Pandit Deendayal Energy University

School of Technology

Department of Electronics and Communication Engineering

Under Graduate Curriculum Handbook (Academic Year 2024-28)

B.Tech. (Electronics and Communication Engineering)
w. e. f. July, 2024

Department of Electronics and Communication Engineering (ECE)

School of Technology, PDPU

Vision:

To become a higher learning and research pioneer and to produce creative solutions using knowledge in the domain of Electronics and Communication Engineering to meet sustainable societal and environmental needs.

Mission:

- To deliver high-value education and strive for global recognition by excelling in teaching, research, and public service.
- To provide globally competent and futuristic graduates prepared for life-long engagement in the highly dynamic field of ECE.
- To develop engineering skills to meet futuristic technological challenges for sustainable environment, economy, and society.

Program Educational Objectives (PEOs):

- Prepare professionals with futuristic skills for industry, research organizations and academia in the field of electronics and communication engineering.
- Impart knowledge and technical skills to students for contribution to the design and development in Electronics, Communication and Signal Processing, and VLSI systems.
- Motivating graduates for lifelong learning with leadership qualities, ethics and life skills to become good human beings and engineering professionals.

Program Outcomes (POs):

The graduates of ICT department will be able to:

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

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

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

4. ***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.

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

6. ***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.

7. ***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.

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

9. ***Individual and team work:*** Function effectively as an individual, and as a member or leader in diverse teams and in multidisciplinary settings.

10. ***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.

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

12. ***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.

Program Specific Outcomes (PSOs):
The graduates of Electronics and Communication Engineering will be able to

• Apply electronics and communication engineering knowledge to solve multidisciplinary problems using tools and technologies.

• Understand, analyze and evaluate the impact of electronics and communication technology on Environment, Energy, Infrastructure, Organizations and Economy.

• Contribute to the environment, society and industries by providing solutions spanning Electronics, Communication and Signal Processing, and VLSI Systems.

Course Outline

Sem		Course Name	Th	Tut	Pra	Hrs	Cr
Sem I	HSC	Humanities – 1	2	0	0	2	2
	BSC	Mathematics – 1	3	1	0	4	4
	BSC	Physics	3	0	0	3	3
	BSC	Physics – Laboratory	0	0	2	2	1
	BSC	Environment Science	2	0	0	2	2
	ESC	Workshop Practices	0	0	2	2	1
	BSC	Biology for Engineers	2	0	0	2	2
	ESC	Computer Programming -I	1	0	0	1	1
	ESC	Computer Programming -I Laboratory	0	0	2	2	1
	HSC	Universal Human Values	1	0	0	1	1
	HSC	Indian Knowledge System	2	0	0	2	2
			16	**1**	**5**	**23**	**20**
Sem II	HSC	Humanities – 2	2	0	0	2	2
	BSC	Mathematics – 2	3	1	0	4	4
	BSC	Chemistry	3	0	0	3	3
	BSC	Chemistry – Laboratory	0	0	2	2	1
	ESC	Introduction to Electrical Engineering	3	0	0	3	3
	ESC	Introduction to Electrical Engineering-Laboratory	0	0	2	2	1
	ESC	Engineering Graphics	0	0	4	4	2
	HSC	Yoga, Health & Hygiene OR NCC/NSS	0	0	2	2	1
	HSC	Organizational Behaviour	1	0	0	1	1
	ESC	Computer Programming -II	1	0	0	1	1
	ESC	Computer Programming -II Laboratory	0	0	2	2	1
			13	**1**	**12**	**26**	**20**
Sem III	Pro	Civic and Social Service Internship	0	0	0	0	1
	ESC	Introduction to Artificial Intelligence (Department Specific)	3	0	0	3	3
	PC	Digital Circuits	3	0	0	3	3
	PC	Digital Circuits Laboratory	0	0	2	2	1
	PC	Electronics Devices and Circuits	3	0	0	3	3
	PC	Electronics Devices and Circuits Laboratory	0	0	2	2	1
	PC	Networks and Systems	3	1	0	4	4
	BSC	Math-3	3	1	0	4	4
			15	**2**	**4**	**21**	**20**
Sem IV	ESC	Industry 4.0 (Department Specific)	2	0	0	2	2
	ESC	Industry 4.0 – Laboratory (Department Specific)	0	0	2	2	1
	OE	Open Elective 1 (From Other School)	3	0	0	3	3
	PC	Analog Electronics	3	0	0	3	3
	PC	Analog Electronics Laboratory	0	0	2	2	1
	PC	Analog Communication	3	0	0	3	3
	PC	Analog Communication Laboratory	0	0	2	2	1
	PC	Electromagnetics and Transmission Lines	3	1	0	4	4
	PC	Digital Signal Processing	3	0	0	3	3
	PC	Digital Signal Processing Laboratory	0	0	2	2	1
			17	**1**	**8**	**26**	**22**
Sem V	OE	Open Elective 2 **((NPTEL/SWAYAM/MOOC))**	3	0	0	3	3

