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ANALOG & DIGITAL COMMUNICATION **Course Code : 314329**

Programme Name/s	**: Electrical and Electronics Engineering/ Medical Electronics/ Electronics & Computer Engg.**
Programme Code	**: EK/ MU/ TE**
Semester	**: Fourth**
Course Title	**: ANALOG & DIGITAL COMMUNICATION**
Course Code	**: 314329**

I. RATIONALE

The importance of electronic communication in our society is incomparable to any other recent development. It has revolutionized communication in both the professional and personal way of human interaction. Without electronic communication, we cannot access and apply the available information in a timely way. This subject will enable students with the basics of analog and digital communication which is used in electronic communication and have greatly impacted our lives.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to attain the following industry/employer expected outcome through various teaching learning experiences:
Maintain basic analog and digital communication systems.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Analyze the basics of communication system.
- CO2 - Maintain AM and FM communication systems.
- CO3 - Use various pulse modulation techniques.
- CO4 - Maintain communication systems based on digital modulation techniques.
- CO5 - Select relevant multiplex and multiple access techniques in various communication applications.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme												
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
314329	ANALOG & DIGITAL COMMUNICATION	ADC	DSC	4	-	2	-	6	3	3	30	70	100	40	25	10	25@	10	-	-	150

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Total IKS Hrs for Sem. : 1 Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Explain the importance of electronic communication. TLO 1.2 Explain block diagram of basic electronic communication system. TLO 1.3 List different types of Noise in communication system. TLO 1.4 Classification of electronic communication. TLO 1.5 Explain the concept of electromagnetic spectrum.	**Unit - I Overview of Electronics Communication** 1.1 Fundamentals of electronic communication: definition of analog signal, digital signal and baseband signal 1.2 Elements of basic electronic communication system: block diagram, function of each block 1.3 Noise in electronic communication system, effects of noise in communication systems, types of noise (internal, external),Signal to Noise ratio, Figure of merit 1.4 Types of electronic communication: simplex, duplex-half and full 1.5 Concept of electromagnetic spectrum and transmission bandwidth 1.6 Ancient communication methods in India: History of communication, non-verbal communication such as drum sounds, pigeons, messenger, symbols, and smoke signals (IKS-1 hour, no question in theory paper)	Lecture using Chalk-Board Demonstration Video Demonstrations

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Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
2	TLO 2.1 Describe modulation techniques. TLO 2.2 Explain the process of different analog modulation techniques. TLO 2.3 Explain AM communication systems. TLO 2.4 Explain FM communication systems. TLO 2.5 Calculate modulation index of AM and FM signal.	**Unit - II Analog Modulation Techniques** 2.1 Modulation: Need and classification of modulation techniques 2.2 Amplitude Modulation (AM): Definition, block diagram, waveforms, mathematical representation of AM signal and representation of AM signal in the time domain and frequency domain, modulation index, percentage modulation (numerical) and applications 2.3 Types of AM band spectrum: DSB, SSB, and VSB, power relation in AM wave (no derivation only numerical) 2.4 Generation of AM: Block diagram, working principle and waveform 2.5 Demodulation of AM: Diode detector and practical diode detector (block diagram, working principle) 2.6 Frequency Modulation (FM): Definition, block diagram, working principle, waveform, mathematical representation of FM signal, types of FM (narrowband, wideband), representation of FM signal in the time domain and frequency domain, frequency deviation ratio, modulation index (numerical)	Presentations Lecture using Chalk-Board
3	TLO 3.1 Describe block diagram of digital communication techniques. TLO 3.2 Explain different types of Analog Pulse Modulation techniques. TLO 3.3 Describe sampling and quantization process. TLO 3.4 Explain different types of Digital Pulse Modulation techniques. TLO 3.5 Compare different Pulse Modulation techniques.	**Unit - III Pulse Modulation Techniques** 3.1 Elements of Digital Communication system with its block diagram, it's need, advantages, disadvantages and applications 3.2 Classification of pulse modulation, Analog Pulse Modulation: Pulse Amplitude Modulation (PAM), Pulse Width Modulation (PWM), Pulse Position Modulation (PPM) [definition, block diagram, working principle and waveform] 3.3 Digital Pulse Modulation: Pulse Code Modulation (PCM)- definition, block diagram, working principle with waveform, Sampling theorem, types of sampling, Nyquist sampling theorem, Aliasing effect, Quantization process, Quantization Error 3.4 Digital Pulse modulation: Delta Modulation (DM), Adaptive Delta Modulation (ADM) [only definition, block diagram, working principle with waveform and their comparison] 3.5 Comparison of analog pulse modulation and digital pulse modulation	Lecture using Chalk-Board Video Demonstrations Presentations

