

**BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI  
(END SEMESTER EXAMINATION)**

**CLASS: BTECH  
BRANCH: ECE**

**SEMESTER :  
SESSION : MO/2022**

**SUBJECT: EC445 INTRO. TO SIGNAL PROCESSING**

**TIME: 3:00 Hours**

**FULL MARKS: 50**

**INSTRUCTIONS:**

1. The question paper contains 5 questions each of 10 marks and total 50 marks.
  2. Attempt all questions.
  3. The missing data, if any, may be assumed suitably.
  4. Before attempting the question paper, be sure that you have got the correct question paper.
  5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.
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- Q.1(a) State the expressions for convolution integral and convolution sum. Why is the convolution integral so important in the analysis of LTI systems? [2]
- Q.1(b) Explain the Commutative, Distributive, and Associative properties of the convolution integral. [3]
- Q.1(c) Show that: [5]
- (a)  $x(t) * \delta(t - t_0) = x(t - t_0)$ , where  $\delta$  is the unit impulse signal.
- (b)  $x(t) * u(t) = \int_{-\infty}^t x(\tau) d\tau$ , where  $u$  is the unit step function.
- Q.2(a) What is the region of convergence (ROC) in Laplace transform? What are its properties? [2]
- Q.2(b) Consider the signal:  $x(t) = -e^{-at}u(-t)$ ,  $a$  is real. Find the ROC. [3]
- Q.2(c) Find the Laplace transform of [5]
- a.  $x(t) = -e^{-at}u(-t)$
- b.  $x(t) = e^{at}u(-t)$
- Q.3(a) What is the relationship between Z-transform and the Laplace transform? [2]
- Q.3(b) What is the difference in the ROCs of Laplace transform and Z-transform, respectively? State the linearity and time shifting properties of Z-transform. [3]
- Q.3(c) Consider the sequence:  $x[n] = \begin{cases} a^n & 0 \leq n \leq N, a > 0, \\ 0 & \text{otherwise.} \end{cases}$  [5]
- Find  $X(z)$  and find the poles and zeros of  $X(z)$ .
- Q.4(a) Which type of signals are represented by Fourier series and transform, respectively. What is the Dirichlet condition for the convergence of Fourier series? [2]
- Q.4(b) Explain the linearity, time shifting, and frequency shifting properties of the Fourier transform. [3]
- Q.4(c) Explain the most common types of ideal frequency-selective filters, i.e., ideal low-pass filter (LPF), ideal high-pass filter (HPF), ideal band-pass filter (BPF), and ideal band-stop filter (BSF). What should be the phase response to avoid phase distortion in the filtering process? [5]
- Q.5(a) What do you understand by 'sample space' and 'event' in probability theory? State the Bayes rule for conditional probability. [2]
- Q.5(b) Explain independent and mutually exclusive events. How do the joint probabilities of these two events behave? [3]
- Q.5(c) Define random variable. List the properties of probability density function (pdf) of a continuous random variable  $X$ . [5]

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