	HSC	Engineering Economics	3	0	0	3	3
	PE	Program Elective 1	3	0	0	3	3
	PC	Control Systems	3	0	0	3	3
	PC	Control Systems Lab	0	0	2	2	1
	PC	Linear Integrated Circuits and Applications	3	0	0	3	3
	PC	Linear Integrated Circuits and Applications Laboratory	0	0	2	2	1
	PC	Digital Communication	3	0	0	3	3
	PC	Digital Communication Laboratory	0	0	2	2	1
			18	**0**	**6**	**24**	**21**
Sem VI	OE	Open Elective 3 (From Other Department of FoET)	3	0	0	3	3
	PE	Program Elective 2	3	0	0	3	3
	PE	Program Elective 3	3	0	0	3	3
	PC	Computer and Communication Networks	3	0	0	3	3
	PC	Computer and Communication Networks Laboratory	0	0	2	2	1
	PC	Computer Organization and Microprocessor	3	0	0	3	3
	PC	Computer Organization and Microprocessor Lab	0	0	2	2	1
	PC	Microwave and Antenna	3	0	0	3	3
	PC	Microwave and Antenna Lab	0	0	2	2	1
			18	**0**	**6**	**24**	**21**
Sem VII	Pro	Summer Internship	0	0	0	0	2
	OE	Open Elective 4 (From Other Department of FoET)	3	0	0	3	3
	PE	Program Elective 4 (3-0-0)	3	0	0	3	3
	PE	Program Elective 5 (3-0-0)	3	0	0	3	3
	PC	Modern Wireless Communication	3	0	0	3	3
	PC	Modern Wireless Communication Lab	0	0	2	2	1
	PC	Embedded System Design	3	0	0	3	3
	PC	Embedded System Design Lab	0	0	2	2	1
	PC	Digital CMOS VLSI Design	3	0	0	3	3
	PC	Digital CMOS VLSI Design Lab	0	0	2	2	1
		Seminar					1
			18	**0**	**6**	**24**	**24**
Sem VIII		**Course Name**					
	Pro	Major/Comprehensive Project					**12**

Program Core Electives:

Semester	VLSI/Embedded systems	Communication Systems	Computer systems	Control
5	Digital Systems Design using HDL	Opto Electronics and Optical Communication		
6	Analog IC Design	Satellite Communication	Machine Learning and Applications	Introduction to Robotics
	Power Electronics	Information Theory and Coding	Database Management Systems	Modern Control Systems
7	Advanced Processors and SoCs	Advanced Communication Networks	Internet of Things	Drones: Design, Theory and Applications
	IC Technology	Radar and Navigation Systems	Deep Learning and Applications	
	Mixed Signal VLSI Design			

1st Semester

<Course Code>					Mathematics – I					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

1. To be able to evaluate problems related to differential and integral calculus of complex functions.
2. To be able to obtain area, volume using integral calculus.
3. To be able to formulate and solve various engineering problems using the calculus.
4. To study the properties of sequence and series and to check the convergence and divergence.

UNIT I: DIFFERENTIAL CALCULUS AND ITS APPLICATIONS **08 Hrs.**

Partial derivative and its application - Euler's theorem - Total derivatives - Jacobians – Maxima and Minima of two variables using Lagrange's multipliers. Taylor's series, Convergence of power series.

UNIT II: INTEGRAL CALCULUS AND ITS APPLICATIONS **12 Hrs.**

Definition and evaluation of double integral (Cartesian – Polar form) – Change of orders - Change of variables – Evaluation of triple integral, change of variables (Cartesian to spherical – and cylindrical) – Applications, area – volume – center of mass – center of gravity by double and triple integral.

