

Interview tips for candidates applying to SPCOM stream

Candidates will be examined on their analytical ability in three (3) of the following areas in addition to basic mathematics (Item 0 below), so total 4 areas. Beyond this, the candidate should exhibit excellent reasoning skills, irrespective of domain.

- 0 **Basic mathematics (mandatory for all candidates):** Integration, differentiation, differential equations, simple special functions (e.g. logarithms, trigonometric functions, exponential etc.), basic complex analysis, basics of numerical methods.

1. **Linear algebra:** Matrices and Gaussian elimination, Vector spaces, linear dependence and independence, basis of a vector space. Concept of Orthogonality, Determinant, Eigenvalues and Eigenvector, and Positive definite matrices. Solutions of linear equations
 - Reference book: Linear Algebra and Its Applications by Gilbert Strang

2. **Probability and random variables:** Meaning and axioms of probability, Repeated trials, Concept of a random variable and its characterization, Functions of one or two random variables, Sequence of random variables, Random Processes and their characterization. Stationarity of various kinds, power spectral density
 - Reference book: Probability, random variables and stochastic processes

3. **Digital signal processing:** Discrete Time-Signals and Systems, The z-Transform, Sampling of Continuous-Time Signals, Transform Analysis of Linear Time-Invariant Systems, Structures for Discrete-Time Systems, Discrete Fourier Transform, Sample Rate Conversion, linear phase systems and group delay minimum phase systems, basics of filter design, Basics of image processing.
 - Reference book: Discrete-time Signal Processing Alan V. Oppenheim, Ronald Schafer,

4. **Communication Theory:** Geometric representation of signals, AWGN and its power spectral density, Conversion of continuous AWGN channel into vector channels, Likelihood functions, Coherent detection – maximum likelihood decoding, Correlation receiver, Probability of error, Passband transmission model, Phase shift keying, detection of signals with unknown phase, Non-coherent modulations, Differential phase shift keying, Types of Modulation

- Reference book: Communication systems by Simon Haykin

5. **Signals and system:** LTI systems, Fourier series representation of periodic signals, Continuous time Fourier transform, Time and frequency characterization of signals and systems, Laplace transform, Signals and systems in discrete time, DTFT and the DFT, Sampling Theorem, Z transform, Filtering

Reference book: Signals and System by Oppenheim, Willsky, and Nawab

6. **Basics of Programming:** Variables, functions and classes, mathematical operations, details of data structures. Any one programming language or pseudo-code can be used to demonstrate these concepts. Basics, Threads and semaphores, Distributed algorithms, Complexity, Convergence, computation theory, Security basics, Graph Theory.

Reference book: Any book of your choice

Candidate should note the following

1. Problems posed will test the basics, and the ability to think “on one’s feet. It’s not enough to just remember things: you should have understood the concepts and know how to apply them in a given situation Candidates may also be asked questions in their preferred area of research or any related area. These questions will be from topics of undergraduate/postgraduate study, as applicable. The nature of the questions will be to explore the student’s clarity of thought and depth of understanding of the topics, rather than descriptive system level knowledge.
2. Candidates will be required to choose any of the topics beforehand and state their choice when required from the department.
3. These are only suggested books. Candidates can refer to any standard book of their choice. Questions need not be from the book itself.