

## COURSE OUTCOMES

- CO 1: Analyze signal attributes and apply the concept of Fourier transform and series to observe signal in frequency and time domain, and explore the concepts of stochastic processes.
- CO 2: Select appropriate analog modulation techniques for specified broadcasting requirements and design corresponding transmission and reception systems with their spectral representations.
- CO 3: Apply the concept of sampling theorem to develop and analyze different Pulse Modulation based communication systems including PCM and their integration with TDM system for signal transmission and reception.
- CO 4: Apply problem solving skills to recommend appropriate digital communication techniques considering the principle of operation of ASK,FSK,PSK,QPSK and QAM.
- CO 5: Analyze the significance of various terminologies associated with Wireless and Satellite Communication and evaluate the performance
- CO 6: Analyze the significance of signal communication with Optical Communication technology and various and various applications.

## COURSE DETAILS

### Introduction

Basic communication system , Signals in time and frequency domain, Fourier transform and Series, properties of FT and FS, Various Signal functions, Brief Idea of Probability, Cumulative Distributive Function, Probability Density Function, Gaussian and Rayleigh PDF. Concept of Signal to Noise Ratio.

### Amplitude Modulation Techniques

Need of Modulation, Frequency Translation, Principle of AM, side bands, Power Relationship, Assignable Frequency spectrum, Side band Transmission, DSB, SSB, VSB, AM modulators and demodulators, AM Radio Receiver, Super hetero-dyne Principle.

### Frequency Modulation Techniques

Principle of FM, Frequency Deviation, Spectrum of FM wave, Power in Modulated wave, Narrow band FM, Pre-emphasis and De-emphasis, Block Diagram of FM Transmitter, FM Detector, Block Diagram of FM Receiver,

### Pulse Modulation Techniques

Analog vs Digital modulation, Sampling Process, Pulse Amplitude Modulation, Pulse Width Modulation, Pulse Position Modulation, Time Division Multiplexing, Frequency Division Multiplexing, The Quantization Process, Pulse Code Modulation, Bandwidth vs SNR trade-off in PCM.

### Digital Modulation

Data Form, Principles involved in ASK, PSK (BPSK, QPSK,  $\pi/4$  QPSK), FSK.

### Different Communication Systems

Introduction to Modems, Brief concept of satellite communication, Fiber optic communication and Mobile communication.

### Textbooks:

1. B.P. Lathi, Modern Digital and Analog Communications Systems, Oxford Univ Press, 4<sup>th</sup> Edition.
2. Simon Haykin, Introduction to Analog & Digital Communication System, .Wiley Student edition 2011

### Reference book:

1. H. Taub, and D.L. Schilling, Principles of Communication System, McGraw Hill, 3rd Edition



## FORMAT-1

Semester: 4<sup>th</sup>

Programme: B.Tech.. Regular

Branch/Specialization: ECSc

### SPRING END SEMESTER EXAMINATION

4<sup>th</sup> Semester, ECSc (B.Tech.)

### COMMUNICATION ENGINEERING

EC20008

Time: 2.5 Hours

Full Marks: 50

Answer any SIX questions.

Question paper consists of four SECTIONS i.e. A, B, C and D.

Section A is compulsory.

Attempt minimum one question each from Sections B, C, D.

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable and all parts of a question should be answered at one place only.

SECTION-A (Learning levels 1 and 2)				Learning levels as per Bloom's taxonomy	Course Outcomes (CO)
1.		Answer the following questions.	[1 × 10]		
	(a)	The CDF of a Random Variable is given as $F_X(x) = \begin{cases} 0, & x < 0 \\ kx^3, & 0 < x < 9 \\ 900k, & 9 < x < \infty \end{cases}$ ; Then find the value of P(5 < x ≤ 8)	1	1	1
	(b)	State any two Kepler's laws of planetary motion for satellite communication.	1	2	5
	(c)	A carrier of frequency 10 <sup>6</sup> Hz and amplitude 3 V is frequency modulated by a sinusoidal modulating signal frequency 500 Hz and of peak amplitude 1 V. The frequency deviation is 1 kHz. The level of the modulating waveform is changed to 5 V peak and the modulating frequency is changed to 2 kHz. Write the expression of the new FM signal.	1	1	2
	(d)	List the names of various analog and digital modulation schemes.	1	1	2
	(e)	Define noise in communication and state the significance of signal to noise ratio (SNR).	1	1	2
	(f)	In an AM Super Heterodyne Receiver, the incoming signal has a frequency of 0.535 MHz. Find the local oscillator frequency and image frequency for the incoming signal with an intermediate frequency of 0.455 MHz	1	1	2
	(g)	The signal x(t)=12cos(800πt)cos(1800πt) is ideally sampled at 4600 samples/sec. Does it show Aliasing Effect? Justify.	1	2	3

