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Question Paper Code : 80112

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2019.

Third Semester

Electronics and Communication Engineering

EC 8352 — SIGNALS AND SYSTEMS

(Common to Medical Electronics/B.E. Biomedical Engineering/Computer and Communication Engineering/Electronics and Telecommunication Engineering)

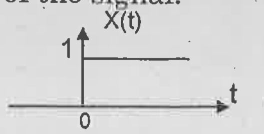
(Regulation 2017)

Time : Three hours — Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

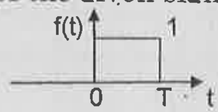
1. Find the even and odd part of the signal.



2. Determine whether the given discrete time sequence is periodic or not. If the sequence is periodic, find the fundamental period. $x[n] = \cos\left(\frac{n}{8}\right)\cos\left(\frac{\pi n}{8}\right)$.

3. Find the Fourier series coefficients for the given signal. $x(t) = [1+\cos(2\pi t)]\left[\sin\left(10\pi t + \frac{\pi}{6}\right)\right]$.

4. Find the Laplace transform of the given signal.



5. Check whether the given system is causal and stable. $h(t) = (e)^{-4t}\, u(t+10)$.

6. State Dirichlet's condition for Region of convergence.

7. Define Sampling theorem.

8. Write the relationship between DTFT and Z-transform.

9. Determine the Z-transforms of the following two signals. Note that the Z–transforms for both have the same algebraic expression and differ only in the ROC. $x_1[n] = \left(\frac{1}{2}\right)^n u[n]$ and $x_2[n] = -\left(\frac{1}{2}\right)^n u[-n-1]$.

10. Find the initial and final values of the function, $X(z) = \frac{1+z^{-1}}{1-0.25z^{-2}}$.

PART B — (5 × 13 = 65 marks)

11. (a) (i) Draw the waveforms represented by the following step functions,

$\rightarrow f_1(t) = 2u(t-1)$ $\rightarrow f_2(t) = -2u(t-2)$

$\rightarrow f(t) = f_1(t) + f_2(t)$ $\rightarrow f(t) = f_1(t) - f_2(t)$. (5)

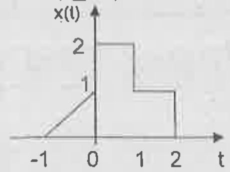
(ii) Determine the energy and power of the given signal $x(t) = t\,u(t)$. (4)

(iii) Check whether the given system is linear or not $y(t) = x^2(t)$. (4)

Or

(b) (i) A continuous time signal $x(t)$ is shown in figure below, Sketch and label each of the following signals.

$x(t-2)$, $x(2t+3)$, $x\left(\frac{3}{2}t\right)$, and $x(-t+1)$. (4)



(ii) Determine the energy and power of the given signal (4)

$x[n] = \cos\left[\frac{\pi}{4}n\right]$.

(iii) Check whether the given system is Linear/nonlinear, Time Variant /Time Invariant, Causal/Non-causal $y[n] = x[n] - x[n-1]$. (5)

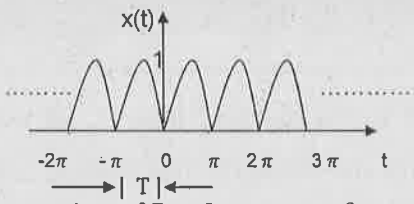
12. (a) Find the Fourier transform of each of the following signals and sketch the magnitude and phase as a function of frequency, including both positive and negative frequencies (13)

(i) $\delta(t-5)$

(ii) $e^{-at}u(t)$ a real, positive.