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Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
4	TLO 4.1 Explain different types of digital modulation techniques. TLO 4.2 Describe M-ary encoding techniques. TLO 4.3 Explain the different types of M-ary techniques. TLO 4.4 Compare digital modulation techniques with respect to different parameter.	**Unit - IV Digital Modulation Techniques** 4.1 Digital modulation techniques: Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Phase Shift Keying (PSK), Binary Phase-shift keying (BPSK), Quadrature Phase Shift Keying (QPSK), Quadrature Amplitude Modulation (QAM)- block diagram and their working principle and waveform 4.2 M-ary Encoding technique: Definition and it's need 4.3 Types of M-ary Encoding techniques: M-ary ASK, M-ary FSK,M-ary PSK 4.4 Comparison of digital modulation techniques: ASK,FSK and PSK	Lecture using Chalk-Board Presentations Video Demonstrations
5	TLO 5.1 Explain multiplexing of signals. TLO 5.2 Explain different multiplexing techniques. TLO 5.3 Compare different multiplexing techniques on the basis of different parameter. TLO 5.4 Explain different multiple access techniques. TLO 5.5 Explain telemetry process.	**Unit - V Multiplexing and Multiple Access Techniques** 5.1 Multiplexing: Need and classification 5.2 Multiplexing techniques:Time Division Multiplexing (TDM),Frequency Division Multiplexing (FDM), Code Division Multiplexing (CDM) [definition, block diagram, working principle, waveform] 5.3 Multiple Access techniques: Time Division Multiple Access(TDMA), Frequency Division Multiple Access (FDMA),Code Division Multiple Access(CDMA) [definition, block diagram, working principle, waveform] 5.4 Comparison of multiple access techniques: TDMA ,FDMA and CDMA 5.5 Telemetry system: It's need ,types, block diagram, working principle and applications	Presentations Lecture using Chalk-Board Video Demonstrations Site/Industry Visit

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Test the output of simplex and duplex mode of communication.	1	*Simplex, half duplex and full duplex communication link using switches, wires and LEDs.	2	CO1
LLO 2.1 Interpret the effect of change in modulating frequency on AM signal.	2	AM modulated waveforms in different modulating frequencies.	2	CO2
LLO 3.1 Generate Amplitude Modulated wave. LLO 3.2 Measure modulation index of an AM envelope.	3	*Modulation of a high frequency carrier with sinusoidal signal to obtain AM signal.	2	CO2
LLO 4.1 Generate Frequency Modulated wave.	4	Generation of FM modulated wave for different carrier frequency.	2	CO2
LLO 5.1 Generate AM wave using any simulation software for given carrier frequency.	5	Generation of AM wave using any simulation software for given carrier frequency.	2	CO2
LLO 6.1 Generate FM wave using given carrier frequency.	6	Use any simulation software to generate FM wave for a given carrier frequency.	2	CO2

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 7.1 Generate Natural and Flat top sampled signal.	7	*Generation of Natural and Flat top sampled signal.	2	CO3
LLO 8.1 Test the performance of the Pulse Code modulated and demodulated wave. LLO 8.2 Observe and draw input and output waveform.	8	*Performance of the Pulse Code modulator/demodulator circuit.	2	CO3
LLO 9.1 Generate ASK Modulated and Demodulated wave. LLO 9.2 Observe and draw input and output waveform	9	*Performance of the Amplitude Shift Keying(ASK) Modulator and Demodulator circuits.	2	CO4
LLO 10.1 Generate FSK Modulated and Demodulated wave. LLO 10.2 Observe and draw input and output waveform.	10	Performance of the Frequency Shift Keying(FSK) Modulator and Demodulator circuits.	2	CO4
LLO 11.1 Generate PSK Modulated and Demodulated wave. LLO 11.2 Observe and draw input and output waveform.	11	*Performance of the Binary Phase Shift Keying(BPSK) Modulator and Demodulator circuits.	2	CO4
LLO 12.1 Generate QAM modulated and demodulated wave. LLO 12.2 Observe and draw input and output waveform.	12	Performance of Quadrature Amplitude Modulation(QAM) modulator and demodulator circuits.	2	CO4
LLO 13.1 Test the performance for n-input time division multiplexing (TDM) signal. LLO 13.2 Observe and draw input and output waveform.	13	Performance for n-input time division multiplexing (TDM) circuit.	2	CO5
LLO 14.1 Test the performance for n-input frequency division multiplexing (FDM) signal. LLO 14.2 Observe and draw input and output waveform.	14	*Performance for n-input frequency division multiplexing (FDM) circuit.	2	CO5
LLO 15.1 Generate TDM signal using relevant simulation software. LLO 15.2 Observe simulation output for TDM transmitter and receiver.	15	*Generation of TDM signal using relevant simulation software.	2	CO5
LLO 16.1 Generate FDM signal using relevant simulation software. LLO 16.2 Observe simulation output for FDM transmitter and receiver.	16	Generation of FDM signal using relevant simulation software.	2	CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING /

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SKILLS DEVELOPMENT (SELF LEARNING)

