ANNA UNIVERSITY, CHENNAI

NON- AUTONOMOUS COLLEGES

AFFILIATED TO ANNA UNIVERSITY

M.E. COMMUNICATION SYSTEMS

REGULATIONS 2025

PROGRAMME OUTCOMES (POs):

PO	Programme Outcomes
PO1	An ability to independently carry out research /investigation and development work to solve practical problems
PO2	An ability to write and present a substantial technical report/document.
PO3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program

PROGRAMME SPECIFIC OUTCOMES(PSOs):

PSO	Programme Specific Outcomes
PSO1	Ability to design and implement innovative solutions to solve complex problems in Communication Engineering.
PSO2	Competence to independently undertake research projects involving simulation, measurement, and product development in Communication-related fields.

ANNA UNIVERSITY, CHENNAI

POSTGRADUATE CURRICULUM (NON-AUTONOMOUS AFFILIATED INSTITUTIONS)

Programme: M.E., Communication Systems **Regulations:** 2025

Abbreviations:

BS – Basic Science (Mathematics, Physics, Chemistry)

ES – Engineering Science (General (**G**), Programme Core (**PC**), Programme Elective (**PE**)

SD – Skill Development

SL – Self Learning

OE – Open Elective

L – Laboratory Course

T – Theory

LIT – Laboratory Integrated Theory

PW – Project Work

TCP – Total Contact Period(s)

Semester I

S. No.	Course Code	Course Title	Type	Periods Per Week			TCP	Credits	Category
				L	T	P			
1.	MA25C05	Advanced Mathematical Methods (ECE)	T	3	1	0	4	4	BS
2.	CU25C01	Advanced Radiation Systems	T	3	0	0	3	3	ES(PC)
3.	CU25C02	Modern Digital Communication Systems	T	3	0	0	3	3	ES (PC)
4.	CU25C03	Advanced Digital Signal Processing	T	3	1	0	4	4	ES (PC)
5.	CU25C04	Analog and Digital Electronic System Design	LIT	3	0	2	5	4	ES(PC)
6.	CU25C05	Digital Communication Systems Laboratory	L	0	0	4	4	2	ES (PC)
7.	CU25101	Technical Seminar	-	0	0	2	2	1	SD
						Total	**25**	**21**	

Semester II

S. No.	Course Code	Course Title	Type	Periods Per Week			TCP	Credits	Category
				L	T	P			
1.		Radio Frequency Transceiver Design	T	3	0	0	3	3	ES(PC)
2.		Programme Elective I	T	3	0	0	3	3	ES(PE)
3.		Machine Learning	T	3	1	0	4	4	ES(PC)
4.		Advanced Wireless Communication Networks	LIT	3	0	2	5	4	ES(PC)
5.		Advanced Communication Systems laboratory	L	0	0	4	4	2	ES(PC)
6.		Industry Oriented Course I	-	1	0	0	1	1	SD
7.		Industrial Training	-	-	--	-	---	1	SD
8.		Self-Learning Course	-	-	--	-	---	1	--
Total							**20**	**19**	

Semester III

S. No.	Course Code	Course Title	Type	Periods Per Week			TCP	Credits	Category
				L	T	P			
1.		Programme Elective II	T	3	0	0	3	3	ES(PE)
2.		Programme Elective III	T	3	0	0	3	3	ES(PE)
3.		Programme Elective IV	T	3	0	0	3	3	ES(PE)
4.		Open Elective	T	3	0	0	3	3	-
5.		Industry Oriented Course II	-	1	0	0	1	1	SD
6.		Project Work I	-	0	0	12	12	6	SD
Total							**25**	**19**	

Semester IV

S. No.	Course Code	Course Title	Type	Periods per week			TCP	Credits	Category
				L	T	P			
1.		Project Work II	---	0	0	24	24	12	SD
Total							**24**	**12**	

Programme Elective Courses (PE)

