

JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Regular), November 2017

B. Tech in Electrical Engineering, Semester V

Roll No.....

EE504: Electrical Signals & Systems

Time: 3 hours

Max. Marks: 100

Instructions to students:

1. Do not write anything other than your roll number on question paper.
2. Assume suitable data wherever required and mention it clearly.
3. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.

Q.1A Short answer/objective type questions (10 questions @ 1 mark)

10

i. Identify the time invariant system

(A) $x(t) \longrightarrow \boxed{\text{System}} \longrightarrow x(t - \tau)$

(B) $x(t - \tau) \longrightarrow \boxed{\text{System}} \longrightarrow y(t - \tau)$

(C) $x(t + \tau) \longrightarrow \boxed{\text{System}} \longrightarrow y(t)$

(D) $x(t) \longrightarrow \boxed{\text{System}} \longrightarrow \text{constant}$

ii. A continuous-time system is characterized by

$$y^3(t) + y^2(t) + y(t) = x^2(t) + x(t)$$

Then system is

(A) linear and dynamic

(B) linear and static

(C) nonlinear and dynamic

(D) nonlinear and static

iii. Identify nonperiodic signal

(A) $x(t) = \cos^2 t$

(B) $x(t) = \cos 2\pi t \cdot u(t)$

(C) $x(t) = \sin \frac{2\pi}{3} t$

(D) $x(t) = \sin^2 t$

iv. The response $y(t)$ of linear system is

(A) zero input response

(B) zero state response

(C) zero input response + zero state response

(D) zero input response - zero state response

v. The impulse response of the system having transfer function $H(s) = \frac{1}{s^2(s+1)}$ is

(A) $(t^2 * e^{-2t})u(t)$

(B) $(t^2 e^{-t})u(t)$

(C) $(te^{-t})u(t)$

(D) $(t * e^{-t})u(t)$

vi. The impulse response $h[n]$ of the LTI system is $h[n] = u[n+3] + u[n-2] - 2u[n-7]$. The system is

(A) stable but not causal

(B) stable and causal

- (C) causal but unstable (D) unstable and noncausal
- vii. Mark the correct statement
 (A) $x(t) * \delta(t - t_0) = x(t_0)$ (B) $x(t) * \delta(t) = 1$
 (C) $x(t) * \delta(t - t_0) = x(t - t_0)$ (D) $x(t) * \delta(t - t_0) = x(t + t_0)$
- viii. The convolution of $u(n)$ with $u(n - 4)$ at $n = 5$ is
 (A) 5 (B) 2 (C) 1 (D) 0
- ix. The Fourier series of a real, even periodic signal will contain only
 (A) cosine terms (B) sine terms
 (C) even terms (D) odd harmonics
- x. The Fourier transform of $u(t)$ is
 (A) $\frac{1}{j2\pi f}$ (B) $j2\pi f$
 (C) $\frac{1}{1 + j2\pi f}$ (D) none of these

Q.2 Short answer type questions (4 questions @ 2.5 marks) 10

- Differentiate between Real and Complex signals.
- With examples, explain Deterministic and Random signals.
- What do you mean by periodic and nonperiodic signals?
- Find out the unit step sequence as a discrete-time signal.

Q.3A Given the continuous time signal specified by 05

$$x(t) = \begin{cases} 1 - |t| & -1 \leq t \leq 1 \\ 0 & \text{otherwise} \end{cases}$$

Determine the resultant discrete-time sequence obtained by uniform sampling of $x(t)$ with a sample interval of (a) 0.25 s, (b) 0.5 s, (c) 1.0 s.

Q.3B Let $x_1(t)$ and $x_2(t)$ be periodic signals with fundamental periods T_1 and T_2 , respectively. Under what conditions is the sum $x(t) = x_1(t) + x_2(t)$ periodic, and what is the fundamental period of $x(t)$ if it is periodic? 05

Q.4A Show that all finite periodic signals are power signals. 05

Q.4B Find the even and odd components of the signal $x(t) = e^{-2t} \cos(t)$. 05

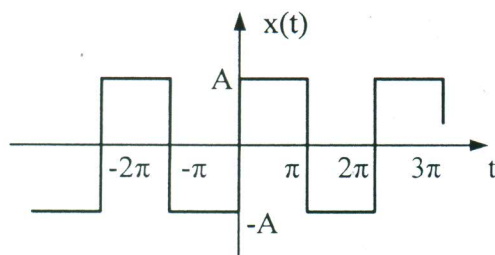
Q.5A Explain any two of the following properties of convolution integral: 2.5
 (a) Convolution with an impulse +
 (b) Differentiation property 2.5
 (c) Time-scaling property

Q.5B Determine and sketch the convolution of the following two signals: 05

$$x(t) = \begin{cases} 1, & -1 < t < 1 \\ 0, & \text{elsewhere} \end{cases} \quad \text{and} \quad h(t) = \delta(t + 1) + 2\delta(t + 2)$$

Q.6A With the help of an example, explain quarter-wave symmetry. Also, find the coefficients. 2+3

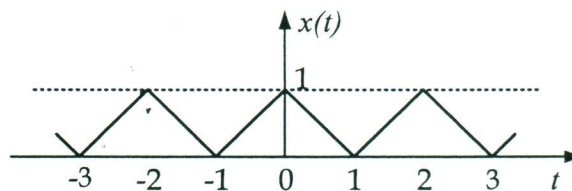
Q.6B



Find the trigonometric Fourier series for the square wave shown in Fig. and plot the line spectrum. 05

OR

Find the trigonometric Fourier series for the triangular wave shown in Fig. and plot the line spectrum. 05



Q.7A Explain any two of the following properties of continuous time Fourier series: 05

- Differentiation property
- Periodic convolution property
- Frequency shifting property

Q.7B Suppose we are given the following information about a continuous time periodic signal with period 3 and Fourier coefficients X_n : 05

- $X_n = X_{n+2}$
- $X_n = X_{-n}$
- $\int_{-0.5}^{0.5} x(t) dt = 1$
- $\int_{0.5}^{1.5} x(t) dt = 2$

Determine $x(t)$.

OR

Show that the Fourier series coefficients of the signal 05

$$z(t) = x(t)y(t) = \sum_{n=-\infty}^{\infty} X_n e^{jn\omega_0 t}$$

Are given by the discrete convolution

$$Z_n = \sum_{k=-\infty}^{\infty} X_k Y_{n-k}$$

Q.8 Explain the Duality property of the Continuous-time Fourier transform. Also find the Fourier transform of $G(\omega)$ of the signal 5+5

$$g(t) = \frac{1}{1 + jt}$$

Q.9A Can an aperiodic signal be represent by Fourier series? If yes, show how. If no, then explain why not. 10

Q.9B Suppose we are given the following information about a periodic signal $x(n)$ with period $N = 8$ and Fourier series coefficients X_k : 10

- $X_k = -X_{k-4}$
- $x(2n + 1) = (-1)^n$

Sketch one period of $x(n)$.

OR

Let $x(n)$ be a periodic signal with period $N = 8$ and Fourier series coefficients $X_k = -X_{k-4}$. A signal

$$y(n) = \left(\frac{1 + (-1)^n}{2} \right) x(n-1)$$

with period $N = 8$ is generated. Denoting the Fourier series coefficients of $y(n)$ by Y_k , find a function such that

$$Y_k = f(k)X_k$$