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10EC44

**Fourth Semester B.E. Degree Examination, Dec.2017/Jan.2018**  
**Signals and Systems**

Time: 3 hrs.

Max. Marks:100

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

**PART - A**

- 1 a. Categorize the following signal as energy or power signal, and find the corresponding energy or power of the signal.  $x(t) = \cos(\pi t) + \sin(5\pi t)$ . (06 Marks)
- b. For  $x(n)$  and  $y(n)$  shown in Fig.Q1(b), draw  $x(n+1) \cdot y(-2-n)$ . (06 Marks)

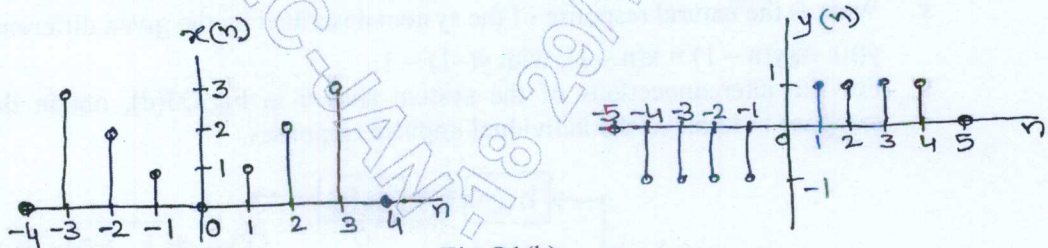


Fig.Q1(b)

- c. Determine whether the following signal is periodic or not. If periodic, find its fundamental period.  $x(n) = \cos\left(\frac{\pi n}{3}\right) \cdot \sin\left(\frac{\pi n}{5}\right)$ . (04 Marks)
- d. Determine whether the system described by the following input output relation is time-invariant or not  $y(t) = \frac{1}{L} \int_{-\infty}^t x(\tau) d\tau$ . (04 Marks)
- 2 a. The impulse response of a discrete time LTI system is given by  $h(n) = a^n[u(n) - u(n-5)]$ . Determine the output of the system for the input  $x(n) = b^n u(n)$ , using convolution sum. (06 Marks)
- b. Evaluate the continuous time Convolution of the two signals given in Fig.Q2(b). (06 Marks)

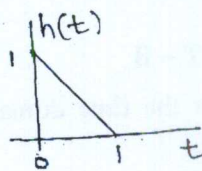


Fig. Q2(b)

- c. Compute the discrete time convolution sum of the following two sequences using any method  $x_1(n) = \{1, 2, 3, 4\}$ ,  $x_2(n) = \{1, 1, 3, 2\}$ . (04 Marks)
- d. The impulse response of a continuous time LTI system is given by  $h(t) = e^{2t}u(t-1)$ . Is the system causal and stable? Give reason for your answer. (04 Marks)

- 3 a. Find the forced response of the system shown in Fig.Q3(a), where  $x(t) = \cos(t)$ . (06 Marks)

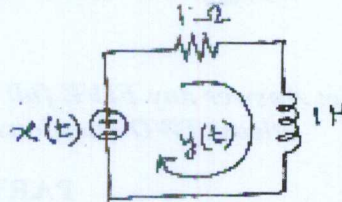


Fig.Q3(a)

- b. Draw the direct form I and direct form II implementations of the system described by the following differential equation :  $\frac{d^3}{dt^3}y(t) + 2\frac{d}{dt}y(t) + 3y(t) = x(t) + 3\frac{d}{dt}x(t)$ . (06 Marks)
- c. What is the natural response of the system described by the given difference equation?  $y(n) - \frac{1}{16}y(n-1) = x(n-1)$ , with  $y(-1) = 1$ . (04 Marks)
- d. For the interconnections of the system shown in Fig.Q3(d), obtain the overall impulse response in terms of the individual impulse responses. (04 Marks)

