JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST - 3 EXAMINATIONS-2022

B.Tech - III Semester (ECE)

COURSE CODE (CREDITS): 18B11EC412 (4) MAX. MARKS: 35

COURSE NAME: Fundamentals of Signals & Systems

COURSE INSTRUCTORS: Dr. Vikas Baghel MAX. TIME: 2.0 Hours

Note: All questions are compulsory. Marks are indicated against each question in square brackets.

Q1. a) The transfer function of a linear time invariant system is given by $H(s) = 2s^4 - 5s^3 + 5s - 2$. The number of zeros in the right half of the s-plane is _____. **[1]** **[CO1]**

b) Find $x[0]$ if $X(z) = \frac{3z^2}{(z+3)(z-3)}$. **[2]**

c) If the Laplace transform of a signal $y(t)$ is $Y(s) = \frac{1}{s(s-1)}$. Find its final value. **[2]**

d) Consider the signal $f(t) = 1 + 2cos(\pi t) + 3sin\left(\frac{2\pi}{3}t\right) + 4cos\left(\frac{\pi}{2}t + \frac{\pi}{4}\right)$, where t is in seconds. Find its fundamental time period, in seconds. **[2]**

Q2. **a)** State and prove Initial Value theorem of Laplace Transform. **[2]** **[CO3]**

b) An LTI system has following transfer function $H(s) = \frac{3-s}{(s+3)(s^2-4)}$. Determine the following. **[3]**

(i) Draw poles and zeros of the systems

(ii) Stability of the system

(iii) Causality of the system

Q3. **a)** Determine the inverse Laplace transform of $X(s) = \frac{1}{s^2+3s+2}$, $-2 < Re\{s\} < -1$. **[2]** **[CO3]**

b) For a causal LTI system having a transfer function $H(s) = \frac{1}{s+1}$. Find the output $y(t)$ if the input $x(t)$ is $e^{-t}u(t) + e^{2t}u(-t)$. **[3]**

Q4. a) Using long division method, determine four terms of inverse z-transform of [2] **[CO4]**

$$H(z) = \frac{1 + 2z^{-1}}{1 - 2z^{-1} + z^{-2}}$$

b) Determine the Z-transform, corresponding ROC and the pole-zero diagram of the signal $x[n] = 2^n u[-n] + \left(\frac{1}{4}\right)^n u[n-1]$. [3]

Q5. a) State and prove convolution property of Z-transform. [3] **[CO4]**

b) Consider the sequence $x[n] = a^n u[n] + b^n u[n]$, where $u[n]$ denotes the unit-step sequence and $0 < |a| < b| < 1$. Find region of convergence (ROC) of the z-transform of $x[n]$. [2]

Q6. a) Explain the method of interpolation. Find the reconstructed signal using the appropriate equations. [2] **[CO5]**

b) State Sampling theorem. [2]

c) A continuous-time sinusoid of frequency $33Hz$ is multiplied with a periodic impulse train of frequency $46Hz$. The resulting signal is passed through an ideal analog low-pass filter with a cutoff frequency of $23Hz$. Find fundamental frequency (in Hz) of the output. [2]

d) Let $x(t)$ be a signal with Nyquist rate ω_0. Determine the Nyquist rate for each of the following signals: [2]

i. $x(t) + x(t-1)$

ii. $\frac{dx(t)}{dt}$

iii. $x^2(t)$

iv. $x(t)\cos(\omega_0 t)$