Criteria adopted for shortlisting PhD applications (Regular, Direct, ERP and Part-Time)

Area of Research: Signal Processing/Communication/Equivalent
Selection: Dec. 2021 Admissions

Criteria for Regular category:

1. M.Tech/M.E./M.S. (GEN/OBC/EWS: 70% or 7.5; SC/ST: 65% or 7.0)
2. 1st preference for PhD specialization as Signal Processing and Communication

In case of B.Tech. degree only:

1. BTech/BE (GEN/OBC/EWS: 75% or 8.0; SC/ST: 70% or 7.5
2. Valid GATE score for candidate other than IITs
3. 1st for PhD specialisation as Signal Processing and Communication

Criteria for Direct PhD category:

1. B.Tech/BE (GEN/OBC/EWS: 75% or 8.0; SC/ST: 70% or 7.5)
2. Valid GATE score for candidate other than CFTI
3. 1st preferences for PhD specialisation as Signal Processing and Communications

Criteria for ERP category:

1. Minimum 2 years of work experience
2. All criteria for Regular category

Criteria for PART-TIME category:

1. Minimum 2 years of work experience
2. All criteria for Regular category

Date of Interview: 16 - 17 December 2021.
There will be no written test. Interview syllabus is specified in Annexure I.

Any applicant who satisfies the above mentioned criteria, but his/her name is not in the list can also appear for online interview on mentioned dates. Provided he/she has already applied within due date.

Engineering Mathematics: Vector space, basis, linear dependence and independence, matrix algebra, eigen values and eigen vectors, rank, solution of linear equations – existence and uniqueness. Calculus: Mean value theorems, theorems of integral calculus, evaluation of definite and improper integrals, partial derivatives, maxima and minima, multiple integrals, line, surface and volume integrals, Taylor series. Differential Equations: First order equations (linear and nonlinear), higher order linear differential equations, Cauchy's and Euler's equations, methods of solution using variation of parameters, complementary function and particular integral, partial differential equations, variable separable method, initial and boundary value problems. Vector Analysis: Vectors in plane and space, vector operations, gradient, divergence and curl, Gauss's, Green's and Stoke's theorems. Complex Analysis: Analytic functions, Cauchy's integral theorem, Cauchy's integral formula; Taylor's and Laurent's series, residue theorem. Numerical Methods: Solution of nonlinear equations, single and multi-step methods for differential equations, convergence criteria. Probability and Statistics: Mean, median, mode and standard deviation; combinatorial probability, probability distribution functions - binomial, Poisson, exponential and normal; Joint and conditional probability; Correlation and regression analysis.

Signals and Systems : Fourier series and Fourier transform representations, sampling theorem and applications; Discrete-time signals: discrete-time Fourier transform (DTFT), DFT, FFT, Z-transform, interpolation of discrete-time signals; LTI systems: definition and properties, causality, stability, impulse response, convolution, poles and zeros, parallel and cascade structure, frequency response, group delay, phase delay, digital filter design techniques.

a) Signal Processing/Communication or equivalent:

Communications: Autocorrelation and power spectral density, properties of white noise, filtering of random signals through LTI systems; Analog communications: amplitude modulation and demodulation, angle modulation and demodulation, spectra of AM and FM, superheterodyne receivers, circuits for analog communications; Information theory: entropy, mutual information and channel capacity theorem; Digital communications: PCM, DPCM, digital modulation schemes, amplitude, phase and frequency shift keying (ASK, PSK, FSK), QAM, MAP and ML decoding, matched filter receiver, calculation of bandwidth, SNR and BER for digital modulation; Fundamentals of error correction, Hamming codes; Timing and frequency synchronization, intersymbol interference and its mitigation; Basics of TDMA, FDMA and CDMA.

Electromagnetics: Electrostatics; Maxwell's equations: differential and integral forms and their interpretation, boundary conditions, wave equation, Poynting vector; Plane waves and properties: reflection and refraction, polarization, phase and group velocity, propagation through various media, skin depth; Transmission lines: equations, characteristic impedance, impedance matching, impedance transformation, S-parameters, Smith chart; Waveguides: modes, boundary conditions, cut-off frequencies, dispersion relations; Antennas: antenna types, radiation pattern, gain and directivity, return loss, antenna arrays; Basics of radar; Light propagation in optical fibers.

b) Image and Video Processing or equivalent:

Digital Signal Processing: Sampling and aliasing. Discrete Fourier transform (DFT) and properties, comparison between circular convolution and linear convolution, linear convolution from circular convolution. Direct evaluation of the DFT, The fast Fourier transform, Decimation-in-time (DIT) algorithm, Decimation-in-frequency (DIF) algorithm, differences and similarities between DIT and DIF algorithms and inverse DFT (IDFT). Frequency selective filters, design of digital filters from analog filters, design of lowpass, highpass, bandpass and band stop filters, design of IIR filters from analog filters, realization of digital filters. Linear phase FIR filters, frequency response of linear phase FIR filters and location of zeros, Design of FIR filters using windows, realization of FIR filters.

Digital Image Analysis: Digital image fundamentals; Image Enhancement in Spatial Domain; Gray Level Transformation, Histogram Processing, Spatial Filters; image Transforms; Fourier Transform and

their properties, Fast Fourier Transform; Image Enhancement in Frequency Domain; Colour Image Processing; Image warping and restoration; Image Compression; Image Segmentation; edge detection, Hough transform, region based segmentation; Morphological operators; Representation and Description; Features based matching and Bayes classification; Introduction to some computer vision techniques; Imaging geometry.