SIDDHARTH GROUP OF INSTITUTIONS :: PUTTUR
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QUESTION BANK (DESCRIPTIVE)

Subject with Code : SIGNALS AND SYSTEMS(18EC0403)

Course & Branch: B.Tech - EEE

Year & Sem: II B.Tech & II Sem **Regulation:** R18

UNIT –I

INTRODUCTION TO SIGNALS AND SYSTEMS

SHORT ANSWER QUESTIONS (2 MARKS)

1. Define a Signal. What is the relation between impulse, step, ramp and parabolic signals? [L1][CO1][2M]
2. How are the signals are classified? [L1][CO1][2M]
3. Define Unit impulse and Unit step Signals. [L1][CO1][2M]
4. Distinguish between periodic and non-periodic signals [L4][CO1][2M]
5. Distinguish causal and anti-causal signals. [L4][CO1][2M]
6. Define Linear and Non-Linear System [L1][CO1][2M]
7. Define time-variant and time-invariant systems. [L1][CO1][2M]
8. How are systems classified? [L1][CO1][2M]
9. Define stable and unstable systems. [L1][CO1][2M]
10. Define causal and non-causal systems. [L1][CO1][2M]

LONG ANSWER QUESTIONS (10 MARKS)

1. Define various elementary signals in continuous time and discrete time and indicate them graphically [L1][CO1][10M]
2. What are the basic operations on signals? Illustrate with an example. [L1][CO1][10M]
3. Explain the classification of signals in both continuous time and discrete time with suitable examples. [L2][CO1][10M]
4.(a) Find which of the signals are causal or non-causal. [L1][CO1][05M]
   (i) $x(t)= e^{2t}u(t-1)$ (ii) $x(t)=3\ \text{sinc}\ 2t$ (iii) $x(n)=u(n+4)-u(n-2)$ (iv) $x(t)=u(-n)$
   (b) Sketch the following signals [L1][CO1][05M]
   (i) $2u(t+2)- 2u(t-3)$ (ii) $u(t+4)\ u(-t+4)$ (iii) $r(t)-r(t-1)-r(t-3)-r(t-4)$ (iv) $\pi(t-2)$
5. Find whether the following signals are periodic or not? If periodic determine the fundamental Period
   (a) $\sin 12\pi t$ (b)$3\sin 200\pi t+4\cos 100t$ (c) $\sin 10\pi t+\cos 20\pi t$
   (d)$\sin(10t+1)- 2\cos(5t-2)$ (e) $e^{j4\pi t}$ [L1][CO1][10M]
6. (a) Find the even and odd components of the following signals [L1][CO1][05M]
   (i) $x(t)= e^{j2t}$ (ii) $x(t) =(1+t^2+t^3)\cos^2 10t$ (iii) $x(n)=\{-3,1, \underset{\uparrow}{2}, -4,2\}$ (iv) $x(n)=\{5,4,\underset{\uparrow}{3},2,1\}$
   (b)Determine whether the following signals are energy signals or power signals. Calculate their energy or power? [L1][CO1][05M]
   (i)$x(t)= 8\cos 4t\cos 6t$ (ii) $\sin^2 \omega_0 t$ (iii) $x(t)= e^{j[3t+(\pi/2)]}$ (iv) $x(n)=(1/2)^n u(n)$
7. Define a system. How are systems classified? Define each one of them. [L4][CO1][10M]
8. Check whether the following system is [L1][CO1][10M]
   (a) Static or dynamic (b) linear or non- linear

(c) Causal or non- causal (d) Time invariant or time variant

(i)$d^3y(t)/dt^3+2d^2y(t)/dt^2+4\ dy(t)/dt+3y^2(t)=x(t+1)$

(ii)$d^2y(t)/dt^2+2y(t)\ dy(t)/dt+3ty(t)=x(t)$

9. Check whether the following system is [L1][CO1][10M]

(a) Static or dynamic (b) linear or non- linear

(c) Causal or non- causal (d) Time invariant or time variant

(i)$y(n)=\log_{10}|x(n)|$ (ii) $y(n)=x^2(n)+1/x^2(n-1)$ (iii) $y(t)=at^2\ x(t)+bt\ x(t-4)$