S. No.	Course Code	Course Title	Periods per week			Total Contact Periods	Credits
			L	T	P		
1.		Wavelets and Sub band Coding	3	0	0	3	3
2.		Wireless Sensor Networks and WBAN	3	0	0	3	3
3.		Ultra Wide Band Communications	3	0	0	3	3
4.		VLSI for Wireless Communication	3	0	0	3	3
5.		Cognitive Radio Communications	3	0	0	3	3
6.		Quantum Communication and Networking	3	0	0	3	3
7.		Telecommunication System Modeling and Simulation	3	0	0	3	3
8.		Massive MIMO and mmWave System	3	0	0	3	3
9.		Advanced Satellite Based Systems	3	0	0	3	3
10.		Communication Network Design	3	0	0	3	3
11.		Digital Communication Transceivers	3	0	0	3	3
12.		Co-operative Communication	3	0	0	3	3
13.		Security for Wireless Communication Networks	3	0	0	3	3
14.		Signal Detection and Estimation	3	0	0	3	3
15.		Solid State Device Modeling and Simulation	3	0	0	3	3
16.		RF Integrated Circuit Design	3	0	0	3	3
17.		Image and Video Processing	3	0	0	3	3
18.		MEMS and NEMS	3	0	0	3	3
19.		Image Processing and Pattern	3	0	0	3	3
20.		Analog and Mixed Signal VLSI Design	3	0	0	3	3

Semester I

MA25C05	Advanced Mathematical Methods (ECE)	L	T	P	C
		3	1	0	4

Course Objectives:

This course aims to equip students with advanced mathematical and computational techniques focuses on developing problem-solving skills for designing efficient circuits, communication protocols, and embedded systems.

Calculus of Variations: Variation and its properties, Euler's equation, Functionals dependent on first and higher order derivatives, Functionals dependent on functions of several independent variables, Some applications, Direct methods, Ritz method.

Queueing Models: Markovian queues, Birth and death processes, Single and multiple server queueing models, Little's formula, Queues with finite waiting rooms, Queues with impatient customers: Balking and reneging. Finite source models, M/G/1 queue, Pollaczek Khinchin formula, M/D/1 and M/EK/1 as special cases, Series queues, Open Jackson networks.

Graph Theory: Introduction to paths, trees, Isomorphism, Matrix coloring and directed graphs, Some basic algorithms: Dijkstra's Algorithm, Depth-First search, Breadth-First search, Prims Algorithm, Kruskal Algorithm

Optimization Techniques: Linear programming, Basic concepts, Graphical and simplex methods, Big M method, Transportation problems, Assignment problems.

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%

Assessment Methodology: Quiz (5%), Assignments (10%), Review of Question Papers (IES, GATE, SSC Questions) (20%), Projects (20%), Flipped Class (5%), Internal Examinations (40%).

References:

1. Elsgolc, L. D. – *Calculus of Variations*, Dover Publications.
2. Gross, D. & Harris, C. M. – *Fundamentals of Queueing Theory*, Wiley.
3. Deo, N. – *Graph Theory with Applications to Engineering and Computer Science*, PHI.
4. Hillier, F. S. & Lieberman, G. J. – *Introduction to Operations Research*, McGraw-Hill.
5. Kanti Swarup, Gupta P.K., & Man Mohan – *Operations Research*, Sultan Chand & Sons.

E-resources:

1. https://nptel.ac.in/courses/111/105/111105039
2. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-262-discrete-stochastic-processes
3. https://nptel.ac.in/courses/106/106/106106183

CU25C01	Advanced Radiation Systems	L	T	P	C
		3	0	0	3

Course Objective:
This course aims to Provides foundation in antenna principles, arrays, modern structures, measurements, and recent trends in advanced antenna design.

Antenna Fundamentals: Radiation mechanisms, Maxwell's equations, antenna parameters, dipole, monopole, loop analysis, current distribution, radiation integrals. Numerical methods -MoM, FEM, FDTD, simulation tools.

Activities:

Write a report on real-world antenna installations

Antenna Arrays and Beamforming: Linear and planar arrays, beamforming, phased arrays, array synthesis (Binomial, Chebyshev), smart antennas, mutual coupling.
Activities:

1. MATLAB/Python simulation of linear and planar array patterns
2. Comparison chart activity of beamforming methods

Aperture and Reflector Antennas Aperture radiation, horn and slot antennas, Babinet's principle, reflector types and design, GTD, performance metrics.

Activities:
1. Design exercise: horn/reflector using standard formulas,
2. Concept map of diffraction and equivalence principles

Modern and Specific Antennas: Microstrip, fractal, reconfigurable, MIMO, mmWave, THz, wearable and implantable antennas, feeding and tuning methods.