UNIT III: VECTOR CALCULUS **10 Hrs.**

Gradient, divergence and curl – Directional derivative – Irrotational and Solenoidal vector fields – Vector Integration – Simple problems on line, surface and volume integrals – Green's theorem in a plane, Gauss divergence theorem and Stokes' theorem (without proofs) – Simple application involving cubes and rectangular parallelepipeds.

UNIT IV: SEQUENCE AND SERIES **12 Hrs.**

Definition. Convergent, divergent, bounded & monotone sequences. Infinite sums: Basics Taylor series, Convergence and divergence, Tests for convergence for positive term series, Alternating series – Leibnitz test, Absolute convergence, conditional convergence.

TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1 : Identify the use of convergence of infinite series in engineering aspects.
CO2 : Understand the concept of Directional derivative, Irrotational and Solenoidal vector fields.
CO3 : Apply the concept of differential and integral calculus in engineering problems.
CO4 : Analyze the obtained solution in linear and non-linear domains.
CO5 : Appraise mathematical problems from complex domain.
CO6 : Evaluate problems on Green's, Stokes' and Divergence theorems.

TEXT/REFERENCE BOOKS

1. B. S Grewal, Higher Engineering Mathematics, Khanna Pub.
2. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, Alpha Science.
3. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley.
4. G. Strang, Linear Algebra and its Applications, Cengage Learning.
5. K. Hoffman and R. A. Kunze, Linear Algebra, Prentice Hall of India.

<Course Code>					Applied Physics					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. Understand Electric and Magnetic Fields, applying vector algebra.
2. Apply Maxwell's equations to analyse electromagnetic waves and transmission.
3. Analyse semiconductor behaviour and its applications in electronic devices
4. Evaluate optical phenomena and their engineering applications in communications.

UNIT I: ELECTRICITY AND MAGNETISM **12 Hrs.**

Vector Algebra, Fundamental theorems of Gradient, Curls, and Divergence, Curvilinear co-ordinates, Continuous charge distribution, Divergence and Curl of Electrostatic Field, Electric potential and its applications, Work and Energy in Electrostatic, Bio-Savart's law, Divergence and curl of magnetic fields, Vector Potential, Ohm's law, EMF, Faraday's law of electromagnetic induction, Energy in Magnetic Fields, Maxwell's correction to ampere's law and Maxwell's equations, Poynting Vector.

UNIT II: ELECTROMAGNETIC WAVES **10 Hrs.**

Waves equation, Reflection and Transmission of waves, Polarisation, Wave equation for E and B for monochromatic plane waves, Propagation in linear media, reflection and transmission in normal and oblique incidence, Electromagnetic waves in conductors, Frequency dependence of permittivity, Waveguides, TE waves in rectangular waveguide, The Coaxial transmission line.

UNIT III: PHYSICS OF SOLIDS **10 Hrs.**

Fermi electron gas, Fermi level and surface, Energy bands, Energy Gap, Energy and band structure of conductor, insulators and semiconductors, Intrinsic semiconductors at 0K and room temperature, Intrinsic conductivity, Types of semiconductors, doping impurities, Temperature variation of carrier concentration, Electrical conductivity in semiconductors, Hall Effect, and magnetic materials

UNIT IV: OPTICS **10 Hrs.**

Nature of light waves, Fermat's principle, Coherent Sources, Interference, Two source interference, Interference in thin films, Newton's ring, Fresnel and Fraunhofer diffraction, Diffraction from single slit and double slit, Lasers, optical fibres and Holography, Applied optics: engineering measurements.

TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1 : Recall fundamental laws and principles of electromagnetism and optics.
CO2 : Explain concepts of waves, conductivity, and semiconductor properties.
CO3 : Utilize principles to solve problems in electricity, magnetism, and optics.
CO4 : Evaluate electromagnetic phenomena and semiconductor behaviour through experimentation.
CO5 : Assess the effectiveness of engineering design for electromagnetic and optical devices.
CO6 : Design solutions for engineering challenges involving electromagnetics and semiconductors.

TEXT/REFERENCE BOOKS

1. Griffith, D. J., Introduction to Electrodynamics, Prentice Hall.
2. M. N. Avadhanulu and P G Kshirsagar, A text book of Engineering Physics, S.Chand Publications.
3. Sears and Zemansky, University physics, Pearson publications.
4. Principles of Electromagnetics, Matthew N. O. Sadiku, Oxford publications.
5. Hecht, E., Optics, Pearson Education.
6. M. A. Wahab, Solid State Physics: Structure and Properties of Materials, Narosa Publishing House Pvt. Ltd.-New Delhi.

