Entrance Exam Includes Questions from Following Subjects

SIGNALS AND SYSTEMS (15%)

Linear Time-Invariant (LTI) Systems: Signal representation, use of pulses; Discrete-time LTI-systems: the convolution sum; Continuous-time LTI-systems: the convolution integral; Properties of LTI-systems

Fourier Series and Transform: Fourier series: representation of periodic signals and properties; Fourier integral: representation of aperiodic and periodic signals; Forward and reverse/inverse Fourier transforms; Fourier transform properties

Fourier Analysis for Discrete Time Signals and Systems: Discrete time Fourier series: representation of periodic signals and properties; Discrete time Fourier transform (DTFT): representation of aperiodic signals; Forward and inverse/reverse DTFT; Properties of DTFT

Signal Transmission: Filtering: frequency selective and frequency shaping; Modulation

Noise, Energy and Power: White and colored noise, stochastic signals, finite energy and finite power signals, Parseval's theorems, signal to noise ratio

Sampling of Continuous Signals: Sampling and aliasing, the sampling theorem, conversion to discrete time signals, reconstruction and zero-order hold compensation

Discrete Time Signals and Systems: Discrete time systems and difference equations; z-transform: convergence, properties, finite impulse response (FIR) and infinite impulse response (IIR) filters, correlation: cross correlation and auto correlation

DIGITAL SIGNAL PROCESSING (15%)

Z-Transform: Definition of the z-transform, relation between the Z-transform and the Fourier transform of a sequence, properties: linearity, shifting, convolution, scaling, multiplication by K Vector sequences; Inverse z-transform: direct division, partial fraction expansions, the inverse integral; System response, transfer function $H(z)$, transient and steady state sinusoidal response - pole-zero relationships, stability.

Discrete filters: Filter structures, second order sections, ladder and wave filters; Frequency response; Sampling continuous signals, spectral properties of continuous signals, aliasing, anti-aliasing signals and reconstruction analog filters; Effects of sample and hold at filter input and output; Digital filters, finite precision implementations of discrete filters; Scaling & noise in digital filters, quantized signals, quantization error, linear models

Finite Duration Impulse Response (FIR) Digital Filters: FIR filter design by Fourier approximation, the complex Fourier series, Gibbs phenomena in FIR filter design approximations, applications of window functions to frequency response smoothing; Window functions, rectangular, Hanning, Hamming and Kaiser windows; FIR filter design by the frequency sampling method; FIR filter design using the Remez exchange algorithm; Linear phase FIR filters, unit sample response symmetry, group delay.

Infinite Impulse Response (IIR) Digital Filters : Classical filter design using polynomial approximations, Butterworth, Chebychev, elliptic and Bessel forms, IIR filter design by transformation-matched Z-transform, impulse-invariant transform and bilinear transformation, application of the bilinear transformation to IIR lowpass discrete filter design, spectral transformation, highpass, bandpass and notch filters

The Discrete Fourier Transform: The discrete Fourier transform (DFT) derivation, properties of the DFT, DFT of non-periodic data, use of window functions

Introduction of the Fast Fourier Transform (FFT): FFT computation methods, Spectral analysis and convolution using FFT, Power spectral density using DFT/FFT algorithms

ANALOG COMMUNICATIONS (10%)

ommunication Channels Overview: Free space, wire, cable waveguide and fiber, telephone and data channels

Linear Modulation: Modulation properties, AM and DSBSC modulation, demodulators and detectors-square law, synchronous demodulation, carrier recovery techniques, SSBSC modulation and demodulation, VSB modulation and applications, noise in AM broadcast techniques, AM stereo transmitter and receiver topologies

Angle Modulation: Instantaneous frequency and Bessel functions, frequency modulation and narrowband FM, modulator configurations, demodulators, discriminators, PLL discrete and IC, pre-emphasis, de-emphasis, threshold effect, noise and SNR in FM systems, FM receivers and FM stereo

Noise in Communication Systems: Mathematical representation in the time and frequency domain, I and Q components of noise, noise in linear and angle modulation systems

DIGITAL COMMUNICATION (15%)

