Communication Engineering & Coding Theory
Code: CS401
Contacts: 3L
Credits: 3

Module - 1**: *Elements of Communication system, Analog Modulation & Demodulation, Noise, SNR* Analog- to- Digital Conversion**. (Basic ideas in brief) [8]
Introduction to Base Band transmission & Modulation (basic concept) ***(1L);***
Elements of Communication systems (mention of transmitter, receiver and channel); origin of noise and its effect, Importance of SNR in system design ***(1L);***
Basic principles of Linear Modulation (Amplitude Modulation) ***(1L);***
Basic principles of Non-linear modulation (Angle Modulation - FM, PM) ***(1L);***
Sampling theorem, Sampling rate, Impulse sampling, Reconstruction from samples, Aliasing ***(1L);***
Analog Pulse Modulation - PAM (Natural & flat topped sampling), PWM, PPM ***(1L);***
Basic concept of Pulse Code Modulation, Block diagram of PCM ***(1L);***
Multiplexing - TDM, FDM ***(1L);***

Module - 2**: Digital Transmission:** [8]
Concept of Quantisation & Quantisation error, Uniform Quantiser ***(1L);***
Non-uniform Quantiser, Alaw & law companding (mention only) ***(1L);*** Encoding, Coding efficiency ***(1L);***
Line coding & properties, NRZ & RZ, AMI, Manchester coding PCM, DPCM ***(1L);***
Baseband Pulse Transmission, Matched filter (mention of its importance and basic concept only), Error rate due to noise ***(2L);***
ISI, Raised cosine function, Nyquist criterion for distortion-less base-band binary transmission, Eye pattern, Signal power in binary digital signals ***(2L);***

Module - 3**: Digital Carrier Modulation & Demodulation Techniques:** [8]
Bit rate, Baud rate ***(1L);***
Information capacity, Shanon's limit ***(1L);***
M-ary encoding, Introduction to the different digital modulation techniques - ASK, FSK, PSK, BPSK, QPSK, mention of 8 BPSK, 16 BPSK ***(2L);***
Introduction to QAM, mention of 8QAM, 16 QAM without elaboration ***(1L);***
Delta modulation, Adaptive delta modulation (basic concept and importance only, no details ***(1L);*** introduction to the concept of DPCM, Delta Modulation, Adaptive Delta modulation and their relevance ***(1L);***
Spread Spectrum Modulation - concept only. ***(1L)***.

Module - 4**: Information Theory & Coding**: [8]
Introduction, News value & Information content ***(1L);***
Entropy ***(1L);***
Mutual information ***(1L);***
Information rate ***(1L);***
Shanon-Fano algorithm for encoding ***(1L);***
Shannon's Theorem - Source Coding Theorem ***(1L);***
Channel Coding Theorem, Information Capacity Theorem (basic understanding only) ***(1L);***
Error Control & Coding - basic principle only. ***(1L);***

Text Books:
1. An Introduction to Analog and Digital Communications by Simon Haykin; Published by Wiley India.
2. Data Communication and Networking by Behrouz A. Forouzan, Published by Tata McGraw-Hill
References:
1. Communication Systems 4th Edition by Simon Haykin; Published by Wiley India (Student Edition)
2. Principles and Analog and Digital Communication by Jerry D Gibson, Published by MacMillan.
3. Communication Systems by A. B. Carlson, Published by McGraw-Hill.

Learning Outcome: [These are the minimum competence to be developed; the students will be encouraged to learn more and acquire better understanding.]

Module -1: The student will be able to differentiate between base-band transmission and modulation and **compute antenna size** from knowledge of carrier frequency; (Tutorial: To identify different communication processes based on these two methods and appreciate their relative merit and demerit); The learner will be able to **determine the carrier and message frequencies** from the expression for AM signals and Angle modulated signals. Given an expression for a modulated signal, the student must be able to **recognize the type of modulation**. The ability to explain each and every block of the PCM system must be acquired.

Module -2: The student must be able to appreciate the importance of digital modulation over analog modulation in respect of noise immunity (concept); The student will be able to compute the coding efficiency of binary and decimal coding systems; The relative merits and demerits of the different digital modulation techniques to be understood clearly; (Tutorial: Students should be encouraged to find out where these different modulation techniques are used in everyday life); Capability to calculate signal power in digital systems to be mastered.

Module -3: Ability to compute bit rate and baud rate for different signals to be developed; the student must be able to compare between the channel capacity in case of channels of varying band-width and SNR value and predict the maximum data rate possible; The learner must be able to compare the merits and short comings of the basic digital modulation techniques. (Tutorial: Find out the area of application for each with reason for such application)

Module -4: Student will be able to calculate the information content, entropy and information rate for given situations; He/she will be able to appreciate the importance of the different line coding and error coding techniques. (Tutorial: Find out the range of applicability).