Program Structure & Syllabus

Bachelor of Technology

(Electronics and Computer Engineering)

Duration: 04 Years

Batch: 2025-2029

School of Engineering and Applied Sciences

Department of Electronics and Communication Engineering

Vision of the University:

To be a global leader in education, research, and innovation, empowering higher learning ecosystem.

Mission of the University:

- Empower all the members of the Bennett ecosystem and provide thought leadership, focus on nation building and prepare our graduates to move with the Times.
- Cultivate international partnerships and collaborations with academic institutions, industry, and government organizations and provide a rigorous and innovative education that equips students with the knowledge, skills, and ethical values required to excel in their careers.
- Foster a culture of lifelong learning, adaptability, and critical thinking, ensuring graduates are prepared to tackle emerging challenges in all academic fields.
- Drive interdisciplinary research and innovation, pushing the boundaries of human knowledge, addressing pressing global issues and solving real world problems.
- Enhance a collaborative environment that encourages faculty and students to engage in research, innovation, and entrepreneurship, creating a lasting impact on society.
- Promote diversity, equity, and inclusion, ensuring that all individuals, regardless of background, feel welcomed, respected, and empowered.
- Prepare students to become global citizens, capable of addressing global challenges and contributing to the well-being of communities worldwide.
- Provide a globally connected career services networking with graduate employers and alumni.
- Foster a strong sense of ethical responsibility in our graduates, emphasizing the importance of ethical conduct, sustainability, and social impact in professional practice.
- Commit to ongoing assessment and improvement of our programs and invest in modern infrastructure and advanced technology to support teaching, research, and innovation adapting to the evolving needs of students, industries, and society.

Vision of the School:

To be a leading centre of excellence in engineering education, research and innovation, fostering the development of skilled engineers who will shape the future of science and technology and contribute to the betterment of society.

Mission of the School:

1. Provide high-quality science and engineering education: The school is dedicated to delivering rigorous, comprehensive, and contemporary education that equips students with the necessary knowledge, skills, and ethical values to excel in the field of science and engineering.
2. Foster research and innovation: Encourage and support cutting-edge research and innovation in various scientific and engineering disciplines, promoting interdisciplinary collaboration, entrepreneurship skills to address real-world challenges. The school aims to be at the forefront of technological advancements and contribute to the body of knowledge in science and engineering.
3. Promote experiential learning: Create an environment that generate new knowledge with emphasis on hands-on learning experiences, practical applications of scientific and engineering principles, and collaboration with industry partners. The school strives to develop graduates who are ready to tackle real-world problems, promote entrepreneur and adapt to a rapidly evolving engineering landscape.
4. Cultivate professional ethics and social responsibility: Instil in students a strong sense of professional ethics, integrity, and social responsibility. The school aims to produce engineers who are committed to sustainable development, ethical practices, and actively contribute to society's well-being.

Vision of the Department:

To nurture the students who are ready to accept challenges for bringing positive transformative impact on the lives of the communities and become future leaders.

Mission of the Department:

The mission of the Department of Electronics and Communication Engineering is:

- To impart required disciplinary knowledge through undergraduate education, Ph.D. and inter-disciplinary research.
- To offer an innovative and career-focused curricula inline with technological advancements.
- To foster graduates with technical skills, creativity to solve problems of societal relevance.

Program Educational Objectives (PEO):

1. Graduates will understand the core concepts of electronics and computer engineering, covering areas such as circuit analysis, signal processing, electromagnetic theory, and digital communication systems, enabling them to solve intricate engineering problems effectively.

2. Graduates will proficiently apply their theoretical understanding to real-world engineering tasks, capable of designing, simulating, implementing, and optimizing electronic circuits, communication, computing systems, and embedded systems using appropriate tools and methods, thus preparing them for practical industrial roles.

3. Graduates will possess the adaptability and drive for lifelong learning and professional advancement in a dynamic field, equipped to embrace emerging technologies, methodologies, and industry trends, while also demonstrating ethical awareness, professionalism, integrity, and strong communication skills in their interactions within the engineering community and broader society.

PEO to Mission Statement Mapping:

Mission Statements → / PEO Statements ↓	M1	M2	M3
PEO1	3	2	1
PEO2	2	3	2
PEO3	2	3	3

1: Low **2: Medium** **3: High**

Program Outcomes (POs) and Program Specific Outcomes (PSOs):

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate considerations for public health and safety, and cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and teamwork: Function effect and as a member or leader in diverse teams and diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PSOs:

PSO1: To inculcate professional competencies, to work as an individual and in a team by inculcating problem-solving and communication skills through diverse pedagogical practices.

PSO2: To apply domain specific knowledge through analysis and design to provide solutions for electronics and computer industry and/or to become successful entrepreneur.

PSO3: An ability to make use of acquired technical knowledge to adapt emerging technologies to develop innovative ideas and solutions.

Mapping of POs/PSOs to PEOs:

PEO Statements → / Program Outcomes ↓	PEO1	PEO2	PEO3
PO1	3	2	1
PO2	3	3	1
PO3	3	3	1
PO4	1	3	2
PO5	2	3	1
PO6	1	3	2
PO7	1	2	3
PO8	1	1	3
PO9	3	1	3
PO10	1	1	3
PO11	1	3	2
PO12	1	2	3
PSO1	3	2	3
PSO2	2	3	1
PSO3	1	3	2

1: Low **2: Medium** **3: High**

List of Courses

Semester: I

S.No.	Course Name	Course Code	Credit	L	T	P
1	Fundamentals of Electrical and Electronics Engineering	EECE1001L	4	2	1	2
2	Computational Thinking and Programing	2025CSET100	4	2	0	4
3	Engineering Calculus	EMAT101L	4	3	1	0
4	Professional Skills	USEC1001	2	2	0	0
5	Communication Skills	UAEC1001	2	2	0	0
6	Inculcation of Human Values and Professional Ethics	UVAC1001	2	2	0	0
7	Community Project and Social Responsibility	UVAC1002	2	2	0	0
Total Credits			**20**			

Semester: II

S.No.	Course Name	Course Code	Credit	L	T	P
1	Elements of Classical and Quantum Waves	EPHY115L	4	3	0	2
2	Linear Integrated Circuits	EECE1004L	4	3	0	2
3	Signals and Systems	EECE1002L	4	3	0	2
4	Linear Algebra and Ordinary Differential Equation	EMAT102L	4	3	1	0
5	Leadership and Management Skills	USEC1002	2		0	0
6	Soft Skills and Personality Development	UAEC1002	2		0	0
7	Environment and Sustainability	UVAC1003	2	2	0	0
Total Credits			**22**			

Semester: III

S.No.	Course Name	Course Code	Credit	L	T	P
1	Network Analysis and Synthesis	EECE203L	4	3	0	2
2	Fundamentals of Logic Design	EECE207L	4	3	0	2
3	Object Oriented Programming	EECE104P	4	2	0	4
4	Complex Analysis and Partial Differential Equation	EMAT205L	3	2	1	0
5	Electronic Design	EECEXXXL	3	1	0	4
6	Technical and Creative Writing	EECEXXXL	2	2	0	0
Total Credits			**20**			

Semester: IV

S.No.	Course Name	Course Code	Credit	L	T	P
1	Probability Theory and Stochastic Processes	EECE210L	4	3	1	0
2	HDL programing	EECE208P	3	2	0	2
3	Data Structures	EECE218L	3	2	0	2
4	Analog Circuits-I	EECE209L	4	2	1	2
5	Embedded Systems	EECE216P	4	2	0	4
6	Technical Presentation	EECEXXXL	2	2	0	0
Total Credits			**20**			

Semester: V

S.No.	Course Name	Course Code	Credit	L	T	P
1	Machine Learning	EECE369L	4	3	0	2
2	Analog and Digital Communications	EECE311L	4	3	0	2
3	Digital Signal Processing	EECE313L	4	3	0	2
4	Computer Networks	EECE314L	3	3	0	0
5	Analog Circuits-2	EECE212L	4	2	1	2
6	Specialization Elective - 1		4			
Total Credits			**23**			

Semester: VI

S.No.	Course Name	Course Code	Credit	L	T	P
1	Computer Architecture	EECE301L	3	3	0	0
2	VLSI Design	EECEXXXL	4	2	1	2
3	Design and Analysis of Algorithms	EECEXXXL	4	3	0	2
4	Cybersecurity	EECE220L	3	3	0	0
5	Image Processing	EECE360L	3	2	0	2
6	Specialization Elective - 2		4			
Total Credits			**21**			

Semester: VII

S.No.	Course Name	Course Code	Credit	L	T	P
1	Elective - 1		3	0	0	0
2	Elective - 2		3	0	0	0
3	Elective - 3		3	0	0	0
4	Specialization Elective - 3		4			
5	Specialization Elective - 4		4			
6*	Summer Internship	EECE4196J	2	0	0	4
7	Design Project	EECEXXXJ	3	0	0	6
Total Credits			**22**			

* Students will complete summer internship at the end of 6th semester and it will be evaluated in 7th semester.

Semester: VIII

S.No.	Course Name	Course Code	Credit	L	T	P
1	Research Project/ Dissertation	EECEXXXJ	12	0	0	24
2	Elective-4		3	3	0	0
Total Credits			**15**			

List of Elective Courses

S.No.	Course Name	Course Code	Credit	L	T	P
1	Electronic Measurement Techniques and Instrumentation	EECE340L	3	3	0	0
2	Advanced Digital Circuits	EECE341L	3	3	0	0
3	MOS Device Modelling	EECE342L	3	3	0	0
4	Testing And Verification	EECE343L	3	3	0	0
5	Introduction To Microelectromechanical Systems	EECE345L	3	3	0	0
6	Information Theory Coding	EECE361L	3	3	0	0
7	Detection And Estimation Theory	EECE362L	3	3	0	0
8	Advanced Digital Signal Processing	EECE363L	3	3	0	0
9	Statistical Signal Processing	EECE364L	3	3	0	0
10	High-Speed Digital Design	EECE443L	3	3	0	0
11	Low Power VLSI Design	EECE446L	3	3	0	0
12	Optical Communication	EECE451L	3	2	0	2
13	Microwave Devices	EECE453L	3	3	0	0

List of Specialization Electives

S.No.	Specialization Domains
1	VLSI
2	Embedded Systems and IoT
3	Data and Signal Analytics

Specialization courses: VLSI

S.No.	Course Name	Course Code	Credit	L	T	P
1	VLSI Technology	EECE3041L	4	3	1	0
2	CMOS Integrated Circuits	EECE3042L	4	3	1	0
3	System on Chip Design	EECE4043L	4	3	0	2
4	RF Integrated Circuits	EECE4044L	4	3	1	0

Specialization Courses: Embedded Systems and IoT

S.No.	Course Name	Course Code	Credit	L	T	P
1	Embedded System Hardware-Software Co-Design	EECE459L	4	3	0	2
2	FPGA Architecture and Programming	EECE460L	4	3	0	2
3	IoT Networks and Protocols	EECE4051L	4	3	0	2
4	Real Time Operating System	EECE4052L	4	3	0	2

Specialization Courses: Data and Signal Analytics

S.No.	Course Name	Course Code	Credit	L	T	P
1	Introduction to Data Analytics	EECE366L	4	3	0	2
2	Deep Learning	EECE464L	4	3	0	2
3	Natural Language Processing	EECE463L	4	3	0	2
4	Computer Vision	EECE458L	4	3	0	2

SEMESTER-I

Name of Program	B. Tech in Electronics and Communication Engineering				
EECE1001L	Fundamentals of Electrical and Electronics Engineering	L	T	P	C
Owning School/Department	SEAS/ECE	2	1	2	4
Pre-requisites/Exposure	NA				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1 : Analyse basic electrical circuits using fundamental laws of circuit theory and network theorems.
CO2 : Investigate the gain and cut-off frequency of the passive filter circuit.
CO3 : Understanding basics of transformers and motors.
CO4 : Develop an insight into the physics of a diode and transistors.
CO5 : Convert numbers into different number systems, verify digital gates and simplify

CO-PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3							3			3	3	3	
CO2	3	3							3			3	3	3	
CO3	3	3							3			3	3	3	
CO4	3	3							3			3	3	3	
CO5	3	3							3			3	3	3	

1=weakly related 2= moderately related 3=strongly related

Course Contents:

Module I: 12 lecture hours

Basic Circuit Theory: Ohm's law; current source, voltage source, dc, ac, periodic signal concept, examples of different periodic signals, their average, RMS value, resistors in series and parallel, voltage and current division. Kirchoff's current law (KCL) and Kirchhoff's voltage law (KVL), Nodal analysis and Mesh analysis. Network theorems: Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, and Superposition theorem. Introduction to the capacitor (C), introduction to phasor diagram, series and parallel combination of capacitors, Impedance and frequency dependency, Introduction to the inductor (L), series and parallel combination of inductors, Impedance and frequency dependency, units of L, C measurements, series and parallel RLC circuits.

Module II: 6 lecture hours

The need of the transformer, Mutual inductance, self-inductance, coefficient of coupling, Basics of voltage and current transformers, the equivalent circuit of the transformer, single-phase motors, dc motors, stepper motors, induction motors and their applications.

Module III: **12 lecture hours**

Diodes and its applications, Semiconductor Materials: Classification of materials based on energy-band theory, electrons and holes, intrinsic and extrinsic semiconductors, doping for n and p-type semiconductors; Diode circuits: PN Junction diode and its applications: Half wave, centre tapped full-wave rectifier circuit, bridge rectifier circuit, the efficiency of rectifier circuits, ripple factor, rectifiers with filter circuits. Zener diode, Voltage regulation. Three-terminal device characteristics (BJT and MOSFET): Introduction to bipolar junction transistor (BJT), working of BJT as a switch, Structure of a MOSFET, working of a MOSFET, current-voltage characteristics of a MOSFET, MOSFET as a switch.

List of Experiments

Simulation and Hardware Realization of the following Experiments will be conducted by students:

1. Introduction to CRO, Signal generator, multimeter, breadboard and DC voltage source
2. Ohm's law, Kirchoff's current law and voltage law
3. Thevenin's theorem, Norton's theorem
4. Low pass and high pass Filters (using Resistor and Capacitor).
5. Current-Voltage characteristics of a PN Junction Diode (Ge and Si)
6. Half Rectifier with Filter
7. Full-wave Rectifier
8. Clipper circuits
9. Clamper circuits
10. Design of voltage regulator using Zener diode (load regulation and line regulation)

Note: It can be beneficial for a student to perform the simulation before commencing the hardware.

Text Books :

1. Robert L. Boylestad, Introductory Circuit Analysis, Pearson Education, 12th Edition, 2013.
2. Robert L. Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory, Pearson Education, 12th Edition, 2013.

Reference Books :

1. Leonard S Bobrow, Foundations of Electrical Engineering, Oxford Higher Education.
2. Donald Neamen, Microelectronics Circuit Analysis and Design, Tata McGraw Hill.
3. David A. Bell, Electronic Instrumentation and Measurements, Oxford Higher Education

Assessment Scheme:

Components	Internal Assessment	Mid Term Exam	End Exam	Total
Weightage (%)	40	20	40	100

Name of Program	B. Tech in Electronics and Communication Engineering				
2025CSET100	Computational Thinking and Programming	L	T	P	C
Owning School/Department	SEAS/ECE	3	0	2	4
Pre-requisites/Exposure	NA				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1 : Solve given problem in Python by using standard programming constructs.

CO2 : Build programs using the features of object-oriented programming languages.

CO3 : Make use of Python inbuilt APIs to write functions.

CO-PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3		2	3							1	2	2	2
CO2	3			2	3							3	3	2	2
CO3	3		3	2	3							3	3	2	2

1=weakly related 2= moderately related 3=strongly related

Course Contents:

Module I: 12 lecture hours

Why Python, Applications of Python, Versions of Python, Number system, Binary, Octal, Literals, Variables, Data types, Operators, Control Structures if/else/elif, Nested if/else, Lists/Nested Lists, Tuple.

Module II: 17 lecture hours

Iterative Control, While loop, For loop, Range, Break, Continue, Pass, Nested Loops, Loop inside if, List Operations, List comprehension, Membership operator, Functions, Default argument, required arguments, keyword argument, variable arguments, Function invoking, Nested functions, Lambda functions, Map Reduce, Recursive Functions, Factorial, GCD using Euclid Algorithm, Dictionary Operations, Sets, Enumerators.

Module III: 16 lecture hours

String Operations, Slicing, File Handling, Exception Handling, Modules, Namespaces, Local, Global, and Built-in Namespaces, Object Oriented Programming, Classes and Objects, Encapsulation, Data abstraction, Inheritance, Polymorphism, Interactive Graphics, Displaying Images, Generating Colors, Graphics Objects, Entry Objects, Turtle, Tkinter, Working with Widgets, Controlling Layout with Geometry Managers, Events and Event Handlers, Developing Interactive applications.

List of Experiments

The lab component of this course is designed to practice computational problems to enable the students to develop computational thinking

Text Books :

1. Dierbach, *Introduction to Computer Science Using PYTHON: A Computational Problem-Solving Focus* (1st ed.), Wiley, 2015, ISBN 978-8126556014.

Reference Books :

1. Martinez, D. and Jesús, S. D, *Applied Computational Thinking with Python: Design Algorithmic Solutions for Complex and Challenging Real-world Problems* (1st ed.), Packt Publishing, 2021, ISBN 978-1839216763

Assessment Scheme:

Components	**Internal Assessment**	**Mid Term Exam**	**End Exam**	**Total**
Weightage (%)	40	20	40	100

Name of Program	B. Tech in Electronics and Communication Engineering				
EMAT101L	Engineering Calculus	L	T	P	C
Owning School/Department	School of Computer Science Engineering and Technology	3	1	0	4
Pre-requisites/Exposure	10+2 Mathematics				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: *Understand* the foundational concepts of real analysis including sequences, series, limits, continuity, and differentiability, and apply relevant theorems such as the Intermediate Value Theorem and Mean Value Theorem.

CO2: *Apply* techniques of single-variable calculus including Taylor series, Riemann integration, advanced integration methods, and improper integrals to solve standard problems in mathematics and engineering.

CO3: *Analyze* functions of several variables using partial derivatives, gradient, Hessian matrix, and optimize functions using second derivative test and Lagrange multipliers.

CO4: *Evaluate* integrals involving multiple variables and parametric surfaces using double and triple integrals, coordinate transformations, and compute surface areas and volumes in different coordinate systems.

CO-PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO11	PSO2	PSO3
CO1	3	2			1						1	1	2		
CO2	3	2			2						1	1	2	2	
CO3	3	3		2	2						2	1	3	2	1
CO4	3	2			2						2	1	2		2

1=weakly related 2= moderately related 3=strongly related

Course Contents:

Module I: 11 lecture hours

The Real Number System, Archimedean Property, Convergence of a Sequence, Monotone Sequences, Cauchy Criterion, Bolzano-Weierstrass Theorem, Limit inferior and Limit Superior. Infinite Series, Convergence Tests including nth term test, Integral test, Comparison test, Ratio test, Root test, and Alternating series test.

Module II: 11 lecture hours

Limit, Continuity, Existence of Maxima, Intermediate Value Property. Differentiability, Rolle's Theorem, Mean Value Theorem. Convexity, Concavity, L'Hospital Rule, Fixed Point Iteration Method, Taylor's Theorem, Taylor and Maclaurian Series, Power Series.

Module III: **11 lecture hours**

Riemann Integration, Advanced Integration Techniques (includes discussion of integration by parts, trigonometric integrals, trigonometric substitution, integration of rational functions using partial fraction decomposition), Fundamental Theorems of Calculus, Area between two curves; Polar Coordinates, Volumes by slicing, Washer and Shell Methods, Length of a plane curve, Areas of Surfaces of Revolution. Improper Integrals, Beta-Gamma Functions.

Module IV: **11 lecture hours**

Functions of Several Variables: limit, Continuity and Differentiability, Chain Rule, Directional Derivative, Gradient. Mixed Derivative Theorem, MVT, Extended MVT, Taylor's Theorem in Multiple Variables, Hessian, Maxima, Minima, Second Derivative Test, Lagrange Multiplier Method. Double Integrals, Change of Variable in a Double and Triple Integrals, Area of a Parametric Surface and surface integral. Surface Area, Surface Integrals.

Text Books :

1) Maurice D. Weir and Joel Hass, *Thomas' Calculus* (14th ed.), Pearson Education India, 2018. ISBN 978-9353060411, ISBN 9789353060411.
2) K. A. Ross, *Elementary Analysis: The Theory of Calculus* (2nd ed.), Springer, 2013. ISBN 978-1493901289, ISBN 978-1461462705.
3) Erwin Kreyszig, *Advanced Engineering Mathematics* (10th ed.), Wiley, 2010. ISBN 978-8126554232, ISBN 8126554231.

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Reference Books :

1) S. R. Ghorpade and B. V. Limaye, *A Course in Calculus and Real Analysis*, Springer-Verlag New York, 2006. ISBN 978-0387305301, ISBN 0387305300.
2) James Stewart, *Calculus* (7th ed.), Brooks Cole Cengage Learning, 2012. ISBN 9780538497817, ISBN 0538497815.
3) Robert G. Bartle and Donald R. Sherbert, *Introduction to Real Analysis* (4th ed.), Wiley, 2014. ISBN 978-8126551811, ISBN 812655181X.

Assessment Scheme:

Components	Internal Assessment	Mid Term Exam	End Exam	Total
Weightage (%)	40	20	40	100

Name of Program	B. Tech in Electronics and Communication Engineering					
USEC1001	Professional Skills	L	T	P	E	C
Owning School/Department	School of Liberal Arts	0.5	0	2	2	2
Pre-requisites/Exposure	NA					

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Build resumes, prepare for interviews, and understand recruitment processes.

CO2: Participate in group discussions and collaborative brainstorming activities.

CO3: Explore and plan career paths using personal reflection and research tools.

CO4: Demonstrate effective team behaviour, internal communication skills, and professional etiquette in diverse cultural contexts.