10.(a) Check whether the following systems are causal or not? [L1][CO1][05M]

(i)$y(t)=x^2(t)+x(t-4)$ (ii) $y(t)=x(t/2)$ (iii)$y(n)=x(2n)$

(b) Find whether the following systems are stable or not [L1][CO1][05M]

(i) $y(t)=(t+5)\ u(t)$ (ii) $y(t)=(2+e^{-3t})\ u(t)$ (iii) $h(n)=a^n$ for $0<n<11$

UNIT –II

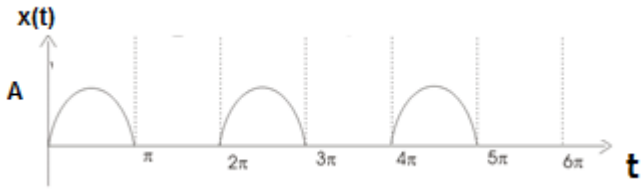
FOURIER SERIES AND FOURIER TRANSFORM

SHORT ANSWER QUESTIONS

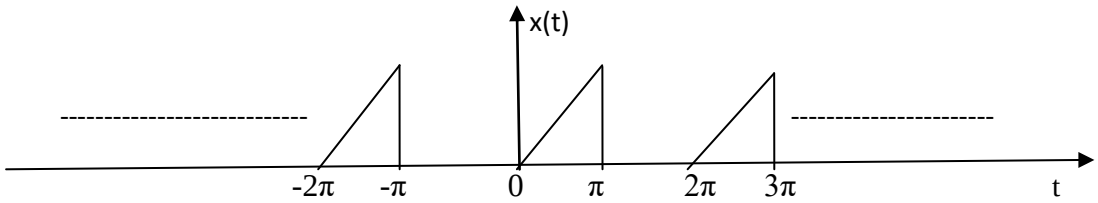
1. What is Fourier Series. [L1][CO2][2M]
2. Waht is the three important classes of Fourier series methods available. [L1][CO2][2M]
3. What are the Dirichlet's conditions? State them. [L1][CO2][2M]
4. What is the Relationship between exponential Fourier series and trigonometric Fourier series coefficients? [L1][CO2][2M]
5. How do you obtain Cosine Fourier series from exponential Fourier series? [L1][CO2][2M]
6. Differentiate the Fourier series and Fourier transform. [L1][CO2][2M]
7. What is Fourier transform? [L1][CO2][2M]
8. Define Linearity Property of Fourier Transform [L1][CO2][2M]
9. What are the Merits of Fourier Transform? [L1][CO2][2M]
10. Define Fourier transform and Inverse Fourier transform of discrete time signal. [L1][CO2][2M]

LONG ANSWER QUESTIONS

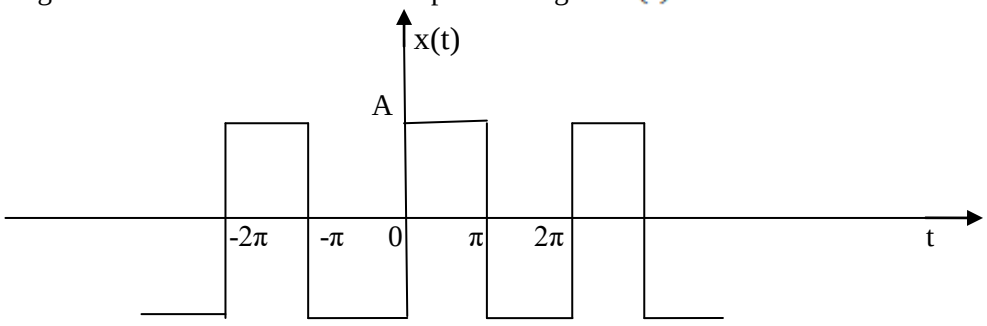
1. Find the Fourier series expansion of the half wave rectified sine wave shown in figure. [L1][CO2][10M]



2. State and Prove any Five Properties of the Fourier Series. [L3][CO2][10M]
3. Find the trigonometric Fourier series for the periodic signal $x(t)$ shown in below [L3][CO2][10M]



4. Explain about exponential Fourier series and derive the Fourier series coefficient [L1][CO2][10M]
5. Find the trigonometric Fourier series for the periodic signal $x(t)$ shown in below.



