Signals and Systems Important Questions PDF

Signals and Systems usually covers classification of signals and systems, LTI systems and convolution, Fourier series and Fourier transform, Laplace and Z-transforms, and sampling. Frequent questions ask you to test system properties, find convolution, compute Fourier series coefficients, use transform properties, find ROC and inverse Z-transform, and apply the Nyquist rate.

Key takeaways

- Classification: continuous and discrete, periodic, even and odd, energy and power signals.
- System properties and LTI systems: linearity, time invariance, causality, stability and convolution.
- Transforms: Fourier series, Fourier transform, Laplace transform and Z-transform with ROC.
- Sampling: sampling theorem, Nyquist rate, aliasing and reconstruction.
- These are practice questions based on common syllabus topics, not verified past papers.

About these important questions

These are **practice questions** built from topics that appear in most Indian B.Tech syllabi for Signals and Systems, including AKTU and universities that follow the AICTE model curriculum. They are **not verified past papers**, and we do not claim that any question will appear in your exam. Unit numbers and topic order differ between universities, so first match each unit below with your own university syllabus. For real previous papers, use your university's official archive. AKTU students can download them from the AKTU old question paper page.

Each unit lists key definitions, derivations or theory questions, numericals with short answer outlines, and long-answer questions. Use the outlines to check your method, then write full solutions yourself.

Unit 1: Classification of Signals and Systems

Key definitions: continuous-time and discrete-time signals, periodic and aperiodic, even and odd, energy and power signals, unit impulse, unit step, ramp, signum, time shifting, scaling and reversal, linear, time-invariant, causal, stable, memoryless and invertible systems.

Numericals (answer outline):

- Find the energy of x(t) = e^(-2t)u(t). Answer: E = ∫ e^(-4t) dt from 0 to infinity = 1/4. It is an energy signal with zero average power.

- Check whether x(t) = cos(2t) + sin(3t) is periodic. Outline: periods π and 2π/3, their ratio is rational, so it is periodic with fundamental period 2π.
- Is y(t) = t x(t) linear and time-invariant? Answer: linear but time-variant.
- Is y[n] = x[n] + x[n + 1] causal? Answer: no, because it uses a future input.
- Find the even and odd parts of a given signal: xe = [x(t) + x(-t)]/2 and xo = [x(t) - x(-t)]/2.

Unit 2: LTI Systems and Convolution

Key definitions: impulse response, convolution integral and convolution sum, properties of convolution, BIBO stability, step response, system described by differential or difference equations.

Numericals (answer outline):

- Find u(t) * u(t). Answer: t u(t).
- Find e^(-at)u(t) * u(t) for a > 0. Answer: (1/a)(1 - e^(-at))u(t).
- Find the convolution of two finite sequences such as {1, 2, 1} and {1, 1} using the tabular method. Answer: {1, 3, 3, 1}.
- Check whether h(t) = e^(-2|t|) is stable. Outline: ∫|h(t)| dt = 1 is finite, so the system is BIBO stable.

Long-answer questions: Show that an LTI system is completely described by its impulse response. Find the impulse response of a system given by a first-order difference equation.

Unit 3: Fourier Series and Fourier Transform

Key definitions: trigonometric and exponential Fourier series, Dirichlet conditions, Parseval's theorem, Gibbs phenomenon, Fourier transform, magnitude and phase spectrum.

Results to remember: e^(-at)u(t) has transform 1/(a + jω); a rectangular pulse transforms to a sinc function; the impulse transforms to 1; time shifting multiplies the transform by e^(-jωt0); convolution in time becomes multiplication in frequency.

Numericals (answer outline):

- Find the exponential Fourier series of a periodic square wave and sketch the line spectrum.
- Find the Fourier transform of a rectangular pulse of width T and amplitude A. Answer: AT sinc(ωT/2), written as AT sin(ωT/2)/(ωT/2).
- Use Parseval's theorem to find the energy of a signal in the frequency domain.

Unit 4: Laplace and Z-transforms

Key definitions: bilateral and unilateral Laplace transform, region of convergence (ROC), transfer function, poles and zeros, Z-transform, ROC in the z-plane, inverse Z-transform by partial fractions, power series and residues.

Results to remember: $a^n u[n]$ has Z-transform z/(z - a) with ROC |z| > |a|; $-a^n u[-n - 1]$ has the same expression with ROC |z| < |a|. A causal LTI system is stable when all poles of H(z) lie inside the unit circle, or when all poles of H(s) lie in the left half of the s-plane.