<Course Code>					Applied Physics Laboratory					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE	
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

1. Understand principles of electromagnetism and their experimental applications.
2. Analyse experimental setups and procedures related to electricity and magnetism.
3. Apply concepts of electromagnetic phenomena and optics in practical experiments.
4. Investigate semiconductor device electrical properties through experimentation.

LIST OF EXPERIMENTS

1 To determine e/m using Thomson's method.
2 To study Bio-Savart's Law.
3 To verify Faraday and Lenz's law.
4 To study the magnetic field along the axis of a coil
5 To determine the electrical conductivity of metals.
6 To study the characteristics of Si solar cells.
7 To study the phenomenon of photoconductivity using CdS photo-resistor.
8 To determine energy band gap of semiconductor using four probe method.
9 To study the hall effect and determine hall voltage, hall coefficient, type of majority charge carriers, carrier concentration and hall angle.
10 To study of the ferromagnetic hysteresis.
11 To determine the wavelength of monochromatic light (sodium light) using Newton's rings.
12 To measure the slit width of single, blade and double slits.
13 To understand fundamental of optical fibres and analogue optical fibre communication.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1 : Recognize electromagnetic principles and practical applications in experimental setup.
CO2 : Interpret experimental setups and procedures for electricity, magnetism, and optics.
CO3 : Demonstrate and implement the concepts of electromagnetic phenomena and optics.
CO4 : Investigate the electrical properties of semiconductor device.
CO5 : Examine the experimental data to identify trends and physical relationships.
CO6 : Design experiments to investigate electromagnetism and semiconductor properties.

TEXT/REFERENCE BOOKS

1. Griffith, D. J., Introduction to Electrodynamics, Prentice Hall.
2. M. N. Avadhanulu and P G Kshirsagar, A text book of Engineering Physics, S. Chand Publications.
3. Sears and Zemansky, University physics, Pearson publications.
4. Principles of Electromagnetics, Matthew N. O. Sadiku, Oxford publications.
5. Hecht, E., Optics, Pearson Education.
6. M. A. Wahab, Solid State Physics: Structure and Properties of Materials, Narosa Publishing House Pvt. Ltd.-New Delhi.

<Course Code>					ENVIRONMENTAL SCIENCE					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	0	0	2	2	25	50	25	--	--	100

COURSE OBJECTIVES

1. To develop a comprehensive perspective of environment and sustainable development
2. To understand the causes and effects of various types of pollution
3. To develop an understanding of the various strategies for controlling the pollution
4. To introduce the emerging environmental domains

UNIT I : INTRODUCTION TO ENVIRONMENT **05 Hrs.**

Sustainable Development; Sustainable Development Goals; Environmental Studies – Its importance and Multidisciplinary nature, Introduction to Environmental Parameters and their standards (air, water, soil, noise, etc.); Ecosystem and its types, Ideal ecosystem, Biodiversity : Its importance and conservation.

UNIT II : MULTI-SCALE ENVIRONMENTAL POLLUTION (GLOBAL, REGIONAL AND LOCAL) **06 Hrs.**

Pollution, Causes and Effects of different types of pollution : Air Pollution, Water Pollution, Soil Pollution, Solid Waste (organic and Inorganic) Pollution, Hazardous Waste Pollution, Marine Pollution, Noise Pollution, Thermal Pollution, Radioactive Pollution; Introduction to man-made disasters like floods, heat waves, landslides, etc., Introduction to the various instruments for measuring air pollution, water pollution, noise, etc.

UNIT III : ENVIRONMENTAL POLLUTION CONTROL STRATEGIES **09 Hrs.**

Multi-approaches for reducing various types of pollution: Introduction to Water and Wastewater treatment technologies, Air and Noise pollution control techniques, Introduction to different environmental management concepts like Swachh Bharat Mission, Mission LiFE (Lifestyle For Environment), etc. Indian Culture and Traditional Wisdom for managing environment

UNIT IV: EMERGING ENVIRONMENTAL MANAGEMENTS DOMAINS **08 Hrs.**

Concept of Zero Liquid Discharge (ZLD) and the reuse of the treated wastewater, Green Credit Rules - 2023, Clean Development Mechanisms (CDM) and Carbon Credits, Green Buildings, Carbon Footprint and Water Footprint, Green Business, International Environmental Laws, Environmental Auditing

TOTAL HOURS: 28 Hrs.

