INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE DESCRIPTOR

Course Title	**ANALOG COMMUNICATIONS**				
Course Code	**AEC005**				
Programme	B.Tech				
Semester	IV	ECE			
Course Type	Foundation				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	3	2
Chief Coordinator	Ms.L.Shruthi, Assistant Professor, ECE				
Course Faculty	Dr.P.Munisamy, Professor, ECE Ms.G.Ajitha, Assistant Professor, ECE Ms.P.Saritha, Assistant Professor, ECE Ms.L.Shruthi, Assistant Professor, ECE				

I. COURSE OVERVIEW:

This subject is concerned with the theory of systems for the conveyance of information. The transmission of information-bearing signal over a band pass communication channel, such as telephone line or a satellite channel usually requires a shift of the range of frequencies contained in the signal to another frequency range suitable for transmission. A shift in the signal frequency range is accomplished by modulation. This subject introduces the definition of modulation, need of modulation, types of modulation- AM, PM and FM, Various types of AM, spectra of AM, bandwidth requirements, Generation of AM & DSB-SC, detection of AM & DSB-SC, and power relations.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
UG	AHS011	III	Mathematical Transform Techniques

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Analog Communications	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✘	Videos
✘	Open Ended Experiments						

V. EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into five units and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	**Theory**		**Total Marks**
Type of Assessment	CIE Exam	Quiz / AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Lectures, Assignments.
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	3	Lab related exercises
PO 5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.	2	Design Exercises.

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Professional Skills:** An ability to understand the basic concepts in Electronics & Communication Engineering and to apply them to various areas, like Electronics, Communications, Signal processing, VLSI, Embedded systems etc., in the design and implementation of complex systems.	3	Seminar
PSO 2	**Problem-Solving Skills:** An ability to solve complex Electronics and communication Engineering problems, using latest hardware and software tools, along with analytical skills to arrive cost effective and appropriate solutions.	2	Lab related exercises
PSO 3	**Successful Career and Entrepreneurship:** An understanding of social-awareness & environmental-wisdom along with ethical responsibility to have a successful career and to sustain passion and zeal for real-world applications using optimal resources as an Entrepreneur.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Develop skills for analyzing different type's signals in terms of their properties such as energy, power, and correlation and apply for analysis of linear time invariant systems.
II	Analyze various techniques of generation and detection of amplitude modulation, frequency modulation, and phase modulation signals.
III	Differentiate the performance of AM, FM, PM systems in terms of Power, Bandwidth and Signal-to-Noise Ratio.
IV	The major objectives of this subject are for the students to establish a firm foundation for the understanding of telecommunication systems and evaluate analog Communication system in terms of the complexity of the transmitters and receivers.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AEC005.01	CLO 1	Discuss the modeling of idealized signals and analyze the periodic signals with the help of Fourier Transform..	PO 1, PO 2	3
AEC005.02	CLO 2	Discuss about the system and their classifications based on properties and derive the transfer function of linear time variant and invariant system.	PO 1, PO 2	3
AEC005.03	CLO 3	Understand and analyze the concept of convolution and correlation of signals.	PO 1, PO 2	3
AEC005.04	CLO 4	Discuss about the basic elements of communication system, importance of modulation and different types of modulation.	PO 2	2
AEC005.05	CLO 5	Understand the time domain, frequency domain description and power relations of amplitude modulation, various techniques of generation and detection of AM. Noise in AM.	PO 1, PO 2	3
AEC005.06	CLO 6	Analyze the time domain, frequency domain description of Double Side Band Suppressed Carrier (DSB SC), various generation techniques and detection techniques of DSB SC, Noise in DSB SC.	PO 1, PO 2	3
AEC005.07	CLO 7	Understand the time domain, frequency domain description of amplitude modulation single side band modulated wave, various techniques of generation and detection of SSB, Noise in SSB SC.	PO 2	3
AEC005.08	CLO 8	Analyze the time domain, frequency domain description of Vestigial side band modulation, generation and detection of VSB.	PO 1	3
AEC005.09	CLO 9	Discuss the comparison of different amplitude modulation techniques and applications of various amplitude systems.	PO 2	3
AEC005.10	CLO 10	Analyze the basic concepts of Frequency modulation like single tone , spectrum analysis of frequency modulated wave and transmission bandwidth of FM.	PO 1	3
AEC005.11	CLO 11	Understand the concepts of narrow band frequency modulation, wide band frequency modulation and pre emphasis and de emphasis circuits in FM.	PO 1	3
AEC005.12	CLO 12	Discuss the generation of frequency modulation waves by direct method and indirect method and detection methods like balanced frequency discriminator, foster seeley discriminator, phase locked loop etc.,	PO 1	3
AEC005.13	CLO 13	Discuss the concept of receivers in communication system and receiver types like tuned radio frequency receiver and super heterodyne receiver.	PO 1	3