CO-PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1					2			2	1	2	2	1	1		
CO2									3	3	1		2		
CO3					2	1			2		1	1	2		
CO4						2		2	2	3	1	1	2		

1=weakly related 2= moderately related 3=strongly related

Course Contents:

Module I: 6 lecture hours

Career Skills: Resumes & Interviews

- Resume, CV, Biodata: Differences and Formats
- STAR Approach to Interviews
- Resume Peer Review & Mock Interviews

Module II: 6 lecture hours

Group Discussion Skills

- Importance and Types of Group Discussions
- Techniques for Effective Participation
- Common
- Listening as a Team Skill; Active Listening
- Simulated Group Discussion Sessions with Peer Feedback

Module III: 6 lecture hours

Exploring Career Opportunities

- SWOT Analysis
- Researching Careers (Industry + Social Sector)
- Career Vision Board or Career Roadmap Presentation

Module IV: **6 lecture hours**
Team Collaboration & Internal Communication

- Understanding Critical Thinking and Problem- Solving
- Building Trust within Teams
- Practicing Empathy and Collaboration
- Practical Activity: Group Problem-solving Exercise and Team-building Exercises

Module V: **6 lecture hours**

- Essentials of Presentation Skills (Structure, Visuals, Delivery)
- Professional Etiquette: Verbal & Nonverbal
- Social & Cultural Etiquette; Respecting Diversity in Workplace Practices
- Role-play Activities

Text Books :

- Cottrell, S. (2017). Critical Thinking Skills: Developing Effective Analysis and Argument. Palgrave.
- Raman, Meenakshi & Sharma, Sangeeta. *Technical Communication: Principles and Practice*. OUP, 2015.
- Bovée, Courtland L. & Thill, John V. *Business Communication Today*. Pearson, 2018.

Reference Books :

- Cottrell, S. (2019). The Study Skills Handbook. Red Globe Press.
- Hartley, S. (2017). The Fuzzy and the Techie: Why the Liberal Arts Will Rule the Digital World. Houghton Mifflin Harcourt.
- Trilling, B., & Fadel, C. (2009). 21st Century Skills: Learning for Life in Our Times. Jossey-Bass.

EXPERIENTIAL ACTIVITIES

- Active Listening
- Documentation
- Project Planning
- Team Management
- Conflict Resolution
- Leadership
- Entrepreneurial Mindset

Assessment Scheme:

Components	Internal Assessment	Mid Term Exam	End Exam	Total
Weightage (%)	40	20	40	100

Name of Program	B. Tech in Electronics and Communication Engineering					
UAEC1001	Communication Skills	L	T	P	E	C
Owning School/Department	School of Liberal Arts	0.5	0	2	2	2
Pre-requisites/Exposure	NA					

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Explain how language has historically functioned as a tool of learning, access, and expression.
CO2: Demonstrate critical listening and reading across genres, with sensitivity to tone, intent, and framing.
CO3: Produce purposeful, context-sensitive, and reflective writing and oral communication.
CO4: Reflect on how language shapes perception, identity, and social interaction.

CO-PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1						2		1		2			1		
CO2						1		1		2		1	1		
CO3						1		1		2		1	2		
CO4						2		1		1		1	1		

1=weakly related 2= moderately related 3=strongly related

Course Contents:

Module I: 6 lecture hours

Language as a Human Skill

Origins and evolution of language; literacy and access; socio-economic language gaps; counselling as communication; core listening techniques and questioning skills.

Module II: 6 lecture hours

Language and the brain

Neuroscience of speech, reading, and listening; attention and overload; empathy in communication; metaphor in thought; barriers to listening.

Module III: 6 lecture hours

Listening and Nonverbal Semiotics

Types of listening; active listening as ethical practice; body language and authenticity cues; analysis of tone and framing in messages.

Module IV: 6 lecture hours

Oral Communication and Persuasion

Structuring talks; delivery modes; persuasive framing; credibility and presence; vocabulary, fluency, and common speaking errors

Module V: **6 lecture hours**
Writing & Ethical Communication

Writing process; reading comprehension; reflective and concise writing; email etiquette; social media communication ethics and responsible digital use

Text Books :

- Knapp, Mark L. and Hall, Judith A. Nonverbal Communication in Human Interaction. Cengage Learning, 2013.
- Berko, Roy M., Wolvin, Andrew D., and Wolvin, Darlyn R. Communicating: A Social, Career, and Cultural Focus. Pearson, 2010

Reference Books :

- Lakoff, George and Johnson, Mark. Metaphors We Live By. University of Chicago Press, 2003.
- Mercier, Hugo and Sperber, Dan. The Enigma of Reason. Harvard University Press, 2017.
- Ong, Walter J. Orality and Literacy: The Technologizing of the Word. Routledge, 2002.
- Pinker, Steven. The Sense of Style: The Thinking Person's Guide to Writing in the 21st Century. Viking, 2014.

Assessment Scheme:

Components	Internal Assessment	Mid Term Exam	End Exam	Total
Weightage (%)	40	20	40	100

Name of Program	B. Tech in Electronics and Communication Engineering					
UVAC1001	Inculcation of Human Values and Professional Ethics	L	T	P	E	C
Owning School/Department	School of Liberal Arts	0.5	0	2	2	2
Pre-requisites/Exposure	NA					

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Describe the meaning, purpose, and relevance of human values and professional ethics.
CO2: Understand the importance of values in individual, social, career, and national life.

CO3: Demonstrate empathy, respect, and effective communication to build harmonious interpersonal relationships.
CO4: Use non-violent and constructive approaches to resolve conflicts at individual, societal, and global levels.
CO5: Recognize the interdependence of individuals, society, and nature, and contribute toward sustainable living.

CO-PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1			2			2		3	1	2			2		
CO2			2			1			2	2			1		
CO3			2			2			2	2			2		
CO4			2			1		1	2	2			1		
CO5			2			2		1	2	2			2		

1=weakly related 2= moderately related 3=strongly related

Course Contents:

Module I: 8 lecture hours

Introduction to Indian Ethos

- Meaning and significance of Universal Human Values
- Origin of Indian Ethos
- The concept of "Vasudhaiva Kutumbakam" (Unity in Diversity; the world is one family)
- Discussion on Purnata and Sunyata
- Fundamental human aspirations: Happiness and Prosperity
- Harmony at different levels: Individual, Family, Society, and Nature
- Limitation of Language and Development of Indian Aesthetics
- Bhagavad Gita on Karma Yoga and Tyaga

Module II: 7 lecture hours

Human Values and Ethics

- Respect, trust, and empathy in interpersonal relationships
- Gandhi’s notion of Truth
- Ethical leadership and professional integrity.
- Humility (Vinaya) in Chanakya's Perspective
- Conflict resolution and non-violent communication

Module III: 5 **lecture hours**
Constitutional Values and Global Citizenship

- Ethical consumerism and sustainability
- Social justice and human rights
- Role of individuals in community development

Module IV: 5 **lecture hours**
Values and Skills for Youth

- Understanding the self: Body, Mind, and Consciousness
- Self-awareness and self-exploration
- Vedanta "Atman and Brahman"
- Developing emotional intelligence and mindfulness

Module V: 5 **lecture hours**
Integrated Personality and Well-being

- Practice Yoga and Meditation
- Practicing gratitude towards others and the environment
- Integral Humanism

Text Books :

- Sharma, C. D. (2003). Introduction to Indian Philosophy. Motilal Banarasi Das Publishers.
- Goleman, D. (1995). Emotional intelligence: Why it can matter more than IQ. Bantam Books.
- Gandhi, M. K. (1993). An autobiography: The story of my experiments with truth (M. Desai, Trans.). Beacon Press. (Original work published 1927)
- Brown, B. (2012). Daring greatly: How the courage to be vulnerable transforms the way we live, love, parent, and lead. Gotham Books.

Reference Books/ suggested readings :

- Dweck, C. S. (2006). Mindset: The new psychology of success. Random House.
- Duckworth, A. (2016). Grit: The power of passion and perseverance. Scribner.
- Covey, S. R. (1989). The 7 habits of highly effective people: Powerful lessons in personal change. Free Press.
- Sinek, S. (2009). Start with why: How great leaders inspire everyone to take action. Portfolio.
- Frankl, V. E. (1984). Man's search for meaning (I. Lasch, Trans.). Beacon Press. (Original work published 1946)
- Brown, B. (2012). Daring greatly: How the courage to be vulnerable transforms the way we live, love, parent, and lead. Gotham Books.

Assessment Scheme:

Components	Internal Assessment	Mid Term Exam	End Exam	Total
Weightage (%)	40	20	40	100

Name of Program	B. Tech in Electronics and Communication Engineering					
UVAC1002	Community Project and Social Responsibility	L	T	P	E	C
Owning School/Department	School of Liberal Arts	0.5	0	2	2	2
Pre-requisites/Exposure	NA					

Course Outcomes (COs)

On completion of this course, the students will be able:

CO1: To develop an understanding of community so that students can develop an awareness and consciousness of diverse communities, neighborhoods, and society.
CO2: To formulate leadership skills as well as entrepreneurship skills to approach community-based problems and solutions.
CO3: To enhance communication skills to interact with local and regional community sensitively.
CO4: To demonstrate a systematic approach to problem-solving through evaluating systems critically and carefully.
CO5: To develop responsibility towards community as well as remain committed to becoming responsible citizens of society.

CO-PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1						2			2	1					
CO2						2			3	2	2		2	2	
CO3						2		1	2	3			2		
CO4						2		1		1			2		
CO5						3		1		1					

1= weakly related 2 = moderately related 3 = strongly related

Course Contents:

Module I: 5 lecture hours

Introduction: Appreciation of Rural Society

- Introduction to rural society and social responsibility
- Understanding the concept of rural society
- Identifying social problems and issues relevant to communities
- Selecting and defining a community-based project
- Identifying and engaging with a specific community group
- Forming teams to work on different aspects of the project
- Assessing the feasibility of the identified project

Module II: 10 lecture hours

Understanding Rural and Local Economy and Livelihood: Project Designing and Planning

- Conducting preliminary field exploration
- Designing appropriate research methods for the community project
- Developing effective community engagement strategies
- Submitting a clear and structured statement of the problem

Module III: **10 lecture hours**

Rural and Local Institutions: Project Implementation

- Designing surveys and qualitative research methods to approach the identified problem
- Identifying target groups for data collection
- Conducting surveys, interviews, and observations
- Recording and documenting findings systematically

Module IV: **5 lecture hours**

- Discuss and interpret their research findings.
- Critically analyze the implications of their findings within a socio-economic framework.
- Present their research findings to the class. Conclude the project with the submission of a comprehensive report.

Books/ suggested readings :

1. Maira, Arun (2019) Transforming Systems: Why the World Needs a New Ethical Toolkit, New Delhi: Rupa Publications.
2. Atkinson, Paul. "Why Do Fieldwork?" *Sociologisk Forskning* 43, no. 2 (2006): 128–34. http://www.jstor.org/stable/20853481.
3. Cassell, Joan. "Ethical Principles for Conducting Fieldwork." *American Anthropologist* 82, no. 1 (1980): 28–41. http://www.jstor.org/stable/676126.
4. V. K. Jairath, and Meenakshi Thapan. "Nature and Significance of Subjectivity in Fieldwork." *Economic and Political Weekly* 23, no. 9 (1988): 408–9. http://www.jstor.org/stable/4378164.
5. Garoutte, Lisa. "The Sociological Imagination and Community-Based Learning: Using an Asset-Based Approach." *Teaching Sociology* 46, no. 2 (2018): 148–59. https://www.jstor.org/stable/26589015.
6. Rundblad, Georganne. "Addressing Social Problems, Focusing on Solutions: The Community Exploration Project." *Teaching Sociology* 26, no. 4 (1998): 330–40. https://doi.org/10.2307/1318772.
7. Carter, Marion, Estela Rivero, Wendy Cadge, and Sara Curran. "Designing Your Community-Based Learning Project: Five Questions to Ask about Your Pedagogical and Participatory Goals." *Teaching Sociology* 30, no. 2 (2002): 158–73. https://doi.org/10.2307/3211380.

Assessment Scheme:

Components	Internal Assessment	Mid Term Exam	End Exam	Total
Weightage (%)	40	20	40	100

SEMESTER-II

Name of Program	B. Tech in Electronics and Communication Engineering				
EPHY115L	Elements of Classical and Quantum Waves	L	T	P	C
Owning School/Department	SEAS/Physics	3	0	2	4
Pre-requisites/Exposure	NA				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Students will be familiar with introductory ideas in various state-of-the-art topics in optics and LASER systems.
CO2: To understand the postulates of quantum mechanics and the basic principles of quantum mechanics and its mathematical structure
CO3: To understand electrostatic fields and potentials, produced by regular shaped charged bodies and basics of magnetic field.

CO-PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3			2				2				3		1
CO2	2	3			2				2				2		
CO3	2	3			2				2				2		

1=weakly related 2= moderately related 3=strongly related

Course Contents:

Module I: Optics and Lasers **17 lecture hours**

Interference, Thin film interference, Interferometers–Michelson Interferometer, Diffraction – CD as diffraction grating – Diffraction by crystals -polarizers.
LASER – characteristics – Spontaneous and Stimulated emission- population – inversion, Metastable states - optical feedback - Nd-YAG laser, CO_2 laser, Semiconductor laser – Industrial and medical applications. Optical Fibers – Total internal reflection – Numerical aperture and acceptance angle, Fiber optic communication, Fiber sensors, Fiber lasers.

Module II: Basic Quantum Mechanics **16 lecture hours**

Photons and light waves - Electrons and matter waves –Compton effect - The Schrodinger equation (Time dependent and time independent forms) - meaning of wave function – Normalization and Probability –Free particle - particle in a infinite potential well: finite potential well, potential step, potential barrier and tunneling, delta potential, Kronig-Penny model.

Module III: Electrostatic and Magnetic Fields **12 lecture hours**

Introduction to vector calculus and coordinate systems, Gauss's Law and its applications. Electric field in matter, Polarization and displacement vector, Electric Permittivity and dielectric constant,

Magnetic field due to moving charges, Biot-Savart law and its applications. Magnetic field in matter.

List of Experiments

1. Error estimation
2. Young's Double Slit
3. Diffraction Grating
4. Newton's Ring
5. Planck's constant
6. e/m measurement
7. Equipotential surface
8. Biot-savart Law
9. Helmoltz Coil
10. Hall Effect

Text Books :

1. Arthur Beiser, *Concepts of Modern Physics,* 6th Edition, McGraw-Hill Higher Education (2017), ISBN 0070151555

2. D. J. Griffiths, *Introduction to Quantum Mechanics*, 2nd Edition, Pearson Prentice Hall, (2004), ISBN 0131118927

Reference Books :

1. Feynman, Leighton and Sands, *The Feynman Lectures in Physics, Vol III*, Pearson, (2013), ISBN 8131792131

2. Stephen Gasiorowicz, *Quantum Physics*, 3rd Revised Edition, John Wiley & Sons, (2003), ISBN 8126511176

Assessment Scheme:

Components	Internal Assessment	Mid Term Exam	End Exam	Total
Weightage (%)	40	20	40	100

Name of Program	B. Tech in Electronics and Communication Engineering				
EECE1004L	Linear Integrated Circuit	L	T	P	C
Owning School/Department	SEAS/ECE	3	0	2	4
Pre-requisites/Exposure	NA				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: To study the basic principles, configurations and practical limitations of op-amp.
CO2: To understand the various linear and non-linear applications of op-amp.
CO3: To analyze and deign op-amp oscillators, single chip oscillators and frequency generators
CO4: To understand the operation of the most commonly used D/A and A/D converter types and its applications.

CO-PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2								2	2		1
CO2	2	1	2	1								1	3		2
CO3	2	2	1	2								2	2		
CO4	3	2	3	2								2	2		1

1=weakly related 2= moderately related 3=strongly related

Course Contents:

Module I: **15 lecture hours**

Introduction to Operational Amplifiers and Characteristics: Introduction, Block diagram, characteristics and equivalent circuits of an ideal op-amp, various types of Operational Amplifiers and their applications, Power supply configurations for OP-AMP applications, inverting and non-inverting amplifier configurations.

The Practical op-amp: Introduction, Input offset voltage, offset current, thermal drift, Effect of variation in Power supply voltage, common mode rejection ratio, Slew rate and its Effect, PSRR and gain – bandwidth product, frequency limitations and compensations, transient response, Interpretation of an OPAMP datasheet.

Module II: **10 lecture hours**

Amplifiers and Oscillators: Summing amplifier, Integrators and differentiators, Instrumentation amplifier, Differential input and differential output amplifier, Voltage-series feedback amplifier, Voltage-shunt feedback amplifier, Log/ Antilog amplifier, isolation amplifiers, Triangular/rectangular wave generator, phase-shift oscillators bridge oscillator.

Module III: **10 lecture hours**

Comparators and Converters: Comparator, Zero Crossing Detector, Monostable and Astable Multivibrator, Schmitt Trigger, Voltage limiters, Clipper and clampers, Absolute value output

circuit, Peak detector, Sample and hold Circuit, Precision rectifiers, Voltage-to-current converter, Current-to-voltage converter.

Module IV: **10 lecture hours**

Active Filters and Advanced Applications: Classification of filters, magnitude and frequency response, 1st and 2nd order low pass, high pass and band pass filters, Band reject filters, All pass filters.

List of Experiments

Note: It can be beneficial for a student to perform the simulation before commencing the hardware.

1. Introduction to Op-amps – pins, data sheets, Characterization of Op-amp.
2. To study the inverting amplifier, non-inverting amplifier, summing amplifier and the subtractor difference amplifier using Op-amps (IC-741).
3. To study the various feedback amplifiers using Op-amps (IC-741).
4. To study the RC-phase shift and Wien Bridge Oscillator circuit using Op- Amps (IC-741).
5. To study the half-wave and full-wave precision rectifier circuits using Op- Amps (IC-741).
6. To study the performance of instrumentation, gain amplifier circuit using Op-amp (IC-741).
7. To study the operation and characteristics of Phase Locked Loop (PLL).
9. To study the operation of Voltage Regulator circuit using Op-amp (IC-741).
10. To study the operation and applications of Integrated Circuit Timer (IC 555)

Note: It can be beneficial for a student to perform the simulation before commencing the hardware.

Text Books :

1. Ramakant A Gayakwad, “Op-Amps and Linear Integrated Circuits,” Pearson, 4th Ed, 2015.
2. Salivahanan, Bhaaskaran, “Linear Integrated Circuits,” McGraw Hill Co. 2nd Ed, 2017.

Reference Books :

1. Robert F. Coughlin, and Driscoll,” Operational Amplifiers and Linear Integrated Circuits”, 6/e, Pearson Education. Reprint 2007.
2. P. R. Gray and R. G. Meyer,” Analysis and Design of Analog Integrated Circuit, John Wiley, 4th Ed, Reprint 2009

Assessment Scheme:

Components	Internal Assessment	Mid Term Exam	End Exam	Total
Weightage (%)	40	20	40	100

Name of Program	B. Tech in Electronics and Communication Engineering				
EECE1002L	Signals and Systems	L	T	P	C
Owning School/Department	SEAS/ECE	3	0	2	4
Pre-requisites/Exposure	**NA**				

Course Outcomes (COs)

On completion of this course, the students will be able

CO1: To understand the fundamentals of signals and systems, their classification.

CO2: To understand the characteristics of LTI systems

CO3: To analyze continuous time signals and systems in Fourier and Laplace domain

CO4: To analyze discrete time signals and systems in Fourier and Z domain

CO-PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2								2	2		1
CO2	2	1	2	1								1	3		2
CO3	2	2	1	2								2	2		
CO4	2	2	1	2								1	1		

1=weakly related 2= moderately related 3=strongly related

Course Contents:

Module I: 10 lecture hours

Introduction to continuous-time and discrete-time signals and systems, classification of signals, Introduction to continuous-time and discrete-time signals and systems, classification of signals, Continuous-time LTI system, Convolution integral, Unit impulse response, properties of convolution integral, discrete time LTI system, convolution sum, properties of convolution sum.

Module II: 6 lecture hours

Continuous-time Fourier series, properties of continuous-time Fourier series, Discrete-time Fourier series, properties of discrete-time Fourier series.

Module III: 8 lecture hours

Continuous-time Fourier transform, convergence of Fourier transform, properties of Fourier transform, signal transmission through LTI system, Discrete-time Fourier transform (DTFT), periodicity of DTFT, convergence of DTFT, properties of DTFT.

Module IV: 10 lecture hours

Laplace transform (Bilateral and Unilateral), relationship between unilateral and bilateral Laplace transform, relationship between Laplace transform and Fourier transform, Region of convergence (ROC), properties of ROC, properties of Laplace transform, Solution of differential equation using Laplace Transform

Module V: 8 lecture hours

Z-transforms (Bilateral, Unilateral), relationship between z-transform and DTFT, s to z-plane mapping, region of convergence (ROC), properties of ROC, properties of z-transform, inverse z-transform, Solution of differential equation using Z-Transform

List of Experiments

1. Write a program to generate the following signals (a) Unit step (b) Unit ramp (c) Unit impulse in continuous time and discrete time domain.
2. Write a program to verify different operations in time domain on different signals.
3. Write a program to find even and odd parts of the signal.
4. Write a program to determine the convolution of two signals.
5. Write a program to observe Gibbs phenomena
6. Write a program to plot the Fourier transform of a given signal.
7. Write a program to determine the Laplace transform of a signal.
8. Write a program to determine the z-transform of a signal.
9. Write a program to plot the poles and zeros of a given transfer function in S domain and z domain
10. Create a Simulink schematic of a system and verify whether it is LTI or not

Text Books:

1. Oppenheim, Willsky and Nawab, *Signals and Systems*, Pearson Education India, (2nd ed.), 2015.
2. Barry Van Veen, Simon Haykin, *Signals and Systems*, Wiley; (2nd ed.), 2007. ISBN: 978-8126512652
3. Tarun Kumar Rawat, *Signals and Systems*, Oxford University Press, 2010. ISBN: 978-0198066798

Reference Books:

1. B. P. Lathi, "Principles of Linear Systems and Signals", 2nd Edition, Oxford, 2009.
2. M. J. Roberts, "Signals and Systems Analysis using Transform methods and MATLAB", McGraw- Hill Education, 2018

Assessment Scheme:

Components	**Internal Assessment**	**Mid Term Exam**	**End Exam**	**Total**
Weightage (%)	40	20	40	100

Name of Program	B. Tech in Electronics and Communication Engineering				
EMAT102L	**Linear Algebra and Ordinary Differential Equations**	L	T	P	C
Owning School/Department	SEAS/ECE	3	1	0	4
Pre-requisites/Exposure	EMAT101L				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Solving system of linear equations by using Gaussian elimination to reduce the augmented matrix to row echelon form or to reduced row echelon form.