COURSE OUTCOMES:

On completion of the course, student will be able to:

CO-1: Demonstrate comprehension of sustainable development and environmental aspects.
CO-2: Recognize the interdisciplinary characteristics inherent in Environmental studies.
CO-3: Evaluate the impact of various pollutants on the environment.
CO-4: Assess the efficacy of different technologies for environmental pollution control.
CO-5: Analyze different environmental management policies and their implications.
CO-6: Synthesize knowledge about emerging environmental management paradigms.

TEXT-BOOK AND REFERENCE BOOKS:

1. Bharucha Erach, Textbook for Environmental Studies, UGC New Delhi.
2. Daniel B. Botkin & Edwards A. Keller, Environmental Science, Wiley India edition.
3. Miller T. G. Jr., 2006. Environmental Science, Clengage Learning.
4. R. Rajagopalan, Environmental Studies, Oxford University Press.
5. Gilbert Masters and Wendell P. Ela, Introduction to Environmental Engineering and Science, PHI.

<Course Code>					Workshop Practice					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE	
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

1. To understand safety in various manufacturing processes.
2. Learn how to use various measuring tools for engineering applications.
3. Hands on training and preparation of job using wood, metal and sheet as per drawing.
4. Understand various manufacturing processes like machining, welding, soldering and 3D printing for prototypes.

LIST OF EXPERIMENTS

1 Introduction to Workshop safety, layout and identification of various materials- plastic, wood, metals-ferrous and nonferrous, rubber, glass etc.
2 Use of measuring tools for engineering applications
3 Fitting job: Detailed drawing of work piece, use of fitting tools and job preparation.
4 Carpentry job: Detailed drawing of work piece, use of carpentry tools and job preparation.
5 Sheet metal job: Detailed drawing of work piece, use of sheet metal working tools and job preparation.
6 Plumbing job: Internal/External threading, piping network using Tees, Elbows, Reducer, Bends etc
7 Hands on training on mini lathe and milling machine
8 Demonstration of welding, brazing and soldering
9 Soldering and desoldering for PCB
10 3D printing using polymer and metal.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1 : Define workshop safety and various engineering materials
CO2 : Understand various measuring equipment
CO3 : Apply various workshop tools in preparing job for carpentry, fitting, sheet metal and plumbing
CO4 : Examine various manufacturing operations like welding and machining
CO5 : Evaluate soldering operation for PCB
CO6 : Create prototype using 3D printing

TEXT/REFERENCE BOOKS

1. S. K. Hajra Choudhury, Elements of Workshop Technology, Vol. I & II, Media Promoters and Publishers.
2. H. S. Bawa, Workshop Practice, Tata-McGraw Hill.
3. Kalpakjian S. And Steven S. Schmid, Manufacturing Engineering and Technology, Pearson Education India Edition.
4. Rao P.N., Manufacturing Technology, Vol. I and Vol. II, Tata McGraw Hill House.

<Course Code>					Biology For Engineers					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	0	0	2	2	25	50	25	--	--	100

COURSE OBJECTIVES

1. To understand the basic biological concepts and their engineering applications.
2. To introduce the students with an understanding of biodesign principles to create novel devices and structures.
3. To provide the students an appreciation of how biological systems can be re-designed as substitute products for natural systems.
4. To study the development of interdisciplinary vision of biological engineering.

UNIT I: INTRODUCTION TO BIOMOLECULES **7 Hrs.**

Cell as a basic unit of life, prokaryotic and eukaryotic cells, microbes, plant and animal cells; Cell organelles – structure and function; Cell membrane. Vitamins and Minerals, Carbohydrates, Lipids, Amino Acids and proteins, Nucleic Acids (DNA and RNA).

UNIT II: NATURE-BIOINSPIRED MECHANISMS **7 Hrs.**

Brain as a CPU system (architecture, CNS and Peripheral Nervous System, signal transmission, EEG, Robotic arms for prosthetics). The eye functions as a camera. Heart as a pump system, The ear and nose as signal transmission models. Lungs operate as an exchange model, kidneys function as a filtration system. Echolocation (ultrasonography, sonars), Photosynthesis (photovoltaic cells, bionic leaf). Bird flying (GPS and aircrafts), Lotus leaf effect (Super hydrophobic and self-cleaning surfaces), Plant burrs (Velcro).

