INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE DESCRIPTOR

Course Title	**ANALOG COMMUNICATIONS**				
Course Code	**AECB12**				
Programme	B.Tech				
Semester	IV	ECE			
Course Type	Core				
Regulation	IARE - R18				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	3	1.5
Chief Coordinator	Mrs. G Ajitha, Assistant Professor				
Course Faculty	Dr.P.Munasamy, Professor Mrs.P.Saritha, Assistant Professor Mr.G.Kiran Kumar, Assistant Professor				

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, 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	Credits
UG	AHSB11	II	Mathematical Transform Techniques	4

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 modules and each module 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 module. 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 20 marks for Continuous Internal Examination (CIE), 05 marks for Quiz and 05 marks for Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	Theory			Total Marks
Type of Assessment	CIE Exam	Quiz	AAT	
CIA Marks	20	05	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 20 marks of 2 hours duration consisting of five descriptive type questions out of which four 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 - Online Examination

Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)

This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning centre. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc.

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:

The course should enable the students to:	
I	Introduce the communication system and need of modulation.
II	Understand the concepts of Amplitude Modulation and its types (DSB-SC, SSB and VSB).
III	Understand the concepts of Angular Modulation, FM and types of FM.
IV	Describe the behavior of analog communications in the presence of noise and also the basics of analog pulse modulation techniques.
V	Classify and discuss the different types of transmitters and receivers.

IX. COURSE OUTCOMES(COs):

COs	Course Outcome	CLOs	Course Learning Outcome
CO 1	Understand the basic concepts of the communication systems and illustrate different amplitude modulation techniques.	CLO 1	Discuss about the basic elements of communication system, importance of modulation and different types of modulation.
		CLO 2	Understand the time domain, frequency domain description and power relations of amplitude modulation, various techniques of generation and detection of AM.
		CLO 3	Analyze the time domain, frequency domain description of Double Side Band Suppressed Carrier (DSB SC), various generation techniques and

COs	Course Outcome	CLOs	Course Learning Outcome
			detection techniques of DSB SC, Noise in DSB SC.
CO 2	Analyze the time domain and frequency domain description of SSB and VSBSC and compare various amplitude modulation schemes.	CLO 4	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.
		CLO 5	Analyze the time domain, frequency domain description of Vestigial side band modulation, generation and detection of VSB.
		CLO 6	Discuss the comparison of different amplitude modulation techniques and applications of various amplitude systems.
CO 3	Analyze generation and detection of FM signal and comparison between amplitude and angle modulation schemes.	CLO 7	Analyze the basic concepts of Frequency modulation like single tone , spectrum analysis of frequency modulated wave and transmission bandwidth of FM.
		CLO 8	Understand the concepts of narrow band frequency modulation, wide band frequency modulation and pre emphasis and de emphasis circuits in FM.
		CLO 9	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.,
CO 4	Gain the knowledge of different noise sources and evaluate the performance of the communication system in the presence of noise	CLO 10	Discuss the different types of Noises and noise source, Narrowband Noise In phase and quadrature phase components and its Properties.
		CLO 11	Analyze the Noise in DSB and SSB System, Noise in AM System, Noise in Angle Modulation System, Pre-emphasis and de-emphasis circuits.
CO 5	Interpret with different types of receivers and study different pulse modulation and demodulation techniques.	CLO 12	Discuss the concept of receivers in communication system and receiver types like tuned radio frequency receiver and super heterodyne receiver.
		CLO 13	Analyze the characteristics of the receiver like sensitivity, selectivity, image frequency rejection ratio, choice of intermediate frequency and fidelity.
		CLO 14	Understand the different Pulse analog modulation techniques.
		CLO 15	Acquire the knowledge and develop capability to succeed national and international level competitive examinations.

