INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE DESCRIPTOR

Course Title	**DIGITAL COMMUNICATIONS**				
Course Code	AEC009				
Programme	B.Tech				
Semester	V	ECE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	3	2
Chief Coordinator	Dr. S.Vinoth, Associate Professor				
Course Faculty	Mr. G.Kiran Kumar, Assistant Professor Ms. M.Saritha, Assistant Professor Ms. P.Annapurna, Assistant Professor				

I. COURSE OVERVIEW:

The course will make them to understand various digital modulation techniques and source coding techniques. Demonstrate the ability to analyze base band transmission and pulse shaping schemes. Interpret the concept of linear block codes and convolution codes. Understand the principle of general transform domain approach and the concept of Viterbi algorithm. Further, it emphasis the knowledge on various pulse modulation schemes.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AEC005	IV	Analog Communications	4

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Digital 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, with 25 marks for Continuous Internal Examination (CIE) and 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 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

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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, Exercises.
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.	2	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.	3	Design, Mini Project

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:** To produce engineering Professional capable of synthesizing and analyzing mechanical systems including allied engineering streams.	2	Seminar
PSO 2	**Software Engineering Practices:** An ability to adopt and integrate current technologies in the design and manufacturing domain to enhance the employability.	-	-
PSO 3	**Successful Career and Entrepreneurship:** To build the nation, by imparting technological inputs and managerial skills to become technocrats.	2	Guest lectures

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES :

I	Understand the different digital modulation techniques.
II	Discuss the importance of error detection and correction codes and use them in presence of channel noise.
III	Describe and analyze the methods of transmission of digital data using baseband and carrier modulation techniques.
IV	Decompose codes separately into source codes, channel codes, and develop competency in modeling and analyzing communication system elements.

IX. COURSE OUTCOMES (COs):

COs	Course Outcome	CLOs	Course Learning Outcome
CO 1	Analyze, interpret and model the components of digital communication systems.	CLO 1	Understand the basic concepts of pulse amplitude modulation (PAM), pulse position modulation (PPM) and pulse width
		CLO 2	Describe the advantages and disadvantages of digital communication systems and remember the concept of pulse code modulation
		CLO 3	Understand the concept of sampling, quantization and coding.
CO 2	Analyze, model, evaluate and compare various digital modulation techniques.	CLO 4	Understand and remember the concept of amplitude shift keying modulation and
		CLO 5	Analyze the frequency shift keying modulator, coherent and non-coherent
		CLO 6	Describe the difference between binary phase shift keying ad quadrature phase shift keying

COs	Course Outcome	CLOs	Course Learning Outcome
CO 3	Analyze, interpret and model baseband pulse transmission systems and digital pass band transmission systems	CLO 7	Understand the concept of baseband transmission and various line-coding formats used in digital communication systems.
		CLO 8	Describe the significance of pulse shaping to reduce inter-symbol interference in digital communications.
		CLO 9	Understand the operation of raised cosine filter and eye patterns of various ASK PSK and FSK digital modulation techniques.
CO 4	Analyze, evaluate information theory and compare spread spectrum techniques and performance of spread spectrum.	CLO 10	Understand and Remember the concept of mutual information and entropy in information theory.
		CLO 11	Design various mathematical modeling schemes for communication channel and determine their channel capacity.
		CLO 12	Analyze various spread spectrum modulation schemes.
		CLO 13	Direct sequence spread spectrum and frequency hopping spread spectrum.
CO 5	Review, analyze and design error-correcting codes used in digital communication.	CLO 14	Analyze the significance of linear block codes and convolution codes in digital communications. Interpret the difference between hamming codes and binary cyclic codes.
		CLO 15	Understand various types and approaches such as time domain approach and transform domain approach for implementation of convolution codes.
		CLO 16	Design different types of error detection and correction techniques for linear block codes and convolution codes.
		CLO 17	Acquire experience in building and troubleshooting simple digital communication system using digital modulation and demodulation techniques.
		CLO 18	Acquire the knowledge and develop capability to succeed in 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
AEC009.01	CLO 1	Understand the basic concepts of pulse amplitude modulation (PAM), pulse position modulation (PPM) and pulse width modulation (PWM). (PPM) and pulse width modulation (PWM).	PO1	3
AEC009.02	CLO 2	Describe the advantages and disadvantages of digital communication systems and remember the concept of pulse code modulation technique.	PO1	3
AEC009.03	CLO 3	Understand the concept of sampling, quantization and coding.	PO2	2
AEC009.04	CLO 4	Understand and remember the concept of amplitude shift keying modulation and demodulation.	PO5	3
AEC009.05	CLO 5	Analyze the frequency shift keying modulator, coherent and non-coherent frequency shift keying detectors.	PO5	3
AEC009.06	CLO 6	Describe the difference between binary phase shift keying ad quadrature phase shift keying techniques.	PO2	2
AEC009.07	CLO 7	Understand the concept of baseband transmission and various line-coding formats used in digital communication systems.	PO2	2
AEC009.08	CLO 8	Describe the significance of pulse shaping to reduce inter-symbol interference in digital communications.	PO2	2
AEC009.09	CLO 9	Understand the operation of raised cosine filter and eye patterns of various ASK PSK and FSK digital modulation techniques.	PO5	3
AEC009.10	CLO 10	Understand and Remember the concept of mutual information and entropy in information theory.	PO1	3
AEC009.11	CLO 11	Design various mathematical modeling schemes for communication channel and determine their channel capacity.	PO1	3