CO2: To be familiar with the concepts of dimension of a subspace and the rank and nullity of a matrix.

CO3: To calculate the eigenvalues and eigenvectors of a square matrix using the characteristic polynomial.

CO4: Fundamental concepts of ordinary differential equations.

CO5: Solving linear differential equations of both first and higher order.

CO-PO/PSO Mapping

COs POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1									1	2		
CO2	3											1	2		
CO3	3											1	2		
CO4	3											1	2		
CO5	3	3	1									1	2		

1=weakly related 2= moderately related 3=strongly related

Course Contents:

Module I: 12 lecture hours

Review of Matrices, System of linear equations, Gauss elimination method, Elementary matrices, Invertible matrices, Gauss-Jordon method for finding inverse of a matrix, Review of Basic properties of determinant, Cofactor expansion, Determinant method for finding inverse of a matrix, Cramer's Rule, Vector space, Subspace and Examples, Linear span, Linear independence and dependence and Examples, Basis, Dimension, Extension of a basis of a subspace, Intersection and sum of two subspace, Examples**.** Linear transformation, Kernel and Range of a linear map, Rank-Nullity Theorem, Rank of a matrix, Row and column spaces, Solvability of system of linear equations, some applications, Inner product**,** Cauchy-Schwartz inequality.

Module II: 10 lecture hours

Orthogonal basis, Gram-Schmidt orthogonalization process, Orthogonal projection, Orthogonal complement, Projection theorem, Fundamental subspaces. Fundamental subspaces and their relations, An application (Least square solutions and least square fittings). Eigen-values, Eigen-vectors, Characterization of a diagonalizable matrix, Diagonalization: Example, An application. Diagonalization of a real symmetric matrix, Representation of a real linear map by matrices.

Module III: **12 lecture hours**

Introduction to DE, Order of DE, First Order ODE $F(x, y, y') = 0$. Concept of solution (general solution, singular solution, implicit solution etc.) Geometrical interpretations (direction fields), Separable form, Reduction to separable form, Exact equations, Integrating factors, Linear equations, Bernoulli equation, orthogonal trajectories, Picard's existence and uniqueness theorem (without proof), Picard's iteration method, Second order linear ODE: fundamental system and general solutions of homogeneous equations, Wronskian, Reduction of order, Characteristic equations: real distinct roots, complex roots, repeated roots, Non-homogeneous equations: Undetermined coefficients and Variation of parameters**.**

Module IV: **11 lecture hours**

Extension to higher order differential equations, Euler-Cauchy equation, Real analytic solutions of Linear second order equations, Linear system of Differential equations, Fundamental Set, Linearly independent solutions, Laplace transform: Laplace and inverse Laplace transforms, First shifting theorem, Transforms of derivative and integral, Differentiation and Integration of transforms, unit step function, Second shifting theorem**,** Convolution and applications, Initial value problems**.**

Text Books:

1. G. Strang, *Introduction to linear algebra* (4th ed.), Brooks/Cole India, 2006. ISBN: 978-0030105678, 0030105676.
2. E. Kreyszig, *Advanced Engineering Mathematics* (10th ed.), John Wiley & Sons, 2010. ISBN: 978-0470458365, 0470458364.

Reference Books:

1. K. Hoffman and R. Kunze, Linear Algebra (2nd ed.), Prentice Hall India, 2004. ISBN: 9789332550070, 9332550077.
2. G.F. Simmons, Differential equations with applications and historical notes (2nd ed.), 2002. ISBN: 978-0070530713, 0070530718.
3. E. A. Coddington, An Introduction to Ordinary Differential Equations, Dover Publication, 1989. ISBN: 9780486659428.
4. S. L. Ross, Differential Equations (3rd ed.), Wiley India, 1984. ISBN: 9788126515370, 8126515376.

Assessment Scheme:

Components	**Internal Assessment**	**Mid Term Exam**	**End Exam**	**Total**
Weightage (%)	40	20	40	100

Name of Program	B. Tech in Electronics and Communication Engineering					
USEC1002	Leadership and Management Skills	L	T	P	E	C
Owning School/Department	School of Management	2	0	0	0	2
Pre-requisites/Exposure	NA					

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Explain fundamental concepts of leadership and management, including leadership theories, team organization, and self-management practices.

CO2: Apply managerial and leadership skills such as planning, time management, motivation, negotiation, and conflict resolution in team-based and professional scenarios.

CO3: Analyze entrepreneurial processes and develop innovative solutions using design thinking approaches, including idea generation, validation, prototyping, and business planning.

CO4: Evaluate ethical issues and financial decisions by applying ethical frameworks, integrity principles, and basic personal finance management techniques.

CO-PO/PSO Mapping

COs POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1			2			2	1		2	3	3		3		
CO2			2			2	1		2	3	3		2		
CO3			2			2	1		2	1	3		1	1	
CO4			2			3	1	2	2	3	3		2		

1= weakly related 2 = moderately related 3 = strongly related

Course Contents:

Module I: 6 lecture hours

Leadership Skills

- *Introduction to Leadership*: Leadership, Role and functions of a leader, Importance of leadership,
- *Characteristics of an effective leader:* Models of leadership (autocratic and democratic model),
- *Theories of leadership:* Trait and behavioral theories
- *Leadership skills*: Motivation, Negotiation, and Networking

Module II: 5 lecture hours

Managerial Skills

- *Basic Managerial Skills:* Planning for Effective Management, How to Organize Teams? Time Management, Conflict and Stress Management.
- *Self-management Skills:* Emotional Quotient, Developing Self-Awareness with JOHARI Window

Module III: 5 lecture hours

Basics of Entrepreneurship: End-to-end process of creating an entrepreneurial venture, leveraging available resources and networks, Building teams.

- Creating a business plan: Problem identification and idea generation, Idea validation, Pitch making

Module IV: 5 **lecture hours**
Innovative Leadership and Design Thinking

- *Innovative leadership:* The Mindset of Innovative Leaders
- *Design thinking*: Design Thinking as a Leadership Tool, Prototyping, Feedback Driving Innovation

Module V: 7 **lecture hours**
Ethics and Integrity

- Definition and importance of ethics and integrity in leadership, Ethics vs. integrity vs. compliance,
- The 7 Components of Integrity, Classic ethical theories (utilitarianism, deontology), Frameworks for ethical decision-making,
- Ethical Leadership, Ethical Dilemma, Navigating Conflicts of interest, whistleblowing, transparency.

Module VI: 2 **lecture hours**
Managing Personal Finance

- Budgeting: Setting personal goals, estimate likely expenses, Monitor spending to obtain the most value for available funds.
- Saving and investing: Advantages of saving money, Concept of the present and future value of money

Text Books:

- Carnegie, D. (2018). *Overcoming Worry and Stress*. New Delhi: Manjul Publishing
- House.
- Covey, S. R. (2020). *The 7 Habits of Highly Effective People (30th Ed.)*. New Delhi:
- Simon & Schuster.
- Dawkins, E. R. (2016). *52 Weeks of Self Reflection—Your Guided Journal of Self*
- Drucker, P. F. (2006). The Effective Executive. New York: Harper Business.
- Goleman, D. (1995). Emotional Intelligence. New Delhi: Bloomsbury Publishing India
- Private Limited.
- Robbins, S. P., Coulter M., and Fernandez A. (2019). Management (14th edition). Noida, India: Pearson Education.
- Sternberg, R. J. (2004). International Handbook of Intelligence. Cambridge, UK: Cambridge University Press.

Assessment Scheme:

Components	Internal Assessment	Mid Term Exam	End Exam	Total
Weightage (%)	40	20	40	100

Name of Program	B. Tech in Electronics and Communication Engineering					
UAEC1002	Soft Skills and Personality Development	L	T	P	E	C
Owning School/Department	School of Liberal Arts	2	0	0	0	2
Pre-requisites/Exposure	NA					

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Improve interpersonal skills to foster positive relationships with peers, superiors, and subordinates.

CO2: Build and enhance self-awareness, self-confidence, and emotional intelligence.

CO3: Master time management and stress management techniques to improve productivity.

CO4: Identify and develop key traits that contribute to personal and professional growth

CO-PO/PSO Mapping

COs POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1			2			2	3			3			3		
CO2			2			2	3			3			2		
CO3			2			2	3			1			1		
CO4			2			3	3			3			2		

1= weakly related 2 = moderately related 3 = strongly related

Course Contents:

Module I: Introduction to Soft Skills and Personality Development 6 lecture hours

Introduction to soft skills, significance in the workplace and personal life, Types of soft skills: Communication, interpersonal, time management, problem-solving, identifying personal strengths and weaknesses, Personality: concept and elements, salient characteristics, role of personality in shaping behavior and interactions, Big 5 theory, Triguna Theory.

Module II: Developing communication skills 6 lecture hours

Verbal Communication Skills: art of speaking confidently and clearly. tone, pitch, and language choice in different settings. Non-Verbal Communication Skills: Body language, facial expressions, and gestures. interpreting non-verbal cues. Active listening techniques: Paraphrasing, summarizing, and questioning. Barriers to effective listening and how to overcome them.

Module III: Enhancing Interpersonal Relationships 6 lecture hours

Building Trust and Rapport: importance of trust in relationships, techniques for building rapport and fostering cooperation. Conflict Resolution: Identifying sources of conflict, techniques for resolving conflicts and reaching consensus, Emotional Intelligence: Understanding and developing emotional intelligence, significance in building strong relationships

Module IV: Enhancing Self Esteem for improved personality **6 lecture hours**

Role of Self-Esteem in Personality Development, Components of Self-Esteem: Self-acceptance, self-confidence, self-respect, and self-worth, challenging Negative Self-Talk, techniques for self esteem, role of positive affirmation

Module V: Time Management **6 lecture hours**

Understanding time as a precious asset, impact of time management on personal and professional life, Consequences of poor time management, Prioritization Strategies, SMART goals, time management as a tool for stress reduction

Text Books:

- **Barun, R. S. (2017).** Soft skills: Enhancing employability and developing personality. Cambridge University Press.
- Brewer, W. F., & Burk, C. W. (n.d.). Soft skills for workplace success. Pearson.

Reference Books:

- Covey, S. R. (1989). The 7 habits of highly effective people. Simon & Schuster
- Goleman, D. (1995). Emotional intelligence: Why it can matter more than IQ. Bantam Books.

Assessment Scheme:

Components	Internal Assessment	Mid Term Exam	End Exam	Total
Weightage (%)	40	20	40	100

Name of Program	B. Tech in Electronics and Communication Engineering					
UVAC1003	Environment and Sustainability	L	T	P	E	C
Owning School/Department	School of Engineering and Applied Sciences	2	0	0	0	2
Pre-requisites/Exposure	NA					

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Understand the concepts of environment, sustainability, population growth, and the use of natural resources, including their impact on sustainable development.

CO2: Explain the causes and effects of climate change and evaluate strategies for mitigation and adaptation at local, regional, and global levels.

CO3: Identify different types of pollution and emerging contaminants and apply appropriate waste management and pollution control methods.

CO4: Understand major environmental laws, policies, and international agreements, and explain their importance in environmental protection and sustainability.

CO-PO/PSO Mapping

COs POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1			2				3								2
CO2			2				3								2
CO3			2			1	3								2
CO4		1	2			1	3	2					1	1	3

1= weakly related 2 = moderately related 3 = strongly related

Course Contents:

Module I: 6 lecture hours

Population growth, Resource Consumption and Sustainable Development

Introduction to environment and sustainability, Sustainability and population growth and variation among nations, Population explosion and growth curve, Fundamentals of ecology, Natural resources-renewable and non-renewable resources, Problem associated with natural resources, Biodiversity, Renewable and non-renewable energy, Sustainable development goals (SDG), Achieving SDGs and sustainability indices, Case studies of sustainable development.

Module II: 8 lecture hours

Environmental Issues and Climate Change

Local environmental issues: Urban pollution, waste management, Regional environmental issues: Deforestation, desertification, transboundary pollution, Global Environmental Issues: global warming, ozone depletion, loss of biodiversity, ocean acidification.

Module III:

Environmental Pollution and Management **6 lecture hours**

Causes and effects of climate change, Carbon footprint and reduction strategies, Climate change mitigation: Carbon sequestration, afforestation, renewable energy, Climate change adaptation: Climate-resilient agriculture, water conservation, disaster management.

Module IV: **10 lecture hours**

Environmental Policies and Legislation

International Environmental Treaties and Conventions: Paris Agreement, Kyoto Protocol, Montreal Protocol, CBD, National Environmental Laws and Regulations: The National Environment Tribunal Act, 1995, Environmental Protection Act, Water Act, Air Act, Forest Conservation Act, Wildlife Protection Act.

Text Books:

- Miller, G. Tyler, and Scott E. Spoolman. Environmental Science. 16th ed. Boston: Cengage Learning, 2019. ISBN 9781337569613.
- Masters, Gilbert M., and Wendell P. Ela. Introduction to Environmental Engineering and Science. 3rd ed. Boston: Pearson, 2023. ISBN 9780137848584.

Reference Books:

- E. Barucha, Textbook of Environmental Studies for undergraduate Courses, 2nd Edition, Universities Press,2013, ISBN: 9788173718625.
- R. Rajagopalan, Environmental Studies: From Crisis to Cure, 3rd Edition, Oxford University Press, 2016, ISBN: 9780199459759.
- C.S. Rao, Environmental Pollution Control Engineering, 4th Edition, New Age International Pvt. Ltd, 2023, 978-8122472288.

Assessment Scheme:

Components	Internal Assessment	Mid Term Exam	End Exam	Total
Weightage (%)	40	20	40	100

SEMESTER-III

Name of Program	B. Tech in Electronics and Communication Engineering				
EECE203L	**Network Analysis and Synthesis**	L	T	P	C
Owning School/Department	SEAS/ECE	3	0	2	4
Pre-requisites/Exposure	NA				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: To develop a strong foundation in network theorems and circuit analysis techniques, enabling students to analyze and simplify complex electrical circuits.
CO2: To introduce the concepts of transient and steady-state responses in RLC circuits and apply mathematical tools like Laplace transforms for their evaluation.
CO3: To familiarize students with two-port network parameters (Z, Y, H, and T parameters) and their applications in analyzing interconnected systems.
CO4: To enable students to design and synthesize passive filters and evaluate their frequency responses.
CO5: To apply the principles of network synthesis for realizing electrical circuits from given network functions, fostering skills for practical electronic system design.

CO-PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3			2				3			3	3	3	
CO2	3	3			2				3			3	3	3	
CO3	3	3			2				3			3	3	3	
CO4	3	3			2				3			3	3	3	
CO5	3	3			2				3			3	3	3	

1=weakly related 2= moderately related 3=strongly related

Course Contents:

Module I: **12 lecture hours**

Review of network theorems, Substitution theorem, Reciprocity theorem, Tellegen's theorem, Millman's theorem, Compensation theorem, Delta-Star transformations, Formulation and solution of network equilibrium equations on loop and node basis-review, Nodal and mesh analysis including super-node, super-mesh, dependent sources (VCVS, VCCS, CCVS, CCCS), Two port networks, Z, Y, ABCD and h-parameters, Reciprocity and Symmetry, Interrelation of two-port parameters, Interconnection of two-port networks.

Module II: **12 lecture hours**

Review of inductor and capacitor- current voltage phase lead-lag, impedance, Coupled Circuits, Dot Convention for representing coupled circuits, Coefficient of coupling. Transient response RC, RL, and

RLC circuits, Steady state response of network to periodic signals, integrator, differentiator, resonant circuits-Band Width and Q-factor for series and parallel circuits.

Module III: **11 lecture hours**

Network filters (Lowpass, Highpass, Bandpass and Bandstop), Review of Laplace transforms and its application: circuit analysis (steady state and transient), Network Functions, Significance of Poles and Zeros, Restriction on location of Poles and Zeros, Time domain behaviour from Pole-Zero plots.

Module IV: **10 lecture hours**

Hurwitz polynomial, Properties of Hurwitz polynomial, Positive real functions and their properties, Concepts of network synthesis, Realization of simple R-L, R-C and L-C functions in Cauer-I, Cauer-II, Foster-I and Foster-II forms.

List of Experiments

All experiments should be simulated using a SPICE simulator and implemented in hardware.

1. Verification of principle of superposition with dc and ac sources.
2. Verification of Tellegen's theorem for two networks of the same topology.
3. Determination of Z parameters of a two-port network.
4. Determination of Y parameters of a two-port network.
5. Determination of h parameters of a two-port network.
6. Determination of ABCD parameters of a two-port network.
7. Transient response of series RL circuit.
8. Transient response of series RC circuit.
9. Determination of transient response of current in RLC circuit with step voltage input for under damp, critically damp and over damped cases.
10. Determination of frequency response of current in series and parallel RLC circuit with sinusoidal ac input
11. Determination of driving point and transfer functions of a two-port ladder network and verify with theoretical values.

Textbooks:

1. M. E. V. Valkenberg, *Network Analysis* (3rd ed.), Prentice Hall International Edition., 2007. ISBN 978-9353433123.
2. Charles K Alexander, MNO Sadiku, *Fundamentals of Electric Circuits* (7th ed.), McGraw Hill, 2022. ISBN 9789355320162
3. S. K. Bhattacharya, Manpreet Singh, Network Analysis and Synthesis (1st ed.), Pearson, 2015, ISBN 978-93-325-4285-3
4. WH Hayt, JH Kemmerly, SM Durbin, Engineering Circuit Analysis (9th ed.), McGraw Hill, 2020, ISBN 978-9390185139

Reference Books:

1. Franklin F. Kuo, *Network Analysis and Synthesis* (2nd ed.), Wiley India., 2008. ASIN B0007FP5IA.
2. Norman Balabanian, Theodore A. Bickart, (99th ed.), Wiley, 1969. ISBN 978-0471045762

Additional simulation: Use SPICE software to introduce dc and time-domain simulations.

Assessment Scheme:

Components	Internal Assessment	Mid Term Exam	End Exam	Total
Weightage (%)	40	20	40	100

Name of Program	B. Tech in Electronics and Communication Engineering				
EECE207L	**Fundamentals of Logic Design**	L	T	P	C
Owning School/Department	SEAS/ECE	3	0	2	4
Pre-requisites/Exposure	NA				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1 : Develop an understanding of designing a digital logic circuit-based system to achieve a prescribed task.
CO2 : Apply a test procedure to characterize a logic circuit
CO3 : Analyze and Interpret digital circuits and develop an ability to conduct experiments
CO4 : Analyze and synthesize logic networks using both traditional techniques and modern CAD tools.
CO5 : Investigate the state diagrams and form the logic circuits for them.

CO-PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2								2			2	3	2	1
CO2	2	1	2	1					2			1	3	2	2
CO3	3	2	1	2					2	3		2	3	2	2
CO4	3	2	1	2	3				2	3		1	3	2	2
CO5	3	2	1	2					2	2		1	3	2`	2

1=weakly related 2= moderately related 3=strongly related

Course Contents:

Module I: 10 lecture hours

Introduction to number system and their conversion. Minimization Techniques: Boolean postulates and laws, De-Morgan's Theorem, Principle of Duality - Boolean expression, Minimization of Boolean expressions, Minterm, Maxterm, Sum of Products (SOP), Product of Sums (POS), Karnaugh map Minimization, Don't care conditions, Quine-McCluskey method of minimization, Logic Gates, Implementations of Logic Functions using gates, Multi-level gate implementations, Tristate gates.

Module II: 12 lecture hours

Combinational circuits, Design procedure, Half and full adders, Half and full subtractors, Parallel binary adder and subtractor, Fast Adder, Carry Look Ahead adder, Serial Adder/Subtractor, BCD adder, Binary Multiplier, Multiplexer/Demultiplexer, decoder/encoder, priority encoder, parity checker, parity generators, code converters, magnitude Comparator.

Module III: **14 lecture hours**

Latches, Flip-flops, Master-slave flip-flop, Characteristic table and equation, Edge triggering, Level Triggering, Realization of one flip flop using other flip flops, Serial adder/subtractor, Counters: Asynchronous and synchronous, up/down, Modulo-n, Design of synchronous circuits: state diagram, state table, state minimization, state assignment, shift registers, universal shift registers, shift register counters, Sequence generator.

Module IV: **9 lecture hours**

Synchronous Sequential Circuits, Design and Use of Algorithmic State Machine, Analysis of Synchronous Sequential Circuits, Asynchronous Sequential Circuits, Reduction of state and flow tables, Problems in Asynchronous Circuits, Hazards in logic circuits (combinational and sequential), Design of Hazard Free Switching circuits.

List of Experiments

Simulation and Hardware Realization of the following Experiments will be conducted by students:

1. Familiarization of tabletop instruments, IC datasheet.
2. Logic behaviour of various IC-based logic gates. (IC-7400, 7408, 7486)
3. Propagation delay of gates. (IC 7404 NOT GATE)
4. Combinational circuit design using decoders (IC 74155 Dual-2*4 decoder and external NAND GATES.)
5. Adders and Subtractors (AND, OR, EXOR GATE IC-7408, 7432, 7486)
6. Multiplexers and Demultiplexers (IC 74151, 74155, 7493)
7. Cross-coupled NAND/NOR latches (7400, 7402)
8. Flip-flops (IC 7474, 7476, &LED Strip)
9. Operation of a 4-bit binary counter (Mode-16 & mode-10 counters using IC 7400, 7408, 7486, 7493, & LED strip)
10. Up/down Counters (asynchronous/ripple and synchronous)
11. Shift registers (IC -74195 & LED strips)
12. Ring/Johnson Counters from the interconnection of D flip-flops (7474).

Note: It can be beneficial for a student to perform the simulation before commencing the hardware.

Text Books :

1. Mano, Morris M., and Ciletti, Michael D., *Digital Design: With an Introduction to the Verilog HDL* (5th ed.), Pearson Education, 2017. ISBN 978-0132774208.

2. Mano, Morris M., *Digital Logic and Computer Design* (1st ed.), Pearson Education, 2016. ISBN 978-9332542525, 978-9332586048, ISBN 9332586047.

Reference Books :

1. Floyd, Thomas L., *Digital Fundamentals* (11th ed.), Pearson Education, 2015, ISBN 978-1292075983, ISBN 1292075988.
2. Jain, R. P., *Modern Digital Electronics* (4th ed.), Tata McGraw Hill, 2009, ISBN 978-0070669116.