UNIT III: TRENDS IN BIOENGINEERING **7 Hrs.**

Stem cell and its applications, Bio printing techniques and materials. Applications of Bioinformatics, Artificial Intelligence for diagnosis and detection of communicable and non-communicable diseases, Biosensors in healthcare, Environmental monitoring, Food Safety and Biosecurity.

UNIT IV: ENGINEERING PERSPECTIVES OF BIOLOGICAL SCIENCES **7 Hrs.**

Biology and engineering crosstalk – At cell level: Hybridoma technology, At tissue level: Plant Tissue Culture, Animal Tissue Culture; Tissue Engineering, Introduction to Biomimetics and Biomimicry, Nanobiotechnology, Introduction to Radiology, High-throughput diagnostics in clinics: Molecular Diagnostics (PCR), DNA chips.

TOTAL HOURS: 28 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1 : Gain fundamental knowledge of origin of life.
CO2 : Demonstrate the involvement of major organs and systems in the human body as models for bioengineering design.
CO3 : Analyse the scope and opportunities of Implementing bioengineering concepts relates to advanced imaging and diagnostic techniques for clinical diagnosis and disease management.
CO4 : Get acquainted with concepts of bioengineering trends including biosensors, AI , Imaging techniques in disease diagnosis and treatment
CO5 : Focus on implications of Bioinspired designs, Bioengineering trends including, tissue engineering and molecular diagnostics.
CO6 : Think critically towards exploring innovative biobased solutions for socially relevant problems.

TEXT/REFERENCE BOOKS

1. Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi S., and Jaganthan M., Biology for Engineers, Tata McGraw-Hill, New Delhi.
2. Arthur T. Johnson, Biology for Engineers, CRC Press, Taylor and Francis.
3. Geoffrey M.Cooper, The Cell: A molecular Approach, ASM Press.
4. Sohini Singh and Tanu Allen, Biology for Engineers", Vayu Education of India, New Delhi.
5. Yoseph Bar-Cohen, "Biomimetics: Nature-Based Innovation, CRC Press.
6. Stuart Fox, Krista Rompolski, Human Physiology", McGraw-Hill (eBook).
7. D. Floreano and C. Mattiussi, Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies, MIT Press.

<Course Code>					Computer Programming – I					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
1	0	0	1	1	25	50	25	-	-	100

COURSE OBJECTIVES

1. To understand the usage of operators and data types.
2. To apply different types of Conditional and looping statement.
3. To create different types of data collections.
4. To implement user defined function.
5. To perform different operations upon files.

UNIT 1: Basics of Programming **3 Hrs.**

Introduction to Computer Programming, Features of C language, Structure of C program, program execution flow, C Tokens, variables, Data types, Operators, Decision control statements-if, switch, go to statement. Loop control structures- while, do-while, for loop, Break statement, Continue statement

UNIT 2: Derived Data types **4 Hrs.**

Array: one dimensional and multidimensional array, Declaration, initialization, Array Manipulations. Matrix operations, String-Basic Concepts, Inbuilt String manipulation Functions, Pointer, Pointer arithmetic, Pointer to pointer, Array of Pointers

UNIT 3: Functions and Structures **4 Hrs.**

Introduction to user defined functions, Types of Functions, Call by value-call by reference, recursion, pointers to functions, Structures, Array of Structure, Union

UNIT 4: Files Handling **3 Hrs.**

File handling in C, Different types of files, Operations on Files such as File creation, File deletion, File access modes such as read, write, append, File concatenation, File handling using seek function.

14 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1: Understand basics of programming.
CO2: Identify different programming constructs for a problem.
CO3: Apply appropriate derived data type for data storage.
CO4: Prepare a user defined data type based on data attributes.
CO5: Construct user defined functions for problem solving.
CO6: Analyse different data structure based on application requirement.

TEXT/REFERENCE BOOKS

1. Kernighan & Ritchie, C Programming Language, PHI
2. K. N. King , C Programming: A Modern Approach, W.W. Nortorn
3. David Griffiths and Dawn Griffiths, Head First C: A Brain-Friendly Guide, O'Reilly
4. E.Balaguruswamy, Programming in ANSI C, McGraw-Hill
5. Y.P. Kanetkar, Let us C, BPB Publication
6. Y.P. Kanetkar , Pointers in C, BPB Publications

<Course Code>					Computer Programming – I Laboratory					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE	
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

1. To implement basic programming concepts.
2. To create different types of data collections.
3. To implement user defined function.
4. To perform different file handling operations.

