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| **EC4502** | **Communication Engineering** | **L-T-P: 3-0-0; Total 42 Lectures** |

**Prerequisite**

* Integral and Differential Calculus, Signals and Systems

**COURSE OBJECTIVE**

* The objective of this course is to introduce undergraduate students to the fundamentals of communication systems. After a brief review of signals and systems (mainly Fourier analysis), techniques of transmitting and receiving information signals using analog carrier modulation techniques (AM, FM, PM) are studied. A brief review of random processes is also being studied and baseband digital communication will be taught. The course also aims to introduce students the performance of these systems in the presence of channel noise.

**COURSE CONTENT**

**Unit-I:** Introduction to Communication Engineering; Block Diagram Representation of analog and digital Communication System; Review of signals and systems: Fourier series & Transform and their Properties; Distortion less transmission; Linear Time-invariant System; Hilbert transform; Pre-envelope and canonical representation of band pass signals (Lectures-7)

**Unit-II:** **Analog Modulation and Demodulation:** Amplitude and angle modulation and demodulation systems; Spectral analysis of these operations; Signal Multiplexing (TDM and FDM); Super-heterodyne Receivers and its Characteristics. (Lectures-12)

**Unit-III: Random Variables and Process:** Review of Probability and Random Variables; Random Processes: Basic Concepts- Introduction to Stochastic Processes, Statistical Averages, Autocorrelation and Cross-correlation, Orthogonality and Statistical Independence, Stationary and Ergodic Process, Wide – Sense Stationary Processes, Response of Linear System to Random Processes, Power Spectral Density of Stationary Processes and Sum Process, Statistical Properties of Additive White Gaussian Noise (Lectures - 9)

**Unit-IV:** **Digital Baseband Transmission for Analog Signal-** Sampling Theorem, Sampling of Low Pass Signals, Reconstruction of Sampled Signals, Interpolation, Aliasing Effects, Aperture Effect; PAM, PWM, PPM, Modulation and Demodulation; Pulse Code Modulation (PCM), Quantization Noise, Delta Modulation, Differential PCM (DCPM), Adaptive DCPM; Pulse Shaping:Nyquist Signals, Nyquist Pulse Shaping with Raised Cosine Filtering, Duobinary Signalling; Line Coding Techniques. (Lectures-10)

**Unit-V:** **Noise in Communication System-** Introduction To Noise; Noise Evaluation; Algebraic Representation of Noise; Effect of Noise on Analog Communication System; Effect of Noise on Linear Modulation Systems – SNR calculations for coherent and envelope detection; Effect of Noise on Angle Modulation – Signal to Noise Ratio; Threshold Effect; Pre emphasis & De-emphasis in FM; Repeaters for Signal Transmission (Lectures - 4)

**Text Books**

1. B.P. Lathi and Zhi Ding, ‘Modern Digital and Analog Communication Systems’, 4th Edition, Oxford University Press, 2009.

2. S. Haykin, “Communication Systems”, 5th ed., John Wiley, 2008.

3. S. Haykin, “Digital Communication Systems”, Student Edition, Wiley India Pvt. Ltd.

**Reference Books**

1. J G Proakis & M Salehi, ‘Communications Systems Engineering’, 2nd edition, Prentice-Hall, 2005.
2. Athanasios Papoulis and S. Unnikrishna Pillai, “Probability, Random Variables, and Stochastic Processes”, 4th Edition, Tata McGraw-Hill Education.
3. Principles of Communication Systems by Taub, Schilling and Saha, TMH
4. Electronic Communication Systems by Tomasi, Pearson.

**COURSE OUTCOMES**

Students would be able to –

CO1: Determine the spectral content of periodic and non-periodic signals by applying Fourier analysis.

CO2: Describe and analyse the mathematical techniques of generation, transmission and reception of amplitude modulation (AM), frequency modulation (FM) and phase modulation (PM) signals.

CO3: Evaluate the performance levels (Signal-to-Noise Ratio) of AM, FM and PM systems in the presence of additive white noise

CO4: Describe and analyse the generation and reception of analog pulse modulation and evaluate their performance in presence of noise.

CO5: Understand the basic baseband digital communication system.