ROLL NO. _____

Code: AE112 **Subject: SIGNALS AND SYSTEMS**

AMIETE – ET *{NEW SCHEME}*

Time: 3 Hours **DECEMBER 2014** **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. The period of a function $\cos\left[\frac{\pi}{4}(t-1)\right]$ is

(A) $\frac{1}{8}$sec **(B)** 8 sec

(C) 4 sec **(D)** $\frac{1}{4}$sec

b. A single pulse has a

(A) single frequency component **(B)** continuous frequency component
(C) spectrum of even harmonics **(D)** spectrum of odd harmonics

c. If A_m is the fourier coefficient of x(t) (i.e. $x(t) \xleftrightarrow{FS} A_m$), then, for real x(t), the conjugate symmetry property is given by

(A) $A_{-m} = A_m$ **(B)** $A_{-m} = +A_m$
(C) $A_{-m} = -A^*_m$ **(D)** $A_{-m} = -A_m$

d. If $X(\omega)$ be the fourier transform of a function x(t), then X(0) is

(A) 1 **(B)** 0

(C) ∞ **(D)** $\int_{-\infty}^{\infty} x(t)dt$

e. If $\delta(t)$ denotes a unit impulse, then the Laplace transform of $\frac{d^2\delta(t)}{dt^2}$ is

(A) 1 **(B)** s^2
(C) s **(D)** s^{-2}

f. The Nyquist rate for a signal
$x(t) = 10 \cos(50 \pi t) \cos^2(150\pi t)$ is

(A) 150 samples/sec **(B)** 200 samples/sec
(C) 300samples/sec **(D)** 350 samples/sec

g. The Z transform of a signal is given by $\frac{Z^{-1}\left(1-Z^{-4}\right)}{4\left(1-Z^{-1}\right)^2}$. Its final value is

(A) $\frac{1}{4}$ **(B)** 0
(C) 1.0 **(D)** ∞

h. Let $x(n) = \left(\frac{1}{2}\right)^n u(n)$, $y(n) = x^2(n)$ and $Y\left(e^{j\omega}\right)$ be the fourier transform of y(n). Then $Y\left(e^{jo}\right)$ is

(A) $\frac{1}{2}$ **(B)** 2
(C) 4 **(D)** 4/3

i. The given $y(n) = a^n u(-n-1)$, $a<1$ is:

(A) causal **(B)** non-causal
(C) power signal **(D)** none of these

j. Auto – correlation function of a random process is $e^{-2\alpha|\tau|}$. The power spectral density is

(A) $\frac{2\alpha}{\omega^2+2\alpha^2}$ **(B)** $\frac{4\alpha}{\omega^2+4\alpha^2}$
(C) $\frac{\alpha}{\omega^2+2\alpha^2}$ **(D)** $\frac{2\alpha}{\omega^2+4\alpha^2}$

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

Q.2 a. Discuss basic system properties with the help of two examples of each. **(8)**
(i) causality
(ii) stability

b. Show that system represented by **(4)**
$y(t) = t\,x(t)$ is linear

c. Write short note on convolutional Integral. **(4)**

Q.3 a. Discuss the following properties of continuous time fourier series with the help of one example in each: **(10)**
(i) Time shifting
(ii) Multiplication

b. Determine complex exponential fourier series representation of **(6)**
(i) $x(t) = \cos \omega_0 t$
(ii) $x(t) = \cos 3t + \sin 6t$

Q.4 a. Determine fourier transform of the signal. $x(t) = \mathbf{e}^{-a|t|}$; $a > 0$ **(6)**

b. State and prove the Parseval's Relation for continuous – Time fourier transform using suitable example. **(10)**

Q.5 a. Determine fourier transform of $X(e^{j\omega})$ of the unit step $x[n] = u[n]$ using accumulation property. **(6)**

b. Explain the following properties of Discrete-time fourier Transform. **(10)**
(i) Differentiation in frequency (ii) Duality
(iii) Scaling (iv) Convolution in time domain

Q.6 a. State and explain Time Domain & frequency-Domain aspects of non-ideal filters. **(8)**

b. Find Nyquist rate of the following signals: **(8)**
(i) 10 sinc (5t)
(ii) $\text{sinc}^2(200t)$

Q.7 a. Find Laplace Transform and its ROC of the following: **(8)**
(i) $x(t) = e^{-at}u(t)$
(ii) $x(t) = 3\,e^{-2t}\,u(t) - 2e^{-t}\,u(t)$

b. Discuss following properties of Laplace Transform: **(8)**
(i) Linearity (ii) Time scaling
(iii) Frequency shifting (iv) Scaling

Q.8 a. Determine Z transform of the following: **(8)**

(i) $x[n] = 7\left(\frac{1}{3}\right)^n u(n) - 6\left(\frac{1}{2}\right)^n u(n)$

(ii) $x[n] = \left(\frac{1}{3}\right)^n \sin\left(\frac{\pi}{4}n\right)u(n)$

b. Show that the system represented by **(8)**

$$H(Z) = \frac{1}{1-\frac{1}{2}Z^{-1}} + \frac{1}{1-2Z^{-1}}, |Z| > 2 \text{ is causal.}$$

Q.9 Discuss the following: **(4×4)**
(i) Correlation functions
(ii) Power spectral density (PSD)
(iii) Ergodic processes
(iv) Wide sense stationary (WSS) process