6. (a) Find the Fourier transform of the following [L1][CO2][05M]
(i) sgn(t) (ii) sin $\omega_0 t$ (iii)cos $\omega_0 t$ (iv) 1(Constant Amplitude)
(b). Find the Fourier transform of the following [L1][CO2][5M]
(i) impulse function (ii) $x(t)=e^{-at}u(t)$ (iii) $x(t)=e^{j\omega o^t}$ (iv) x(t)=u(t)
7. State and Prove the properties of Continuous time Fourier transform? [L1][CO2][10M]
8. Find the Fourier transform of the following signals [L1][CO2][10M]
(i) $x(t)=e^{-3t}u(t)$ (ii) $x(t)=te^{-at}u(t)$ (iii) $x(t)=e^{-t}\sin 5t\,u(t)$ (iv) $x(t)=e^{-t}\cos 5t\,u(t)$
9. Find the inverse Fourier transform of the following signals [L1][CO2][10M]
(i) $X(w)=\frac{4(jw)+6}{(jw)2+6(jw)+8}$ (ii) $X(W)=\frac{1+3(jw)}{(jw+3)2}$ (iii) $X(w)=e^{-2w}u(w)$
10. (a) State and prove any three properties of the DTFT. [L2][CO2][5M]
(b) Find the Fourier Transform of the Signal (i) Triangular Pulse (ii) $e^{-a|t|}$ [L1][CO2][5M]

UNIT –III

SIGNAL TRANSMISSION THROUGH LINEAR SYSTESMS

SHORT ANSWER QUESTIONS

1. What are the properties of LTI systems? [L1][CO3][2M]
2. Define transfer function of a system? [L1][CO3][2M]
3. Define impulse response of a system. [L1][CO3][2M]
4. What is a filter? How are filters classified? [L1][CO3][2M]
5. What is the Relation between unit step and impulse response? [L1][CO3][2M]
6. Define sampling and sampling period? [L1][CO3][2M]
7. State Sampling theorem [L1][CO3][2M]
8. What is Nyquist rate and Nyquist interval? [L1][CO3][2M]
9. What is anti-aliasing filter? [L1][CO3][2M]
10. State Sampling theorem? [L1][CO3][2M]

LONG ANSWER QUESTIONS

1. (a) Explain the Filter characteristics of linear systems explain with neat diagrams [L1][CO3[5M]
(b) Define the following (i)Impulse Response (ii)Step Response (iii) Response of the System [L1][CO3][5M]
2. (a) Derive the transfer function and impulse response of an LTI system. [L1][CO3][5M]
(b) Define Linear time variant, Linear time-invariant, step response of the system. [L2][CO3][5M]
3. Discuss the properties of linear time invariant systems. [CO3][10M]
4. (a) Consider a stable LTI System characterized by the differential equation dy(t)/dt+2y(t)=x(t), Find its impulse response. [L3][CO3][5M]
(b) Find the Nyquist Rate and Nyquist Interval of the following signals. [L2][CO3][5M]
(i)x(t)=1+cos 2000 πt + sin 4000 πt (ii) x(t)=10 sin 40πt cos 300πt
5. (a) Let the system function of an LTI system be 1/(jω+2). What is the output of the system for an input $(0.8)^t u(t)$? [L3][CO3][5M]
(b) Consider a causal LTI system with frequency response H(ω)=1/4+jω, for a input x(t), the system is observed to produce the output $y(t)=e^{-2t}u(t)- e^{-4t}u(t)$. Find the input x(t). [L1][CO3][5M]

