

--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

2021

B.Tech. 3rd Semester End-Term Examination

Computer Science and Engineering

BASICS OF SIGNALS AND SYSTEMS

(New Regulation w.e.f. 2017-18)

(New Syllabus w.e.f. 2018-19)

Full Marks – 70

Time – Three hours

The figures in the margin indicate full marks for the questions.

Answer question No. 1 and any four from the rest.

1. Write short answer:

(10 × 1 = 10)

- Define signal.
- Write the mathematical expression for unit ramp signal.
- Define causal and non causal signal.
- What is the condition for stability of a LTI systems?
- What is the area of an unit impulse function?
- Write down the relation between unit step signal and unit impulse function.
- What is meant by Region of Convergence (ROC) in z-transform?
- Define static and dynamic system.
- At $x = 0$, $\sin c(x) =$ _____.
- The sum of two periodic signals $x_1(t)$ and $x_2(t)$ with periods T_1 and T_2 is said to be periodic if the ratio of the periods is _____.

[Turn over

- Define periodic signal, non periodic signal, deterministic signal and random signal. (5)
- Identify the periodic signals and compute periodicity (fundamental period) if periodic

(i) $x(t) = 2 \cos \frac{2\pi t}{3} + 3 \cos \frac{2\pi t}{7}$

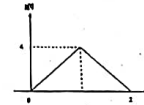
(ii) $x(t) = 3 \cos \left(5t + \frac{\pi}{6} \right)$

(iii) $x[n] = e^{j3\pi n}$. (6)

- (c) Find the convolution of the following signal

$x_1(t) = u(t)$ and $x_2(t) = u(t)$. (4)

3. (a) Sketch and label the even and odd component of the signal shown in fig: (6)



- (b) Define energy and power signal. (4)

- (c) Find the power and energy of the signal $x(t) = e^{-t}u(t)$. (5)

4. (a) Explain with example the following operation on a signal: (3)

(i) Time delaying

(ii) Time folding

(iii) Time scaling

- (b) Sketch the signals- (4)

(i) $u(-2t + 4)$

(ii) $y[n] = x[2n]$ for $x[n] = \{1, 2, 3, 4, 5\}$.

- (c) Determine the following system described by $y(t) = x(t^2)$ is non causal and time variant. (6)

- (d) Find the system $y(t) = 4t + x(t)$ is linear or not. (2)

5. (a) Describe the causality and stability properties of LTI system. (8)
- (b) Determine the response of the LTI system whose input $x[n]$ and impulse response $h[n]$ are given by $x[n] = \{1, 2, 3, 4\}$ $h[n] = \{1, 2, 2, 1\}$. (7)
6. (a) Define Laplace transform State the condition for existence of Laplace transform. Find the Laplace transform of the signal $x(t) = e^{-3t}u(t)$ and plot ROC. (8)
- (b) The impulse response of an LTI system is $h(t) = 2e^{-3t}u(t)$. Find the response of the system for the input $x(t) = 2e^{-4t}u(t)$ using Fourier Transform. (5)
- (c) Define Z-transform. What is meant by region of convergence (ROC) in Z-transform. (2)
7. (a) Find Fourier series coefficient of $x(t) = 4 + 2\cos\frac{2\pi}{3}t + 4\sin\frac{5\pi}{3}t$ and sketch the magnitude and phase spectra. (7)
- (b) Establish the relation between Fourier transform and Laplace transform from their basic definition. (3)
- (c) State Sampling theorem. Show that the sampling frequency must be at least twice the maximum frequency of the signal for the proper reconstruction of the signal. (5)

Total No. of printed pages = 4

CSE 181305

Roll No. of candidate

2	0	0	7	1	0	0	7	0	0
---	---	---	---	---	---	---	---	---	---

2021

B.Tech. 3rd Semester End-Semester Examination

CSE

BASICS OF SIGNAL AND SYSTEMS

(New Regulation & New Syllabus)

Full Marks – 70

Time – Three hours

The figures in the margin indicate full marks
for the questions.

Question No. 1 is compulsory and answer any four questions from the rest.