Numericals (answer outline):

- Find the Z-transform and ROC of $x[n] = (1/2)^n u[n] + (1/3)^n u[n]$. Outline: the ROC is $|z| > 1/2$, the intersection of both ROCs.
- Find the inverse Z-transform of $X(z) = z/[(z - 1)(z - 2)]$ for $|z| > 2$ using partial fractions. Answer: $x[n] = (2^n - 1)u[n]$.
- Solve a difference equation with initial conditions using the unilateral Z-transform.
- Find the transfer function and impulse response of a system from its differential equation using Laplace transform.

Unit 5: Sampling

Key definitions: sampling theorem, Nyquist rate, Nyquist interval, aliasing, anti-aliasing filter, ideal and practical sampling, reconstruction, zero-order hold.

Numericals (answer outline):

- $x(t) = \cos(200\pi t) + \cos(600\pi t)$. Find the Nyquist rate. Outline: the frequencies are 100 Hz and 300 Hz, so fm = 300 Hz and the Nyquist rate is 600 Hz.
- A 1 kHz tone is sampled at 1.5 kHz. Find the alias frequency. Answer: 1.5 - 1 = 0.5 kHz.

Long-answer questions: State and prove the sampling theorem with spectra of the original and sampled signals. Explain aliasing and how an anti-aliasing filter prevents it.

How to score well in Signals and Systems

- Sketch every signal before you operate on it. Time shifting, scaling and convolution are much easier with a diagram.
- Learn a table of standard transform pairs and properties for Fourier, Laplace and Z-transforms.
- Always write the ROC with a Z-transform or Laplace transform. The same expression with a different ROC is a different signal.
- For system property questions, test each property separately and give a one-line reason.

Short-answer (2-mark) questions for Signals and Systems

Short questions test definitions and one-line results. Practise answering each in two to four lines:

1. Define an energy signal and a power signal.
2. What is the fundamental period of $\cos(4\pi t)$? (Answer: 0.5 s.)
3. Define a causal system.
4. What is the condition for BIBO stability of an LTI system?
5. Write the relation between the unit step and the unit impulse.
6. State the time-shifting property of the Fourier transform.
7. What is the Gibbs phenomenon?
8. State Parseval's theorem.
9. Define the region of convergence.
10. Where must the poles of a causal stable discrete system lie? (Answer: inside the unit circle.)
11. State the sampling theorem.

12. What is aliasing?

A 7-day revision plan for Signals and Systems

Use this plan in the last week before the exam. Adjust it to the units and weightage in your own syllabus.

- **Day 1 (Unit 1, Classification of Signals and Systems):** revise the definitions, then solve the numericals and one long answer from this unit without notes.
- **Day 2 (Unit 2, LTI Systems and Convolution):** revise the definitions, then solve the numericals and one long answer from this unit without notes.
- **Day 3 (Unit 3, Fourier Series and Fourier Transform):** revise the definitions, then solve the numericals and one long answer from this unit without notes.
- **Day 4 (Unit 4, Laplace and Z-transforms):** revise the definitions, then solve the numericals and one long answer from this unit without notes.
- **Day 5 (Unit 5, Sampling):** revise the definitions, then solve the numericals and one long answer from this unit without notes.
- **Day 6:** attempt one full three-hour practice paper made from these questions, or an official previous paper from your university archive.
- **Day 7:** go through your formula sheet, the short-answer list and every question you got wrong in the practice paper.

Frequently asked questions

Which unit of Signals and Systems is the most important?

LTI systems with convolution and the transform units (Fourier, Laplace and Z) usually carry the most marks. Sampling is shorter but appears often.

How do I solve convolution questions quickly?

For continuous signals, sketch both signals, flip and shift one, and find the overlap in each interval. For short discrete sequences, the tabular or multiplication method is fastest.

Why is ROC important in Z-transform questions?

The same X(z) can belong to a right-sided, left-sided or two-sided sequence. The ROC decides which one, and it also tells you about causality and stability.

Are these questions from real past papers?

No. These are practice questions based on topics that are common in B.Tech syllabi. They are not verified past papers, and no question is promised to appear in your exam. Check your own university syllabus and official previous papers; AKTU students can use the AKTU old question paper archive.

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