ROLL NO. _____

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

AMIETE – ET (Current & New Scheme)

Time: 3 Hours **June 2018** **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. Which of the following signals are monotonic in nature?

(A) $1- e^{-t}$ **(B)** $1-e^{\sin(t)}$

(C) log(tan(t)) **(D)** cos(t)

b. What is the period of the following signal, x(t) = sin(18*pi*t + 78 deg)?

(A) 1/9 **(B)** 2/9

(C) 1/3 **(D)** 4/9

c. What are the steady state values of the signals, $1- e^{-t}$, and $1-ke^{-kt}$?

(A) 1, k **(B)** 1, 1/k

(C) k, k **(D)** 1, 1

d. What is the nature of the function, y[n] = y[n-1] + x[n]?

(A) Integrator **(B)** Differentiator

(C) Subtractor **(D)** Accumulator

e. What is the causality status of the function y[n] = x[n-1] – x[n-56]?

(A) The system is non causal **(B)** The system is causal

(C) Both causal and non causal **(D)** None of these

f. What is the ROC of the signal x(n) = δ(n-k), k > 0?

(A) z = 0 **(B)** $z = \infty$

(C) Entire z-plane, except at z = 0 **(D)** Entire z-plane, except at $z = \infty$

g. How is the discrete time impulse function defined in terms of the step function?

(A) d[n] = u[n+1] – u[n] **(B)** d[n] = u[n] – u[n-2].

(C) d[n] = u[n] – u[n-1] **(D)** d[n] = u[n+1] – u[n-1].

h. What is the relation between the unit impulse function and the unit ramp function?

(A) r = dd(t)/dt **(B)** d = dr/dt
(C) $d = d^2(r)/dt^2$ **(D)** $r = d^2(d)/dt^2$

i. Evaluate $e^{-at}u(t)*u(t)$, u(t) being the Heaviside function.

(A) $(1 - e^{at})\ u(t)/a$ **(B)** $(1-e^{at})\ u(-t)/a$
(C) $(1- e^{-at})\ u(t)/a$ **(D)** $(1+e^{-at})\ u(t)/a$

j. What is the z-transform of the finite duration signal

x(n)={2,4,5,7,0,1}?
↑

(A) $2 + 4z + 5z^2 + 7z^3 + z^4$ **(B)** $2 + 4z + 5z^2 + 7z^3 + z^5$
(C) $2 + 4z^{-1} + 5z^{-2} + 7z^{-3} + z^{-5}$ **(D)** $2z^2 + 4z + 5 + 7z^{-1} + z^{-3}$

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

Q2. a. A causal system is represented by the following difference equation

y(n) +1/4 y(n-1) = x(n) + ½ x(n-1)

(i) Find the system function H(z) and give the corresponding region of convergence.
(ii) Find the unit sample response of the system.
(iii) Find the frequency response H(ej?) and determine its magnitude and phase.

(3+2+3)

b. Say whether the following system with impulse response h(t) is stable or not

(i) $h(t) = t\ e^{-t}\ u\ (t)$
(ii) $h(t) = e^{-2t}\ u\ (t-1)$ **(4)**

c. Find the step response of the system whose impulse response is given by h(t) = tu(t). **(4)**

Q3. a. Find the Fourier Series coefficients for the CT periodic signal. **(6)**

b. Consider a discrete time LTI system with impulse response

$$h[n] = \begin{cases} 1, & 0 \le n \le 2 \\ -1, & -2 \le n \le -1 \\ 0, & otherwise \end{cases}$$

Give that the input to this system is

$x[n] = \sum_{k=-\infty}^{\infty} \delta[n - 4k]$,

determine the fourier series co-efficient of the output y[n]. **(10)**

Q4. a. List the properties of Fourier Transform and explain them. **(4)**

b. Determine the Fourier transform of each of the following periodic signals.

(i) $\sin(2\pi t + \frac{\pi}{4})$

(ii) $1 + \cos(6\pi t + \frac{\pi}{8})$ **(6+6)**

Q5. a. Find the DTFT of the following

(i) x[n] = {1,-1,2,2 }

(ii) x[n] = 2n u[n]

(iii) x[n] = (0.5) n + 2 –n u[-n-1) **(3+3+4)**

b. Write the properties of DTFT. **(2)**

c. Find discrete-time Fourier Transform and plot the spectrum for $x(n) = (½)^n u(n)$. **(4)**

Q6. a. Determine the response of the LTI system whose input x(n) and impulse response h(n) are given by: x(n) = {1,2,3,1}; h(n) = {1,2,1,-1} **(6)**

↑ ↑

b. State and prove sampling theorem. **(5)**

c. A signal x(t) = 2sin4000πt +3Sin5000πt +4sin800πt has to be represented by its samples. Find the minimum sampling rate for low pass and band pass considerations. **(5)**

Q7. a . Define region of convergence of a Laplace transform. How to obtain Fourier transform from its Laplace transform? State final value theorem of Laplace transforms. **(5)**

b. Find the Laplace transform of $e^{-at} u(t)$. **(3)**

c. Consider a signal $x(t) = e^{-2t}u(-t) + e^{-3t}u(t)$. Determine its Laplace Transform and locate the poles, zeros and the ROC in the s – plane. **(8)**

Q8. a. State and prove the time delay theorem of z transform**.** **(5)**

b. Find the z transform of the sequence x[n] = {8, 3,-2, 0, 4,- 6}and determine its ROC. **(6)**

c. Find the Z transform of the sequence x[n] = u[n] – u[n-3] x[n] = {1,2,-1,2,3}. **(5)**

Q9. a. State and explain the concept of shot noise. **(4)**

b. Consider a random process , x(t) = Acos(ωt + Θ), where Θ is a uniform random variable in the range $[-\pi, \pi]$ and A, ω are constants. Find if x (t) is wide sense stationary process? **(8)**

c. Mention the physical significance of power spectral density. **(4)**