Assessment Scheme:

Components	Internal Assessment	Mid Term Exam	End Exam	Total
Weightage (%)	40	20	40	100

Name of Program	B. Tech in Electronics and Communication Engineering				
EECE104P	**Object-Oriented Programming**	L	T	P	C
Owning School/Department	SEAS/ECE	2	0	4	4
Pre-requisites/Exposure	NA				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1 : Understand the usage of functions and pointers in C/C++.
CO2 : Design simple data structures such as an array, queue, linked list etc.
CO3 : Implement object-oriented programming concepts.
CO4 : Develop algorithms for some real-world problems.

CO-PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3							3	3	2	1
CO2	3	3	3	3	3							3	3	2	1
CO3	3	3	3	3	3							3	3	2	1
CO4	3	3	3	3	3	3	3	3	3	3	3	3		3	3

1=weakly related 2= moderately related 3=strongly related

Course Contents:

Module I: 10 lecture hours

Basic principles of the C++ programming language; the OOPs methodology; Introduction: What is C++? Why C++? C and C++; Object-Oriented Programming; Types and declarations: Booleans, Integer Types, Floating-Point Types, Sizes, Void, numerations, Declarations.

Module II: 10 **lecture hours**

Loops, if-else conditions, nested loops, Pointers, Arrays, Pointers to Arrays, Constants, References, Pointers to void, Structures.

Module III: 10 lecture hours

Functions: Function Declarations, Argument Passing, Value Return, Overloaded Function Names, Default Arguments, Pointer to Function, Macros; Source Files and Programs; Classes; Operator overloading; Derived class.

List of Experiments

The lab component of this course is designed to practice computational problems to enable the students to develop computational thinking.

Text Books :

1. Stanley B. Lippman, Josée Lajoie, Barbara E. Moo, *C++ Primer Paperback (English)*, 5th Edition, Indian edition, Pearson. 2012 ISBN: 9780321714114.
2. Robert Lafore, *Object-Oriented Programming in C++*, 4th Edition, Indian edition, Pearson. ISBN: 0672323087.

Reference Books :

1. Yashavant P. Kanetkar, *Let Us C++,* Paperback, BPB Publications, 2010. ISBN:8183333575.
2. K.R. Venugopal, *Mastering C++,* 2nd edition, McGraw Hill Education 2017. ISBN: 9781259029943.

Assessment Scheme:

Components	**Internal Assessment**	**Mid Term Exam**	**End Exam**	**Total**
Weightage (%)	40	20	40	100

Name of Program	B. Tech in Electronics and Communication Engineering				
EMAT205L	**Complex Analysis and Partial Differential Equations**	L	T	P	C
Owning School/Department	SCSET/MAT	2	1	0	3
Pre-requisites/Exposure	EMAT101L				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Understand the fundamental concepts of complex variable theory.

CO2: Introduce students to some physical problems in Engineering models that results in partial differential equations.

CO3: Introduce students to how to solve partial differential equations with different methods.

CO-PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1									2	2		1
CO2	2	2	3	2									3		2
CO3	2	2	2	2								2	2		

1=weakly related 2= moderately related 3=strongly related

Course Contents:

Module I: 14 lecture hours

- Complex numbers and elementary properties, Conjugate and Modulus, Polar form of a complex number, Complex elementary functions,
- Limits, continuity and differentiation, Cauchy-Riemann equations
- Analytic and harmonic functions, Anti-derivatives and path (contour) integrals
- Cauchy's integral formula, Morera's Theorem, Liouville's Theorem, Fundamental Theorem of Algebra and Maximum Modulus Principle
- Taylor series, Power series, Singularities and Laurent series, Cauchy's Residue Theorem and applications, Conformal mapping, Mobius transformation

Module II: 14 lecture hours

- Introduction to PDEs, Classification of first-order PDEs, Quasi-linear first-order PDEs, The method of Lagrange, The method of characteristics, Cauchy problem
- Nonlinear first-order PDEs, Extension of the method of characteristics to nonlinear equations, Cauchy's problem for nonlinear PDEs, Compatible equations, Charpit's method, Second-order linear PDEs, Classifications, Reduction to canonical form

- Second-order wave equation, Infinite and semi-infinite string problems, D' Alembert's solution, Boundary and initial value problems, Method of separation of variables, Wave equation, Heat conduction equation, Laplace's equations and solutions.
- Introduction to Fourier Series, Historical development, Examples, Fourier cosine and sine series, Differentiation and integration of Fourier Series, Parseval's identity,
- Fourier integral, Fourier transform, Fourier sine and cosine transform, The Fourier transform method for wave propagation and heat flow problem in an infinite string

Text Books:

1. J. W. Brown and R. V. Churchill, *Complex Variables and Applications* (9th ed.), Mc-Graw Hill, 2013, ISBN-10: 0073383171.
2. I. N. Sneddon, *Elements of Partial Differential Equations*, Dover publications. 2006, ISBN-10: 9780486452975.

Reference Books:

1. J. H. Mathews and R. W. Howell, *Complex Analysis for Mathematics and Engineering*, Laxmi publications, 2011, ISBN-10: 9380853416.
2. R. Haberman, *Elementary Applied Partial Differential equations with Fourier Series and Boundary Value Problem (3rd ed.)*, Pearson. 1997, ISBN-10: 013263807X.
3. E. Kreyszig, *Advanced Engineering Mathematics (9th ed.)*, John Wiley & Sons, 2011, ISBN-10: 8126531355.

Assessment Scheme:

Components	Internal Assessment	Mid Term Exam	End Exam	Total
Weightage (%)	40	20	40	100

Name of Program	B. Tech in Electronics and Communication Engineering				
EECEXXXX	**Electronics Design**	L	T	P	C
Owning School/Department	SEAS/ECE	1	0	4	3
Pre-requisites/Exposure	**Nil**				

Course Outcomes:

CO1: Apply design thinking and engineering tools to develop functional prototypes involving basic electronics and embedded systems.

CO2: Demonstrate proficiency in PCB design using KiCad and microcontroller programming using Proteus for simple real-world applications.

CO3: Demonstrate the ability to create accurate 2D sketches and 3D models of mechanical components using manual graphics and CAD software, applying appropriate constraints, features, and assemblies.

CO-PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2		3					2	3	2	3	2	3
CO2	3	2	2		3					2	3	2	3	3	3
CO3	3	2	2		3					2	3	2	3	3	3

Module 1 **5 Hours**

Engineering problem solving, Design thinking: Empathize, Define, Ideate, Prototype, Test, Interdisciplinary approach in engineering, Introduction to electronic components (resistors, capacitors, LEDs, transistors, etc.), microcontroller basics, Introduction to embedded C programming, Getting started with Proteus: interface, libraries, and simulation basics, Writing and uploading firmware (via .hex files), Simulating sensors, actuators, and display modules, Debugging and testing.

Module 2 **5 Hours**

Overview of KiCad environment, Schematic creation and component library management, PCB layout design, rule checks, and 3D visualization, Generating Gerber files and exporting for fabrication

Module 3 **5 Hours**

Introduction to AutoCAD:

Manual Graphics: Engineering Drawing, Geometrical Constructions and Scales, 1st and 3rd angle projections, Orthographic Projection, Projection of points, lines, planes & solids, Surface development.

Introduction to 2D modeling

Drawing settings: Units, Limits; Drafting settings: Ortho, Polar, Grid, Snap, Polar Tracking, Object snap, Dynamic inputs, Quick properties; Drawing tools: Line, Arc, spline, Ellipse, Polyline, Array, Wipeout, Layer and its properties, Parametric modeling, Dimensioning, Annotation, Object selection method etc.

Introduction to 3D solids and sections:

Construction of Simple solids, Working on UCS, creating solids and surfaces from 2D objects, Modifying in 3D space, Advanced solid editing, Additional editing tools, Refining the reviews, Visualization, Working drawing on 3D Models. Hands on practice by students.

Case Studies:

AutoCAD Based modeling of Piston, Gear, Clutch lever, Brackets and Lever Assembly, etc.

Experiments

1. **Blinking LED Program** – Simulate an LED blinking at a fixed interval.
2. **LED Pattern Generator** – Implement basic LED chaser/sequencer.
3. **Interfacing Push Button and LED** – Toggle LED based on button press.
4. **7-Segment Display Counter** – Display numbers 0-9 on a 7-segment display.
5. **Analog Sensor Reading (LDR/Temperature)** – Use ADC to read sensor data and simulate it in Proteus.
6. **PWM Signal Generation** – Create a dimming effect using PWM on an LED.
7. **DC Motor Control** – Use Proteus to simulate H-Bridge-based motor control.
8. **Traffic Light Controller** – Multi-LED control based on time logic.
9. **LCD Display Interface** – Display static and dynamic text using 16x2 LCD.
10. **Digital Thermometer** – Read analog data from a temperature sensor and display it on LCD.
11. **Design a PCB using milling machine**

List of Hands-on for Module-3 (20 lab hours):

1. Drawing of Scales
2. Drawing of Projection of Points & lines
3. Drawing of Projection of Planes
4. Drawing of Projection of solids
5. Drawing of Surface Development
6. Basics 2D and 3D drawings and solid modelling
7. Modelling of Real-World Products
8. Use of Array and its application
9. Basics of Layers and drawings at different perspectives
10. Case Studies

Textbooks:

1) N D Bhatt, *Engineering Drawing* (53rd ed.), Charotar Publishing House Pvt. Ltd, 2014. ISBN 9789380358963.
2) Shibu K. V., Introduction to Embedded Systems, 2nd Ed., McGraw Hill, 2016, ISBN 9789339219680.

3) Muhammad Ali Mazidi, The 8051 Microcontroller and Embedded Systems, 2nd Ed., Pearson, 2007, ISBN 9780199681273.
4) Peter Dalmaris, KiCad Like a Pro: A comprehensive hands-on guide for learning the world's favourite open-source PCB design tool, 3rd Ed., Tech Explorations, 2022, ASIN B09VB5QYL6.

Reference books:

1. Colin H Simmons, *Manual of Engineering Drawing* (4th ed.), Elsevier, 2012, ISBN 9789382291572.
2. K.P Ramchandran, G.K Vijayaraghavan, M.S Balasundaram, Mechatronics- Integrated Mechanical Electronic Systems, John Wiley & Sons, 2008, ISBN 9788126518371.

Assessment Scheme:

Components	Internal Assessment	Mid Term Exam	End Exam	Total
Weightage (%)	40	20	40	100

SEMESTER-IV

Name of Program	B. Tech in Electronics and Communication Engineering				
EECE210 L	**Probability Theory and Stochastic Processes**	L	T	P	C
Owning School/Department	SEAS/ECE	3	1	0	4
Pre-requisites/Exposure	NA				

Course Outcomes (COs)

By the end of this program, students should have the following knowledge, skills and values:

CO1: To introduce the basic understanding of the fundamentals of probability theory including the axioms of probability, independence, and conditional probability.
CO2: To learn to understand discrete and continuous probability distributions.
CO3: To learn to develop an understanding of stochastic random processes and their analysis.
CO4: To understand the concept of random variables and how to use them to solve probabilistic problems.
CO5: Introduce confidence intervals and perform statistical inference such as hypothesis testing.

CO-PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3		1										2	2	
CO2	3	2	1										2	2	
CO3	2	2	1										2	2	
CO4	2	2	1										2	2	
CO5	2	2	1										2	2	

1=weakly related 2= moderately related 3=strongly related

Course Contents:

Module I **6 lecture hours**

Elements of Probability: Review of probability theory, Sample space and Events, Axioms of probability, Conditional Probability, Independent Events, Bays Theorem, Problems.

Module II 12 **lecture hours**

Random Variables and Expectation: Random variable, Types of Random Variables, jointly distributed random variables, Independent random variables, Probability density function, Cumulative distribution function, conditional distributions, Expectation, Properties of Expected value, the Expected value of the sum of random variables, Variance, Conditional Expectation, Covariance and variance of sums of random variables, Moment generating function, mean and median, Markov inequality, Chebyshev's inequality, Problems.

Special Distributions: Bernoulli Distribution, Binomial Distribution, Hypergeometric Distribution, Poisson Distribution, Negative Binomial Distribution, Normal Distribution,

Gamma Distribution, Beta Distribution, Lognormal Distributions, Gaussian Distribution, Uniform Distribution, Cauchy Distribution, Problems.

Module III 8 **lecture hours**

Joint Distributions: Joint distribution, Marginal distribution, Conditional distributions, bivariate distribution, correlation and regression, Problems.

Module IV 9 **lecture hours**

Stochastic Processes: Random processes, Characterization of random processes, Classification of random processes: Stationary processes, WSS, Markov Processes, Normal Processes, Ergodic Processes, Poisson processes, Wiener Processes.

Analysis of Random Processes: Continuity, Differentiation and integration, Power Spectral Density, White Noise, Fourier Transform of Random Processes.

Module V 10 **lecture hours**

Distributions of Sampling Statistics: The Central Limit Theorem, distributions of the sample mean and the sample variance for a normal population, Chi-Square, t and F distributions, problems.

Estimation and Hypothesis Testing: Maximum likelihood estimation, confidence intervals for parameters in one sample and two sample problems of normal populations, confidence intervals for proportions, Null and alternative hypotheses, the critical and acceptance regions, two types of error, power of the test, the most powerful test and Neyman-Pearson Fundamental Lemma.

TEXTBOOKS/LEARNING RESOURCES

1. V. Rohatgi, and A. Saleh, *Introduction to Probability Theory and Statistics*, (2nd ed.), Wiley-Interscience, 2000.
2. S.M. Ross, *Introduction to Probability and Statistics for Engineers and Scientists*, Academic Press, (4th ed.), 2009. ISBN: 978-0123704832
3. W. Feller, *An Introduction to Probability Theory and Its Applications*, John Wiley & Sons; (3rd ed.), 1968. ISBN-13: 978-0471257080

REFERENCE BOOKS/LEARNING RESOURCES

1. Papoulis and S. Unnikrishnan Pillai Probability, Random Variables and Stochastic Processes, McGraw Hill Education; (4th ed.), 2017. ISBN: 978-0070486584

Assessment Scheme:

Components	Internal Assessment	Mid Term Exam	End Exam	Total
Weightage (%)	40	20	40	100

Name of Program	B. Tech in Electronics and Communication Engineering				
EECE208P	**HDL Programming**	L	T	P	C
Owning School/Department	SEAS/ECE	2	0	2	3
Pre-requisites/Exposure	EECE207L				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1 : To design logic circuits using different HDL implementation styles
CO2 : To make the students design and evaluate combinational-circuit building blocks
CO3 : To make the students design and test circuits employing flip-flops, registers, counters, and a simple processor
CO4 : To make the students design and analyze synchronous sequential circuits

CO-PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2	3				1		2	2	3	2	2
CO2	2	2	1	2	3				1		2	2	3	2	2
CO3	2	3	2	2	3				1		2	2	3	2	3
CO4	3	2	1	3	3				1		2	2	3	2	3

1=weakly related 2= moderately related 3=strongly related

Course Contents:

Module I: 10 lecture hours

Emergence of HDLs and advancement, level of abstractions, hierarchical modelling concepts, EDA tools. Lexical conventions, keywords and identifiers, Logic elements, expressions-operands and operators, modules and ports- designing a test-bench, built-in primitives, user-defined primitives-combinational and sequential. Data flow modeling- continuous assignment and operators.

Module II: 10 lecture hours

Behavioral modeling- blocking and non-blocking assignment, statements and inter-statement and intra-statement delays; regular delay control and zero delay control, structural modeling-module instantiation and ports. Tasks and functions: declaration and innovation. Conditional compilation and execution, timing scales, displaying hierarchy. Designing of combinational logic circuits using HDL Verification of gate level net-list. Designing of sequential logic circuits using HDL, PLI and VPI implementations.

Module III: **10 lecture hours**

CMOS based implementation of logic gates. Detailed description Mealy and Moore machines. Programmable logic devices, introduction to programmable logic array and programmable array logic. Basic structure of field programmable gate array (FPGA) and its applications, latest FPGAs available in the market with brief about specifications, bitstream generation and implementation on FPGA board.

List of Experiments

Simulation and realization of the following experiments will be conducted by students:

Implementation of the following design using Verilog (generate the schematic also):

1. Introduction to simulation platform and implementation of logic gates
2. Combinational Circuits:
   (a) Adders and subtractors
   (b) 2 to 4 decoders and 8 to 3 encoders
   (c) 8 to 1 multiplexer and demultiplexer
   (d) 4 bits binary to gray converter, gray to binary coder converter
   (e) BCD to excess-3 code convertor
3. 16-bit ALU design
4. Flip-flops (SR, D, JK and T)
5. 4-bit binary up-counters (synchronous & asynchronous)
6. 4-bit binary down-counters (synchronous & asynchronous)
7. Binary MOD counters
8. Ring counter/Johnson Counter

Project: Implementation of basic logic gates on FPGA board.

Text Books :

1. Michael D. Ciletti , *Advanced Digital Design with Verilog HDL*, (2nd ed.), Pearson, 2011, ISBN-13: 978-8131711125, ISBN-10: 8131711129
2. Joseph Cavanagh, *Verilog HDL Design Examples* (1st ed.), CRC Press, 2021, ISBN-13: 978-0367778811.
3. Samir Palnitkar, *Verilog HDL* (2nd ed.), Pearson India, 2003, ISBN-13: 978-8177589184.

Reference Books :

1. Cem Unasalan, Bora Tar , "*Digital System Design with FPGA – Implementation using Verilog and VHDL*," McGraw Hill Education, Indian Edition. ISBN-13: 978-1259837906, ISBN-10: 9781259837906

2. Mano & Ciletti, *Digital Design: With an Introduction to Verilog HDL*, (5th ed.) Pearson 2013, ISBN 13: 9788131794746, ISNB 10: 8131794741

Assessment Scheme:

Components	Internal Assessment	Mid Term Exam	End Exam	Total
Weightage (%)	40	20	40	100

Name of Program	B. Tech in Electronics and Communication Engineering				
EECE218L	**Data Structures**	L	T	P	C
Owning School/Department	SEAS/ECE	2	0	2	3
Pre-requisites/Exposure	NA				

Course Outcomes (COs)

On completion of this course, the students will be able to:
CO1: Understand the basics of arrays, queues, and stacks.
CO2: Implementation of pointers and linked list.
CO3: Designing various sorting algorithms.
CO4: Understand the structure of trees and graphs.
CO5: Applying Different data structures algorithms in various problem-solving.

CO-PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2										2	2		1
CO2	2	2		1								2	2		2
CO3	3	2		2								2	2		1
CO4	2	1		1								2	2		1
CO5	2	2										2	2		1

1=weakly related 2= moderately related 3=strongly related

Course Contents:

Module I: 10 lecture hours

Introduction to programming methodologies and design of algorithms. Abstract Data Type, array, array organization; Stacks, Stack Manipulation, Prefix, infix and postfix expressions. Queues and Queue manipulation; Application of stack, Queue, Array Representation of Queue; Recursive algorithms.

Module II: 8 lecture hours

Linked List: Introduction, Linked lists, Representation of linked lists in Memory, Traversing a linked list, Searching a linked list, Memory allocation and Garbage collection, insertion into linked list, Deletion from a linked list, Types of linked list; Searching and Sorting Techniques.

Module III: 12 lecture hours

Trees, Properties of Trees, Binary trees, Binary Tree traversal, Tree manipulation algorithms, binary search trees, AVL Trees, Heaps and their implementation. Graphs: Matrix Representation of Graphs, Breadth First Search, Depth First Search, Spanning Trees; Shortest Path Algorithms, Weighted Shortest Paths, Dijkstra's Algorithm, Minimum spanning tree.

List of Experiments

The lab component of this course is designed to practice computational problems to enable the students to develop computational thinking.

Text Books :

1. R. F. Gilberg, and B. A. Forouzan, *Data structures: A Pseudocode approach with C*, 2nd edition, Thomson Learning. ISBN: 978-0-534-39080-8.
2. A. V. Aho, J. E. Hopcroft, J. D. Ulman, *Data Structures and Algorithm*, 1st edition, Pearson Education. ISBN: 978-0201000238.

Reference Books :

1. Narasimha Karumanchi, *Data Structures and Algorithms Made Easy: Data Structures and Algorithmic Puzzles,* 5th edition, Careermonk Publications, 2016. ISBN: 978- 8193245279.
2. Seymour Lipschutz, *Schaum's outline of theory and problems of data structures*, McGraw Hill Education, 2013, ISBN: 978-0070380011.

Assessment Scheme:

Components	**Internal Assessment**	**Mid Term Exam**	**End Exam**	**Total**
Weightage (%)	40	20	40	100

Name of Program	B. Tech in Electronics and Communication Engineering				
EECE209L	**Analog Circuits-I**	L	T	P	C
Owning School/Department	SEAS/ECE	2	1	2	4
Pre-requisites/Exposure	NA				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Draw load lines for simple circuits having diode, bipolar junction transistor (BJT) and Zener diode and obtain quiescent point. Design, build and analyse voltage regulator circuit using single Zener diode

CO2: Design, assemble and verify biasing circuits for BJT amplifiers in common emitter, common base and common collector mode. Draw Ebers-Moll equivalent circuit for amplifiers and calculate input-output resistance and gain.

CO3: Learn and analyse multistage amplifiers and different types of coupling between two stages.

CO4: Analyse transistor parameters: h-parameters, pi-model

CO-PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1			2				3	2			3	2	
CO2	3	1			2				3	2			3	2	
CO3	3	3	1		3				3	2			3	2	1
CO4	3	3	1		3				1	2			3	2	1

1=weakly related 2= moderately related 3=strongly related

Course Contents:

Module I: 10 lecture hours

Band structure of semiconductors, the concept of Fermi level, intrinsic and extrinsic semiconductors; carrier concentration calculations, generation and recombination, mobilily, drift and diffusion currents.

Ideal diode I-V curve, diode approximations, dc load line and operating point, dc resistance. Small signal analysis and ac resistance of diode. Temperature effects in diode. Ratings of diode: current, power and breakdown ratings. Analysis of Half-wave rectifier, full wave rectifier circuits. Wave-shaping circuits: Clamping, clipping, detector circuits. Zener diode and its application in voltage regulation.

Module II: 10 lecture hours

Bipolar junction transistor (BJT): doping profile in BJT, Transistor as current source, as a switch, as an amplifier, BJT ratings, DC load line in BJT, base-width modulation, Early effect, Kirk effect, current crowding effect. current gain in common base, common emitter and

common collector configurations. Equivalent circuit, Ebers Moll model, high-frequency effects, transient response, temperature effect.

