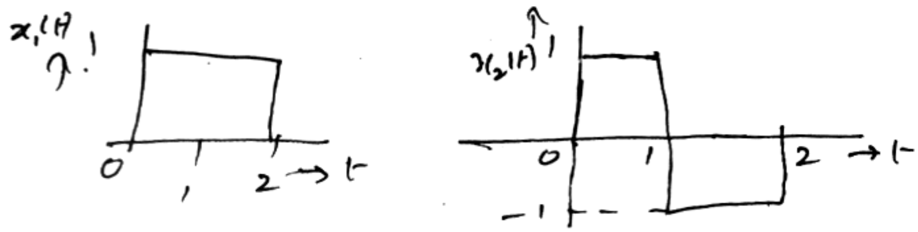
c. A system is represents by the following difference equations,

$y(n) = 3y^2[n-1] - nx[n] + 4x[n-1] - 2x[n+1], \quad n \geq 0$ is the system is, 6

i) Linear ii) Time-invariant iii) Causal iv) Memory. Explain each.

UNIT - II

3 a. Perform convolution of the following signal by graphical method and sketch the resultant signals and verify the same analytically. 12



b. Determine the response of the LTI system whose input $x(n) = \underset{\uparrow}{\{1, 2, 3, 1\}}$ $h(n) = \underset{\uparrow}{\{1, 2, 1, -1\}}$ using tabular method and matrix method. 8

4 a. Consider an RL circuit shown in Fig. 4a. The impulse response of the circuit is $h(t) = \frac{R}{L} e^{-\left(\frac{R}{L}t\right)} u(t)$. Find an expression for the frequency response and plot the magnitude and phase response. 10

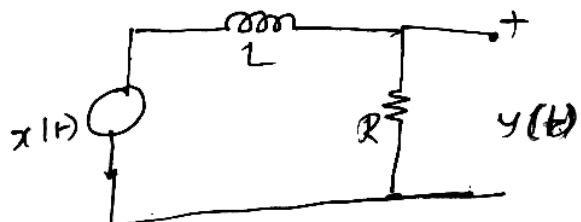


fig 4(a)

b. Find the overall impulse response of the interconnected systems shown in Fig. 4b given that 10

$h(n) = a^n u(n), \quad h_2(n) = \delta(n-1), \quad h_3(n) = \delta(n-2)$

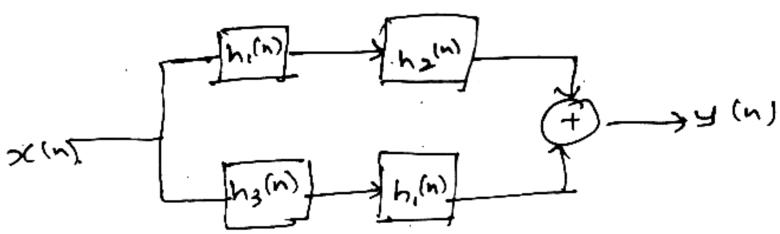


Fig. 4b

UNIT - III

5 a. Solve the difference equation $y(n) + 3y(n-2) + 2y(n-2) = x(n)$. Assume that the system is initially relaxed. Given $x(n) = 4^n u(n)$. 10

b. A difference equation describing a Filter is given below,

$y(n) - \frac{3}{4} y(n-1) + \frac{1}{8} y(n-2) = x(n) + \frac{1}{2} x(n-1)$. Draw direct form-I and direct form-II structure. 4

Contd….3

c. Realize the following system function is cascade form, 6

$$H(z)=\frac{1+\frac{1}{5}z^{-1}}{\left(1-\frac{1}{2}z^{-1}+\frac{1}{3}z^{-2}\right)\left(1+\frac{1}{4}z^{-1}\right)}$$

6 a. Determine the natural response of the system described by the equation, 8

$$\frac{d^2y(t)}{dt^2}+6\frac{dy}{dt}+5y(t)=\frac{dx(t)}{dt}+4x(t) \text{ given } y(0)=1,\ \left.\frac{d_y(t)}{dt}\right|_{t=0}=-2$$

b. Given that, $\frac{d^2y(t)}{dt^2}+2\frac{dy(t)}{dt}+3y(t)=4\frac{dx(t)}{dt}+5x(t)$ draw the direct form-I and direct form-II. 6

c. Determine the Fourier series representative of the square wave shown in Fig. 6(c). 6

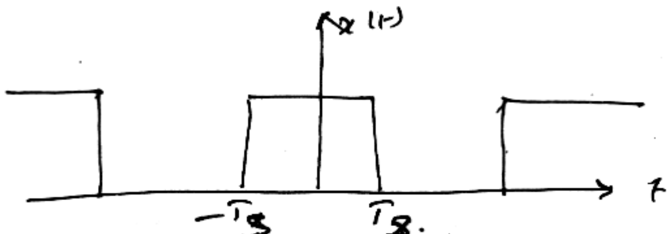


fig 6(c)

UNIT - IV

7 a. State and prove Frequency convolution and Parseval's relations for DTFT. 10

b. Determine the Fourier transforms of the triangular pulse shown in Fig. 7(b), 10

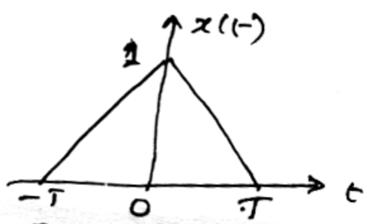


Fig 7(b)

8 a. Find the inverse Fourier Transforms of, 8

$X(j\Omega)=\frac{1}{(4+j\Omega)^2}$, using convolution property.

b. Determine the frequency response for the difference equations given by, 6

$$\frac{d^2y(t)}{dt^2}+5\frac{dy(t)}{dt}+6y(t)=-\frac{d}{dt}x(t)$$

c. Find the Fourier Transform of the impulse train , 6

$$P(t)=\sum_{n=-\infty}^{\infty}8(t-nT)$$

UNIT - V

9 a. State and prove Initial value and Final value theorem. 6

b. State and prove any four properties of Z-transform. 8

c. Find the Z-transform of the sequence,

$x[n] = 3\left[-\tfrac{1}{2}\right]^n u(n) - 2(3)^n u(-n-1)$ Hence find ROC. 6

10 a. Find the inverse Z-transform of,

$$x[z] = \frac{z^4 + z^2}{\left(z - \tfrac{1}{2}\right)\left(z - \tfrac{1}{4}\right)} \quad |z| > \frac{1}{2}$$ 10

b. Solve the difference equation,

$y(n) = \tfrac{1}{4} y(n-1) - \tfrac{1}{8} y(n-2) = x(n) + x(n-1)$ The initial conditions are $y(-1) = 1$, $y(-2) = -1$ the input $x(n) = 3^n u(n)$ 10

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