ROLL NO. ________________

Code: AE57/AC57/AT57/AE112 **Subject: SIGNALS AND SYSTEMS**

AMIETE – ET/CS/IT (Current & New Scheme)

Time: 3 Hours **June 2019** **Max. Marks: 100**

PLEASE WRITE YOUR ROLL NO. AT THE SPACE PROVIDED ON EACH PAGE IMMEDIATELY AFTER RECEIVING THE QUESTION PAPER.

NOTE: There are 9 Questions in all.

- **Question 1 is compulsory and carries 20 marks. Answer to Q.1 must be written in the space provided for it in the answer book supplied and nowhere else.**
- **The answer sheet for the Q.1 will be collected by the invigilator after 45 minutes of the commencement of the examination.**
- **Out of the remaining EIGHT Questions answer any FIVE Questions. Each question carries 16 marks.**
- **Any required data not explicitly given, may be suitably assumed and stated.**

Q.1 Choose the correct or the best alternative in the following: (2×10)

a. $y[n] = nx[-n]$ is a

(A) Non causal system
(B) Non Linear, time invariant system
(C) Linear, time variant and dynamic system
(D) None of these

b. What is the fundamental period of the signal $x(t) = 2\cos(4\pi t) + 3\mathrm{Sin}(3\pi t)$?

(A) 1/2 **(B)** 2/3
(C) 3/4 **(D)** 2

c. If $x(t)$ is the continuous time signal with a period 'T_0' and Fourier coefficients a_n then average power 'P' of $x(t)$ is given by

(A) $\sum_{n=-\infty}^{\infty} |a_n|^2$ **(B)** $\frac{1}{T_0}\int_{T_0} |x(t)|^2 dt$

(C) Both **(A)** and **(B)** **(D)** None of these

d. Continuous Fourier transform of the signal $x(t) = u(-t)$ is

(A) $\frac{1}{j\omega}$ **(B)** $-\frac{1}{j\omega}$

(C) $j\omega$ **(D)** None of these

e. Consider an LTI system with impulse response $h[n] = \delta[n - n_0]$. The frequency response is

(A) $e^{-\omega n_0}$ **(B)** $e^{\omega n_0}$
(C) 1 **(D)** None of these

f. A continuous time signal $x(t)$ is obtained at the output of the ideal filter with cut off frequency $\omega_c = 1000\pi$. If impulse train sampling is performed on $x(t)$, which of the following sampling periods would guarantee that $x(t)$ can be recovered from its sampled version using an appropriate low-pass filter?

(A) $T = 0.5\times10^{-3}$ **(B)** $T = 10^{-4}$

(C) $T = 2\times10^{-3}$ **(D)** None of these

g. Laplace transform of $x(t) = \frac{\sin t}{t}$ is

(A) $X(s) = \frac{\pi}{2} - \tan^{-1} s$ **(B)** $X(s) = \frac{\pi}{2} + \tan^{-1} s$

(C) $X(s) = -\frac{\pi}{2} - \tan^{-1} s$ **(D)** None of these

h. Z-transform of $y[n] = n^2 x[n]$ is

(A) $Y[z] = z\frac{d^2}{dz^2}X[z]$ **(B)** $Y[z] = -z^2\frac{d^2}{dz^2}X[z]$

(C) $Y[z] = z^2\frac{d^2}{dz^2}X[z]$ **(D)** None of these

i. Z-transform and ROC of $u(n-1)$ are

(A) $\frac{z}{z-1}$ and $|z|>1$ **(B)** $\frac{1}{z-1}$ and $|z|>1$

(C) $\frac{z}{z-1}$ and $|z|<1$ **(D)** $\frac{1}{z-1}$ and $|z|<1$

j. Identify the correct statement regarding probability distribution function $(F_X(x))$

(A) $F_X(x)$ is left and right continuous

(B) $F_X(-\infty) = -1$

(C) $F_X(\infty) = 0$

(D) $F_X(x)$ is non decreasing function

Answer any FIVE Questions out of EIGHT Questions.
Each question carries 16 marks.

Q.2 a. Determine and plot the Even and Odd component of the signal $x(t) = tu(t+2) - tu(t-1)$. **(8)**

b. Determine the continuous time convolution of h(t) and x(t)

$x(t) = \begin{cases} 3, & 0 \le t \le 4 \\ 0, & \text{otherwise} \end{cases}$ $h(t) = \begin{cases} 2, & 0 \le t \le 2 \\ 0, & \text{otherwise} \end{cases}$ **(8)**

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Q.3 a. If $x_1(t)$ and $x_2(t)$ are two continuous-time signals with common period T_0 and Fourier series coefficients a_n and b_n, respectively, then Fourier series coefficient of convolution integral of $x_1(t)$ and $x_2(t)$ are given by $T_0 a_n b_n$. **(8)**

b. Find the Fourier series coefficients of the signal given below and plot the magnitude and phase spectra. **(8)**

$x(t) = 2\sin(2\pi t - 3) + \sin(6\pi t)$

Q.4 a. Find the Fourier transform of the signal $x(t) = \frac{2}{1+t^2}$. **(8)**

b. Find Fourier transform of the continuous time signal given below. **(8)**

$$x(t) = \frac{t^{n-1}}{(n-1)!} e^{-bt} u(t)$$

Q.5 a. Find the Fourier transform of the following discrete time signal. **(8)**

$x[n] = a^{|n|}, \quad |a| < 1$

b. Explain about the following properties of discrete time Fourier transform. **(8)**

(i) First difference of signal $x[n]$ (ii) Time reversal

(iii) Time expansion (iv) Differentiation in frequency

Q.6 a. Explain about the time domain and frequency domain aspects of non-ideal filters. **(8)**

b. Explain about sampling with zero order hold. **(8)**

Q.7 a. Find the Laplace transform of the following signal. **(8)**

$$x(t) = \frac{e^{4t} - e^{-3t}}{t}$$

b. Find the inverse Laplace transform of the following **(8)**

$$X(s) = \frac{s^2 + s + 1}{s^2 - s + 1}$$

Q.8 a. Determine the response $y(n), n \geq 0$ of the system described by the second-order difference equation $y(n) - 3y(n-1) - 4y(n-2) = x(n) + 2x(n-1)$

For the input $x[n] = 4^n u[n]$. **(8)**

b. Find the inverse z-transform for the following **(8)**

$$X(z) = \frac{az^{-1}}{(1-az^{-1})^2}, \quad |z| > |a|$$

Q.9 a. If X and Y are two random variable and Z = X + Y then show that **(8)**

VAR (Z) = VAR (X) + VAR (Y) + 2COV (X,Y).

b. The power spectral density of a WSS white noise process limited in a range $-w \leq f \leq w$ is given as $\frac{N_0}{2}$. Find the average power and autocorrelation function. **(8)**