Module III: **10 lecture hours**

Transistor biasing circuits. base resistance bias, collector feedback bias, emitter feed-back bias, Voltage divider bias, stiff and firm voltage divider, practical design guidelines. Stability. Small signal model of BJT, h- parameters, hybrid p model, T-model, small signal model and analysis of CE, CB, CC amplifiers. coupling and bypass capacitors. AC Beta, emitter degeneration, comparison of CE, CB, CC.
Voltage gains, input impedance, output impedance, effect of source and load on amplifier, efficiency of an amplifier, frequency response.

List of Experiments

Simulation and Hardware Realization of the following Experiments will be conducted by students:

Experiment on following topics will be conducted by students

1. Measurement of p-n diode I-V characteristics in forward and reverse biasing and Zener diode I-V characteristics in reverse bias in breakdown region.
2. Designing, assembling and testing of a voltage regulator circuit using a single Zener diode. Study of load and line regulation characteristics.
3. Making and testing of a half wave and bridge rectifier circuit. Studying the effect of a capacitor filter on the output waveform.
4. Biasing schemes for BJT and Understanding Load line / Q Point.
5. Designing, building and testing of a current source using a BJT in common base mode for two values of current: (a) 100 μA and (b) 10 mA. Evaluation of their characteristics as a function of load resistance.
6. Common Emitter Amplifier.
7. Common Collector (Emitter Follower) and Common Base Amplifier
8. Designing and building a differential amplifier using BJT and studying its characteristics.
9. Assembling and testing of a Colpitts oscillator.

Note: It can be beneficial for a student to perform the simulation before commencing the hardware.

Text Books :

1. Adel S. Sedra and Kenneth C. Smith, *Microelectronics Circuits Theory and Applications*, International Student Edition, Fifth Edition, Oxford University Press, 2004, ISBN-13: 978-0-19-806225-7, ISBN-10: 0-19-806225-7.
2. Donald l. Schlling and Charles Belove, *Electronic Circuits: Discrete and Integrated*, Third Edition, Tata McGraw Hill, ISBN 10: 0071006028 / ISBN 13: 9780071006026
3. Albert Paul Malvino and David J Bates, *Electronic Principles*, 7th Edition, Tata McGraw Hill, 2007, ISBN-13: 978-0-07-063424-4, ISBN-10: 0-07-063424-4
4. S. Salivahanan and N Suresh Kumar, *Electronic Devices and Circuits*, 4th Edition, McGraw Hill Education 2017ISBN-13: 978-93-392-1950-5, ISBN-10: 93-392-1951-1
5. Debashis De and K P Ghatak, *Basic Electronics*, 2010, Pearson, ISBN-13: 978-81-317-1068-5

Reference Books :

1. Jacob Millman, Christos C Halkias and Chetan D Parikh, *Integrated Electronics, Analog and Digital Circuits and Systems*, Second Edition, McGraw Hill Education India P Ltd, 2-18. ISBN-13: 978-0-07-015142-0, ISBN-10: 0-07-015142-3

Assessment Scheme:

Components	Internal Assessment	Mid Term Exam	End Exam	Total
Weightage (%)	40	20	40	100

Name of Program	B. Tech in Electronics and Communication Engineering				
EECE216P	**Embedded Systems**	L	T	P	C
Owning School/Department	SEAS/ECE	2	0	4	4
Pre-requisites/Exposure	NA				

Course Outcomes (COs)

CO1: Design and develop embedded systems using microcontrollers and Embedded C programming
CO2: Interface and control peripherals such as sensors, actuators, and communication modules
CO3: Implement and manage real-time operating system (RTOS) tasks and synchronization techniques.
CO4: Optimize embedded systems for power efficiency and performance.
CO5: Develop and troubleshoot real-world embedded applications through hands-on lab experiments and mini projects.

CO-PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2		3					2	3	2	3	2	3
CO2	3	2	2		3					2	3	2	3	3	3
CO3	3	2	2		3					2	3	2	3	3	3
CO4	3	2	2		3					2	3	2	3	3	3
CO5	3	2	2		3					2	3	2	3	3	3

1=weakly related 2= moderately related 3=strongly related

Course Contents:

Module I: 6 lecture hours

Introduction to Embedded Systems, Embedded Products (i.e., Cell Phones, Robots, GPS, Cameras, Transaction Terminals, and Industrial Controllers), Definition and characteristics of embedded systems, Embedded system architecture, Design challenges and considerations; The Design and Development Process for a new embedded product, Software Development and Debug Tool Flows.

Module II: 8 lecture hours

Microcontroller Architecture and Programming: Microcontroller vs. Microprocessor, Architecture of ARM Cortex-M, AVR, and PIC, Memory organization and I/O ports., Instruction set and assembly language programming, GPIO programming and delay generation.

Module III: **8 lecture hours**

Introduction to Embedded C, Data types, variables, and constants, Bit manipulation and register-level programming, Interrupts and handling, best practices for efficient embedded programming. Interfacing sensors (temperature, humidity, motion), Interfacing actuators (motors, relays), Communication protocols: UART, SPI, I2C, ADC and DAC interfacing.

Module IV: **8 lecture hours**

Introduction to RTOS, Multitasking and task scheduling, Task creation, deletion, and prioritization, Synchronization (semaphores, mutex), RTOS timers and memory management. Power optimization techniques in embedded systems, Low-power modes (sleep, standby), Debugging tools and techniques, In-circuit debugging and serial debugging, Designing a small embedded system application, Real-world case studies of embedded systems.

List of Experiments

1. Introduction to the embedded development board (e.g., Arduino, STM32, or ESP32).
2. Setting up the development environment and running basic programs (LED blinking)
    a. Basic digital input and output
    b. LED blinking with delay loops
3. Interfacing push buttons and controlling LEDs.
    a) Use of timers to generate periodic signals
    b) Generate a Sine wave analog output with AnalogOut
4. Writing C programs for GPIO control.
5. Using interrupts to handle external events.
6. Generating PWM signals.
    a. Using PWM to dim an LED with pushbuttons and interrupts
    b. Using PWM to control an RGB LED
7. Interfacing temperature sensor (LM35 or DHT11) with a microcontroller.
8. Reading analog data using ADC.
9. Communicating with external devices using UART/I2C/SPI.
10. Creating multiple tasks using FreeRTOS.
11. Implementing task synchronization using semaphores.
12. Measuring task execution time.
13. Using sleep modes in microcontrollers.
14. Debugging using serial prints and breakpoints.
15. A basic USB mouse function with the navigation switch
16. Reading an Analog Input from a Potentiometer with AnalogIn
17. I2C bus IMU and USB virtual com port
18. Serial TTL level color graphics LCD display
19. Driving high current devices with a relay
20. Power Transistor Driver for DC motor speed control with PWM (one direction only)
21. RC Servo position control using PWM

22. Reversible DC motor with speed control using an H-Bridge
23. MEMS microphone for Audio Input
24. Stepper motor control with a dual H-Bridge
25. Use the speaker for audio output
26. Wi-Fi networking and IoT
27. Measure and print the distance to the nearest object using the VL53L0X LIDAR TOF sensor

Text Books:

1. James O. Hamblen, Introduction to embedded systems using windows embedded CE (2nd ed.), 2007.
2. John D. Carpinelli, Computer Systems Organization and Architecture (1st ed.), Pearson Education Asia, 2000. ISBN-13: 978-8177587678, ISBN-10: 8177587676
3. Raj Kamal, Embedded Systems: Architecture, Programming, and Design, McGraw Hill.
4. Shibu K. V., Introduction to Embedded Systems, McGraw Hill.
5. Muhammad Ali Mazidi, The 8051 Microcontroller and Embedded Systems, Pearson.

Reference Books :

1. https://os.mbed.com/handbook/Homepage
2. Joseph Yiu, The Definitive Guide to ARM Cortex-M Processors, Newnes.

Assessment Scheme:

Components	Internal Assessment	Mid Term Exam	End Exam	Total
Weightage (%)	40	20	40	100

SEMESTER-V

Name of Program	B. Tech in Electronics and Communication Engineering				
EECE369L	**Machine Learning**	L	T	P	C
Owning School/Department	ECE/SEAS	3	0	2	4
Pre-requisites/Exposure	Linear Algebra				

Course Outcomes (COs)

By the end of this program, students should have the following knowledge, Skills and values:

CO1: Understand and apply the fundamental concepts in solving, designing and analyzing supervised and unsupervised machine learning problems
CO2: Understand and comprehend both linear and non-linear regression models to solve regression problems with appropriate regularization techniques
CO3: Apply unsupervised learning techniques such as clustering, density estimation, and dimensionality reduction to solve real-world problems and discover patterns in unlabeled data
CO4: Understand and apply various machine learning techniques and combine multiple learners to address and optimize real-world decision-making problems.

CO-PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	3							3			3
CO2	3	3	2	3	3							3			3
CO3	3	3	2	2	3							3			3
CO4	2	3	3	2	3	2			3	3		1			3

I =weakly related 2= moderately related 3-strongly related

Course Contents:

Module I **13 lecture hours**

Survey of techniques for development and analysis of software that learns from experience. Supervised classification: Bayesian learning , support vector machine, loss functions, kernels, Perceptron: artificial neural networks, and deep learning. Specific techniques: linear classifiers, nonparametric methods, K nearest neighbor, decision trees, random forest. Performance analysis of machine learning algorithms.

Module II **10 lecture hours**

Supervised regression: (a) linear regression: least square linear regression model, Bayes Linear Regression (b) non-linear regression: ridge regression, lasso regression, SVM regression, logistic regression.

Module III **10 lecture hours**

Unsupervised learning: clustering, K-Means, Hierarchical, density based, Expectation Maximization, Mixture of Gaussian, density estimation, dimensionality reduction.

Module IV **12 lecture hours**

Dimensionality reduction; Principal Component Analysis, LDA, Graphical Models, Hidden Markov models; Bayesian estimation; Combining multiple learners, Reinforcement learning.

List of Experiments

Lab Work (MATLAB/PYTHON): Hands-on experience in solving real-life problems using machine learning techniques, focusing on working with real-world datasets and building and evaluating models in practical scenarios.

1. Preprocess data (handle missing values, scale features, encode categorical data), visualize using histograms, scatter plots, box plots, and heatmaps.
2. Build a decision tree classifier for binary classification, covering training, testing, and model evaluation.
3. Implement K-Nearest Neighbors (KNN) for Iris species classification and analyze performance with varying K values.
4. Use Naive Bayes to classify text (e.g., spam vs. non-spam) and evaluate with confusion matrix, precision, and recall.
5. Train an SVM with non-linear kernel to classify images (e.g., handwritten digits), analyze accuracy and decision boundaries.
6. Build and train an Artificial Neural Network using Backpropagation, test on relevant datasets.
7. Perform customer segmentation using K-Means clustering based on annual spending in various product categories.
8. Implement linear regression to predict car prices, evaluate with MSE and R-squared.
9. Implement logistic regression for Iris classification, plot confusion matrix, and evaluate accuracy.
10. Apply PCA for dimensionality reduction on Iris dataset, visualize in lower dimensions.

Text Books /Learning Resources:

1. ETHEM ALPAYDIN, Introduction to Machine Learning 3RD Edition Paperback – 2015; Publisher: Phi; 3RD edition (2015); ISBN-10: 8120350782; ISBN-13: 978-8120350786
2. Russell, Artificial Intelligence 3e: *A Modern Approach Paperback – 2015*; Publisher: Pearson Education India; 3 edition (2015); ISBN-10: 9789332543515; ISBN-13: 978-9332543515; ASIN: 9332543518

3. Tom M. Mitchell, *Machine Learning Paperback* – 1 Jul 2017; Publisher: McGraw Hill Education; First edition (1 July 2017); ISBN-10: 1259096955; ISBN-13: 978-1259096952
4. Yuxi Hayden Liu, *Python Machine Learning* By Example Paperback – Import, 31 May 2017, Publisher: Packt Publishing Limited (31 May 2017), ISBN-10: 1783553111, ISBN-13: 978-1783553112

REFERNCE BOOKS/LEARNING RESOURCES:

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman *Elements of Statistical Learning,* Springer
2. Christopher Bishop, *Pattern Recognition and Machine Learning* excellent in classification and regression
3. Kevin Murphy, *Statistical Machine Learning*

Assessment Scheme:

Components	**Internal Assessment**	**Mid Term Exam**	**End Exam**	**Total**
Weightage (%)	40	20	40	100

Name of Program	B. Tech in Electronics and Communication Engineering				
EECE214L	**Electromagnetic Field Theory**	L	T	P	C
Owning School/Department	SEAS/ECE	2	1	0	3
Pre-requisites/Exposure	NA				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Understanding the basics of electric, magnetic fields and the associated laws
CO2: Understand the coupling between electric and magnetic fields through Maxwell's equations and its physical significance
CO3: Study the behaviour of EM waves in different media.
CO4: Gain insights of transmission lines and its losses.
CO5: Learn various waveguide structures and their behaviour.

CO-PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2											3	2	3
CO2	2	2											2		1
CO3	2	2											2		1
CO4	2	2											2		1
CO5	3	2											3	2	3

1=weakly related 2= moderately related 3=strongly related

Course Contents:

Module I **14 lecture hours**

Review of Electromagnetics: Line, surface, volume integrals, Gradient, divergence, curl, Divergence theorem, Stokes theorem.
Electric field, Gauss law, Electric potential, conductors and dielectric in static electric field, electric flux density and dielectric constant, boundary conditions, Capacitance, Poisson's and Laplace equations, Boundary value problems, Uniqueness theorem, Current and current density, continuity of current
Ampere's law, Biot-Savart law, Magnetic field intensity, permeability, magnetic boundary conditions, inductance

Module II **12 lecture hours**

Maxwell's equations – Differential and integral form, physical significance, Poynting vector, Poynting Theorem, Wave equation in an isotropic homogeneous medium and its solution, phasor notation, the polarization of waves, reflection, and refraction of plane waves at plane boundaries, wave propagation in metal and dielectric.

Module III **10 lecture hours**

Transmission Lines: Description of transmission lines, telegraph equations, lossless propagation, Standing waves; Smith chart; Transmission line matching: Single and double-stub matching, quarter-wave transformers.

Module IV **9 lecture hours**

Waveguides: Electromagnetic fields in parallel-plate, rectangular, and circular waveguides, TE and TM modes, wave impedance, wave velocities, attenuation in waveguides.

Text Books :

1. R.K Shevgaonkar, "*Electromagnetic Wave",* Tata McGraw-Hill Education.
2. Hayt, W.H. and Buck, J.A., "*Engineering Electromagnetics*", 7th Ed., Tata McGraw-Hill.
3. Kraus, J.D. and Fleisch, D.A., "*Electromagnetics with Applications*", McGraw-Hill.
4. Sadiku, M.N.O., "*Elements of Electromagnetics*", 3 rd Ed., Oxford University Press.

Reference Books :

1. Narayana Rao, N., "*Elements of Engineering Electromagnetics*", 5th Ed., Prentice-Hall of India.
2. Jordan, E.C. and Balmain, K.G., "*Electromagnetic Waves and Radiating Systems*", 2nd Ed., Prentice-Hall of India.
3. Ramo, S.A., Whinnery, J.R. and Van Duzer, T., "*Fields and Waves in Communication Electronics"*, 3rd Ed., John Wiley

Assessment Scheme:

Components	Internal Assessment	Mid Term Exam	End Exam	Total
Weightage (%)	40	20	40	100

Name of Program	B. Tech in Electronics and Communication Engineering				
EECE311L	Analog and Digital Communications	L	T	P	C
Owning School/Department	SEAS/ECE	3	0	2	4
Pre-requisites/Exposure	NA				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Understand the concept of modulation in analog and digital communication systems.

CO2: Analyse and compare different analog modulation schemes in terms of power efficiency, bandwidth and noise performance.

CO3: Understand the process of analog to digital (A/D) conversion and the steps involved in A/D conversion.

CO4: Understand digital modulation techniques and evaluate their error performance in the presence of noise.

CO5: Analyze and interpret design trade-offs in terms of power efficiency, noise performance, bandwidth, bit rate and bit error rate

CO-PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO2	PSO3
CO1	3			2	3			2	3				2		2
CO2	2			1	2			1	2				3		1
CO3	2			2	2			2	1				2		2
CO4	2			2	2			2	1				1		1
CO5	3			2	3			2	3				2		2

1=weakly related 2= moderately related 3=strongly related

Course Contents:

Module I: 8 lecture hours

Need of modulation, Concept of modulation and demodulation, Continuous wave (CW) modulation: amplitude modulation (AM) - double sideband (DSB); double sideband suppressed carrier (DSBSC); single sideband suppressed carrier (SSBSC), Coherent detection, Envelope Detection, Costas receiver, Comparison of amplitude modulation techniques, Coherent Detection, vestigial sideband (VSB) modulation.

Module II: 8 lecture hours

Angle modulation: - phase modulation (PM) & frequency modulation (FM); narrow and wideband FM. Direct and indirect methods of FM generation, Detection of FM signals, Representation of narrowband noise; receiver model, signal to noise ratio (SNR), noise figure, noise temperature, noise in DSB-SC, SSB, AM & FM receivers, pre-emphasis and de-emphasis. Phase lock loop, Super-heterodyne receiver (AM and FM). pulse amplitude modulation (PAM); pulse width modulation (PWM); pulse position modulation (PPM).

Module III: **8 lecture hours**

Sampling and Quantization: Review of the Sampling theorem, Aliasing, Signal Reconstruction, Quantization, Uniform & Non-uniform Quantization, Quantization Noise, companding, μ-Law and A-Law Compressors, Time Division Multiplexing, Basic Concept and principle of PCM, Prediction filtering, DPCM, Delta Modulation, Noise Considerations in DPCM and DM.

Module IV: **8 lecture hours**

Baseband Transmission: Properties of Line codes, Power Spectral Density of Unipolar / Polar RZ and NRZ, Bipolar NRZ, Manchester, Inter-symbol Interference, Nyquist criterion for distortionless transmission, Pulse shaping, Eye pattern, Equalization.

Module V: **10 lecture hours**

Digital modulation schemes: Coherent Binary Schemes: ASK, FSK, PSK, QPSK, MSK, Coherent M-ary Schemes, Calculation of average probability of error for different modulation schemes, Power spectra of digitally modulated signals, Performance comparison of different digital modulation schemes.

List of Experiments

Simulation and Hardware Realization of the following Experiments will be conducted by students:

1. Amplitude modulation and demodulation.
2. Frequency modulation and demodulation.
3. Pre-emphasis and De-emphasis
4. Pulse Amplitude Modulation and demodulation.
5. Pulse Width Modulation and demodulation.
6. Sampling Theorem – Verification
7. PCM and DPCM Generation and Detection
8. Delta Modulation
9. Time Division Multiplexing
10. Amplitude Shift Keying: Generation and Detection
11. Frequency Shift Keying: Generation and Detection
12. Phase Shift Keying: Generation and Detection
13. QPSK: Generation and Detection

Text Books :

1. B.P. Lathi, Zhi Ding, Hari M. Gupta, Modern Digital and Analog Communication Systems: Adapted Version Paperback – Jul 2017.
2. H. Taub, D.L. Schilling, G. Saha, Principles of Communication Systems, 4th edition, McGraw Hill Education, 2013.
3. Simon Haykin, Communication Systems, 4th edition, Wiley Publication, 2006.

Reference Books :

1. A. Bruce Carlson, Paul B. Crilly, Communication Systems, 5th edition, McGraw Hill Education, 2011
2. B. Sklar, "Digital Communication Fundamentals and Applications", 2nd Edition, Pearson Education, 2009.

Assessment Scheme:

Components	Internal Assessment	Mid Term Exam	End Exam	Total
Weightage (%)	40	20	40	100

Name of Program	B. Tech in Electronics and Communication Engineering				
EECE313L	Digital Signal Processing	L	T	P	C
Owning School/Department	SEAS/ECE	3	0	2	4
Pre-requisites/Exposure	EECE205L				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Learn the basic theory behind DFT / FFT and its applications to filtering
CO2: Understand the characteristics of digital filters and Design FIR and IIR digital filters
CO3: Realize various structures of FIR and IIR filters
CO4: Understand the basic concepts of finite word length effects in the context of digital filters
CO5: Understand the fundamental concepts of multirate signal processing

CO-PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2								2	2		1
CO2	2	1	2	1								1	3		2
CO3	2	2	1	2								2	2		
CO4	2	2	1	2								1	1		
CO5	3	2	3	2								2	2		1

1=weakly related 2= moderately related 3=strongly related

Course Contents:

Module I: 10 lecture hours

Review of DTFT and z-transform, Introduction to Discrete Fourier Transform (DFT) – deriving DFT from DTFT, Properties of DFT, Circular Convolution, Linear Filtering Approach for Computing DFT, Filtering long data sequences – Overlap add and Overlap save methods, FFT computation of DFT, Radix-2 Algorithms - Decimation-in-time, Decimation-in-frequency.

Module II: 10 lecture hours

FIR Filter Design: Linear Phase FIR filter, Frequency Response of Linear-phase FIR filters, Design Techniques for Linear-Phase FIR Filters: Fourier Series Method, Windowing Techniques (Rectangular, Hamming, Hanning), Frequency Sampling method. Direct form and linear phase realizations of FIR filter.

Module III: 12 lecture hours

IIR Filter design: Analog Filter Design (Butterworth and Chebyshev), Design of IIR filter from Analog Filter - Impulse Invariance Method and Bilinear transformation Method, Frequency Transformation in Digital Domain, Realizations of IIR filter structures – Direct form I, Direct form II, Cascade and Parallel form.

Module IV: **6 lecture hours**

Finite word length effects: Fixed point and floating point number representation, quantization - truncation and rounding - quantization noise, input/output quantization., quantization errors

Module V: **7 lecture hours**

Multirate signal processing: Decimation, Interpolation, Sampling rate conversion by a rational factor, Brief overview of DSP architectures.

