



# GUJARAT TECHNOLOGICAL UNIVERSITY

Subject Name : ELECTRONICS AND COMMUNICATION

SUBJECT CODE: 3154701

B.E. 5<sup>th</sup> SEMESTER

**Type of course:** Mathematical analysis, designing, building and testing analog communications systems with applications to telecommunication systems.

**Prerequisite:** Fourier series, Fourier Transforms, Circuit Theory

**Rationale:** This course explores the fundamentals of electronic communication systems. The course has two primary focuses:

- (1) Understanding electronic communications systems in analog form from deterministic approach
- (2) Design and analysis of analog communications systems.

### Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks			Practical Marks			
			ESE (E)	PA (M)		ESE (V)		PA (I)		
PA	ALA	ESE		OEP						
4	0	2	5	70	20	10	20	10	20	150

### Content:

Sr. No.	Content	Total Hrs	%Wei
1	<b>Introduction to communication systems:</b> Communication system, Analog and digital Messages, Channel effect, Modulation and detection, Bandwidth of different information signals, Historical review of telecommunication, Applications	3	2
2	<b>Analysis and transmission of signals:</b> Aperiodic (non-periodic) signal representation by Fourier integral, Fourier transforms of some useful functions, signal transmission through a linear system, signal distortion over a communication channel, Signal energy and energy spectral density, signalpower and power spectral density.	6	12
3	<b>Passive Circuits:</b> Introduction, Series tuned circuits, Parallel tuned circuits, self-capacitance of a coil, Skin effect.	3	5
4	<b>Amplitude modulation(AM)/Demodulation:</b> Concept of modulation, Mathematical representation of sinusoidal Amplitude modulated signals in time and frequency domain- Double sideband Full carrier (DSBFC) , Double sideband suppressed carrier(DSBSC) and single sideband suppressed carrier modulations(SSBSC), Vestigial Sideband (VSB)	10	18

	modulation and Quadrature amplitude modulation(QAM), power and bandwidth calculations for DSBFC, DSBSC, SSBSC, VSB and QAM modulations, Non sinusoidal AM – effective modulation index, Effective voltage and current for sinusoidal and non-sinusoidal AM, AM generation: FET balanced modulator and IC balanced modulator circuits, Diode ring modulator, SSB generation: balanced modulator-filter method, phasing method and the third method, AM detection: peak (envelope detector), synchronous detectors, square law detectors.		
5	Angle modulation/demodulation: Concept of instantaneous frequency and angle modulation, sinusoidal FM and its time domain representation, spectral components of angle modulated signals, power in sinusoidal FM and modulation index, Carson's rule, equivalence between Frequency modulation(FM) and Phase modulation(PM), Angle modulator circuits, Fm transmitters, Armstrong method of FM generation, Fm stereo broadcast, FM detection: Basic slope detector, Foster-Seeley discriminator, ratio detector, PLL detector and Quadrature detector, Concept of Amplitude limiter, Pre-emphasis and de-emphasis circuits, Interference in angle modulated systems.	12	24
6	Radio receivers: Functions of radio receivers, working of super heterodyne radio receivers, tuning ranges, tracking, sensitivity and gain, image rejection, spurious responses, Adjacent channel selectivity, Automatic gain control, Electronically tuned, receivers, IC receivers, AM receivers, FM receivers	8	16
7	Noise: Introduction, thermal noise, Shot noise, Partition Noise, Low frequency noise, Burst noise, a noise, High frequency noise, BJT and FET noises, Equivalent input noise generators, Signal to noise ratio (SNR), SNR of Tandem connection, Noise factor and noise figure, Amplifier input noise in terms of noise figure, Noise factor in cascaded amplifiers, Noise factor and equivalent input noise generators, noise factor of a lossy network, Noise temperature, Measurement of noise temperature and noise factor, narrow-band band pass noise. Behavior of Analog systems in presence of Noise	8	16
8	Introduction of amateur radio technology What is Ham radio? How to become radio amateur? Importance of Ham radio during natural calamities, Technology used in amateur radio	2	6

**Suggested Specification table with Marks (Theory):**

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	15	20	35	10	10

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)**

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

### Reference Books:

1. Electronic Communications by Dennis Roddy & John Coolen IV Edition PHI.
2. Digital and analog communication system by B.P.Lathi .Zhi Ding (international 4<sup>th</sup> Edition), OXFORD university press.
3. Electronic Communications by Kennedy McGraw Hill Publication.
4. Electronic Communications Systems by Wayne Tomasi. Pearson education India.
5. Electronic Communication Systems by Roy Blake By Cengage learning.
6. Communication Systems By Simon Haykins By Wiley India.
7. Theory and Problem Of Electronic Communication By Lloyd Temes and Mitchel E.Schulz(Second edition), McGraw Hill Publication.

### Course Outcome:

After learning the course the students should be able to:

- [1] To understand the basics of communication system.
- [2] To analyze different type of passive circuits (Tuned circuits).
- [3] To study different types of noise in communication systems, their effect on communication systems and parameters to analyze noise in the system.
- [4] To understand basic blocks and operations of different stages of super-heterodyne receiver.
- [5] To study the Fourier transforms to analyze different signals and systems and observe frequency content of signal using spectrum analyzer.
- [6] To study the need of modulation and understand the basic concept of amplitude modulation and phase modulation.
- [7] To understand different techniques for amplitude modulation and demodulation.
- [8] To understand the different techniques for frequency modulation and demodulation.
- [9] To plot frequency response of communication circuits like RF amplifier, IF amplifier, pre-emphasis and de-emphasis.
- [10] To learn working of AM/FM Transmitters
- [11] To become aware of amateur radio technology

### List of Experiments:

1. To observe amplitude modulation waveforms for different modulation index.
2. To observe frequency modulation waveform and to measure peak frequency deviation.
3. To observe frequency spectrum of AM and FM waveforms.
4. To generate amplitude modulation signal.
5. To extract information signal from AM signal using diode detector.
6. To extract information signal from FM signal using ratio detector or PLL detector.
7. To obtain frequency response of pre-emphasis and de-emphasis circuits.
8. To obtain frequency response of RF amplifier.
9. To understand working of AGC circuit. To measure output of amplifier circuit with and without AGC circuit.
10. To generate and detect SSB signal.
11. To obtain fidelity response of AM or FM receiver.
12. To understand block diagram of FM receiver and observe signals at different stages.
13. Visit of AM/FM radio station

**Mini Project:**

To construct AM or FM transmitter and receiver.

**Design based Problems (DP)/Open Ended Problem:**

- Design FM transmitter/receiver for 50 MHz to use within educational campus.
- Design parallel LC tune circuit to amplify signal of frequency 890 MHz

**Major Equipment:**

- Digital storage oscilloscope
- RF Signal generator
- Function generator
- Spectrum Analyzer (optional)
- Communication Engineering trainer kits like Generation and detection of Amplitude and frequency modulation

**List of Open Source Software/learning website:**

- NPTEL Video lectures
- gEDA Analog Simulation tool to simulate analog communication circuits (In Linux operating system)
- Website for Amateur radio technology: <http://www.arrl.org/technology>
- SCILAB

**ACTIVE LEARNING ASSIGNMENTS:** Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.