1. Answer any ten questions : (10 × 1 = 10)
- (i) A lumped parameter system is described by
- Ordinary differential equations
 - Partial differential equations
 - Both (a) and (b)
 - None of above
- (ii) $y(n) = x(2n)$ is for a
- Time invariant system
 - Time-varying, dynamic system
 - Linear, time-varying, dynamic system
 - Linear, time invariant, static system
- (iii) Fourier Series applies to
- Only periodic signal
 - Only aperiodic signal
 - Both periodic and aperiodic signal
 - Only random signal

[Turn over

- (iv) The net areas of sinusoids over complete periods are
 (a) Finite (b) Infinite
 (c) Zero (d) None of these
- (v) If the frequency spectrum of a function is discrete, then the function is
 (a) Discrete (b) Aperiodic
 (c) Periodic (d) Random
- (vi) The Fourier Transform of $e^{-at} u(t)$ is
 (a) $1/j\omega$ (b) $1/a - j\omega$
 (c) $1/a + j\omega$ (d) $1/a^2 - \omega^2$
- (vii) The impulse response of a system is $h(t)$ when the input is $\delta(t)$. The output $y(t)$ will be
 (a) $y(t)$ (b) $\delta(t)$
 (c) $h(t)$ (d) None of these
- (viii) The initial value of $L^{-1}\left[\frac{5}{s(s+2)}\right]$ is
 (a) 0 (b) 5
 (c) Infinity (d) 5/2
- (ix) For the existence of Fourier series, Dirichlet's conditions are
 (a) Necessary (b) Sufficient
 (c) Necessary and sufficient (d) None of these
- (x) $u(t-a) = 0$, if
 (a) $t-a = 0$ (b) $t-a < 0$
 (c) $t-a > 0$ (d) $t > a$
- (xi) A deterministic signal has
 (a) No uncertainty (b) Uncertainty
 (c) Partial uncertainty (d) None of above
- (xii) A signal is an energy signal if
 (a) $E = 0, P = 0$ (b) $E = \text{infinite}, P = \text{finite}$
 (c) $E = \text{finite}, P = 0$ (d) $E = \text{finite}, P = \text{infinite}$

2. (a) What are the types of representation of discrete-time signals? Represent a sequence in all types. (7)
- (b) (i) Find the even and odd components of the following signal: (2+2=4)
 (1) $1-2t+3t^3$
 (2) 2, 1, 4, 3, 5
 ↑
- (ii) Determine power and rms value of the signal: (2+2=4)
 (1) $x(t) = 5 \sin\left(10t + \frac{\pi}{2}\right)$
 (2) $e^{-j5t} \cos 2t$
3. (a) Show that the sum of two sinusoids is periodic provided that their frequencies are integral multiples of a fundamental frequency ω_0 . (7)
- (b) Find the Fourier Transform of: (4+4=8)
 (i) $x(t) = e^{-3t} \sin 4tu(t)$
 (ii) $x(t) = te^{-at} u(t)$
4. (a) Find the inverse Laplace transform of: (5+5=10)
 (i) $X(S) = \frac{2s+1}{(s+1)(s^2+2s+2)}$
 (ii) $X(S) = \frac{3s^2+8s+6}{(s+2)(s^2+2s+1)}$
- (b) State and prove the sampling theorem. What is Nyquist rate? (4+1=5)
5. (a) Check whether the following systems are: (4+4=8)
 (i) Static or dynamic
 (ii) Linear or non linear
 (iii) Causal or non-causal
 (iv) Time variant or invariant:
 (1) $y(t) = \text{od}\{x(t)\}$
 (2) $y(t) = atx(t) + bt^2 x(t-2)$
- (b) Define a system. How are systems classified? Define each one of them. (7)

6. (a) State and prove the Parseval's Theorem in Fourier Transform. (7)
(b) Discuss the advantages and limitations of Fourier Transform, Z- Transform and Laplace Transform. (8)
7. Write short notes on: (any *three*) : (3 × 5 = 15)
- (a) Convolution
 - (b) ROC and its properties
 - (c) Sampling
 - (d) Aliasing
 - (e) Discrete time Fourier Transform.