Activites:
1. Mini project: Microstrip or fractal antenna design using CST/HFSS,
2. Invited expert talk on recent trends in antenna design

Antenna Measurements: Antenna test environments, anechoic/reverb chambers, gain, pattern, impedance, polarization

Activities:
1. Lab visit or virtual demo of anechoic chamber setup
2. Report writing on modern antenna testing

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%

Assessment Methodology: Quiz (5%), Assignments (10%), Review of Question Papers (IES, GATE, SSC Questions) (20%), Projects (20%), Flipped Class (5%), Internal Examinations (40%).

References

1. Balanis, C. A. (2016). Antenna theory: Analysis and design . John Wiley & Sons.
2. Gross, F. B. (2011). Frontiers in antennas: Next generation design and engineering. McGraw Hill.

3. Drabowitch, S., Papiernik, A., Griffiths, H. D., Encinas, J., & Smith, B. L. (2013). Modern antennas. Springer.
4. Krauss, J. D. (2017). Antennas. John Wiley & Sons.
5. Stutzman, W. L., & Thiele, G. A. (2012). Antenna theory and design. John Wiley & Sons.

	CO description	**PO Mapping**	**PSO1**	**PSO2**
CO1	Analyze the radiation mechanisms in antennas.	PO3(3)	3	2
CO2	Design and evaluate antenna performance in various systems.	PO1(3) PO2(3)	2	2
CO3	Use the modern simulation tools and measurement techniques for design and analysis of antennas.	PO2(3) PO1(3)	3	3

CU25C02	Modern Digital Communication Systems	L	T	P	C
		3	0	0	3

Course Objectives:

To understand the concepts of coherent/non-coherent receivers, bandlimited signalling, equalization, channel coding, OFDM, and CDMA for multiuser communication.

Coherent and Non-Coherent Communication: Coherent receivers, IQ modulation/demodulation, QAM, MFSK, DPSK, Rayleigh/Rician channels, BER performance, synchronization techniques.

Activities 1: Simulation and BER Analysis of Coherent vs Non-Coherent Receivers in MATLAB/Python
2: Hands-on Lab with Software-Defined Radio (SDR) or GNU Radio

Equalization Techniques: ISI, Nyquist criterion, partial response signaling, linear and decision feedback equalizers, adaptive equalization.

Activities 1: Simulating ISI and Equalization Techniques in MATLAB/Python
2: Nyquist Criterion and Partial Response Signaling – Practical Design and Analysis

Block Coded Digital Communication: Binary block codes, channel capacity, Shannon's theorem, spread spectrum, BPSK/DPSK with coding, Hamming, BCH, Reed-Solomon, STBC.

Project 1: Simulate Hamming, BCH, and RS codes in noisy channels
2: Coded modulation with spread spectrum and STBC simulation

Convolutional Coded Digital Communication: Polynomial, state/tree/trellis diagrams, Viterbi decoding, error performance, turbo coding and iterative decoding.

Activities 1: Implement convolutional encoding and Viterbi decoding
2: Turbo Coding – Encoding and Iterative Decoding

Multicarrier and Multiuser Communications: OFDM modulation/demodulation, FFT implementation, bit/power allocation, PAPR, CDMA, multiuser detection, SIC.

Project 1: OFDM System Design and Analysis using FFT in MATLAB/Python
2: CDMA System Simulation with Multiuser Detection

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%

Assessment Methodology: Quiz (5%), Assignments (10%), Review of Question Papers (IES, GATE, SSC Questions) (20%), Projects (20%), Flipped Class (5%), Internal Examinations (40%).

References:

1. Proakis, J. G., & Salehi, M. (2014). Digital communication. McGraw Hill.
2. Haykin, S. (2014). Digital communication systems. John Wiley & Sons.

3. Sklar, B., & Ray, P. K. (2009). Digital communications: Fundamentals & applications. Pearson Education.
4. Lathi, B. P., & Ding, Z. (2025). Modern Digital and Analog Communication Systems. Oxford University Press.
5. Rappaport, T. S. (2002). Wireless communications. Pearson Education.

	CO description	**PO Mapping**	**PSO1**	**PSO2**
CO1	Explain the fundamental concepts of digital communication.	**-**	**-**	**-**
CO2	Analyze coherent and non-coherent receiver performance.	PO1(3) PO3(3)	2	2
CO3	Apply the convolutional coding i digital communication	PO3(3)	3	3
CO4	Design and evaluate multicarrier and multiuser systems using OFDM and CDMA..	PO1(3)	3	3

CU25C03	Advanced Digital Signal Processing	L	T	P	C
		3	1	0	4

Course Objective:

This course imparts advanced DSP techniques like multirate processing, adaptive filters, spectral estimation, and real-time architectures for communication applications

Multirate Signal Processing in Communication: Decimation, interpolation, multistage conversion, polyphase filters, filter banks, fractional rate conversion, communication applications.

