Code No: R1631023 **R16** SET - 1

III B. Tech I Semester Regular/Supplementary Examinations, March - 2021

SIGNALS AND SYSTEMS

(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**

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PART –A (14 Marks)

1. a) Define continuous time unit impulse and unit step functions. [2M]
   b) State Parseval's relation for continuous time Fourier transforms. [2M]
   c) What are the effects of sampling rate? [2M]
   d) A signal x(t) has energy E. Calculate the energy of the signal x(t/2). [3M]
   e) If $X(s) = \frac{s+2}{s^2+8s+25}$, find x(t), $t \geq 0$. [3M]
   f) Determine the Z transform of $x(n) = a_n \cos(w_o n)u(n)$. [2M]

PART –B (56 Marks)

2. a) Find whether the following signals are periodic or not? If periodic, determine the fundamental period. [7M]
   i) $x(t) = cos\frac{\pi}{3}t + sin\frac{\pi}{4}t$, ii) $x(t) = 3u(t) + 2sin2t$.
   b) Show that sinusoidal functions are orthogonal functions. [7M]

3. a) Find the exponential Fourier series representation of the signal $x(t) = \cos^2 t$. [7M]
   b) State and prove the following properties of Fourier transform: [7M]
   i) Frequency shifting, ii) Differentiation in time.

4. a) State and prove the sampling theorem for low pass signals. [7M]
   b) The signal $x(t) = \cos 5\pi t + 0.3\cos 10\pi t$ is instantaneously sampled. Find the maximum interval of sampling. [7M]

5. a) Find the convolution of the following signals using graphical method: $x(t)=e^{-3t}u(t)$; $h(t)=u(t-3)-u(t-5)$. [7M]
   b) Sketch and explain characteristics of an ideal Low pass, High pass and Band pass filters. [7M]

6. a) Find the Laplace transform and ROC for the signal $x(t) = e^t \sin 2t$, $t \leq 2$. [7M]
   b) State and prove Time scaling property of Laplace transforms. [7M]

7. a) Prove that the sequence $x(n) = a^n u(n)$ and $x(n) = -a^n u(-n-1)$ have the same X(z) and differ only in ROC. Also plot their ROC. [7M]
   b) Find the inverse Z-transform of $X(z) = \frac{z(z-1)}{(z+1)^3(z+2)^2}$; ROC: $|z| > 2$ [7M]

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Code No: R1631023 **R16** SET - 2

III B. Tech I Semester Regular/Supplementary Examinations, March - 2021

SIGNALS AND SYSTEMS

(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**

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PART –A (14 Marks)

1. a) Define power and energy signals. [2M]
   b) What is Fourier spectrum? [2M]
   c) State sampling theorem for band pass signals. [2M]
   d) Compare ESD and PSD. [3M]
   e) Compute the Laplace transform of the signal $x(t)=te^{-2t}\sin 2t\, u(t)$ using properties of Laplace transform. [3M]
   f) State initial and final value theorems in Z-transform. [2M]

PART –B (56 Marks)

2. a) Find the even and odd parts of the signal $x(t) = e^{-2t}\cos(t)$. [7M]
   b) A rectangular function f(t) is defined by [7M]
   $f(t) = 1$ for $0 < t < \pi$
   -1 for $\pi < t < 2\pi$
   Approximate this function by a waveform sin(t) over the interval $(0,2\pi)$ such that mean square error is minimum.

3. a) Obtain the exponential Fourier series for the function $f(t) = A\sin(\omega t)$ over the interval $0 \le t \le \pi$. Also find the trigonometric Fourier coefficients from exponential Fourier coefficients. [7M]
   b) What is Hilbert transform? How does it differ from other transforms? [7M]

4. a) Explain the effects of under sampling. [7M]
   b) The spectral range of a signal extends from 5.6 MHz to 6.8 MHz. Find the minimum sampling rate and maximum sampling time. [7M]

5. a) For an initially relaxed system, the impulse response h(t) is given by $h(t) = [e^{-2t}-e^{-3t}]u(t)$. Find the excitation x(t) to produce an output $y(t)= t\, e^{-2t}\, u(t)$. [7M]
   b) Obtain the conditions for the distortion less transmission through a system. [7M]

6. a) Write the properties of ROC for Laplace transforms. [7M]
   b) Find the inverse Laplace transform of $X(s) = -\frac{1000}{s^2-100}$ ROC: $-10 < Re(s) < 10$. [7M]

7. a) Find the Inverse Z-transform of the sequence $X(Z) = \frac{z}{2z^2-3z+1}$, ROC: $|z|>1$ [7M]
   b) Prove that, for causal sequences, the ROC is the exterior of a circle of radius r. [7M]

