COMUNICATION SYSTEM I

EX 652

Lecture : 3 **Year : III**
Tutorial : 1 **Part : II**
Practical : 3/2

Course Objectives:

To introduce the student to the principles and building blocks of analog communication systems.

1. Introduction **(4 hours)**

1.1 Analog and Digital communication sources, transmitters, transmission channels and receivers.
1.2 Noise, distortion and interference. Fundamental limitations due to noise, distortion and interference.
1.3 Types and reasons for modulation.

2. Representation of signals and systems in communication **(4 hours)**

2.1 Review of signals (types, mathematical representation and applications)
2.2 Linear/non-linear, time variant/invariant systems. Impulse response and transfer function of a system. Properties of LTI systems.
2.3 Low pass and band pass signals and systems, bandwidth of the system, distortionless transmission, the Hilbert transform and its properties.
2.4 Complex envelops rectangular (in-phase and quadrature components) and polar representation of band pass band limited signals.

3. Spectral Analysis **(4 hours)**

3.1 Review of Fourier series and transform, energy and power, Parseval's theorem
3.2 Energy Density Spectrum, periodogram, power spectral density function (psdf)
3.3 Power spectral density functions of harmonic signal and white noise
3.4 The autocorrelation (AC) function, relationship between psdf and AC function.

4. Amplitude Modulation **(12 hours)**

4.1 Time domain expressions, frequency domain representation, modulation index, signal bandwidth
4.2 AM for a single tone message, carrier and side-band components, powers in carrier and side-band components, bandwidth and power efficiency
4.3 Generation of DSB-FC AM

4.4 Double Side Band Suppressed Carrier AM (DSB-AM), time and frequency domain expressions, powers in side-bands, bandwidth and power efficiency
4.5 Generation of DSB-AM (balanced, ring modulators)
4.6 Single Side Band Modulation, time and frequency domain expressions, powers
4.7 Generation of SSB (SSB filters and indirect method)
4.8 Vestigial Side Bands (VSB), Independent Side Bands (ISB) and Quadrature Amplitude Modulations (QAM)

5. Demodulation of AM signals (6 hours)

5.1 Demodulation of DSB-FC, DSB-SC and SSB using synchronous detection
5.2 Square law and envelop detection of DSB-FC
5.3 Demodulation of SSB using carrier reinsertion , carrier recovery circuits
5.4 Phase Locked Loop (PLL), basic concept, definitions, equations and applications, demodulation of AM using PLL

6. Frequency Modulation (FM) and Phase Modulation (PM) (12 hours)

6.1 Basic definitions, time domain expressions for FM and PM
6.2 Time domain expression for single tone modulated FM signals, spectral representation, Bessel's functions
6.3 Bandwidth of FM , Carson's rule, narrow and wideband FM
6.4 Generation of FM (direct and Armstrong's methods)
6.5 Demodulation of FM and PM signals, synchronous (PLL) and non-synchronous (limiter-discriminator) demodulation
6.6 Stereo FM, spectral details, encoder and decoder
6.7 Pre-emphasis and de-emphasis networks
6.8 The superheterodyne radio receivers for AM and FM

7. Frequency Division Multiplexing (FDM) (3 hours)

7.1 Principle of frequency division multiplexing, FDM in telephony, hierarchy
7.2 Frequency Division Multiple Access (FDMA) systems- SCPC, DAMA, SPADE etc.
7.3 Filter and oscillator requirements in FDM.

Practical

1. Demonstration of power spectrum of various signals using LF spectrum analyzer
2. Generation of DSB-SC, DSB-FC and SSB signals
3. Demodulation of AM signals (synchronous and non-synchronous methods)
4. Generation of FM signals

5. Demodulation of FM signal (limiter-discriminator)
6. Operation of PLL, PLL as demodulator of AM and FM signals.

References:

1. S. Haykin, Analog and Digital communication systems
2. Leon Couch, Digital and analog communication systems
3. B.P.Lathi, Analog and Digital communication systems
4. J. Proakis, Analog and Digital communication systems
5. D. Sharma, Course manual "Communication Systems I".