Data Transmission and Digital Modulation Techniques: Signal receivers and error probability, optimum filters, the matched filter, coherent and non-coherent receivers, binary phase shift keying (BPSK), quadrature phase shift keying (QPSK) and M-ary PSK, frequency shift keying (FSK), imperfect synchronization and error probability in PSK and FSK systems, quadrature amplitude shift keying (QASK), other methods of digital modulation

Information Theory and Coding: Information content, entropy, information rate and coding, Shannon's theorem and channel capacity, parity bit coding for error detection and correction, block codes, coding and decoding, Hamming distance, examples of algebraic codes, introduction to convolution coding and decoding

Review of Sampling Theory: Pulse amplitude modulation (PAM) and bandwidth requirement, PAM natural and flat top sampling, signal recovery, quantization and quantization error

Pulse Code Modulation (PCM) : Encoders, decoders and companders, multiplexing and synchronizing, differential PCM, noise in PCM systems

Delta Modulation (DM): Characteristic encoding methods, adaptive DM and continuously variable DM, sigma delta modulation, noise in DM systems

ELECTROMAGNETIC (15%)

Introduction: Review of electromagnetism, Laplace's and Poisson's equations, boundary value problems, sinusoidally varying field, Maxwell's equation in phasor form.

Uniform Plane Waves: Uniform plane waves in free space, wave polarization, the wave equation and solutions for material media, wave impedances and intrinsic impedance, waves in dielectrics and conductors, Poynting vector, power dissipation, energy storage, refraction and reflection, standing waves, skin depth.

Transmission Lines: Transmission line configurations, transmission line equations, primary and secondary parameters, time domain analysis, discontinuties and reflection, shorted and open line, reflection coefficient, VSWR, arbitrary terminations, impedance matching, Smith Chart, matching methods, the dissipative transmission line.

Waveguides: Introduction to waveguides, TE and TM modes in a parallel-plate wave guide, dispersion, phase and group velocities, rectangular waveguides, cylindrical waveguides, cavity resonators, dielectric waveguides, optical waveguides and systems.

Antennas and Radiating Systems: Retarded potentials, the Hertzian dipole, radiation resistance, directivity, aperture and gain, thin linear antennas, arrays, aperture antennas,

ELECTRONIC DEVICES (15%)

Diodes: PN junction characteristics; Diode characteristics; Applications- half wave and full wave rectifiers (including bridge), DC and RMS output, efficiency, smoothing, ripple factor, conduction angle, and RC filtering; Regulation and Zener diode; LED

Bipolar Junction Transistor: Basic operation of PNP and NPN transistor action; CE, CB and CC configurations; CE characteristics; The CE transistor as a switch and simple amplifier; Thermal instability; Biasing arrangements; Load line and operating point; Saturation and cut-off; Non-linear region distortion; Transistor hybrid parameters; Small signal hybrid equivalent circuit

Field Effect Transistor: Junction field effect transistor (JFET): basic operation, characteristics, and parameters; IGFET (MOSFET): basic operation; Depletion and enhancement MOSFETs; FET as amplifier; Biasing; Small signal FET model

Amplifiers: Basic definition of amplification and gain; Use of decibel; Brief overview of amplifier types; Frequency and phase response; CR network model for transfer function; Multistage amplifiers and coupling; Brief introduction to cascaded amplifier, darlington pair, long tail pair and emitter follower and concept of tuned load; Design of simple single stage amplifier; Use of computer simulation packages.

Power Amplifiers: Class A power amplifier, AC load line; Matching transformer load; Efficiency; Choice of transistor; Amplifier classification (A, B, C); Class B push-pull amplifier, complementary pair, crossover distortion; Integrated circuit power amplifiers (one example)

Operational Amplifiers: Basic parameters of ideal operational amplifier; Derivation of gain for basic inverting and non-inverting amplifiers with feedback; Input offset voltage and current, input bias current, common mode rejection ratio, slew rate, full power bandwidth, and unity gain bandwidth; Integration, differentiation, addition, clipping and comparator circuits.

MATH (15%)

Calculus and Linear Algebra

Differential Equations and Complex Variables

Statistics and Probability

Types of Question:

i) **Objective.**