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Code No: R1631023 **R16** SET - 3

III B. Tech I Semester Regular/Supplementary Examinations, March - 2021

SIGNALS AND SYSTEMS

(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**

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PART –A **(14 Marks)**

1. a) State the relation between step, ramp and delta functions. [2M]
   b) What is the effect of Hilbert transform? [2M]
   c) When does aliasing occur? How can it be avoided? [2M]
   d) Determine the ESD of a gate function of width τ and amplitude A. [3M]
   e) Compute the Laplace transform of the signal $x(t)=t^2e^{-3t}$ u(t) using properties of Laplace transform. [3M]
   f) Mention the methods of finding the inverse Z-transform. [2M]

PART –B **(56 Marks)**

2. a) Check linearity and causality of the following systems: [7M]
   i) $\frac{d^3y(t)}{dt^3} + 7\frac{d^2y(t)}{dt^2} + 9t\frac{dy(t)}{dt} + y(t) = x^2(t)$
   ii). $y(n) = x(n)x(n-2)$.
   b) Show that the functions sin $n\omega_o t$ and cos $m\omega_o t$ are orthogonal over a complete period for all values of m and n. [7M]

3. a) State and prove the following properties of Fourier transform: [7M]
   i) time shifting, ii) convolution.
   b) Derive the expressions for the trigonometric Fourier series coefficients. [7M]

4. a) Find the Nyquist rate and Nyquist interval for the following signals: [7M]
   i) x(t) = 2 sinc(100πt), ii) x(t) = -10 sin (40πt) cos (300πt).
   b) Differentiate between natural and flat top sampling methods. [7M]

5. a) Prove that the autocorrelation function of an energy signal and its energy spectral density are Fourier transform pairs. [7M]
   b) Suppose that the signal x(t)=u(t+0.5)-u(t-0.5) and the signal $h(t)=e^{jwot}$. Determine a value of w_o which ensures that y(0)=0, where y(t)=x(t)*h(t). [7M]

6. a) Find the Laplace Transform of the signal $x(t) = e^{-a|t|}$ and find its ROC. [7M]
   b) If $X(s) = \frac{s+2}{s^2+8s+25}$, find x(t), $t \geq 0$. [7M]

7. a) Find the Z-transform of the following sequences: [7M]
   i) $x(n) = (1 + 2^n + 3^n)u(n)$, ii) $y(n) = x(n+1)u(n)$,
   b) State and Prove Initial and Final value theorems in z-transform. [7M]

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Code No: R1631023 **R16** SET - 4

III B. Tech I Semester Regular/Supplementary Examinations, March - 2021

SIGNALS AND SYSTEMS

(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**

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PART –A (14 Marks)

1. a) Show that $\delta(n) = u(n) - u(n-1)$. [2M]
   b) State Dirichlet's conditions. [2M]
   c) Define Nyquist rate and Nyquist interval. [2M]
   d) Prove that $R_{12}(\tau) = R_{21}(-\tau)$. [3M]
   e) Find the Laplace transform and ROC for the signal $x(t) = e^{t} \sin 2t$, $t \leq 2$. [3M]
   f) Mention the relationship between s-plane and z-plane. [2M]

PART –B (56 Marks)

2. a) Define ramp signal. Illustrate with example. And sketch the following signal $y(t) = r(t) - r(t-2) - r(t-3) + r(t-4)$. [7M]
   b) Prove that the complex exponential signals are orthogonal functions. [7M]

3. a) State and explain the significance of Dirichlet's Conditions. [7M]
   b) Find the Fourier transform of the following signals: [7M]
   i) Signum function, ii) Rectangular function.

4. a) Find the Nyquist rate Nyquist interval for the following signals: [7M]
   i) rect(300t) ii) $-10\sin(40\pi t)\cos(300\pi t)$.
   b) State and explain the sampling theorem for band pass signals. [7M]

5. a) Find the convolution of the signals $x_1(t) = e^{-at}u(t)$; $x_2(t) = e^{-bt}u(t)$ using Fourier transform. [7M]
   b) Derive the relation between rise time and bandwidth of a low pass filter. [7M]

6. a) Prove that the signals $x(t) = e^{-at}u(t)$ and $x(t) = -e^{-at}u(-t)$ have the same X(s) and differ only in ROC. Also plot their ROCs. [7M]
   b) Obtain the relation between Laplace transform and Fourier transform. [7M]

7. a) Find the z-transform and ROC of [7M]
   $$x(n) = 3\left(\frac{5}{7}\right)^{n} u(n) + 2\left(-\frac{1}{3}\right)^{n} u(n).$$
   b) Distinguish between Fourier, Laplace, and Z-transform. [7M]

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