X. 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
AECB12.01	CLO 1	Discuss about the basic elements of communication system, importance of modulation and different types of modulation.	PO 2	2
AECB12.02	CLO 2	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
AECB12.03	CLO 3	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
AECB12.04	CLO 4	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
AECB12.05	CLO 5	Analyze the time domain, frequency domain description of Vestigial side band modulation, generation and detection of VSB.	PO 1	3
AECB12.06	CLO 6	Discuss the comparison of different amplitude modulation techniques and applications of various amplitude systems.	PO 2	3
AECB12.07	CLO 7	Analyze the basic concepts of Frequency modulation like single tone , spectrum analysis of frequency modulated wave and transmission bandwidth of FM.	PO 1	3
AECB12.08	CLO 8	Understand the concepts of narrow band frequency modulation, wide band frequency modulation.	PO 1	3
AECB12.09	CLO 9	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
AECB12.10	CLO 10	Discuss the different types of Noises and noise source, Narrowband Noise In phase and quadrature phase components and its Properties.	PO 1	3
AECB12.11	CLO 11	Analyze the Noise in DSB and SSB System, Noise in AM System, Noise in Angle Modulation System, Pre-emphasis and de-emphasis circuits.	PO 2	3
AECB12.12	CLO 12	Discuss the concept of receivers in communication system and receiver types like tuned radio frequency receiver and super heterodyne receiver.	PO 2	3
AECB12.13	CLO 13	Analyze the characteristics of the receiver like sensitivity, selectivity, image frequency rejection ratio, choice of intermediate frequency and fidelity.	PO 1, PO 2	3

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AECB12.14	CLO 14	Understand the different Pulse analog modulation techniques.	PO 5	2
AECB12.15	CLO 15	Acquire the knowledge and develop capability to succeed national and international level competitive examinations.	PO 5	2

3 = High; 2 = Medium; 1 = Low

XI. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes (COs)	Program Outcomes (POs)			Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 5	PSO 1	PSO 2	PSO 3
CO 1	3	3		3	3	
CO 2	3		2	3		
CO 3	3	3		1	3	
CO 4	3	3		2		1
CO 5		2	2	2		

3 = High; 2 = Medium; 1 = Low

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

(CLOs)	Program Outcomes (POs)												Program Specific Outcomes (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			2								3	2	
CLO 4	2														
CLO 5	3	3			2								3	2	
CLO 6	3	3			2								3	2	
CLO 7		3											3	2	
CLO 8	3														
CLO 9		3													1
CLO10	3												3	2	
CLO 11	3														

(CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 12	3														1
CLO 13	3				2								3	2	1
CLO 14	3	3													
CLO 15		3													

3 = High; 2 = Medium; 1 = Low

XIII. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO1, PO2, PO5, PSO1, PSO2	SEE Exams	PO1, PO2, PO5, PSO1, PSO2	Assignments	PO1, PO2, PO5	Seminars	PO1, PO2, PO5, PSO1, PSO2
Laboratory Practices	PO 2, PO 4	Student Viva	-	Mini Project	-	Certification	-
Term Paper	PO1, PO2, PO5, PSO1, PSO2						

XIV. ASSESSMENT METHODOLOGIES - INDIRECT

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

XV. SYLLABUS

MODULE-I	AMPLITUDE MODULATION	Classes-09
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 AM waves, Generation of AM waves, square law Modulator, Switching modulator, Detection of AM Waves; Square law detector, Envelope detector, Double side band suppressed carrier modulators, time domain and frequency domain description, Generation of DSBSC Waves, Balanced Modulators, Ring Modulator, Coherent detection of DSB-SC Modulated waves, COSTAS Loop.		
MODULE-II	**SSB MODULATION**	**Classes-09**
SSB Modulation: Frequency domain description, Frequency discrimination method for generation of AM SSB Modulated Wave, Time domain description, Phase discrimination method for generating AM SSB Modulated waves. Demodulation of SSB Waves, Vestigial side band modulation: Frequency description, Generation of VSB Modulated wave, Time domain description, Envelop detection of a VSB Wave pulse Carrier, Comparison of AM Techniques, Applications of different AM Systems.		

