

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-IV (NEW) EXAMINATION – SUMMER 2022****Subject Code:3141005****Date:27-06-2022****Subject Name:Signal & Systems****Time:10:30 AM TO 01:00 PM****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

MARKS

- Q.1**
- (a) Define (1) Signal (2) System (3) Deterministic Signal. **03**
 - (b) (1) Describe Inverse System. (2) Describe Time-Invariant System. **04**
 - (c) Determine if the following systems described by (1) $y(t) = \sin[x(t + 2)]$; **07**
(2) $y[n] = x[2 - n]$ are memoryless, causal, linear, time invariant, stable.
- Q.2**
- (a) Write any three properties of Convolution Integral. **03**
 - (b) (1) Write the relation between Unit Step and Impulse function. **04**
(2) Write the relation between Unit Step and Ramp function.
 - (c) Determine the response of the system with impulse response $h(t) = u(t)$ for the input $x(t) = e^{-2t}u(t)$. **07**
- OR**
- (c) The impulse response of the relaxed LTI system is given as, $h[n] = a^n u[n]$ and $|a| < 1$. Determine the response of this system if it is excited by unit step sequence. **07**
- Q.3**
- (a) State equations for trigonometric Fourier Series and exponential Fourier Series. **03**
 - (b) Bring out the difference between DFT and Fourier Transform. **04**
 - (c) Use definition of the Fourier Series to determine the time domain signal represented by the following Fourier series coefficients: **07**
 $X[k] = j\delta[k - 1] - j\delta[k + 1] + \delta[k - 3] + \delta[k + 3]$. $\omega_0 = 2\pi$
- OR**
- Q.3**
- (a) State frequency shifting, time shifting and time scaling properties of Fourier Transform. **03**
 - (b) Obtain the Fourier Transform of following functions: (1) $x(t) = 1$ **04**
(2) $x(t) = \text{sgn}(t)$.
 - (c) Obtain the Fourier Transform of following functions: (1) $x(t) = \cos \omega_0 t$ **07**
(2) $x(t) = \cos \omega_c t u(t)$.
- Q.4**
- (a) Evaluate the convolution $x[n] * \delta[n - n_0]$. **03**
 - (b) Explain (1) Time Shifting and (2) Time Scaling operation with neat figures. **04**
 - (c) Determine 2 – point and 4 – point DFT of a sequence $x[n] = u[n] - u[n - 2]$. **07**
- OR**
- Q.4**
- (a) Discuss Causality and Stability of LTI systems using z – transform. **03**
 - (b) Prove the duality property of Fourier Transform. **04**

- (c) Define Convolution sum. Show that (1) $x[n] * \delta[n] = x[n]$ **07**
 (2) $x[n] * u[n - n_0] = \sum_{k=-\infty}^{n-n_0} x[k]$

- Q.5** (a) State final value and initial value theorem for z – transform. **03**
 (b) Write any four properties of ROC with respect to z – transform. **04**
 (c) Determine z – transform of $x[n] = \cos(\Omega_0 n) u[n]$ **07**

OR

- Q.5** (a) State any three properties of z – transform. **03**
 (b) Find the z – transform and ROC of the following sequence: **04**

$$x[n] = \frac{1}{2} \delta[n + 1] + 5 \left(\frac{1}{2} \right)^{-n} u[n] + 4^n u[-n - 1]$$

- (c) Determine the inverse z – transform of the following $X(z)$ by partial fraction expansion method, **07**

$$X(z) = \frac{(z+2)}{2z^2-7z+3} \text{ if the ROCs are (1) } |z| > 3 \text{ (2) } |z| < \frac{1}{2} \text{ and (3) } \frac{1}{2} < |z| < 3 .$$