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AEC005.14	CLO 14	Analyze the characteristics of the receiver like sensitivity, selectivity, image frequency rejection ratio, choice of intermediate frequency and fidelity.	PO 1, PO 2	3
AEC005.15	CLO 15	Understand the concept of sampling and its types, and analyze the graphical and analytical proof for band limited signals.	PO 2	3
AEC005.16	CLO 16	Apply the concept of analog communication to understand and analyze real time applications.	PO 4	2
AEC005.17	CLO 17	Acquire the knowledge and develop capability to succeed national and international level competitive examinations.	PO 4	2

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

CLOs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3	3											3	2	
CLO 2	3	3											3	2	
CLO 3	3	3											3	2	
CLO 4	2														
CLO 5	3	3											3	2	
CLO 6	3	3											3	2	
CLO 7		3											3	2	
CLO 8	3														
CLO 9		3													
CLO 10	3												3	2	
CLO 11	3														
CLO 12	3														
CLO 13	3												3	2	
CLO 14	3	3													
CLO 15		3													
CLO 16					2										

CLO 17					2										

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO 1, PO 2, PO 5	SEE Exams	PO 1, PO 2, PO 5	Assignments	PO 1	Seminars	PO 2
Laboratory Practices	PO 5	Student Viva	-	Mini Project	-	Certification	-
Term Paper	-						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIII. SYLLABUS:

Unit-I	**SIGNAL ANALYSIS AND LTI SYSTEMS**
Classification of signals and study of Fourier transforms for standard signals, definition of signal bandwidth; Systems: Definition of system, classification of systems based on properties, linear time invariant system , impulse, step, sinusoidal response of a linear time invariant system, transfer function of a linear time invariant system, distortion less transmission through a linear time invariant system; system bandwidth; Convolution and correlation of signals: Concept of convolution, graphical representation of convolution, properties of convolution; Cross correlation ,auto correlation functions and their properties, comparison between correlation and convolution	
Unit-II	**AMPLITUDE AND DOUBLE SIDE BAND SUPPRESSED CARRIER MODULATION**
Introduction to communication system, need for modulation, frequency division multiplexing; Amplitude modulation, definition; Time domain and frequency domain description, single tone modulation, power relations in amplitude modulation waves; Generation of amplitude modulation wave using ,square law and switching modulators; Detection of amplitude modulation waves using square law and envelope detectors; Double side band modulation: Double side band suppressed carrier time domain and frequency domain description; Generation of double side band suppressed carrier waves using balanced and ring modulators; Coherent detection of double side band suppressed carrier modulated waves; Costas loop; Noise in amplitude modulation, noise in double side band suppressed carrier.	
Unit-III	**SINGLE SIDE BAND MODULATION AND VESTIGIAL SIDE BAND MODULATION**
Frequency domain description, frequency discrimination method for generation of amplitude modulation single side band modulated wave; time domain description; Phase discrimination method for generating amplitude modulation single side band modulated waves; Demodulation of single side band waves. Noise in single side band suppressed carrier; Vestigial side band modulation: Frequency description, generation of vestigial side band modulated wave; Time domain description; Envelope detection of a vestigial side band modulation wave pulse carrier; Comparison of amplitude modulation techniques; applications of different amplitude modulation systems.	
Unit-IV	**ANGLE MODULATION**
Basic concepts, frequency modulation: Single tone frequency modulation, spectrum analysis of sinusoidal frequency modulation wave, narrow band frequency modulation, wide band frequency modulation, transmission bandwidth of frequency modulation wave, phase modulation, comparison of frequency modulation and phase modulation; Generation of frequency modulation waves, direct frequency modulation and indirect frequency modulation, detection of frequency modulation waves: Balanced frequency discriminator, Foster Seeley discriminator, ratio detector, zero crossing detector,	