	(h)	Explain Half Duplex and Full Duplex systems with example.	1	2	6
	(i)	Represent the binary data stream 11100 in the given line coding format: (i) Unipolar NRZ                      (ii) AMI RZ	1	1	4
	(j)	Draw a diagram to illustrate the concept of frequency reuse in mobile communication.	1	2	5
<b>SECTION-B</b> (Learning levels 1,2, and 3)				Learning levels as per Bloom's taxonomy	Course Outcomes (CO)
2.	(a)	Identify and discuss any two needs for modulation. Explain how the frequency shifting property of Fourier transform is related to modulation. Draw the block diagram of a communication system.	[4]	1,3	1,2
	(b)	Demonstrate the method of Square Law Modulator for AM generation with neat diagram and equations.	[4]	2	2
3.	(a)	Draw and explain the block diagram of AM Super Heterodyne Receiver. List the advantages of superheterodyne principle.	[4]	2	2
	(b)	A modulating signal is given as $m(t)=2\cos 200t + \cos 400t$ .  (i) Write the time domain expression of DSB-SC signal $S(t) = 2m(t)\cos 1000t$ .  (ii) Apply Fourier Transform to evaluate the frequency domain equation and plot the frequency spectrum.  (iii) Sketch the spectrum when you suppress the carrier. Identify the type of modulation technique obtained.	[4]	3	1,2
<b>SECTION-C</b> (Learning Levels 3 and 4)				Learning levels as per Bloom's taxonomy	Course Outcomes (CO)
4.	(a)	Derive the time domain and frequency domain equations of NBFM and show how narrow band FM has same bandwidth to that of AM signal with proper equations. Plot the spectrum of narrowband FM.	[4]	4	2
	(b)	Construct a block diagram of the Indirect method of Armstrong FM modulator to generate an FM signal with a carrier frequency of 98.1 MHz and $\Delta f = 75$ kHz. Narrowband FM generator is available at a carrier frequency of 100 kHz and a frequency deviation $\Delta f = 10$ Hz. A stock room also has an oscillator with an	[4]	3	2

		frequency of 11 MHz . Select appropriate multiplier constants for designing the multipliers.			
5.	(a)	Draw block diagram of a PCM system .Discuss on the method of sampling used , principle of uniform quantisation and encoding. Write the function of regenerative repeater.	[4]	3	3
	(b)	A sinusoidal signal of amplitude ranging from -2V to +2V and band limited to 7 kHz is transmitted through a PCM channel. Given the sampling rate is thrice the Nyquist rate and the maximum quantization error is 0.1 % . Identify ( i)Code word length (ii)Transmission bandwidth (iii)Final bit rate (iv)Output signal to quantization noise ratio	[4]	4	3
6.	(a)	Compare BASK and BPSK modulation techniques with respect to their mathematical equations, waveforms and analyse their signal space diagrams.	[4]	4	4
	(b)	With mathematical expressions, block diagram of transmitter and waveforms explain the BFSK modulation technique used for modulating message bits 10011 .	[4]	3	4
<b>SECTION-D</b> (Learning levels 4,5,6)				Learning levels as per Bloom's taxonomy	Course Outcomes (CO)
7.	(a)	(i) State advantage and disadvantage of optical communication. Mention different types of optical fibers.  (ii) A multimode step-index fiber has glass core( $n_1 = 1.5$ ) and fused quartz cladding ( $n_2 = 1.46$ ). Determine (i) Critical angle (ii)Acceptance angle (iii)Numerical aperture (iv)Numerical aperture, if cladding is air	[4]	5	6
	(b)	Draw and explain the block diagram of satellite communication. Analyze the reason for keeping the uplink frequency higher than the down link frequency	[4]	4	5
8.	(a)	Using a comparator and a sawtooth generator construct a diagram to generate PWM signal. Also discuss the generation of PPM from PWM with a block diagram and waveforms and briefly explain the process.	[4]	5	3
	(b)	With a neat block diagram explain Frequency Division	[4]	4	2

		<p>Multiplexing.</p> <p>Four signals each band-limited to 5,9,11,14 kHz are transmitted through a FDM channel simultaneously and the modulators used are AM,DSB,SSB and VSB respectively. Determine the minimum bandwidth of FDM channel assuming a guard band of 0.4 kHz and vestige bandwidth of 0.2 kHz</p>			
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