Activities:

1. Simulate decimation and interpolation of speech signals in MATLAB/Python.
2. Design and evaluate polyphase filter banks for sub-band coding.

Adaptive Filtering for Channel Equalization: LMS, NLMS, RLS algorithms, convergence, system identification, noise/echo cancellation, equalizers in mobile/wired systems.).

Activities :

1. Implement LMS and RLS algorithms for channel equalization.
2. Compare convergence behavior with different step sizes and noise levels

Spectral Estimation for Signal Analysis: Non-parametric (Periodogram, Welch), parametric (AR, MA, ARMA), high-resolution (MUSIC, ESPRIT), PSD for speech/radar

Activities:

1. Mini project: PSD analysis of a real-world communication signal (e.g., FM, ECG).
2. Virtual demonstration on subspace-based estimation in MIMO systems.

DSP Architectures and Real-Time Implementation: Fixed/floating-point DSPs, TMS320C67x, pipelining, FPGA-based DSP, SDR, DSP in 5G and IoT applications.

Activities :

1. Mini Project: Optimization of FIR/IIR filters on FPGA or DSP kits..
2. Simulate pipelined filter processing on FPGA (Verilog or Vivado HLS optional).

Applications in Modern Communication Systems: DSP in modulation/demodulation, channel estimation, spectrum sensing, cognitive radio, speech/audio, IoT, biomedical.

Activities:

1. Design and simulate a complete QPSK system with matched filtering.
2. Implement a basic spectrum sensing block for a cognitive radio.

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%

Assessment Methodology: Quiz (5%), Assignments (10%), Review of Question Papers (IES, GATE, SSC Questions) (20%), Projects (20%), Flipped Class (5%), Internal Examinations (40%).

References:

1. Proakis, J. G., & Manolakis, D. G. (2007). *Digital signal processing: Principles, algorithms, and applications* . Pearson.
2. Mitra, S. K. (2010). *Digital signal processing: A computer-based approach*. McGraw-Hill.
3. Hayes, M. H. (2009). *Statistical digital signal processing and modeling*. Wiley.
4. Orfanidis, S. J. (2007). *Optimum signal processing*. McGraw-Hill.
5. Jones, D. L. (2020). *MATLAB for signal processing*. Cambridge University Press.

	CO description	**PO Mapping**	**PSO1**	**PSO2**
CO1	Elaborate multirate signal processing techniques	-	-	-
CO2	Apply adaptive signal processing techniques to solve practical problems	PO1(3) PO3(3)	2	2
CO3	Analyse spectral estimation methods, and direction-of-arrival.	PO1(3)	2	2
CO4	Design and implement real-time DSP algorithms and architectures.	PO1(3)	3	2

CU25C04	Analog and Digital Electronic System Design	L	T	P	C
		3	0	2	4

Course Objective:
To develop skills to design and analyze integrated analog-digital circuits for efficient mixed-signal systems.

MOS Transistor Principles and Logic Gates: MOS transistor characteristics, CMOS inverter, logic gate design, secondary effects, CS, CG, CD amplifiers, cascode, current mirrors.

Activity:
1. Analyze CMOS inverter performance and power metrics.
2. Simulate and compare amplifier configurations using SPICE.

Practicals:
1. DC characteristics of NMOS/PMOS.
2. logic gate simulations (NOT, NAND, NOR).

Single Stage Amplifiers: MOS models and small-signal equivalents, common-source (CS), common-gate (CG), and source-follower (CD) amplifiers, cascode amplifiers, current mirrors.

Activity:
1. virtual demonstration on MOSFET amplifier configurations (CS, CG, CD)
2. Simulating cascode amplifier and current mirror circuits

Practical Experiments:
1. CS amplifier design and performance analysis (Zin, Zout, gain, bandwidth, transient)
2. Current mirror and cascode amplifier simulation

Differential Amplifiers and High-Gain Circuits: Differential amplifier design, gain, CMR, slew rate, bandwidth, power, op-amp design principles, high-gain structures.