phase locked loop, comparison of frequency modulation and amplitude modulation; Noise in angle modulation system, threshold effect in angle modulation system, pre-emphasis and de-emphasis.	
Unit-V	**RECEIVERS AND SAMPLING THEORM**
Receivers: Introduction, tuned radio frequency receiver, super heterodyne receiver, radio frequency amplifier, mixer, local oscillator, intermediate frequency amplifier, automatic gain control; Receiver characteristics: Sensitivity, selectivity, image frequency rejection ratio, choice of intermediate frequency, fidelity; Frequency modulation receiver, amplitude limiting, automatic frequency control, comparison with amplitude modulation receiver; Sampling: Sampling theorem, graphical and analytical proof for band limited signals, types of sampling, reconstruction of signal from its samples.	
Text Books:	
1. B.P. Lahti, "Signals, Systems and Communications", BS Publications, 5th Edition, 2009. 2. S. S. Haykin, "Communication Systems", Wiley Eastern, 2nd Edition, 2006. 3. Taub, Schilling, "Principles of Communication Systems", Tata McGraw-Hill, 4th Edition, 2013	
Reference Books:	
1. B.P. Lathi, "Communication Systems‖, BS Publication", 2nd Edition, 2006. 2. John G. Proakis, Masond, Salehi, "Fundamentals of Communication Systems", PEA, 1st Edition, 2006 3. George Kennedy, Bernard Davis, "Electronics and Communication System", Tata McGraw Hill , 5th Edition, 2011.	

XIV. COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

Lecture No	Topics to be covered	CLOs	Reference
1-2	Understand the signal analysis.	CLO 1	T3: 1.2 to 1.2.3
3-7	Understand the Fourier transform and its properties.	CLO 1	T3 :1.2.4 to 1.4.8
8-11	Classification of the linear systems.	CLO 2	TI:1.1 to 2.5
12-14	Understand the concept of convolution and correlation.	CLO 3	TI :1.1 to 2.5
12-14	Explain the communication system and need for modulation.	CLO 4	T3:1.1 to 1.1.6
15-17	Study the amplitude modulation systems and compare DSBSC and AM.	CLO 5	T3 :3.2 to 3.3.4
18-19	Study the generation and demodulation techniques of AM and DSBSC	CLO 5	T3 :3.2 to 3.3.4
20-21	Analyze the calculation of power and noise.	CLO 6	R1 :3.3, T3- 8.3 to 8.4
22-23	Understand the single side band modulation	CLO 7	T3 :3.4
24-28	Explain the generation of SSB-SC	CLO 8	T3 :3.4.1 to3.4.2, T3 –8.2.
28-32	Study the demodulation of SSB-SC and Power relations.	CLO 8	T3 :3.4.1 to3.4.2, T3 –8.2.
33-35	Understand generation & detection of VSB	CLO 9	T3 :3.5.1 to 3.5.2
36-38	Analyze the importance of the angle modulation.	CLO 10	T3 : 4.1 to 4.3.4
39	Understand the concepts of narrow band frequency modulation, wide band frequency modulation	CLO 11	T3 :4.4 to 4.4.5, T2 – 2.14
40-43	Understand the of generation frequency modulation.	CLO 12	T3 :4.4 to 4.4.5, T2 – 2.14

Lecture No	Topics to be covered	CLOs	Reference
44-45	Study the detection of frequency modulation	CLO 12	T3 :4.4 to 4.4.5, T2 – 2.14
46-48	Analyze the importance of pre emphasis and de emphasis circuits in FM.	CLO 11	T3 :9.1 to 9.5.2
49- 50	Understand the importance of receivers in broadcasting system.	CLO 13	R3 :6.1
51-54	Analyze the characteristics of the receiver	CLO 14	R3:6.2 to 6.4.6
55-60	Understand the sampling operation is basic to digital signal processing and digital communications.	CLO 15	T2:6.2 to 6.3

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S NO	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POs	RELEVANCE WITH PSOs
1	Design of FM radio using NI USRP 2901.	Seminars	PO 1	PSO 1
2	Simulation of analog modulation and demodulation schemes using NI LABVIEW.	Seminars / NPTEL	PO 5	PSO 1
3	Observe the frequency domain representation of analog modulation waveforms using spectrum analyzer.	NPTEL	PO 2	PSO 1
4	Observe the receiver frequency domain representation using spectrum analyzer.	Seminars	PO 2	PSO 1

Prepared by:
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