Or

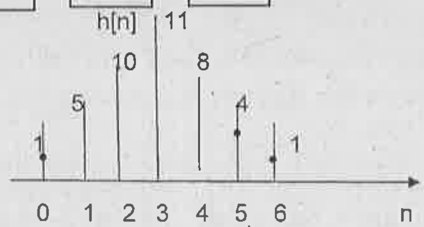
(b) (i) Determine the Fourier Series representation of the given full wave rectifier. (8)



(ii) List the properties of Laplace transform and write its ROC. (5)

13. (a) (i) Consider the cascade interconnection of three stage causal LTI system with impulse response $h_1[n]$, $h_2[n]$ and $h_3[n]$ as shown in figure below. The impulse response $h_2[n] = u[n] - u[n-2]$. The overall impulse response $h[n]$ is given in the figure below.

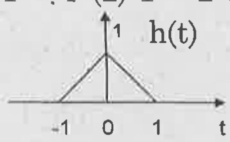
$x[n] \to \boxed{h_1[n]} \to \boxed{h_2[n]} \to \boxed{h_2[n]} \to y[n]$

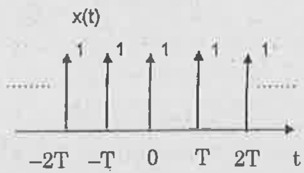


Find the impulse response $h_1[n]$ and the response $y[n]$ of the overall system to the input $x[n] = \delta[n] - \delta[n-1]$. (9)

(ii) Let $h(t)$ be a triangular pulse and let $x(t)$ be the impulse train. Determine and sketch $y(t)$ for the following values of T. (4)

(1) $T = 4$ (2) $T = 2$ (3) $T = 1$ (4) $T = 3/2$.





Or

(b) (i) Find the convolution between $x[n]$ and $h[n]$, where $x[n] = (\alpha)^n u[n]$; $0 < \alpha < 1$ and $h[n] = u[n]$. (6)

(ii) Find the convolution of $x(t)$ and $h(t)$ (7)

$$x(t) = \begin{cases} 2 & for\ -2 \le t \le 2 \\ 0; & \text{otherwise} \end{cases} \quad \text{and } h(t) = \begin{cases} 4 & for\ 0 \le t \le 2 \\ 0; & \text{otherwise} \end{cases}$$

14. (a) (i) Find the inverse Laplace transform of $\left[\frac{s+4}{2s^2+5s+3}\right]$; Roc : $Re\{s\} > -1$. (4)

(ii) Consider the LTI system with impulse response $h[n] = (\alpha)^n u[n]$; $|\alpha| < 1$ and $x[n] = (\beta)^n u[n]$; $|\beta| < 1$. Find the response of the LTI system. (9)

Or

(b) (i) Consider a discrete-time LTI system with impulse response $h[n] = \left[\frac{1}{2}\right]^n u[n]$. Use Fourier transform to determine the response of the system to the input $x[n] = \left[\frac{3}{4}\right]^n u[n]$. (6)

(ii) A difference equation of the system is given as, $y(n) - y(n-1) + \frac{1}{4} y(n-2) = x(n) + \frac{1}{4} x(n-1) - \frac{1}{8} x(n-2)$.
Determine the transfer function of the inverse system. Check whether the inverse system is causal and stable. (7)

15. (a) (i) Find the inverse Z-transform of

$$X(z) = \frac{1-(1/2)z^{-1}}{1+(3/4)z^{-1}+(1/8)z^{-2}}; \ |Z| > \frac{1}{2}.$$ (8)

(ii) Compute discrete-time Fourier Transform of $x(n) = a^n$ for $0 \le n \le N-1$. (5)

Or

(b) (i) Determine the Z-transform and ROC of the given sequence. (5)

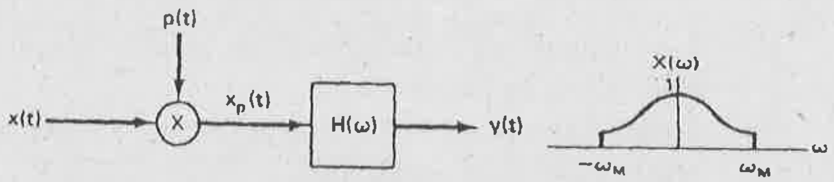
$$x[n] = \left(\frac{-1}{3}\right)^n u[n] - \left(\frac{1}{2}\right)^n u(-n-1).$$