6. Consider a stable LTI system that is characterized by the differential equation [L3][CO3][10M]
$d^2y(t)/dt^2+4dy(t)/dt+3y(t)= dx(t)/dt+2x(t)$ find the response for an input $x(t)=e^{-t}u(t)$.
7. Find the Nyquist rate and Nyquist interval for the following signals [L1][CO3][10M]

(i) x(t)=1+cos 2000 πt +sin 4000 πt (ii) 10 sin 40πt cos 300πt
(iii)x(t)=sinc (100 πt) + 3 $sinc^2$ (60 πt) (iv) x(t)= 2 sinc (100 πt)

8. State and prove the sampling theorem for the band-limited signals with the help of graphical representation. [L1][CO3][10M]
9. (a) Discuss about Effects of the under sampling. [L4][CO3][05M]
(b) A system produces an output of y(t)= e^{-3t} u(t) for an input of x(t)= e^{-5t} u(t). Determine the impulse response and frequency response of the system. [L3][CO3][05M]
10. signal x(t) = 2 cos 400πt + 6 cos 640πt is ideally sampled at fs= 500 Hz . If the sampled signal is passed through an ideal LPF with a cut off frequency of 400Hz, what frequency components will appear in the output? Find the output signal. [L3][CO3][10M]

UNIT –IV

CONVOLUTION AND CORRELATION OF SIGNALS

SHORT ANSWER QUESTIONS

1. What is convolution? State the shift property of convolution. [L1][CO4][2M]
2. State Time convolution and Frequency convolution theorem [L1][CO4][2M]
3. What is correlation and types of correlation? [L1][CO4][2M]
4. What are the properties of cross correlation for energy signals? [L1][CO4][2M]
5. What are the properties of auto correlation for power signals? [L1][CO4][2M]
6. What is the relation between convolution and correlation? [L1][CO4][2M]
7. What are the Properties of ESD? [L1][CO4][2M]
8. Differentiate ESD and PSD? [L1][CO4][2M]
9. State Parseval's energy theorem? [L1][CO4][2M]
10. State Parseval's power theorem? [L1][CO4][2M]

LONG ANSWER QUESTIONS

1. (a) Write the properties of convolution. [L1][CO4][05M]
(b) Find the convolution of the following signal $x_1(t)= e^{-2t}\,u(t)$, $x_2(t)=e^{-4t}\,u(t)$ [L1]CO4][05M]
2. (a) State and prove the time convolution theorem with Fourier transforms. [L1][CO4][05M]
(b) State and prove the frequency convolution theorem with Fourier transforms. [L1][CO4][05M]
3. (a) Derive the relation between convolution and correlation. [L2][CO4][05M]
(b). Write the properties of cross correlation for energy signals [L1][CO4][05M]
4. (a) State and prove the Parseval's theorem for energy signals. [L3][CO5][05M]
(b) State and prove the Parseval's theorem for power signals. [L3][CO4][05M]
5. (a) Derive and Define the properties of Energy Spectral Density. [L1][CO4][05M]
(b) Derive and Define the properties of Power Spectral Density [L1][CO4][05M]
6. (a) Show that R(r) and ESD form Fourier transform pair. [L1][CO4][05M]
(b) Show that R(r) and PSD form Fourier transform pair. [L1][CO4][05M]
7. (a) Verify Parseval's theorem for the energy signal x(t)=e^{-4t} u(t). [L2][CO4][05M]
(b) Determine the autocorrelation function and energy spectral density of x(t)=e^{-at} u(t). [L3][CO4][05M]

8. (a) Find the autocorrelation of the signal $x(t)= a \sin(\omega_0 t + \theta)$.

[L3][CO4][05M]

(b) Distinguish the ESD and PSD.

[L4][CO4][05M]

9. (a) Explain the detection of periodic signals in the presence of noise by auto correlation.

[L1][CO4][05M]

(b) Explain the detection of periodic signals in the presence of noise by cross correlation

[L1][CO4][05M]

Explain the extraction of noise by Filtering.

