GUJARAT TECHNOLOGICAL UNIVERSITY

BE SEMESTER 3 – OLD PAPER – W25 TO S26 – QUESTION BANK

Subject Name & Code: Signals and Systems - BE03000171

Chapter 1: Introduction to Signals & Systems

Repeated Questions:

None identified.

Other Important Questions:

1. Signal Classification and Operations (Theory):

- **Q.** For the signal x(t), plot x(1 − t/2). [Diagram required – refer to the original question paper] **(WINTER 2025, 3 Marks)**
- **Q.** Define periodic and aperiodic signal. Determine whether the following signals are periodic or not? If periodic determine the fundamental period. 1. $x(t) = \cos(4\pi t)$ 2. $x(n) = \cos(n/6)\cdot\cos(n\pi/6)$. **(WINTER 2025, 3 Marks)**
- **Q.** Find even and odd part of x(t) = u(−t). **(SUMMER 2026, 3 Marks)**
- **Q.** Define periodic and aperiodic signal. Also check whether sin(5πt) is periodic or not. **(SUMMER 2026, 3 Marks)**
- **Q.** Compare Energy and Power signals with example. **(SUMMER 2026, 4 Marks)**
- **Q.** Define autocorrelation function of a signal. List its properties. **(WINTER 2025, 3 Marks)**

2. System Properties (Theory):

- **Q.** Define following systems. Invertible system; FIR system; IIR system. **(WINTER 2025, 3 Marks)**
- **Q.** Explain following property for the system y(t) = 3x(−t) − 14. (i) Linearity (ii) Time-invariance (iii) Causality (iv) Dynamicity. **(SUMMER 2026, 7 Marks OR)**

3. System Property Tests (Numerical):

- **Q.** Determine whether the following system is linear, stable, causal and time-invariant using appropriate test. $y(t) = x(t^2)$. **(WINTER 2025, 4 Marks)**
- **Q.** Determine whether the following system is linear, stable, causal and time-invariant using appropriate test. y(n) = x(n) − x(n−1). **(WINTER 2025, 4 Marks OR)**
- **Q.** Determine the following system described by y(t) = cos[x(t−2)] is memoryless, causal, linear, time-invariance or stable? **(SUMMER 2026, 7 Marks)**

Chapter 2: Behaviour of Continuous Time (CT) & Discrete Time (DT) Linear Time Invariant (LTI) System

Repeated Questions:

1. Stability of DT LTI System:

- **Q.** State and prove a condition for a discrete time LTI system to be stable. **(WINTER 2025, 4 Marks; SUMMER 2026, 4 Marks)**

Other Important Questions:

1. Convolution – Definitions and Properties (Theory):

- **Q.** Define convolution integral for a continuous time and a discrete time signals. List properties of convolution. **(WINTER 2025, 7 Marks OR)**
- **Q.** Prove Associative property of Convolution sum. **(SUMMER 2026, 3 Marks)**
- **Q.** Prove Commutative property of convolution sum. **(SUMMER 2026, 3 Marks OR)**

2. LTI System Stability and Causality:

- **Q.** Determine whether the following system with impulse response h(t) = e^(−5t) u(t) is stable or not. **(SUMMER 2026, 4 Marks)**
- **Q.** Prove that DT LTI system is causal if and only if h(n) = 0 for n < 0. **(SUMMER 2026, 4 Marks OR)**

3. Convolution and System Response (Numerical):

- **Q.** The impulse response of the circuit is given as h(t) = e^(−2t) u(t). This circuit is excited by an input of x(t) = e^(−4t) [u(t) − u(t−2)]. Determine the output of the circuit. **(WINTER 2025, 7 Marks)**
- **Q.** For x(n) = δ(n) + 2δ(n−1) − δ(n−3) and h(n) = 2δ(n+1) − 2δ(n−1). Compute y(n) = x(n) ∗ h(n). **(WINTER 2025, 3 Marks OR)**
- **Q.** Compute y(t) = x(t) ∗ h(t) if x(t) = u(t) and h(t) = u(t+3). **(SUMMER 2026, 7 Marks OR)**
- **Q.** Obtain linear convolution of two discrete time signals given as: x[n] = u[n] and h[n] = a^n u[n], a < 1. **(SUMMER 2026, 7 Marks)**

Chapter 3: Introduction to Fourier Series, Fourier Transform

Repeated Questions:

1. Trigonometric Fourier Series (Derivation):

- **Q.** Derive Fourier co-efficients of the Trigonometric Fourier series of an even symmetry periodic signal. **(WINTER 2025, 7 Marks; SUMMER 2026, 7 Marks)**

