

Analog Communication

Code: EC501

Contact: 3L + 1T

Credits: 4

1. Introduction: Elements of Communication System-Transmitters, transmission channels and receivers; Concepts of modulation. [2]

2. Continuous Wave Linear Modulation:

Amplitude modulation (AM):- Time domain expression of baseband signal; modulation index, frequency domain (spectral) representations, phasor diagram, AM transmission bandwidth; AM for a single tone message- carrier and side band components; Transmission requirements for AM, normalized power and side band power.

Double side band suppressed carrier modulation (DSBSC/DSB) - time and frequency domain expressions; Transmission requirements for DSB, bandwidth and transmission power for DSB; Generation of DSB, square law modulators, balanced modulators, ring modulators, switching modulators.

Single side band modulation (SSB):- Basic concept, SSB with suppressed/reduced carrier, advantages and generation of SSB; transmit band width and power, side band filter examples.

Vestigial side band modulation (VSB)- Basic concept and application [8]

3. Demodulation of Linear Modulated Signals:

Demodulation of AM signals- square law and envelope detectors; The super heterodyne receiver for standard AM radio; Synchronous demodulation of AM, DSB and SSB using synchronous detection, Effects of frequency and phase errors in the local oscillator in DSB and SSB

Demodulation of SSB with pilot carrier, use of SSB in telephony.

Phase-Locked Loop (PLL):- Carrier recovery circuits, Basic operation of PLL, mathematical analysis, applications. [6]

4. Angle Modulation (FM/PM):

Instantaneous frequency instantaneous phase, time domain representation for FM and PM, Narrow band angle modulation with frequency and phase, modulation index, Phasor diagram. FM and PM signals for a single tone message, spectral representation, power and effective bandwidth. Generation of wide band FM using Armstrong method, commercial FM requirements. Detection of FM and PM signals, limiter discriminator. Demodulation of PM using PLL. FM broadcasting and stereo FM radio. [8]

5. Random Signals and Noise:

Random Process- Stationary Process, Auto-correlation and power spectral density function (PSDP), Representation of band limited and band pass processes.

Noise sources, White noise, thermal noise, shot noise, PSDF of white signals.

Input and output relationship for random signals and noise passed through a linear invariant system, band limited noise, ARC filtering of white noise. The noise bandwidth of a linear time invariant system and its use in communication.

Narrow band noise representation, generation of narrow band noise and PSDF time domain expression for narrow band noise. [6]

6. Noise Performance of Analog Communication Systems:

Signal-to-noise ratio (SNR) in linear modulation, synchronous detection of DSB.

SNR for AM -DSB and SSB, comparison of DSB, SSB and AM Effect of noise in envelope and square law detection of AM, threshold effects in nonlinear detectors.

SNR for FM, SNR improvement using pre-emphasis and de-emphasis. FM threshold effects, noise clicks in FM system. Comparison of linear and exponential modulation system for additive white band-limited noise channels. [6]