List of Experiments

1. Write a MATLAB program to find convolution (linear/circular) and correlation of two discrete signals.
2. Write a MATLAB program to
    a. Find 8 point DFT, its magnitude and phase plot and inverse DFT.
    b. Find 16 point DFT, its magnitude and phase plot and inverse DFT.
3. Write a MATLAB program to verify the properties of DFT (linearity, circular convolution, circular shift)
4. Write a MATLAB Program to design FIR Low pass filter using Rectangular window, Hanning window, Hamming window
5. Write a MATLAB program to
    a. Implement a Low pass / High pass / Band pass / Band stop IIR Filter using Butterworth approximation.
    b. Implement a Low pass / High pass / Band pass / Band stop IIR Filter using Chebyshev approximation.
6. Write a MATLAB program to understand the effects of interpolation and decimation on the frequency domain representation of a signal.
7. Realize FIR / IIR filter structures in SIMULINK
8. Implement DSP applications (Filtering / multirate signal processing / speech processing) on hardware.

Text Books :

1. S. K. Mitra, *Digital Signal Processing-A Computer based approach,* 4th edition, Tata McGraw-Hill Education, 2013. ISBN: 978-1259098581.
2. John G. Proakis, and Dimitris G. Manolakis, *Digital Signal Processing: Principles, Algorithms, and Applications*, 4th edition, Pearson Education, 2007. ISBN: 978-8131710005.
3. Tarun Kumar Rawat, *Digital Signal Processing*, Oxford University Press, 2015. ISBN: 978-0198081937.

Reference Books :

1. Alan V. Oppenheim and Ronald W. Schafer, *Digital signal processing*, Prentice Hall of India, 2004. ISBN: 978-0132146357.

2. Andreas Antoniou, *Digital Filters: Analysis, Design and Applications*, 2nd edition, McGraw-Hill Publication, 2001. ISBN: 978-0074635124.

Assessment Scheme:

Components	Internal Assessment	Mid Term Exam	End Exam	Total
Weightage (%)	40	20	40	100

Name of Program	B. Tech in Electronics and Communication Engineering				
EECE314L	Computer Networks	L	T	P	C
Owning School/Department	SEAS/ECE	3	0	0	3
Pre-requisites/Exposure	NA				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Understand the working of PSTN/GSTN networks.

CO2: Completely understand the different layers of the ISO-OSI model.

CO3: Learn the various protocols used in the data-link layer for flow and error control.

CO4: Study the details regarding routing protocols used at the network layer and understanding of congestion control mechanisms.

CO-PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	2								2		1
CO2	2	1	2	1	1								3		2
CO3	2	2	1	2	2								2		2
CO4	2	2	1	2	1								1		3

1=weakly related 2= moderately related 3=strongly related

Course Contents:

Module I: 11 lecture hours

Switched Communication Networks, Circuit Switching networks, Time Division Switching-Time Division Space Switching, Time Division Time Switching, Time Multiplexed Time Switching and TSI, Packet Switching, Multistage and combinational switching.

Module II: 12 lecture hours

Seven layered OSI model, Functions of different layers, primitives and services. Data link Control, Flow Control, Stop and Wait flow Control, Sliding Window Flow Control, Error Control, Go-Back-N ARQ, Selective-Reject ARQ, Performance Analysis, HDLC. LAN Protocols-ALOHA, CSMA, CSMA-CD, Implementation and performance issues.

Module III: 14 lecture hours

Basic Principles of Network layer, IPv4, IPv6, IP Addressing, Subnetting, Supernetting, Network Address Translation, Routing Schemes-Distance Vector routing, Link-State routing, Hierarchical routing. Basic Principles of Transport Layer and TCP/UDP description, Port numbers, Client-server architecture. Interconnection. Networks related software, TCP/IP, Novel NetWare, Routers, Bridges and Gateways their Practical implementation aspects. X.25, Internet and related software.

Module IV: **8 lecture hours**

Congestion control in TCP, Open loop and closed loop strategies, Quality of Service (QoS), Traffic shaping, weighted queues. Introduction to ISDN, Broadband-ISDN.

Text Books :

1. B. A Forouzan, *Data Communications and Networking*, 4th edition, Tata McGraw Hill, 2017. ISBN: 9780070634145.
2. W. Stallings, Data & Computer Communication, 10th edition, Pearson, 2013. ISBN: 0133506487.

Reference Books :

1. S. Tanenbaum, *Computer Networks*, 5th edition, Pearson Education India, 2013. ISBN: 9332518742.
2. Thiagarajan Viswanathan, *Telecommunication Switching Systems and Networks*, 2nd edition, Prentice Hall India Learning Private Limited, 2015. ISBN: 8120307135.

Assessment Scheme:

Components	Internal Assessment	Mid Term Exam	End Exam	Total
Weightage (%)	40	20	40	100

Name of Program	B. Tech in Electronics and Communication Engineering				
EECE212L	**Analog Circuits -II**	L	T	P	C
Owning School/Department	SEAS/ECE	2	1	2	4
Pre-requisites/Exposure	NA				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Demonstrate design of multistage amplifiers and power amplifiers.
CO2: Understand the device structure of MOSFET and scaling effects of MOSFET.
CO3: Design circuits diagram of different types of amplifiers using MOSFETs.
CO4: Understand and apply feedback concepts to design different oscillator circuits.

CO-PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2			2				1	2			2		2
CO2	3	2			2				1	2			2		2
CO3	3	2			2				2	3		2	3	2	2
CO4	3	1			2				2	3		1	3	2	2

1=weakly related 2= moderately related 3=strongly related

Course Contents:

Module I: 8 lecture hours

Review of amplifiers and their small signal models. Cascaded Multistage amplifiers, different types of couplings. Current Mirror, Gain of multistage amplifier, cascode amplifiers, Darlington amplifiers, 2- transistor amplifiers. Power amplifiers. Class A and Class B operation. Biasing class A and class B amplifiers, Class C, tuned amplifier.

Module II: 6 lecture hours

Metal-oxide semiconductor (MOS) devices: the concept of surface accumulation, depletion and inversion layer formation. Capacitance-voltage analysis of MOS capacitor. The threshold voltage of MOSFETs, 3-terminal characteristics of MOSFET, short channel effects, scaling of device dimensions, MESFET.

Module III: 8 lecture hours

Small frequency, mid frequency, high frequency models of BJT and MOSFET, Frequency analysis: Cut-off frequencies, band width, gain-bandwidth product. Miller theorem and equivalent. Bode plot. Stray effects, stray capacitance. Lead inductance.

Module IV: 8 lecture hours

Feedback, modification of small signal circuit in the presence of feedback, analysis of amplifier with feedback, Oscillators. Classification of oscillators, condition for oscillation (Barkhausen criterian), LC oscillator, Hartley oscillator, Wein bridge oscillator, RC oscillator, crystal oscillator, frequency stability of oscillator, Multivibrators.

List of Experiments

Simulation and Hardware Realization of the following Experiments will be conducted by students:

1. Design, assembly and testing of biasing schemes for Class B and Class AB amplifiers
2. Measuring frequency response of BJT amplifier stage and corelate it with transistor models.
3. Design and implementation of a tuned amplifier.
4. Assembling and testing of an astable multivibrator using two BJTs.
5. Assembling and testing of monostable multivibrator using two BJTs.
6. Study and measurement of different types of oscillator circuits.
7. Amplifiers using MOSFETs
8. Assembling and testing of a regulated power supply

Note: It can be beneficial for a student to perform the simulation before commencing the hardware.

Text Books :

1. Adel S. Sedra and Kenneth C. Smith, Microelectronics Circuits Theory and Applications, International Student Edition, Fifth Edition, Oxford University Press, 2004, ISBN-13: 978-0-19-806225-7, ISBN-10: 0-19-806225-7.
2. Donald l. Schlling and Charles Belove, Electronic Circuits: Discrete and Integrated, Third Edition, Tata McGraw Hill, ISBN 10: 0071006028 / ISBN 13: 9780071006026
3. Albert Paul Malvino and David J Bates, Electronic Principles, 7th Edition, Tata McGraw Hill, 2007, ISBN-13: 978-0-07-063424-4, ISBN-10: 0-07-063424-4
4. S. Salivahanan and N Suresh Kumar, Electronic Devices and Circuits, 4th Edition, McGraw Hill Education 2017ISBN-13: 978-93-392-1950-5, ISBN-10: 93-392-1951-1
5. Debashis De and K P Ghatak, Basic Electronics, 2010, Pearson, ISBN-13: 978-81-317-1068-5

Reference Books :

1. Jacob Millman, Christos C Halkias and Chetan D Parikh, Integrated Electronics, Analog and Digital Circuits and Systems, Second Edition, McGraw Hill Education India P Ltd, 2-18. ISBN-13: 978-0-07-015142-0, ISBN-10: 0-07-015142-3

Assessment Scheme:

Components	Internal Assessment	Mid Term Exam	End Exam	Total
Weightage (%)	40	20	40	100

SEMESTER-VI

Name of Program	B. Tech in Electronics and Communication Engineering				
EECE301L	**Computer Architecture**	L	T	P	C
Owning School/Department	SEAS/ECE	3	0	0	3
Pre-requisites/Exposure	NA				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Describe computer architecture concepts and mechanisms related to the design of processors, memories, and networks, and explain how these concepts and mechanisms interact.
CO2: Solve computer architecture design problems within the context of balancing application requirements against technology constraints.
CO3: Evaluate various design alternatives and make a compelling quantitative and/or qualitative argument for why one design is superior to the other approaches.

CO-PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3										3		2
CO2	2	2	3	1									3		2
CO3	2	2	3	1									3		2

1=weakly related 2= moderately related 3=strongly related

Course Contents:

Module I: **9 lecture hours**

Introduction to Computer Structure: Programmer's view of a computer system, Hardware designer's view of a computer system, Objectives of computer architecture, Principles in computer design, Computer types, Computer performance.
Computer Arithmetic and Their Hardware Implementation: Unsigned notation arithmetic, Signed notation arithmetic, BCD arithmetic, Floating-point arithmetic, Design of sequential 2's complement circuit, Carry look-ahead adder.

Module II: **12 lecture hours**

Instruction Set Architecture: Instruction set architecture design, addressing modes, Instruction set & Instruction format, Working of assembler and macro assembler, Stacks & subroutines.
Introduction to Computer Organization: Basic computer organization, CPU organization, Memory subsystem organization & interfacing, I/O subsystem organization & interfacing, Micro operation & RTL, Implementation of digital systems by using RTL, Design of ALU, Design of CPU.

Module III: **12 lecture hours**

Micro Sequencer & Micro Programmed Control Unit Design: Generic microinstruction format, Basic micro sequencer design, Design of control unit horizontal & vertical microcode, micro subroutine, concepts of microprograms and microprogrammed control unit

Memory Organization: Classification of memory, Organization of memory chips and memory interleaving, Hierarchical memory system, Cache memory & mapping techniques, Virtual memory concept & its mapping techniques, Page replacement policies.

Module IV: **12 lecture hours**

Input/Output Organization: Interfacing of I/O devices, Program control data transfer, Interrupt controlled data transfer, DMA based data transfer, Serial and parallel data communication, RS-232-C standard.

Advanced Processor Architectures & Parallel Computers: General principles of governing the design of processor architecture and performance enhancement strategies, RISC and CISC processor, Instruction pipelining in RISC, Delay in pipeline execution, Super-scalar processor, VLIW and EPIC architecture, Parallelisms in uni-processor, Classification of parallel computers, Vector computers and Array processor.

Text Books :

1. Morris Mano, Computer System Architecture (revised), Pearson Education India, 3rd Edition (ISBN: 9789332585607)-2017.
2. John D. Carpinelli, Computer Systems Organization and Architecture, Pearson Education India, (ISBN: 9788177587678, 9788177587678)-2006.

Reference Books :

1. J P Hayes, Computer Organization and Architecture- 3rd Edition, McGraw Hill Education, 3rd Edition (ISBN: 978-1259028564)-2017.

Assessment Scheme:

Components	Internal Assessment	Mid Term Exam	End Exam	Total
Weightage (%)	40	20	40	100

Name of Program	B. Tech in Electronics and Communication Engineering				
EECEXXXL	**VLSI Design**	L	T	P	C
Owning School/Department	SEAS/ECE	2	1	2	4
Pre-requisites/Exposure	NA				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1 : Analyze the electrical characteristics of MOS transistors.
CO2 : Design and implement CMOS combinational and sequential circuits.
CO3 : Apply low-power VLSI design techniques to optimize energy efficiency and circuit performance..

CO-PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3									3	2	1
CO2	3	3	3	3	3				2	2			3	3	2
CO3	3	3	3	3	3	3	2					3	3	3	2

1=weakly related 2= moderately related 3=strongly related

Course Contents:

Module I: **10 lecture hours**

Evolution of VLSI Technology, MOS Transistor: Structure, Operation, and Characteristics, CMOS Inverter: DC and Transient Characteristics, MOSFET Capacitances, Threshold Voltage and Channel Length Modulation, Subthreshold Conduction and Leakage, Stick Diagram and Layout Design Rules, Scaling of MOS Devices and Short-Channel Effects,

Module II: **12 lecture hours**

MOS Logic Design: NAND, NOR, XOR Gates, Combinational & Sequential Circuits (Flip-Flops, Registers), VLSI Fabrication Process: Oxidation, Lithography, Ion Implantation, Static and Dynamic Power Dissipation in CMOS Circuits, Logical Effort, Delay Analysis, and Noise Margin, Memory Design: SRAM, DRAM, Flash Memory, Feedback Circuits: Op-amp design, stability analysis, frequency compensation.

Module III: **8 lecture hours**

Low-Power VLSI Design Techniques: Clock Gating, Power Gating, Multi-Vt Design, Timing and Performance Analysis of CMOS Circuits, Fault Modeling and Testing Strategies, Design for Testability (DFT) and Built-In Self-Test (BIST), Advanced VLSI Technologies: FinFETs, 3D ICs, AI in VLSI

List of Experiments

1. Simulate and analyze I-V characteristics of nMOS transistors.
2. Simulate and analyze I-V characteristics of pMOS transistors.
3. Design and simulate a CMOS inverter, analyzing its DC transfer characteristics.
4. Design and simulate CMOS NAND, NOR gates.
5. Design and simulate XOR gates.
6. Design and simulate Differential amplifier.
7. Design and simulate two-stage operational amplifier.
8. Design of D Flip-Flop using CMOS.

Text Books :

1. Jan Rabaey, Anantha Chandrakasan and Borivoje Nikolic, *Digital Integrated Circuits*, 2nd edition, Pearson Education India, 2016. ISBN: 978-9332573925
2. S. M. Kang and Y. Leblebici, *CMOS Digital Integrated Circuits*, 4th Edition, McGraw Hill Education, 2019. ISBN: 978-9353165093
3. Behzad Razavi, *Design of Analog CMOS Integrated Circuits*, McGraw-Hill Education, 2nd Edition, 2017. ISBN: 978-9325983274

Reference Books :

1. R. Jacob Baker, *CMOS: Circuit Design, Layout, and Simulation*, Wiley-IEEE Press, 4th Edition 2019. ISBN: 978-1119481515
2. Neil H.E. Weste and David Harris, *CMOS VLSI Design: A Circuits and Systems Perspective*, Pearson. 4th Edition 2019. ISBN: 978-9332542884

Assessment Scheme:

Components	Internal Assessment	Mid Term Exam	End Exam	Total
Weightage (%)	40	20	40	100

Name of Program	B.Tech. Electronics and Computer Engineering				
EECE220L	Cyber Security	L	T	P	C
Owning School/Department	SEAS/ECE	3	0	0	3
Pre-requisites/Exposure	Computer Networks				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Develop a thorough understanding of the basic concepts, principles, and practices of cyber security.

CO2: Gain proficiency in cryptographic methods and their application in securing data.

CO3: Learn to identify and mitigate security vulnerabilities in network and web applications using tools and techniques like firewalls, IDS/IPS, and secure coding practices.

CO4: Understand and implement security mechanisms in operating systems to protect against malware and unauthorized access.

Course Content:

Module 1: **12 lecture hours**

Introduction to Cyber Security, Cyber Security vs Information Security, Confidentiality, Integrity, and Availability (CIA) Triad, Risk management and Threat modeling, Network Security, Network protocols and layers (TCP/IP, OSI model), Network architecture and perimeter defense, Firewalls and Intrusion Detection/Prevention Systems (IDS/IPS), Virtual Private Networks (VPNs).

Module 2: **12 lecture hours**

Cryptography: Principles of Cryptography, Symmetric Key Cryptography: DES, AES, Public Key Cryptography: RSA, Diffie-Hellman, Hash functions: SHA, MD5

Web Security: Web application architecture and vulnerabilities, OWASP Top 10 vulnerabilities, Input validation, Cross-Site Scripting (XSS), SQL Injection, Cross-Site Request Forgery (CSRF), Clickjacking, Web server security: SSL/TLS, HTTP Strict Transport Security (HSTS)

Module 3: **12 lecture hours**

Operating System Security: Security mechanisms in operating systems: Access control, Authentication, Authorization, and Auditing, File System Security, Malware: Types and Countermeasures, Security updates and patches

Mobile and IoT Security: Mobile device security, Android and iOS security models, Mobile app security, IoT security: Architecture and vulnerabilities, IoT security protocols: Zigbee, Z-Wave, Bluetooth Low Energy (BLE)

Module 4: **9 lecture hours**

Cybersecurity and Ethics: Ethical issues in Cyber Security, Legal issues and regulations: GDPR, HIPAA, FISMA, etc., Cybersecurity career opportunities, Future of Cybersecurity

The list of experiments are as follows (covered as assignment/task):

1. Analyze network traffic using Wireshark to identify potential security threats.
2. Configure a firewall to control incoming and outgoing network traffic based on predetermined security rules.
3. Implement a Virtual Private Network (VPN) to secure data transmission over public networks.
4. Encrypt and decrypt messages using symmetric key algorithms like DES and AES.
5. Perform public key encryption and decryption using RSA and Diffie-Hellman algorithms.
6. Conduct a vulnerability assessment of a web application focusing on OWASP Top 10 vulnerabilities.
7. Implement input validation techniques to prevent Cross-Site Scripting (XSS) and SQL Injection attacks.
8. Configure SSL/TLS on a web server to ensure secure communications.
9. Set up access control mechanisms in an operating system to enforce authentication and authorization.
10. Evaluate the security of a mobile application by analyzing its permissions and security features.

Text Books:

1. Whitman, M.E., Mattord, H.J., Principles of Information Security, Cengage Learning, 2021, ISBN: 0357506561, 9780357506561
2. William Stallings, Cryptography and Network Security: Principles and Practice,8th Edition, Pearson, 2020.
3. Behrouz A. Forouzan, Cryptography & Network Security, McGraw-Hill, 3rd Edition 2015.

Reference Books:

1. W. Stallings, Network Security Essentials: Applications and Standards,6th Edition, Pearson Prentice Hall, 2016.
2. Bryan Sullivan and Vincent Liu, Web Application Security, A Beginner's Guide, McGraw-Hill Education, 2012
3. C. Kaufman, R. Perlman and M. Speciner, Network Security: Private Communication in a Public World, 2nd Edition, Prentice Hall PTR, 2002.

Assessment Scheme:

Components	Internal Assessment	Mid Term Exam	End Exam	Total
Weightage (%)	40%	20%	40%	100%

Name of Program	B. Tech in Electronics and Communication Engineering				
EECE360L	**Image Processing**	L	T	P	C
Owning School/Department	SEAS/ECE	3	0	0	3
Pre-requisites/Exposure	NA				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Understand the basics of digital image processing.
CO2: Learn the concepts of image enhancement, image restoration, and image segmentation in spatial as well as frequency domain.
CO3: Implement step-by-step processing for image-based systems.
CO4: Gain knowledge for analyzing and designing various image processing applications.
CO5: Develop some basic applications using MATLAB®.

CO-PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	2						3			3
CO2	3	3	3	2	3	2						3			3
CO3	2	2	3	3	3	3						3			3
CO4	3	3	2	3	2	3						3			3
CO5	2	1	3	3	3	3						3			3

1=weakly related 2= moderately related 3=strongly related

Course Contents:

Module 1 **12 Lecture Hours**

Introduction to image formation and representation as a 2-D matrix, spatial arrangement of pixels, local neighborhood, analysis in spatial domain and frequency domain using 2-D Fourier Transforms; grey-scale images and colored images representation, resizing of images, Color Models: RGB, HSV etc.

Module 2 **10 Lecture Hours**

Image transformations, rotation, scaling and translation; effect of image transformations in frequency domain; histogram analysis; Filtering of images in spatial domain using convolution and in frequency domain using Fourier transforms.

Module 3 **12 Lecture Hours**

Image enhancement, Laplacian operators, edge detection; image restoration and compression; image representation formats, introduction to video formats; boundary detection, thresholding, region-oriented segmentation.

Module 4 **11 Lecture Hours**

Image morphological operations- erosion, dilation, intersection, union, opening, closing; structuring elements and their usage in various problems; introduction to complete image processing systems like object detection, fingerprint recognition, face recognition etc.

Text Books :

1. Rafael C. Gonzalez and Richard E. Woods, *Digital Image Processing*, 4th edition, Pearson Education. ISBN: 978-0133356724.
2. Bhabatosh Chanda and Dwijesh Dutta Majumder, *Digital Image Processing and Analysis*, 2nd edition, PHI Learning, 2011. ISBN: 978-8120343252.

Reference Books :

1. W. K. Pratt, *Digital Image Processing*, John Wiley & sons, 2007. ISBN: 9780471767770.
2. Rafael C. Gonzalez, Richard Eugene Woods, and Steven L. Eddins, *Digital Image Processing Using MATLAB*, 2nd edition, Pearson Education, 2009. ISBN: 978-0982085400.

Assessment Scheme:

Components	Internal Assessment	Mid Term Exam	End Exam	Total
Weightage (%)	40%	20%	40%	100%

SEMESTER-VII

Name of Program	B. Tech in Electronics and Computer Engineering				
EECEXXX	**Design Project**	L	T	P	C
Owning School/Department	SEAS/ECE	0	0	6	3
Pre-requisites/Exposure	NA				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Demonstrate and understand the hardware/software project assigned to or selected by the students.
CO2: Apply the concepts learnt in first three years of the degree programme to develop a valued application (software/hardware).
CO3: Demonstrate the technical skills to develop an all-inclusive understanding.

CO-PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		3	3									3	3	3
CO2	3		3	3	3								3	3	3
CO3	3		3			3	3	3	3	3	3	3	3	3	3

1=weakly related 2= moderately related 3=strongly related

Course Contents:

Students will undergo an industrial project/research project at organization/university.