(ii) Obtain the direct form I and direct form II realizations of the LTI system. (8)

$$y(n) = -\frac{3}{8} y(n-1) + \frac{3}{32} y(n-2) + \frac{1}{64} y(n-3) + x(n) + 3x(n-1) + 2x(n-2).$$

PART C — (1 × 15 = 15 marks)

16. (a) (i) A system in which the sampling signal $p(t)$ is an impulse train with alternating sign is given in the figure 16(a). The Fourier transform $x(w)$ of the input signal are $x(t)$ and the Fourier transform $H(w)$ as indicated in the figure 16. (11)



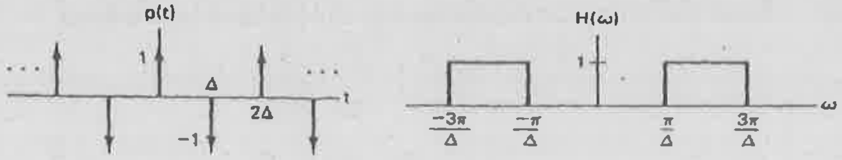


Fig. Q. 16(a)

(1) For $\Delta < \pi / 2\omega_M$, sketch the Fourier transform of $x_p(t)$ and $y(t)$

(2) For $\Delta < \pi / 2\omega_M$, determine a system that will recover $x(t)$ from $x_p(t)$.

(3) For $\Delta < \pi / 2\omega_M$, determine a system that will recover $x(t)$ from $y(t)$.

(4) What is the maximum value of Δ in relation to ω_M for which $x(t)$ can be recovered from either $x_p(t)$ or $y(t)$.

(ii) Using figure 16(a)(i) determine $y(t)$ and sketch $Y(\omega)$ if $X(\omega)$ is given by figure 16 (a) (ii). Assume $\omega_c < \omega_0$. (4)

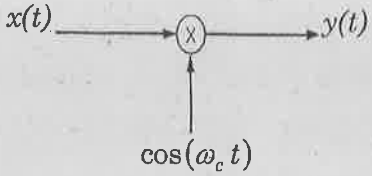


Figure 16(a) (i)

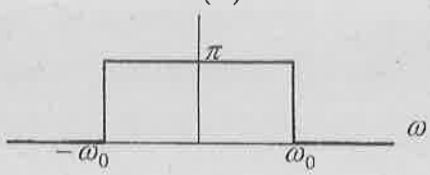


Figure 16(a) (ii)

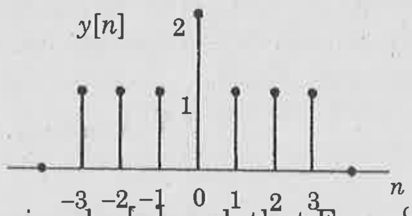
Or

(b) (i) (1) Suppose that the signal $e^{j\omega t}$ is applied as the excitation to a linear, time-invariant system that has an impulse response h(t). By using the convolution integral, show that the resulting output is $H(\omega)\, e^{j\omega t}$, where $H(\omega) = \int_{-\infty}^{\infty} h(\tau)\, e^{j\omega\tau}\, d\tau$.

(2) Assume that the system is characterized by a first-order differential equation $\frac{dy(t)}{dt} + ay(t) = x(t)$.

If $x(t) = e^{j\omega t}$ for all t, then $y(t) = H(\omega)\, e^{j\omega t}$ for all t. By substituting into the differential equation, determine $H(\omega)$. (8)

(ii) Consider the signal $y[n]$. (7)



(1) Find a signal $x[n]$ such that Even $\{x[n]\} = y[n]$ for $n \geq 0$, and Odd $(x[n]\} = y[n]$ for $n < 0$.

(2) Suppose the Even $\{w[n]\} = y[n]$ for all n. Also assume that $w[n] = 0$ for $n < 0$. Find $w[n]$.