AEC009.12	CLO 12	Analyze various spread spectrum modulation schemes such as direct sequence spread spectrum and frequency hopping spread spectrum.	PO5	3
AEC009.13	CLO 13	Analyze the significance of linear block codes and convolution codes in digital communications.	PO5	3
AEC009.14	CLO 14	Interpret the difference between hamming codes and binary cyclic codes.	PO2	2
AEC009.15	CLO 15	Understand various types and approaches such as time domain approach and transform domain approach for implementation of convolution codes.	PO1	3
AEC009.16	CLO 16	Design different types of error detection and correction techniques for linear block codes and convolution codes.	PO5	3
AEC009.17	CLO 17	Acquire experience in building and troubleshooting simple digital communication system using digital modulation and demodulation techniques.	PO5	3
AEC009.18	CLO 18	Acquire the knowledge and develop capability to succeed in competitive examinations.	PO1	3

3= High; 2 = Medium; 1 = Low

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

Course Outcomes (COs)	Program Outcomes (POs)			Program Specific Outcomes (POs)		
	PO 1	PO 2	PO 5	PSO1	PSO2	PSO3
CO 1	3	2		1		
CO 2		2	1			
CO 3	3	2		1		1
CO 4	3	2		1		
CO 5	3	2				1

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

Course Learning 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														
CLO 2	3														
CLO 3		2													
CLO 4					3										
CLO 5					3										
CLO 6		2													
CLO 7		2													
CLO 8		2													
CLO 9					3										2
CLO 10	3														2
CLO 11	3														2
CLO 12					3										
CLO 13					3										
CLO 14		2											2		
CLO 15	3												2		
CLO 16					3								2		
CLO 17					3								2		
CLO 18	3												2		

3 = High; 2 = Medium; 1 = Low

XIII. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO1, PO2, PO5, PSO1, PSO3	SEE Exams	PO1, PO2, PO5, PSO1, PSO3	Assignments	PO 1 PO 2	Seminars	PO1, PO2, PO5, PSO1, PSO3
Laboratory Practices	–	Student Viva	–	Mini Project	–	Certification	–
Term Paper	PO1, PO2, PO5,PSO1, PSO3						