Assessment Scheme:

Components	Internal Assessment	Mid Term Exam	End Exam	Total
Weightage (%)	40	20	40	100

SEMESTER-VIII

Name of Program	B. Tech in Electronics and Computer Engineering				
EECEXXX	**Research Project/ Dissertation**	L	T	P	C
Owning School/Department	SEAS/ECE	0	0	24	12
Pre-requisites/Exposure	NA				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Demonstrate and understand the hardware/software project assigned to or selected by the students.

CO2: Apply the concepts learnt in the first three years of the degree programme to develop a valued application (software/hardware).

CO3: Demonstrate the technical skills to develop an all-inclusive understanding.

CO4: Extend the design project to a major project in order to have comprehensive learning of a complex application.

CO5: Contribute to the research outcome of the department/University by communicating potential research articles to reputed journals/conferences.

CO-PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3		3				3		3	3	3	3	3
CO2	3	3	3	3	3	3	3		3		3	3	3	3	3
CO3	3		3		3				3		3		3	3	3
CO4	3		3		3				3		3		3	3	3
CO5	3	3	3		3				3		3	3	3	3	3

1=weakly related 2= moderately related 3=strongly related

Course Contents:

Students will undergo an industrial project/research project at organization/university.

Assessment Scheme:

Components	Internal Assessment	Mid Term Exam	End Exam	Total
Weightage (%)	40	20	40	100

Electives

Name of Program	B. Tech in Electronics and Communication Engineering				
EECE340L	Electronic Measurement Techniques and Instrumentation	L	T	P	C
Owning School/Department	SEAS/ECE	3	0	0	3
Pre-requisites/Exposure	NA				

Course Outcomes (COs)

On completion of this course, the students will be able to:

By the end of this program, students should have the following knowledge, skills and values:
CO1: Investigate sources of errors in measurements and their rectification.
CO2: Apply various measurement techniques in instrumentation applications.
CO3: Apply time domain analysis on first order systems.
CO4: Explore and estimate the performance of several bridge circuits.
CO5: Investigate multiple oscilloscopes and recorders to be used in measurement industries.

CO-PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3									2			2
CO2	2	1	2									1			3
CO3	2	2	1									2			2
CO4	2	2	1									1			1
CO5	3	2	3									2			2

1=weakly related 2= moderately related 3=strongly related

Course Contents:

Module I: **10 lecture hours**

Measurements and Errors: Accuracy, Precision, Significant Figures, Types of Errors, Statistical Analysis, Limiting Errors, Bridge Measurements (AC and DC bridges), Analysis of Linear Systems, Static and Dynamic characteristics, Time Domain Response, I Order response for Step Input, Ramp Input, Impulse Input, Bourdon Tube, Pressure Gauges, Measurement of Flow (Magnetic).

Module II: **8 lecture hours**

Electromechanical & Digital Indicating Instruments: PMMC Mechanism, DC Ammeters and Voltmeters, Series and Shunt Type Ohmmeter, Alternating Current Indicating Instruments (Moving Iron instruments, electrodynamometer instrument), Digital Voltmeters, Vector Voltmeter, Guarding Techniques, Automation in Voltmeter.

Module III: **8 lecture hours**

Signal generation and analysis: Sine Wave Generator, Sweep Frequency Generator, Pulse and Square wave Generator, Function Generator, Analyzer, Wave Analyzer, Distortion Analyzer, Harmonic Distortion Analyzer, Spectrum Analyzer, Logic Analyzer.

Module IV: **8 lecture hours**

Oscilloscopes and recorders: Simple CRO, Dual Beam, Dual Trace, Sampling Oscilloscope, Analog and Digital Storage Oscilloscope, Recorders, Analog and Digital Recorders

Module V: **10 lecture hours**

Advanced measurement and computer-controlled test systems: Scanning Probe, Microscope, Atomic Force Microscope, Magnetic Force Microscope, Scanning Tunneling Microscope, Testing an Audio Amplifier, Testing a Radio Receiver, Instruments used in Computer Controlled Instrumentation, Case Studies in Instrumentation, Electronic Weighing System, Digital Transducer.

Text Books :

1. Helfrick, Albert.D. and Cooper, William. D., *Modern Electronic Instrumentation and Measurement Techniques*, PHI Learning Private Limited, 2010, ISBN: 978-8120307520, ISBN: 8120307526.
2. Kalsi. H. S., *Electronic Instrumentation* (3rd ed.), Tata McGraw Hill Publishing Company Ltd., 2010, ISBN: 978-0070702066.

Reference Books :

1. Sawhney. A. K., *A Course in Electrical and Electronic Measurements and Instrumentation*, Dhanpat Rai & Co., 2012, ISBN: 978-8177001006, ISBN: 8177001000.
2. Doeblin, Earnest O., *Measurement Systems Application and Design* (4th ed.), McGraw Hill International editions, 1990, ISBN: 978-0070173385, ISBN: 0070173389.
3. Bouwens, A. J., *Digital Instrumentation*, McGraw Hill, 1986, ISBN: 978-0070664395, ISBN: 0070664390.

Assessment Scheme:

Components	Internal Assessment	Mid Term Exam	End Exam	Total
Weightage (%)	40	20	40	100

Name of Program	B. Tech in Electronics and Communication Engineering				
EECE341L	Advanced Digital Circuits	L	T	P	C
Owning School/Department	SEAS/ECE	3	0	0	3
Pre-requisites/Exposure	Network Analysis, Logic Design				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Design and Analysis of various MOSFET and CMOS logic circuits with Area, Power, and Noise Margin considerations.
CO2: Computing various capacitances in a MOS Transistors
CO3: Realize MOSFET inverters with a resistive load, NMOS load, and CMOS inverters.
CO4: Design multiple-input CMOS logic circuits and perform DC and transient analysis.
CO5: Design dynamic circuits and sequential circuits.
CO6: Design of arithmetic circuits such as adders, multipliers, and shifters.
CO7: Analysis of capacitive loads and various delay models and delay calculation.
CO8: Learn the effect of scaling, short channel, ESD and power supply noise.

CO-PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	2							2			2
CO2	2	1	2	1	3							1			3
CO3	2	2	1	2	2							2			2
CO4	2	2	1	2	1							1			1
CO5	3	2	3	2	2							2			2
CO6	2	1	2	1	3							1			3
CO7	2	2	1	2	2							2			2
CO8	2	2	1	2	1							1			1

1=weakly related 2= moderately related 3=strongly related

Course Contents:

Module I: 16 lecture hours

Overview of VLSI Design flow- Review of MOS transistors, threshold voltage, ON current, subthreshold slope, off-state current, Switch model of a MOSFET, Channel length modulation, body bias effect and short channel effects, MOSFET capacitances, Junction capacitances-oxide related capacitances- MOSFET as switch-Switch models of inverter-MOSFET realization of inverters, Resistive load, NMOS load and CMOS inverters-DC and Transient analysis-Area, power and noise margin considerations-Stick diagram and layout of a CMOS inverter

Module II: 14 lecture hours

CMOS inverter, static characteristics, noise margin, effect of process variation, supply scaling, dynamic characteristics, inverter design for a given VTC and speed, effect of input

rise time and fall time, static and dynamic power dissipation, energy & power-delay product, sizing chain of inverters, latch-up effect.

.**Module III:** **12 lecture hours**

Static CMOS design, Complementary CMOS, static properties, propagation delay, Elmore delay model, power consumption, logical effort for transistor sizing, ratioed logic, NMOS, Pass transistor, Complementary pass transistor and transmission gate logic, DCVSL, DPTL dynamic CMOS design, speed and power considerations, Domino logic and its derivatives, 6T SRAM and DRAM cell.

Text Books :

1. Sung-Mo Kang and Yusuf Leblebici, CMOS Digital Integrated Circuits- Analysis & Desing, MGH, Third Ed., 2003 ISBN-13: 978-0070530775, ISBN-10: 9780070530775
2. Jan M. Rabaey, Digital Integrated Circuits- A Design Perspective, (2nd Edition) Prentice Hall, 2005, ISBN-13: 978-0130909961, ISBN-10: 0130909963
3. R.J. Baker, H.W.Li, and D.E.Boyce, CMOS Circuit Design, Layout and Simulation, Wiley-IEEE Press, 2007, ISBN-13: 978-0780334168, ISBN-10: 0780334167.

Reference Books :

1. David A. Hodges, Horace G. Jackson, and Resve A. Saleh, *Analysis and Design of Digital Integrated Circuits*, (3rd Edition), McGraw-Hill, 2004, ISBN-13: 978-0072283655, ISBN-10: 0072283653.
2. Christopher Saint and Judy Saint, *IC layout basics: A practical guide*, McGraw-Hill Professional, 2001, ISBN: 0071386254.
3. John P Uyemura, *Introduction to VLSI Circuits and Systems*, Wiley India, 2006, ISBN: 9788126509157.
4. Neil H.E.Weste and Kamran Eshraghian, *Principles of CMOS VLSI Design- A Systems Perspective*,(2nd Edition). Pearson Publication, 2005, ISBN-13: 978-0201533767, ISBN-10: 0201533766.
5. Ivan Sutherland, Robert F. Sproull and David Harris, *Logical Effort Designing Fast CMOS Circuits*, (1st Edition), Morgan Kaufmann, 1999, ISBN-13: 978-1558605572, ISBN-10: 9781558605572.
6. William Liu, *Simulation: Including BSIM3v3 and BSIM4*, Wiley-IEEE Press, Feb 2001 ISBN: 978-0-471-39697-0..
7. R. Jacob Baker, *CMOS: Circuit Design, Layout, and Simulation* (3rd Edition), Wiley-IEEE Press, Sep 2010, ISBN: 978-0-470-88132-3.
8. Thomas A. DeMassa and Zack Ciccone, *Digital Integrated Circuits,* Wiley, Dec 1995, ISBN-13: 978-0471108054, ISBN-10: 9780471108054.

Assessment Scheme:

Components	Internal Assessment	Mid Term Exam	End Exam	Total
Weightage (%)	40	20	40	100

Name of Program	B. Tech in Electronics and Communication Engineering				
EECE342L	MOS Device Modelling	L	T	P	C
Owning School/Department	SEAS/ECE	3	0	0	3
Pre-requisites/Exposure	Semiconductor Device				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Design and Analysis of various MOSFET and CMOS logic circuits with Area, Power, and Noise Margin considerations.
CO2: Knowledge of the principle of operation of MOS FETs
CO3: Model the small signal and Large signal behavior of the MOSFET for various applications.
CO4: Development of novel MOSFET structures and their models.

CO-PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	2							2			2
CO2	2	1	2	1	3							1			3
CO3	2	2	1	2	2							2			2
CO4	2	2	1	2	1							1			1

1=weakly related 2= moderately related 3=strongly related

Course Contents:

Module I: 16 lecture hours

Review of basic electrostatics in a semiconductor, drift, diffusion phenomenon in semiconductor conduction, Semiconductor surfaces, Ideal MOS structure, MOS device in thermal equilibrium, Non-Ideal MOS: work function differences, charges in oxide, interface states, band diagram of non ideal MOS, flat band voltage, electrostatics of a MOS (charge based calculations), calculating various charges across the MOSC, threshold voltage, MOS as a capacitor (2 terminal device), Three-terminal MOS, effect on threshold voltage.

Module II: 14 lecture hours

MOSFET (Enhancement and Depletion MOSFETs), mobility, on current characteristics, off current characteristics, subthreshold swing, the effect of interface states on the subthreshold swing, drain conductance and transconductance, effect of source bias and body bias on threshold voltage and device operation, Scaling, Short channel and narrow channel effects-High field effects.

Module III: **6 lecture hours**

MOS transistor in dynamic operation, Large signal Modeling, the small signal model for low, medium and high frequencies.

Module IV: **6 lecture hours**

SOI concept, PD SOI, FD SOI, and their characteristics, the threshold voltage of an SOI MOSFET, Multi-gate SOI MOSFETs, Alternate MOS structures.

Text Books :

1. Yannis Tsividis, Operation and Modeling of the MOS transistor: Oxford University Press, 2010, ISBN-10: 9780198097372.
2. Y. Taur and T.H. Ning, Fundamentals of Modern VLSI DevicesCambridge University Press, 1998, ISBN:0-521-55959-6.
3. Jean- Pierrie Colinge, Silicon-on-insulator Technology: Materials to VLSI Kluwer Academic publishers group, 2004, ISBN-13: 978-1-4419-9106-5.
4. Jean-Pierre Colinge, Physics of Semiconductor Devices, Kluwer Academic Publishers, 2002, ISBN-13: 978-0-306-47622-8.

Reference Books :

1. E.H. Nicollian and J. R. Brews, *Metal Oxide Semiconductor - Physics and Technology*, John Wiley and Sons, 2003, ISBN-13: 978-0471430797, ISBN-10: 047143079X.
2. Donald A Neamen, Semiconductor Physics and Devices: Basic Principles, (4th Edition) McGraw-Hill, 2003, ISBN-13: 978-0073529585, ISBN-10: 0073529583.

Assessment Scheme:

Components	Internal Assessment	Mid Term Exam	End Exam	Total
Weightage (%)	40	20	40	100

Name of Program	B. Tech in Electronics and Communication Engineering				
EECE343L	Testing and Verification	L	T	P	C
Owning School/Department	SEAS/ECE	3	0	0	3
Pre-requisites/Exposure	Fundamentals of Logic Design and testing				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Model different types of faults in the digital circuits using appropriate fault models.
CO2: Generate test patterns required to detect faults in a circuit.
CO3: Determine the testability of a circuit.
CO4: Design methods/techniques to improve the testability of digital circuits.
CO5: Design Logic BIST circuits based on LFSRs.
CO6: Explain various techniques for verification.

CO-PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2								2	2		1
CO2	2	1	2	1								1	3		2
CO3	2	2	1	2								2	2		
CO4	2	2	1	2								1	1		
CO5	3	2	3	2								2	2		1
CO6	2	2	1	2								1	2		

1=weakly related 2= moderately related 3=strongly related

Course Contents:

Module I: **14 lecture hours**

Scope of testing and verification in VLSI design process, Digital System Testing: Fault models – fault equivalence – fault location fault dominance – single and multiple stuck faults – Testing for single stuck faults –Algorithms – random test generation – Testing for bridging faults, Issues in test and verification of complex chips, embedded cores and SOCs.

Module II: **9 lecture hours**

Fundamentals of VLSI testing Fault models. Automatic test pattern generation, Design for testability, Scan design, Test interface, and boundary scan. System testing and test for SOCs. Delay fault testing.

Module III: **10 lecture hours**

Design for Testability: Ad-hoc design for testability techniques – Classical scan designs– Boundary scan standards – Built-in-self-test – Test pattern generation – BIST architecture examples, BIST for testing of logic and memories, Test automation, Design verification techniques based on simulation, analytical and formal approaches.

Module IV: **9 lecture hours**

Functional verification, Timing verification, Formal verification, Basics of equivalence checking and model checking, Hardware emulation.

Text Books :

1. M. Bushnell and V. D. Agrawal*, Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits,* Kluwer Academic Publishers, 2000, ISBN-13: 978-0792379911, ISBN-10: 0792379918.
2. M. Abramovici, M. A. Breuer, and A. D. Friedman, *Digital Systems Testing, and Testable Design,* IEEE Press, 1990, ISBN-13: 978-0780310629, ISBN-10: 9780780310629.
3. Kropf Thomas, *Introduction to Formal Hardware Verification,* Springer Verlag*, 2000,* ISBN 978-3-662-03809-3.
4. Charles H. Roth Jr*; Digital System Design Using VHDL,* Thomson Education*,*2005, ISBN-13: 978-8131518304, ISBN-10: 9788131518304.

Reference Books :

1. P. Rashinkar, Paterson, and L. Singh, *System-on-a-Chip Verification-Methodology and Techniques*, Kluwer Academic Publishers, 2001, ISBN 978-0-306-46995-4.
2. Neil H. E. Weste and Kamran Eshraghian, *Principles of CMOS VLSI Design*, (2nd Edition), Addison Wesley, 1993. ISBN:0-201-08222-5.
3. Neil H. E. Weste and David Harris, *Principles of CMOS VLSI Design,* (3rd Edition), Addison Wesley, 2004, ISBN-13: 978-9332542884, ISBN-10: 9789332542884.
4. J. Bhasker; *A VHDL Synthesis Primer*, B.S. Publications 2001, ISBN 13: 9788178000145.
5. Kenneth L Short, *VHDL for Engineers, Pearson Education*, 2006, ISBN-13: 978-0131424784, ISBN-10: 0131424785.

Assessment Scheme:

Components	Internal Assessment	Mid Term Exam	End Exam	Total
Weightage (%)	40	20	40	100

Name of Program	B. Tech in Electronics and Communication Engineering				
EECE345L	**Introduction to Microelectromechanical Systems (MEMS)**	L	T	P	C
Owning School/Department	SEAS/ECE	3	0	0	3
Pre-requisites/Exposure	NA				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: To introduce the fundamentals of Microelectromechanical Systems (MEMS)
CO2: To teach microfabrication technologies relevant for MEMS fabrication
CO3: To introduce the concept of deformation / displacement / deflection in microstructures when subjected to external stimulus
CO4: To introduce different sensing and actuating mechanism for microstructures in MEMS
CO5: Design, analysis and fabrication techniques of piezoresistive based MEMS (example: pressure sensor and other devices)

CO-PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2														3
CO2	3	3	3	3	1	2						3			3
CO3	3	3	3	3	1	2						2			3
CO4	2	2	1	3	3	2						2			3
CO5	3	3	3	3	3	2						2			3

1=weakly related 2= moderately related 3=strongly related

Course Contents:

Module I **12 Lecture Hours**

Review of microfabrication techniques used in IC fabrication. Introduction to fundamentals of MEMS. Basic elements of MEMS: nozzle, diaphragm, cantilever, bridge, proof mass etc.

Module II **16 Lecture Hours**

Major technologies for MEMS fabrication: Bulk micromachining, surface micromachining, LIGA process. Anisotropic etching of silicon for bulk micromachining for MEMS. MEMS specific unit processes: anodic bonding, front-to-back alignment, sputter deposition of conductors, piezoelectric and dielectric layers. Piezoresistivity in silicon and its application in MEMS based sensors.

Module III **14 Lecture Hours**

Silicon diaphragm and its deformation with pressure: basic understanding, simulation and application in pressure sensor. Optical and capacitive sensing for MEMS based sensors. Comb-drive microstructure for accelerometer. Capacitive and Fabry-Perot pressure sensor using MEMS technologies. RF MEMS switch. DC MEMS switch

Text Books :

1. Lubisa Ristic, Sensor Technology and Devices, Artech House, 1991.
2. Hector J De Los Santos,Introduction to Microelectromechanical Microwave Systems, Artech House, 1991.
3. Semiconductor Sensors, Ed. By S. M. Sze, John Wiley & Sons, 1994.

Reference Books :

1. Fundamentals of Microfabrication and Nanotechnology, Vol. 1, Solid State Physics, Fluidics, and Analytical Techniques in Micro- and Nanotechnology, Marck Madauo, 3rd Ed. CRC Press, 2012
2. Fundamentals of Microfabrication and Nanotechnology, Vol. 2, Manufacturing techniques for Microfabrication and nanotechnology, Marck Madauo, 3rd Ed. CRC Press, 2012
3. Fundamentals of Microfabrication and Nanotechnology, Vol. 3, From MEMS to Bio-MEMS and Bio-NEMS, Marck Madauo, 3rd Ed. CRC Press, 2012

Assessment Scheme:

Components	Internal Assessment	Mid Term Exam	End Exam	Total
Weightage (%)	40	20	40	100

Name of Program	B. Tech in Electronics and Communication Engineering				
EECE361L	**Information Theory and Coding**	L	T	P	C
Owning School/Department	SEAS/ECE	3	0	0	3
Pre-requisites/Exposure	NA				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Understand the basic concepts of information measure and representation.
CO2: Analyze the measures of entropy.
CO3: Gain knowledge about mutual information and channel capacity.
CO4: Understand various coding techniques.

CO-PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3											3			3
CO2	2	3										3			3
CO3	3	2										3			3
CO4	1	3	3			3						3			3

1=weakly related 2= moderately related 3=strongly related

Course Contents:

Module I: 16 lecture hours

Revision: Probability theory, Random variables, Distributions and densities; Functions of random variables, Statistical Averages, Inequalities of Markov and Chebyshev; Weak law of large numbers. Information Measure: Discrete entropy, Joint and conditional entropies; Entropy in the continuous case, Maximization of continuous entropy; Entropy of a bandlimited white Gaussian process; Mutual information and channel capacity.

Module II: 10 lecture hours

Communication channel models, source and channel coding; Discrete memoryless channel, Shannon's theorem, noiseless coding theorem; Uniquely decipherable and instantaneous codes. Kraft- McMillan inequality; optimal codes; Huffman, arithmetic, run-length coding.

Module III: 8 lecture hours

Linear Block Codes: Algebra Background, Groups, Fields, Binary field arithmetic; Vector Spaces over GF(2); Generator and parity check matrices, Syndrome and error detection, Standard array and syndrome decoding; Hamming codes.

Module IV: 8 lecture hours

Polynomial representation, Systematic encoding; Cyclic encoding, BCH codes, RS codes, Syndrome decoding; Generator Sequences, Structural properties; Convolutional encoders, Optimal decoding of convolutional codes- the Viterbi algorithm.

Text Books :

1. Ranjan Bose, *Information theory, coding and cryptography*, McGraw Hill, 2008. ISBN: 978-0070669017.
2. R. B. Ash, *Information Theory*, New edition, Dover. ISBN: 978-0486665214.

Reference Books :

1. R. W. Yeung, *Information Theory and Network Coding*, Springer, 2008. ISBN: 978-0387792330.
2. S. Lin and D. J. Costello, *Error Control Coding*, 2nd edition, Pearson Education. ISBN: 978-0130426727.

Assessment Scheme:

Components	Internal Assessment	Mid Term Exam	End Exam	Total
Weightage (%)	40	20	40	100

Name of Program	B.Tech in Electronics & Communication Engineering				
EECE362L	**Detection and Estimation Theory**	L	T	P	C
Owning School/Department	SEAS/ECE	3	0	0	3
Pre-requisites/Exposure	NA				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Understand and apply the fundamental concepts of detection theory in solving, designing, and analysing of different detection and estimation problems.
CO2: Analyse and compare different estimators for analysis of detection and estimation problems.
CO3: Understand concepts of General Minimum Variance Unbiased Estimation and Cramer-Rao Lower Bound.
CO4: Understand Maximum Likelihood Estimation, Least squares estimation, Bayesian Estimation and Kalman filtering.
CO5: Understand statistical detection theory for deterministic signals, random Signals, and solve real-life problems of signal and data analysis.