Other Important Questions:

1. Fourier Series (Numerical):

- **Q.** Obtain the trigonometric Fourier series for the waveform shown below. [Diagram required – refer to the original question paper] **(WINTER 2025, 7 Marks)**

2. Fourier Transform Properties (Theory):

- **Q.** State and prove time shifting property of Fourier transform. **(WINTER 2025, 3 Marks)**
- **Q.** State and prove differentiation in time domain properties of Fourier transform. **(WINTER 2025, 3 Marks OR)**
- **Q.** Obtain relationship between Laplace and Fourier Transform. **(SUMMER 2026, 4 Marks)**
- **Q.** State and prove time scaling and time shifting property of Fourier transform. **(SUMMER 2026, 4 Marks)**
- **Q.** Prove the duality theorem of Fourier Transform. **(SUMMER 2026, 4 Marks OR)**

3. Fourier Transform Problems (Numerical):

- **Q.** Find the Fourier transform of the following signal. x(t) = 2 for −4 ≤ t ≤ −2; 2 for 2 ≤ t ≤ 4; 0 otherwise. **(WINTER 2025, 4 Marks)**
- **Q.** Using properties of Fourier transform, find the Fourier transform of x(t) = e^(−3t) u(t−2). **(WINTER 2025, 4 Marks OR)**
- **Q.** Using Fourier transform, find the convolution of the signals x1(t) = e^(−2t) u(t) and x2(t) = e^(−3t) u(t). **(WINTER 2025, 7 Marks OR)**
- **Q.** Obtain Fourier Transform of unit step signal. **(SUMMER 2026, 3 Marks OR)**

4. Discrete Fourier Transform (Numerical):

- **Q.** Compute DFT of the sequence x[n] = {2, 0, 3, 1}. **(SUMMER 2026, 3 Marks - placed under Chapter 3 as closest syllabus mapping)**
- **Q.** Compute DFT of the sequence x[n] = {−2, 3, −3, −1}. **(SUMMER 2026, 3 Marks OR - placed under Chapter 3 as closest syllabus mapping)**

Chapter 4: Sampling & Reconstruction

Repeated Questions:

1. Sampling Theorem:

- **Q.** State and prove sampling theorem. / Explain in detail Sampling Theorem. **(WINTER 2025, 7 Marks; SUMMER 2026, 7 Marks OR)**

Other Important Questions:

1. Reconstruction and Aliasing:

- **Q.** Explain reconstruction of a signal from its samples using interpolation process. **(WINTER 2025, 7 Marks OR)**
- **Q.** Explain Aliasing and its effects. **(SUMMER 2026, 7 Marks)**

Chapter 5: Z Transform

Repeated Questions:

None identified.

Other Important Questions:

1. Z-Transform Properties and ROC (Theory):

- **Q.** State and prove multiplication by exponential sequence property of z-transform. **(WINTER 2025, 3 Marks)**
- **Q.** Explain differentiation property in the z-domain. **(WINTER 2025, 3 Marks OR)**
- **Q.** Write the properties of ROC of Z-Transform. **(SUMMER 2026, 7 Marks)**
- **Q.** State and prove time differentiation property of Z-Transform. **(SUMMER 2026, 4 Marks OR)**
- **Q.** Obtain Z-Transform of unit step signal. **(SUMMER 2026, 3 Marks)**

2. Z-Transform of Sequences (Numerical):

- **Q.** Using appropriate properties, find z-transform of x(n) = n(1/3)^n u(n−2). **(WINTER 2025, 4 Marks OR)**
- **Q.** Determine z Transform of following sequences. Also draw the ROC: (1) x[n] = u(n+2) (2) x[n] = 4^n u[n] + 5^n u[−n−1]. **(SUMMER 2026, 7 Marks OR)**

3. Inverse Z-Transform and System Response (Numerical):

- **Q.** Using long division, determine the inverse z-transform of X(z) = (z^(−1) + 2z^(−2)) / (1 − 3z^(−1) + 4z^(−2) + z^(−3)); ROC |z| > 1. **(WINTER 2025, 4 Marks)**
- **Q.** Determine the impulse response h(n) of the causal system described by the difference equation y(n) − (3/4)y(n−1) + (1/8)y(n−2) = x(n) + (1/3)x(n−1). **(WINTER 2025, 7 Marks)**
- **Q.** Find the inverse z-transform of X(z) = (2z − 7) / (z^2 − 5z + 6); ROC |z| < 2. **(WINTER 2025, 7 Marks OR)**

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