XIV. ASSESSMENT METHODOLOGIES - INDIRECT

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

XV. SYLLABUS

UNIT-I	PULSE DIGITAL MODULATION
Pulse Modulation: Analog pulse modulation, Types of pulse modulation; PAM (Single polarity, double polarity); Generation & demodulation of PWM; Generation and demodulation of PPM; Introduction: Elements of digital communication systems, advantages and disadvantages of digital communication systems, applications; Pulse Digital Modulation: Elements of PCM; Sampling, quantization and coding; Quantization error, non-uniform quantization and Companding; Differential PCM (DPCM);Adaptive DPCM; Delta modulation and its drawbacks; Adaptive delta modulation; Comparison of PCM and DM systems; Noise in PCM and DM systems.	
UNIT-II	**DIGITAL MODULATION TECHNIQUES**
Digital Modulation Techniques: Introduction, ASK modulator, coherent ASK detector, non-coherent ASK detector, FSK, bandwidth and frequency spectrum of FSK, non-coherent FSK detector, coherent FSK detector; BPSK, coherent BPSK detection; QPSK; DPSK, DEPSK; Optimal reception of digital signal: Baseband signal receiver; Probability of error; Optimum filter; matched filter, probability of error using matched filter; Probability of error for various line encoding formats; Correlation receiver; Calculation of probability of error for ASK, FSK, BPSK.	
UNIT -III	**BASE BAND TRANSMISSSION AND PULSE SHAPING**
Base Band Transmission: Requirements of a Line-encoding format, Various line encoding formats: Unipolar, Polar, Bipolar; Scrambling techniques: BZ8S, HDB3, computation of power spectral densities of various line encoding formats. Pulse Shaping: Inter symbol interference; pulse shaping to reduce ISI; Nyquist criterion; Raised cosine filter; Equalization; Correlative level coding; Duo-binary encoding, modified duo –binary coding; Eye diagrams for ASK,PSK,FSK; Cross Talk.	
UNIT -IV	**INFORMATION THEORY AND SOURCE CODING**
Information Theory: Information, entropy, conditional entropy; Mutual information; Channel capacity; Various mathematical modeling of communication channels and their capacities; Hartley Shannon law; Tradeoff between bandwidth and S/N ratio; Source coding: Fixed length and variable length Source Coding Schemes, Huffman coding; Source coding to increase average information per bit; Lossy source coding; Spread spectrum modulation: Use of spread spectrum; Direct sequence spread spectrum (DSSS); Code division multiple access using DSSS, frequency hopping spread spectrum; PN-Sequences: Generation and characteristics; Synchronization in spread spectrum systems.	
UNIT -V	**LINEAR BLOCK CODES AND CONVOLUTION CODES**
Linear Block Codes: Introduction to error control coding; Matrix description of linear block codes, error detection and error correction capabilities of linear block codes; Hamming code; Binary cyclic codes algebraic structure, encoding, syndrome calculation and decoding; Convolution Codes: Introduction, Encoding of convolution codes; Time Domain Approach; Transform Domain Approach; General approach; State, Tree And Trellis Diagram; Decoding using Viterbi Algorithm; Burst Error Correction: Block Interleaving and convolution interleaving.	
Text Books:	
1. Herbert Taub, Donald L. Schilling , “Principles of Communication Systems”, TMH, 3rd edition,2008. 2. K. Sam Shanmugam, “Digital and Analog Communication Systems”, John Wiley & Sons, 2nd Edition, 2005.	

3. Herbert Taub, Donald L. Schilling , "Principles of Communication Systems", TMH, 3rd edition,2008.

Reference Books:

1. John Proakis, "Digital Communications", TMH, 2nd Edition 1983.
2. B.P.Lathi, "Modern Analog and Digital Communication", Oxford reprint, 3rd Edition, 2004.
3. Singh, Sapre, "Communication Systems Analog and Digital", TMH, 2nd Edition, 2004.

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
1-3	Understand the concept of Pulse Modulation techniques.	CLO 1	T1-5.2 to 5.3
4-7	Understand the basics of Digital communication and PCM.	CLO 2	T1-5.4 to 5.5
8-12	Understand various pulse code modulation techniques.	CLO 3	T1- 5.6, T1-12.3,
13-17	Analyze various Digital Modulation Techniques.	CLO 4	R2-13.3, T1-6.3
18-20	Understand various PSK modulation techniques.	CLO 5	T1-11.4, R3-9.2 to 9.4
21-22	Understand the concept of probability error.	CLO 6	R2-9.10 to 9.14
23-26	Understand the concept of baseband transmission line coding formats.	CLO 7	R3-8.7, T1-5.5
27-29	Analyze the power spectral density of line coding formats.	CLO 8	R3-8.7, T1-5.5
30-32	Understand various pulse shaping techniques.	CLO 9	T3-4.4 to 4.5
33-34	Analyze various coding and decoding schemes.	CLO 10	T3-4.6
35-36	Understand the concept of eye diagram and cross talk.	CLO 11	T3- 4.11 to T1-52.3
37-41	Understand the concept of information theory and channel capacity.	CLO 12	T3-9.2, T3-9.6, T 3-9.7
42-46	Analyze various source-coding techniques.	CLO 13	T1-13.7, R3-11.1 to 11.7
47-52	Understand the concept of Spread spectrum modulation.	CLO 14	T1-2.7, T1-15.4 to 15.6
53-57	Understand the concept of linear block codes.	CLO 15	T1-13.9
58-60	Understand the concept of convolution codes.	CLO 16	R3-11
61-65	Analyze general approach for convolution codes.	CLO 17	T1-13.18
66-69	Understand the concept of error correction.	CLO 18	T1-13.10

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

S no	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Probability of error for various line-coding formats.	Seminars	PO 1	PSO 1
2	Scrambling techniques: BZ8S, HDB3 And computation of power spectral densities of various line encoding formats.	Seminars / NPTEL	PO 4	PSO 1
3	Various mathematical modeling of communication channels and their capacities.	NPTEL	PO 2	PSO 1

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