MODULE-III	ANGLE MODULATION	Classes-09
Basic concepts, Frequency Modulation: Single tone frequency modulation, Spectrum Analysis of Sinusoidal FM Wave, Narrow band FM, Wide band FM, Constant Average Power. Transmission bandwidth of FM Wave - Generation of FM Waves, Direct FM, Detection of FM Waves: Balanced Frequency discriminator, Zero crossing detector, Phase locked loop, Comparison of FM and AM.		
MODULE-IV	**NOISE IN ANALOG COMMUNICATION SYSTEM**	**Classes-09**
Types of Noise: Resistive (Thermal) Noise Source, Shot noise, Extraterrestrial Noise, Arbitrary Noise Sources, White Noise, Narrowband Noise- In phase and quadrature phase components and its Properties, Modeling of Noise Sources, Average Noise Bandwidth, Effective Noise Temperature, Average Noise Figures, Average Noise Figure of cascaded networks. Noise in DSB and SSB System Noise in AM System, Noise in Angle Modulation System, Noise Triangle in Angle Modulation System, Pre-emphasis and de-emphasis.		
MODULE-V	**RECEIVERS**	**Classes-09**
Receiver Types -Tuned radio frequency receiver, Superhetrodyne receiver, RF section and Characteristics - Frequency changing and tracking, Intermediate frequency, AGC, FM Receiver, Comparison with AM Receiver, Amplitude limiting. Pulse Modulation: Types of Pulse modulation, PAM (Single polarity, double polarity) PWM: Generation and demodulation of PWM, PPM, Generation and demodulation of PPM, Time Division Multiplexing.		
TEXT BOOKS:		
1. S. S. Haykin, "Communication Systems", Wiley Eastern, 2nd Edition, 2006. 2. 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.		

XVI. COURSE PLAN:

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

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1-2	Explain the communication system and need for modulation.	CLO 4	T1: 1.2 to 1.2.3
3-7	Study the amplitude modulation systems and compare DSBSC and AM.	CLO 5	T1 :1.2.4 to 1.4.8
8-11	Time domain and frequency domain description Study generation and detection of AM waves	CLO 2	TI:1.1 to 2.5

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
12-14	Analyze the calculation of power and noise.	CLO 2	TI :1.1 to 2.5
12-14	To study generation of AM waves, detection of AM Waves	CLO 2	T1:1.1 to 1.1.6
15-17	Understand the double side band modulation	CLO 2	T1 :3.2 to 3.3.4
18-19	Explain the generation of DSB-SC	CLO 3	T1 :3.2 to 3.3.4
20-21	Study the demodulation of DSB-SC and Power relations.	CLO 3	R1 :3.3, T1- 8.3 to 8.4
22-23	Understand the single side band modulation	CLO 3	T3 :3.4
24-28	Explain the generation of SSB-SC	CLO 4	T1 :3.4.1 to3.4.2, T3 –8.2.
28-32	Study the demodulation of SSB-SC and Power relations.	CLO 4	T1 :3.4.1 to3.4.2, T3 –8.2.
33-35	Understand generation & detection of VSB	CLO 5	T1 :3.5.1 to 3.5.2
36-38	Analyze the importance of the angle modulation.	CLO 6	T1 : 4.1 to 4.3.4
39	Understand the concepts of narrow band frequency modulation, wide band frequency modulation	CLO 7	T1 :4.4 to 4.4.5, T2 – 2.14
40-43	Understand the of generation frequency modulation.	CLO 8	T1 :4.4 to 4.4.5, T2 – 2.14
44-45	Study the detection of frequency modulation	CLO 8	T1 :4.4 to 4.4.5, T2 – 2.14
46-48	Analyze the importance of pre emphasis and de emphasis circuits in FM.	CLO 9	T1 :9.1 to 9.5.2
49- 50	Understand the importance of receivers in broadcasting system.	CLO 11	R3 :6.1
51-54	Analyze the characteristics of the receiver	CLO 12	R3:6.2 to 6.4.6
55-60	Understand the sampling operation is basic to digital signal processing and digital communications.	CLO 13	T2:6.2 to 6.3

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

S NO	Description	Proposed Actions	Relevance with POs	Relevance with PSOs
1	Simulation of analog modulation and demodulation schemes using NI LABVIEW	Seminars / NPTEL	PO 4	PSO 1
2	Observe the frequency domain representation of analog modulation waveforms using spectrum analyzer.	NPTEL	PO 2	PSO 1
3	Observe the receiver frequency domain representation using spectrum analyzer.	Seminars	PO 2	PSO 1

Prepared by:

Mrs. G Ajitha, Assistant Professor, ECE HOD, ECE