Activity:
1. V9irtual demonstration high-gain amplifier structures and op-amp design

Practical Experiments:
1. Differential amplifier with resistive load (gain, bandwidth, power, CMRR, transient)
2. Design of op-amp style gain stages

Digital Circuit Design and FPGA Implementation: FPGA architecture, datapath design, clocked synchronous circuits, iterative circuits, ASM chart and realization using ASM blocks.

Activity:
1. Virtual demonstration on FPGA architecture and data path circuit design
2. Modelling of synchronous sequential circuits using ASM charts

Practical Experiments:
1. Implementation of combinational circuits on FPGA
2. Implementation of simple state machine and timing analysis

System Design Using HDL and Integration: Logic system and data types in HDL, behavioral and structural modeling, FSM synthesis, mixed-signal integration using simulation tools. **Activity:** 1. Behavioral modeling and synthesis of combinational and sequential circuits 2. Design and synthesis of finite state machines (FSM) using HDL **Practical Experiments:** 3. FPGA realization and real-time output analysis 1. Mixed-signal simulation using Cadence Spectre/Mentor Graphics/SPICE
Weightage: Continuous Assessment: 50%, End Semester Examinations: 50%
Assessment Methodology: Quiz (5%), Assignments (10%), Review of Question Papers (IES, GATE, SSC Questions) (20%), Projects (20%), Flipped Class (5%), Internal Examinations (40%).
References 1. Razavi, B. (2016). Design of analog CMOS integrated circuits. Tata McGraw Hill. 2. Sansen, W. M. C. (2007). Analog design essentials. Springer. 3. Grebene, K. (2003). Bipolar and MOS analog integrated circuit design. John Wiley & Sons. 4. Roth, C. H., Jr. (2005). Fundamentals of logic design. Thomson Learning. **5.** Palnitkar, S. (2003). Verilog HDL: A guide to digital design and synthesis. Pearson.

	CO description	PO Mapping	PSO1	PSO2
CO1	Describe the integration of analog and digital subsystems in electronic system design	-	-	-
CO2	Analyze and design CMOS analog and digital building blocks using device-level models.	PO3(3)		
CO3	Develop and simulate mixed-signal circuits simulation tools for real-time applications.	PO1(3)	3	
CO4	Evaluate the analog and digital sub systems performance parameters through lab experiments..	PO1(3) PO(2)	2	3

CU25C05	Digital Communication Systems Laboratory	L	T	P	C
		0	0	4	2

Course Objectives:

This course aims to covers digital communication performance, wireless systems, digital filter design, and adaptive filtering algorithms.

list of experiments(MATLAB/Scilab/Labview)

use appropriate simulation tools for the following experiments:

1. Generation & detection of binary digital modulation techniques using SDR
2. Spread Spectrum communication system-Pseudo random binary sequence generation-Baseband DSSS.
3. MIMO system transceiver design using MATLAB/SCILAB/LABVIEW
4. Performance evaluation of simulated CDMA system
5. Channel Coder/decoder design (block codes / convolutional codes/ turbo codes)
6. OFDM transceiver design using MATLAB /SCILAB/LABVIEW
7. Channel equalizer design using MATLAB (LMS, RLS algorithms)
8. Design and Analysis of Spectrum Estimators (Bartlett, Welch) using MATLAB
9. BER performance Analysis of M-ary digital Modulation Techniques (coherent & non coherent) in AWGN Environment using MATLAB/SCILAB/LABVIEW
10. Design and performance analysis of Lossless Coding Techniques - Huffman Coding and Lempel Ziv Algorithm using MATLAB/SCILAB/LABVIEW
11. Noise / Echo cancellation using MATLAB (LMS / RLS algorithms).
12. Study of synchronization (frame, bit, symbol.)
13. Wireless channel characterization.

Weightage: Continuous Assessment: 60%, End Semester Examinations: 40%

Assessment Methodology: Project (30%), Assignment (10%), Practical (30%), Internal Examinations (30%)

	CO description	PO Mapping	PSO1	PSO2
CO1	Apply simulation tools like MATLAB, Scilab, or LabVIEW to model, analyze, and evaluate digital communication systems	PO3(3)	2	2
CO2	Design and simulate advanced wireless communication systems and assess their performance under various channel conditions.	PO1(3)	3	2
CO3	Implement and analyze adaptive signal processing algorithms for applications noise/echo cancellation and data compression.	PO1(3) PO(2)	2	3