CO-PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		2									3			3
CO2		3	3	3								3			3
CO3	2	2	3	2								3			3
CO4	2	2	3	2								3			3
CO5	2	2	3	2								3			3

1=weakly related 2= moderately related 3=strongly related

Course Contents:

Module I: **14 lecture hours**

Introduction, Minimum variance unbiased estimation, Existence of the Minimum Variance Unbiased Estimator, Finding the Minimum Variance Unbiased Estimator, Cramer-Rao Lower Bound: General CRLB for Signals in White Gaussian Noise, Transformation of Parameters, CRLB for the General Gaussian Case, Asymptotic CRLB for WSS Gaussian Random Processes.

Linear Model: Introduction, Definition and Properties, Linear Model Examples, General MVUE: Sufficient Statistics, Finding Sufficient Statistics, Using Sufficiency to Find the MVU Estimator, Best Linear Unbiased Estimator (BLUE): Definition of the BLUE, Finding the BLUE.

Module II: **14 lecture hours**

Maximum likelihood estimation (MLE): Finding the MLE, Properties of the MLE, MLE for Transformed Parameters, Numerical Determination of the MLE, Asymptotic MLE, Derivation of Conditional Log-Likelihood for EM Algorithm Example, Least Squares Estimation: The Least Squares Approach, Linear Least Squares, Geometrical Interpretations, Order-Recursive Least Squares, Sequential Least Squares, Constrained Least Squares, Nonlinear Least Squares,

Bayesian estimation: Prior Knowledge and Estimation, Choosing a Prior PDF, Properties of the Gaussian PDF, Bayesian Linear Model, Bayesian Estimation for Deterministic Parameters, Derivation of Conditional Gaussian PDF, Kalman filtering: Dynamical Signal Models, Scalar Kalman Filter, Kalman Versus Wiener Filters.

Module III **14 lecture hours**

Detection Theory in Signal Processing: The Detection Problem. The Mathematical Detection Problem. Hierarchy of Detection Problems. Role of Asymptotics, Summary of Important PDFs: Fundamental Probability Density Functions, Quadratic Forms of Gaussian Random Variables. Asymptotic Gaussian PDF. Monte Carlo Simulations, Statistical Decision Theory I: Neyman-Pearson Theorem. Receiver Operating Characteristics. Irrelevant Data. Minimum Probability of Error. Bayes Risk. Multiple Hypothesis Testing, Deterministic Signals: Matched Filters. Generalized Matched Filters. Multiple Signals. Linear Model, Random Signals: Estimator-Correlator. Linear Model. Estimator-Correlator for Large Data Records. General Gaussian Detection, Statistical Decision Theory II: Composite Hypothesis Testing. Composite Hypothesis Testing Approaches.

Text Books :

1. Steven M. Kay, *Fundamentals of Statistical Signal Processing, Volume 1: Estimation Theory*, Pearson Education, Edition: 2009. ISBN: 9788131728994, 8131728994.
2. Steven M. Kay, *Fundamentals of Statistical Signal Processing, Volume 2: Detection Theory*, by, Pearson Education 2009. ISBN-10: 8131729001, ISBN-13: 978-8131729007

Reference Books :

1. Harry L. Van Trees, *Detection, Estimation, and Modulation Theory, Part I, II, III, IV*.
2. H. Vincent Poor, *Introduction to Signal Detection and Estimation*
3. Louis L. Scharf and Cedric Demeure, *Statistical Signal Processing: Detection, Estimation, and Time Series Analysis*

Assessment Scheme:

Components	Internal Assessment	Mid Term Exam	End Exam	Total
Weightage (%)	40	20	40	100

Name of Program	B.Tech in Electronics & Communication Engineering				
EECE363L	**Advanced Digital Signal Processing**	L	T	P	C
Owning School/Department	SEAS/ECE	3	0	0	3
Pre-requisites/Exposure	NA				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Understand the finite word length effect in digital filters.
CO2: Understand the basic concept of multirate digital signal processing.
CO3: Design and analysis of multirate DSP systems.
CO4: To provide in-depth knowledge of optimal filtering and power spectrum estimation.
CO5: Learn basic knowledge of digital signal processor.

CO-PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	3										
CO2	3	3	2	3	3										
CO3	3	3	2	2	3										
CO4	3	3	3	3	3				1	1	1	1			3
CO5	3	2	3	2	3				1	1	1	1			3

1=weakly related 2= moderately related 3=strongly related

Course Contents:

Module I: 10 lecture hours

Finite Word Length Effects in Digital Filters: Binary fixed point and floating point number representations, Quantization noise, truncation and rounding, quantization noise power, input quantization error, coefficient quantization error, limit cycle IIR filters, Overflow error-signal scaling.

Module II: 12 lecture hours

Multirate Digital Signal Processing: Introduction, Decimation, Interpolation, Sampling Rate Conversion by a Rational Factor I/D, Filter Design and Implementation for sampling rate Conversion, Multistage Implementation of Sampling Rate Conversion, Applications of Multirate Signal Processing: Design of Narrowband filters, Sampling Rate Conversion of Bandpass Signals, Polyphase Decomposition, Digital Filter Banks, QMF Bank.

Module III: 12 lecture hours

Optimal Linear Filters: Mean square error Criteria, FIR Wiener Filter, Non-causal and causal IIR Wiener Filter, Spectral Factorization, Power Spectrum Estimation: Nonparametric Methods, Periodogram, Bartlett's method, Welch's method, Blackman-Tukey Approaches, Parametric Methods, Autoregressive Spectrum Estimation, Moving Average Spectrum Estimation, Autoregressive Moving Average Spectrum Estimation, Linear Prediction.

Module IV: **8 lecture hours**

Introduction to Digital Signal Processor: Evolution of Digital Signal Processor, Digital Signal Processor architecture, Van Neumann architecture, Harvard architecture, Digital Signal Processor Hardware Units, Fixed point and Floating-point digital signal processor.

Text Books :

1. S. K. Mitra, *Digital Signal Processing-A Computer based approach*, Tata McGraw-Hill Education, (4th ed.), 2013. ISBN: 978-1259098581

2. P. P. Vaidyanathan, *Multirate Systems and Filter Banks*, Pearson Education, 1993. ISBN: 978-8177589429

3. Tarun Kumar Rawat, *Digital Signal Processing*, Oxford University Press, 2015. ISBN: 978-0198081937

Reference Books :

1. Monson H. Hayes, *Statistical Digital Signal Processing and Modeling*, John Wiley and Sons, 1996. ISBN: 978-0471594314
2. Simon Haykin, *Adaptive Filter Theory*, Pearson, (5th ed.), 2013. ISBN-13: 978-0132671453

Assessment Scheme:

Components	Internal Assessment	Mid Term Exam	End Exam	Total
Weightage (%)	40	20	40	100

Name of Program	B.Tech in Electronics & Communication Engineering				
EECE364L	**Statistical Signal Processing**	L	T	P	C
Owning School/Department	SEAS/ECE	3	0	0	3
Pre-requisites/Exposure	NA				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Basic understanding of Probability, Random Variables.
CO2: To introduce basic theories of parametric and Non-parametric spectral estimation.
CO3: Learn the basic of Adaptive filtering and Kalman filtering.
CO4: Understand the mathematics underlying these techniques, and with the problems to which they can be applied.

CO-PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	3	3				3	3		3			3
CO2	1	1	2	3	3				3	3		3			3
CO3	2	1	2	2	3				3	3		3			3
CO4	2	3	3	2	3							1			3

1=weakly related 2= moderately related 3=strongly related

Course Contents:

Module I: 8 lecture hours

Review of basic concepts of Stochastic Process and Linear Algebra, Linear System with random input, Spectral factorization theorem and its importance, Innovation process and whitening filter.

Module II: 10 lecture hours

Overview of Non-Parametric Spectral Estimation Techniques, Parametric Spectral Estimation: MA, AR and ARMA modeling, Yule Walker Equation and Levison Durbin Algorithm, Lattice filter (Derived from Levison Durbin Algorithm)

Module III: 10 lecture hours

Linear Minimum Mean-Square Error (LMMSE) Filtering: Wiener Hoff Equation, FIR Wiener filter, Causal IIR Wiener filter, Noncausal IIR Wiener filter, Linear Prediction of Signals, Forward and Backward Predictions, Levinson Durbin Algorithm, Lattice filter realization of prediction error filters

Module IV: 11 lecture hours

Adaptive Filtering: Principle and Application, Steepest Descent Algorithm, Convergence characteristics; LMS algorithm, convergence, excess mean square error, Leaky LMS

algorithm; Application of Adaptive filters, RLS, Application of Adaptive Noise Cancellation, Kalman filtering: Principle and application, Scalar Kalman filter, Vector Kalman filter.

Module V: **6 lecture hours**

Spectral analysis: Estimated autocorrelation function, periodogram, Averaging the periodogram Parametric method, AR spectral estimation and detection of Harmonic signals, MUSIC algorithm.

Text Books :

1. J. G. Proakis, Charles M. Rader, Fuyun Ling, Marc Moonen, Ian K. Proudler, and Chrysostomos L. Nikias, *Algorithms for Statistical Signal Processing*, Prentice Hall; (1st ed.), 2002. ISBN: 978-0130622198
2. Steven M. Kay, *Fundamentals of Statistical Signal Processing: Estimation Theory*, Prentice Hall, 1st edition, 1993. ISBN-13: 978-0133457117
3. Simon Haykin, *Adaptive Filter Theory*, Pearson, (5th ed.), 2013. ISBN-13: 978-0132671453

Reference Books :

1. Monson H. Hayes, *Statistical Digital Signal Processing and Modeling*, John Wiley and Sons, 1996. ISBN: 978-0471594314
2. D.G. Manolakis, V.K. Ingle and S.M. Kogon: *Statistical and Adaptive Signal Processing*, McGraw Hill, 2000. ISBN: 978-1580536103
3. Charles W. Therrien, *Discrete Random Signals and Statistical Signal Processing*, Prentice Hall Signal Processing Series 1992, ISBN: 978-0138521127

Assessment Scheme:

Components	Internal Assessment	Mid Term Exam	End Exam	Total
Weightage (%)	40	20	40	100

Name of Program	B. Tech in Electronics and Communication Engineering				
EECE443L	**High Speed Digital Design**	L	T	P	C
Owning School/Department	SEAS/ECE	3	0	0	3
Pre-requisites/Exposure	EECE203L, EECE214L				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Compare the performances and specifications of various logic families
CO2: To solve propagation and termination problems on lossless and lossy transmission lines for digital circuits.
CO3: Calculate losses in power distribution networks
CO4: Design power distribution techniques that reduce noise
CO5: To use signalling and coding strategies to improve signal integrity in high-speed serial links.
CO6: Design clock distribution techniques that ensure clock signal quality

CO-PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	3										
CO2	3	3	2	3	3										
CO3	3	3	2	2	3										
CO4	3	3	3	3	3				1	1	1	1			3
CO5	3	2	3	2	3				1	1	1	1			3
CO6	3	3	3	2	3				1	2	2	2			3

1=weakly related 2= moderately related 3=strongly related

Course Contents:

Module I: 12 lecture hours

Introduction to high-speed digital design: Frequency, time and distance – Capacitance and inductance effects - High seed properties of logic gates - Speed and power - Modelling of wires -Geometry and electrical properties of wires - Electrical models of wires - transmission lines - lossless LC transmission lines - lossy LRC transmission lines - special transmission lines.

Module II: **10 lecture hours**

Power distribution and noise: Power supply network - local power regulation - IR drops - area bonding - on-chip bypass capacitors - symbiotic bypass capacitors - power supply isolation - Noise sources in digital system - power supply noise - cross talk – inter-symbol interference.

Module III: **11 lecture hours**

Signalling convention and circuits: Signalling modes for transmission lines -signalling over lumped transmission media - signalling over RC interconnect - driving lossy LC lines - simultaneous bi-directional signalling - terminations - transmitter and receiver circuits.

Module IV: **12 lecture hours**

Timing convention and synchronization: Timing fundamentals - timing properties of clocked storage elements - signals and events -open loop timing level sensitive clocking - pipeline timing - closed loop timing - clock distribution - synchronization failure and metastability - PLL and DLL based clock aligners.

Text Books:

1. William S. Dally and John W. Poulton; Digital Systems Engineering, Cambridge University Press, 1998, ISBN-13: 978-0521061759, ISBN-10: 052106175X.
2. Howard Johnson and Martin Graham; High-Speed Digital Design: A Handbook of Black Magic, Prentice Hall PTR, 1993, ISBN-13: 978-0133957242, ISBN-10: 0133957241.

Reference Books:

1. Masakazu Shoji, High-Speed Digital Circuits, Addison Wesley Publishing Company, 1996, ISBN-13: 978-0201634839, ISBN-10: 020163483X.
2. Sung-Mo Kang and Yusuf Leblebici, CMOS Digital Integrated Circuits- Analysis & Design, MGH, (3rd edition), 2003, ISBN-13: 978-0071243421, ISBN-10: 9780071243421.
3. Jan M.Rabaey, Digital Integrated Circuits- A Design Perspective, Prentice Hall, (2nd Edition), 2005, ISBN-13: 978-9332573925, ISBN-10: 9332573921.

Assessment Scheme:

Components	Internal Assessment	Mid Term Exam	End Exam	Total
Weightage (%)	40	20	40	100

Name of Program	B. Tech in Electronics and Communication Engineering				
EECE446L	**Low Power VLSI Design**	L	T	P	C
Owning School/Department	SEAS/ECE	3	0	0	3
Pre-requisites/Exposure	EECE203L, EECE207L				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: To explain various leakage sources and paths in a MOSFET and a digital circuit.

CO2: To calculate on current and leakage current in a MOSFET.

CO3: To calculate static and dynamic power dissipation in a digital circuit.

CO4: To differentiate between power consumption and energy consumption of a digital circuit.

CO5: To calculate leakage power based on input vectors, stacked transistors.

CO6: To describe dynamic voltage scaling.

CO7: To calculate the threshold voltage of a MOSFET when a body bias is applied.

CO8: To calculate the power consumption of a circuit when body bias is applied.

CO-PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	3					1		3			3
CO2	3	3	2	3	3					1		3			3
CO3	3	3	2	2	3					1		3			3
CO4	3	3	3	3	3					1		1			3
CO5	3	2	3	2	3					1		1			3
CO6	3	2	2	1	2					1		1			3
CO7	3	2	2	1	2				1			1			3
CO8	3	2	2	1	2				1			1			3

1=weakly related 2= moderately related 3=strongly related

Course Contents:

Module I: 15 lecture hours

Review of power dissipation in CMOS Circuits – static and dynamic power dissipation- Leakage sources, input vector dependence, stack effect, leakage reduction using natural and forced stacks, power gating, power gating methodologies, dynamic voltage scaling, forward and reverse body bias, standby techniques; MTCMOS circuits-level shifters, timing and power planning, choosing the high VTH value, MTCMOS circuits using sleep transistors.

Module II: 14 lecture hours

Supply voltage scaling approaches: parallelism, pipelining, using multiple supply voltage, module level voltage selection, clustered voltage scaling, level converters, multiple supplies

inside a block, supply voltage limitations, Optimum supply voltage, multiple device threshold, Technology level – feature size scaling, threshold voltage scaling, Transistor sizing for energy minimization, dynamic supply voltage scaling, dynamic threshold voltage scaling.

Module III: **6 lecture hours**

Switching activity estimation in static and dynamic logic, signal statistics, inter-signal correlations, reducing switching capacitance through transistor sizing, logic and architecture optimization, layout techniques, logic restructuring, input ordering, data representation, resource allocation, reducing glitching through path balancing, clock gating.

Module IV: **10 lecture hours**

Behavioral level transforms, algorithm level transforms, architectural transformations, Operation reduction and substitution, logic level optimization and technology mapping, Energy recovery, design with reversible logic, adiabatic logic, peripheral circuits, Power gating, signal isolation, state retention and restoration, architectural issues for power gating, Dynamic voltage and frequency scaling.

Text Books :

1. Anantha Chandrakasan, Robert Brodersen, Low-power CMOS design, IEEE press, 1998, ISBN-13: 978-1461359845, ISBN-10: 1461359848.
2. Kaushik Roy, Sharat C. Prasad, Low-power CMOS VLSI circuit design, John Wiley & Sons, 2000, ISBN-13: 978-8126520237, ISBN-10: 812652023X.
3. Mohab Anis, Mohamed Elmasry, Multi-Threshold CMOS Digital Circuits, Kluwer Academic Publishers, 2003, ISBN-13: 978-8184893595, ISBN-10: 8184893590.

Reference Books :

1. A.Bellamour, M.I.Elmasri, Low power VLSI CMOS circuit design, Kluwer Academic Press, 1995
2. Siva G.Narendran, Anantha Chandrakasan, Leakage in Nanometer CMOS Technologies, Springer, 2005, ISBN-13: 978-0387257372, ISBN-10: 9780387257372.

Assessment Scheme:

Components	Internal Assessment	Mid Term Exam	End Exam	Total
Weightage (%)	40	20	40	100

Name of Program	B. Tech in Electronics and Communication Engineering				
EECE451L	**Optical Communications**	L	T	P	C
Owning School/Department	SEAS/ECE	3	0	0	3
Pre-requisites/Exposure	EECE311L				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Understanding the basic working principle, advantages and applications of optical fiber.
CO2: Study and analysis of different opto-electronic components being utilised in optical communication system. Further, recent advanced development is covered.
CO3: Designing of optical fiber budget link with analysis of errors, SNR and power budget estimation.
CO4: Implementing basic formulations (e.g., group velocity, phase velocity, error etc.) using MATLAB

CO-PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	3					1	2	3			3
CO2	3	3	2	3	3					1	2	3			3
CO3	3	3	2	2	3					1	2	3			3
CO4	3	3	3	3	3					1	1	1			3

1=weakly related 2= moderately related 3=strongly related

Course Contents:

Module I: 16 lecture hours

Introduction to optical communication: evolution of optical communication, basics of optics; optical fibers: ray model and its limitations, wave model, modal fields, b-V diagram, LP modes.

Module II: 14 lecture hours

Signal distortion on optical fibers: attenuation, dispersion, intra- and inter-modal dispersion, different types of fibers, optical sources: LED, laser, optical transmitters, optical detectors: photo-detectors, optical receivers.

Module III: 15 lecture hours

Link design, optical communication systems, BER and SNR calculations, power penalty, optical networks: SONET/SDH, optical amplifiers, WDM devices and systems, advances in optical communication.

Text Books :

1. G. Keiser, Optical Communication (4th ed.), McGraw Hill Education, 2010, ISBN 978-0073380711.
2. G.P. Agrawal, Fiber Optic Communication Systems (4th ed.), Wiley, 2010, ISBN 978-0470505113.

Reference Books :

1. A.K. Ghatak and K. Thyagrajan, *Optical Electronics*, Cambridge Press, 1989, ISBN 978- 0521314084.
2. R.K. Shevgaonkar, NPTEL web and video lectures, www.nptel.ac.in.

Assessment Scheme:

Components	Internal Assessment	Mid Term Exam	End Exam	Total
Weightage (%)	40	20	40	100

Name of Program	B. Tech in Electronics and Communication Engineering				
EECE453L	**Microwave Devices**	L	T	P	C
Owning School/Department	SEAS/ECE	3	0	0	3
Pre-requisites/Exposure	NA				

Course Outcomes (COs)

On completion of this course, the students will be able to:

CO1: Analysis of waveguides and modes like TE or TM modes in waveguides
CO2: Understanding of S-parameters and its utilization to characterise the microwave passive components.
CO3: Developing the knowledge of various microwave tubes as power source
CO4: Understanding the behaviour and design process of microwave oscillators and amplifiers.
CO5: Understanding of measurement process for various microwave components.

CO-PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	3				3	1	2	3			3
CO2	3	3	2	3	3				3	1	2	3			3
CO3	3	3	2	2	3				3	1	2	3			3
CO4	3	3	3	3	3				1	1	1	1			3
CO5	3	2	2	3	3				3	1	2	3			3

1=weakly related 2= moderately related 3=strongly related

Course Contents:

Module I: 14 lecture hours

Rectangular Wave Guide: Field Components, TE, TM Modes, Dominant TE10 mode, Field Distribution, Power, Attenuation. Circular Waveguides: TE, TM modes. Wave Velocities, Microstrip Transmission line (TL), Coupled TL, Strip TL, Coupled Strip Line, Coplanar TL, Microwave Cavities.

Module II: 10 lecture hours

Scattering Matrix, Passive microwave devices: Microwave Hybrid Circuits, Terminations, Attenuators, Phase Shifters, Directional Couplers: Two Hole directional couplers, S Matrix of a Directional coupler, Hybrid Couplers, Microwave Propagation in ferrites, Faraday Rotation, Isolators, Circulators. S-parameter analysis of all components.

Module III: 6 lecture hours

Microwave Tubes: Limitation of Conventional Active Devices at Microwave frequency, Two Cavity Klystron, Reflex Klystron, Magnetron, Traveling Wave Tube, Backward Wave Oscillators: Their Schematic, Principle of Operation, Performance Characteristic and their applications.

Module IV: 9 lecture hours

Solid state amplifiers and oscillators: Microwave Bipolar Transistor, Microwave tunnel diode, Microwave Field-effect Transistor, Transferred electron devices, Avalanche Transit -time devices: IMPATT Diode, TRAPAT Diode

Module V: **6 lecture hours**

Microwave Measurements: General setup of a microwave testbench, Slotted line carriage, VSWR Meter, microwave power measurements techniques, Crystal Detector, frequency measurement, wavelength measurements, Impedance and Refection coefficient, VSWR, Insertion and attenuation loss measurements, measurement of antenna characteristics, microwave link design.

Text Books :

1. Samuel Y. Liao, "Microwave Devices and Circuits", Pearson Education Publication

Reference Books :

1. R.E Collin, "Foundation for Microwave Engineering", John Wiley India Publication.

2. A. Das and S.K. Das," Microwave Engineering", Tata McGraw Hill Publication

Assessment Scheme:

Components	Internal Assessment	Mid Term Exam	End Exam	Total
Weightage (%)	40	20	40	100