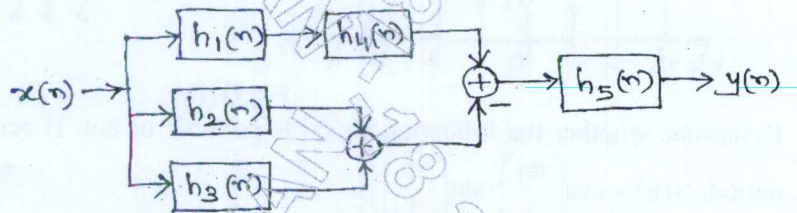


Fig.Q3(d)

- 4 a. A periodic signal with period 4 sec is described over one fundamental period as  $x(t) = 3 - t$ ,  $0 < t < 4$ . Find the exponential Fourier series and plot its magnitude spectrum. (06 Marks)
- b. Determine the discrete time Fourier series representation of the given signal. Draw its magnitude and phase spectra.  $x(n) = \cos\left(\frac{6\pi n}{13} + \frac{\pi}{6}\right)$  (06 Marks)
- c. State and prove frequency shift property with reference to Fourier series of continuous time signals. (04 Marks)
- d. State and prove Parseval's theorem with reference to DTFS. (04 Marks)

**PART - B**

- 5 a. Find the inverse Fourier transform and draw the time domain signal for the rectangular spectrum given by  $X(j\omega) = \begin{cases} 1, & -\frac{W}{2} < \omega < \frac{W}{2} \\ 0, & |\omega| > \frac{W}{2} \end{cases}$ . (08 Marks)
- b. A discrete time rectangular pulse is defined as  $x(n) = \begin{cases} 1, & |n| \leq M \\ 0, & |n| > M \end{cases}$ . Find and plot the DTFT of the signal. (08 Marks)
- c. Using suitable properties find the inverse DTFT of :  $X(j\Omega) = \frac{1}{1 - ae^{-j(\Omega + \pi/4)}}$ ,  $|a| < 1$ . (04 Marks)

- 6 a. A continuous time LTI system produces an output  $y(t) = e^{-t} u(t)$  when excited by the input  $x(t) = e^{-2t} u(t)$ . Evaluate the frequency response and impulse response of the system. (08 Marks)
- b. Find the impulse response and step response of the LTI system shown in Fig.Q6(b) using Fourier analysis techniques. (08 Marks)

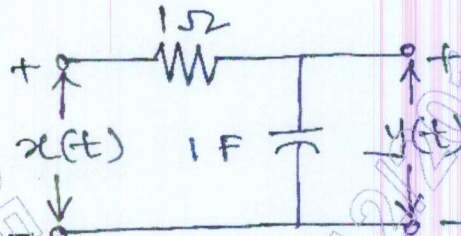


Fig.Q6(b)

- c. A continuous time signal is given by  $x(t) = 4 \cos(100\pi t)$ . What is the minimum sampling rate required to avoid aliasing? If the signal is sampled at 200 Hz, then give the expression for the discrete time signal after sampling. (04 Marks)
- 7 a. Using the Z – transform properties, find the Z – transform and RoC of the following signal :  $x(n) = n\left(\frac{1}{2}\right)^n u(n) * \left(\frac{1}{4}\right)^{-n} u(-n)$ . (08 Marks)
- b. Find the time domain signal corresponding to the given z – transform, using partial fraction expansion approach.  $X(z) = \frac{z^3 - 10z^2 - 4z + 4}{2z^2 - 2z - 4}$ , RoC :  $|z| < 1$ . (08 Marks)
- c. Derive the relation between z – transform and discrete time Fourier transform. (04 Marks)
- 8 a. Consider a system described by the difference equation  $y(n] - 0.9 y[n - 1] = x[n]$ , with initial condition  $y[-1] = 2$ . Find the step response of the system using unilateral z – transform. (08 Marks)
- b. The difference equation of a causal and stable system is given by :  

$$y[n] - \frac{5}{6} y[n - 1] + \frac{1}{6} y[n - 2] = x[n] - 2x[n - 1]$$
Determine the impulse response of the system. Also find the output if the input is  $x[n] = 2^n u[n]$ . (08 Marks)
- c. Determine the transfer function of the inverse of the system, whose difference equation is given by :  $y[n] - \frac{1}{4} y[n - 2] = 6x[n] - 7x[n - 1] + 3x[n - 2]$ . (04 Marks)

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