10. Explain the extraction of a signal from noise by filtering.

[L1][CO4][10M]

UNIT –V

LAPLACE TRANSFORMS AND Z-TRANSFORMS

SHORT ANSWER QUESTIONS

1. What is the Region of Convergence (ROC)? [L1][CO5][2M]
2. What is the relation between Laplace transform and Fourier transform? [L1][CO5][2M]
3. State initial value theorem and final value theorem of Laplace transform. [L1][CO5][2M]
4. What are the properties of ROC? [L1][CO5][2M]
5. What is the Laplace Transform of Parabolic Function.? [L1][CO5][2M]
6. What is the relation between Discrete-time Fourier transform and Z-transform? [L1][CO5][2M]
7. What is the Z-transform of unit step signal? [L1][CO5][2M]
8. Find Z-transform and ROC of $x(n)=(1/2)^n u(n-2)$ [L1][CO5][2M]
9. State the Convolution Property of Z-transform [L1][CO5][2M]
10. Discuss the comparison of Laplace and Z-Transform. [L1][CO5][2M]

LONG ANSWER QUESTIONS

1. State and prove the any five Properties Laplace Transform [L3][CO5][10M]
2. (a) Find the Laplace transform of the signal $x(t)= e^{-at} u(t) - e^{-bt} u(-t)$ and also find its ROC [L1][CO5][05M]

   (b) Find the Laplace transforms and region for the following signals [L1][CO5][05M]

   (i)$x(t)=e^{-5t} u(t-1)$ (ii)$x(t)=e^{2t} \sin 2t$ for $t \leq 0$ (iii) $x(t)=t\, e^{-2|t|}$
3. Find the Laplace transform of the following signals using properties of Laplace transform [L1][CO5][10M]

   (i) $x(t)=t\, e^{-t} u(t)$ (ii) $x(t)=t\, e^{-2t} \sin 2t\, u(t)$ (iii)$x(t)= \sin at/t$ (iv) $x(t)=1-e^t/t$
4. Find the inverse Laplace transform of the following [L1][CO5] [10M]

   (a)$X(s) = 1/ s(s+1)(s+2)(s+3)$ (b) $X(s)= (3s^2+22s+27)/(s^2+3s+2)(s^2+2s+5)$

   (c) $X(s)=s/(s+3)(s^2+4s+5)$
5. (a) Find the convolution of the sequences:

   (i) (ii) [L1][CO5][05M]

   (b) Discuss about the Properties of the ROC of Laplace transform [L3][CO5][05M]
6. (a) State and prove time differentiation and time integration property of Laplace transform [L1][CO5][05M]

   (b). Find the Laplace transform for any 5 standard signals [L1][CO5][05M]
7. Find the inverse z-transform of: [L1][CO5][05M]

   $X(z)=3z^{-1}/(1-z^{-1})(1-2z^{-1})$

   (a)If ROC; $|z|>2$ (b) If ROC ; $|z|<1$ (c) If ROC ; $1<|z|<2$
8. (a) Find the inverse Z-transform of X(z) given $X(z) = 1/(1-az^{-1})$, ROC; $z|>|a|$ [L1][CO5][05M]

   (b) Find the convolution of the sequences: [L1][CO5] [05M]

   $x_1(n)=(1/2)^n u(n)$ and $(1/3)^{n-2}u(n)$
9. (a) State and prove initial and final value theorems of Z-transform? [L3][CO5][05M]

   (b) Using the Properties of Z-transform. Find the Z-transform of following signals [L1][CO5][05M]

   (i) $x(n)=u(-n)$ (ii) $x(n)=2^n u(n-2)$ (iii) $2(3)^n u(-n)$

10. (a) Prove that the final value of x(n) for $X(z) = z^2/(z-1)(z-0.2)$ is 1.25 and its final value is unity? [L3][CO5] [05M]

(b). Find the inverse Z-transform of $X(z)= z^{-1}/(3-4z^{-1}+z^{-2})$, ROC: $|z|>1$ [L1][CO5][05M]

Prepared by: C**. PRASAD**