NA

- NA

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Spectrum analyzer, 9 kHz to 1.5 GHz Frequency range- Typical -135 dBm Displayed Average Noise Level (DANL)	1,2
2	RF signal generator with wide frequency range 100KHz to 150 MHz fine frequency adjustment by calibrated dial built in audio frequency generator wideband oscillator Wide Frequency Range 100 KHz to 150 MHz.	2,3,4
3	AM and FM Trainer kit for Modulation and Demodulation.	2,3,4
4	Simulation software suitable for communication experiments: MATLAB/Simulink, SCILAB.	6,5,16,15
5	Digital Communication Trainer, In-built internal data generator. Type of Modulations and Demodulations: Sampling. Line coding. PCM, DPCM, ASK, FSK, BPSK, QAM, TDM, FDM, TDMA, FDMA.	8,9,2,3,13,5,7,10,12,11,4
6	CRO – 20MHz Dual Trace Dual Channel Oscilloscope with Component Tester	All
7	Function Generator: Frequency Range 0.1Hz to 30MHZ	All
8	Digital storage oscilloscope, 50MHz and above, dual trace, component tester	All
9	3 1/2 digit display, 9999 counts measures: Vac, Vdc (1000V max), Adc, Aac (10 Amp max), Resistance(0-100 Mohm), Capacitance and Temperature measurement (optional).	All

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Overview of Electronics Communication	CO1	10	2	4	6	12
2	II	Analog Modulation Techniques	CO2	12	4	4	6	14
3	III	Pulse Modulation Techniques	CO3	14	4	6	6	16
4	IV	Digital Modulation Techniques	CO4	12	4	6	6	16

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Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
5	V	Multiplexing and Multiple Access Techniques	CO5	12	4	4	4	12
Grand Total				**60**	**18**	**24**	**28**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Two offline unit tests of 30 marks and average of two-unit test marks will be considered for out of 30 marks. For formative assessment of laboratory learning 25 marks. Each practical will be assessed consider 60 % weightage to process, 40 % weightage to product.

Summative Assessment (Assessment of Learning)

- End semester assessment of 70 marks. End semester summative assessment of 25 marks for laboratory learning.

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	1	1	1	2	1		2			
CO2	1	1	1	2	1		2			
CO3	1	1	1	2	1		2			
CO4	1	1	1	2	1		2			
CO5	1	1	1	2	1		2			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Tomasi, Wayne	Electronic Communication Systems	Pearson Education, Delhi, 2009, ISBN NO. 9788131719534
2	P. Ramakrishna Rao	Digital Communication	McGraw Hill, Delhi, 2011, ISBN NO. 978-0070707764
3	Kennedy George, Davis Bernard	Electronic Communication system	McGraw Hill Education, ISBN 0-02-800592-9
4	Louis E. Frenzel Jr.	Principles Of Electronic Communication System	McGraw Hill, Delhi, ISBN13: 9781259932793

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Sr.No	Author	Title	Publisher with ISBN Number
5	Shanmugan, K. Sam	Digital and Analog Communication System	Willey India Edition, ISBN: 81-265-0914-7
6	Sklar, Bernald	Digital Communication	Pearson Education India, Delhi, Second Edition,2014,ISBN:9781292026060

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://archive.nptel.ac.in/courses/117/102/117102059/	Introduction to Electronics Communication.
2	https://archive.nptel.ac.in/courses/117/105/117105144/	Introduction to Digital Communication.
3	https://onlinecourses.nptel.ac.in/noc22_ee05/preview	Principles of Communication Systems - I
4	https://www.youtube.com/watch?v=t8uP2koj_KQ	Communication channel
5	https://www.etti.unibw.de/labalive/experiment/amtransmitterrecodaudiodemo	AM transmitter 1-record audio transmit signal via file
6	https://www.etti.unibw.de/labalive/experiment/am/	Amplitude modulation
7	https://www.etti.unibw.de/labalive/experiment/qpsksignalgeneration/	QPSK signal generation
8	https://www.etti.unibw.de/labalive/index/digitalmodulation/	Digital modulation
9	https://www.etti.unibw.de/labalive/experiment/qpskberequivalentbasebandwopulseshaping/	QPSK bit error rate - equivalent baseband
10	https://www.etti.unibw.de/labalive/experiment/qpsk/	QPSK transmission
11	https://www.etti.unibw.de/labalive/manual/	INTERACTIVE SIMULATION OF COMMUNICATION SYSTEMS
12	https://www.youtube.com/watch?v=qQcpnmJNluU&list=PLF84ABD7D4EBA31C4	Digital Communication Systems
13	http://www.digimat.in/nptel/courses/video/102104068/L09.html	Radio-telemetry
14	https://profhkverma.info/wp/wp-content/uploads/2017/04/Ch-1-Telemetry-Basics.pdf	Telemetry-Basics
15	https://youtu.be/L5jJIN8Z4lo?si=9JMyRy2QU67mluPX	Multiplexing in communication
16	https://youtu.be/vfcb1adKUyo?si=yOomBtg_-9b8Lw2u	Multiple access techniques

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

MSBTE Approval Dt. 21/11/2024 **Semester - 4, K Scheme**