List of Experiments:

1. **Introduction to Computer Programming**: Understanding compilation process through a simple C program, program execution flow, C Tokens, variables and keywords and identifiers, types of C constants and variables.

2. **Simple and formatted Input Output Operations:** Data types, Operators, Input /output statements in C, Formatted I/O, format specifiers, escaper sequences
3. **Decision making and branching:** if, if-else, if-else ladder, switch, go to statement, conditional operator statement

4. **Looping control structures:** while, do-while, for loop, Break statement, Continue statement
5. **Derived Data Type: Array and Strings:** One dimensional and multidimensional array, Declaration, initialization, Array Manipulations. Matrix operations, Basic Concepts, Inbuilt String manipulation with and without using inbuilt functions.
6. **Derived Data Type: Structure and Union:** structure, arrays and structures, structures and functions, pointer to structure, typedef, unions
7. **Functions:** Introduction to user defined functions, Types of Functions, Call by value-call by reference, header file creation, recursion, pointers to functions, arrays and functions
8. **Pointers:** Pointer's basics, use of &, * operator in context to pointers, Pointer arithmetic, Array and String processing using pointer, pointer to pointer, Array of Pointers
9. **File Handling in C:** File handling in C, Different types of files, Operations on Files, File handling functions.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1: Identify the use of appropriate naming conventions and programming style including appropriate comment density.
CO2: Implement a basic C program using appropriate control structure.
CO3: Apply appropriate derived data types based on data attributes.
CO4: Develop solutions with pointers and utilize them to access strings and structures.
CO5: Design user defined functions for problem solving and reuse them across different programs.
CO6: Apply suitable file handling functions and operations.

TEXT/REFERENCE BOOKS

1. Kernighan & Ritchie, C Programming Language, PHI.
2. K. N. King , C Programming: A Modern Approach, W.W. Norton.
3. E. Balaguruswamy, Programming in ANSI C, McGraw-Hill.
4. Y.P. Kanetkar,Let us C, BPB Publication.
5. Y.P. Kanetkar, Pointers in C, BPB Publication.

<Course Code>					Universal Human Values					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
1	0	0	1	1	25	50	25	--	--	100

COURSE OBJECTIVES

1. To understand the need of nurturing human values through the process in value-based education system.
2. To understand and develop a holistic perspective on self-exploration and being in harmony with family, society and nature.
3. To facilitate the students in understanding harmony at all the levels and applying in their profession and work place to lead an ethical life.

UNIT I: HUMAN VALUES AND PROCESS OF VALUE EDUCATION **04 Hrs.**

Human values, human aspirations and the ultimate goal, understanding happiness and prosperity, appraise the meaning of satisfaction and happiness in current scenario, harmony and compatibility, values imbibed education system and process

UNIT II: KNOWING SELF - HARMONY WITH SELF **04 Hrs.**

Understanding self, capabilities and challenges, understanding material (physical facilities) and spiritual needs - need of mind and body, understanding body as an instrument, harmony between mind and body, synchronizing physical health and mental health, practicing healthy habits for healthier me

UNIT III: HARMONY IN RELATIONSHIP – FAMILY, SOCIETY AND NATURE **03 Hrs.**

Harmony in relationships, values for harmony in any human-human interaction, harmony in family, and society, trust and respect for others, self esteem and ego, equality, equity, inclusion and liberation, concept of '*Vasudhaiva Kutumbakam',* understanding co-existence and sync with nature

UNIT IV: HARMONY IN PROFESSION AND ETHICAL BEHAVIOR **03 Hrs.**

Ethical human conduct, acceptance and respect, appraising the qualities of others, professional competence for enabling harmony in system and enabling universal human order, scope of eco-friendly systems, strategies to reach the harmonious ecosystem to reach Universal Human Order '*Sarvabhauma Vyavastha'*

TOTAL HOURS: 14 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1 - Understand the significance of human values, its need, and process of value education.

CO2 - Appraise the meaning of happiness and prosperity as short- and long-term goal of life. Understand them and in context of the current scenario

CO3 - Distinguish between the mind and body, physical and spiritual wellbeing for harmony within self

CO4 - Assess the value of harmonious relationship based on trust, respect and enduring its role in all human-human relationships to build harmonious society

CO5 - Understand the importance of harmony with nature and appreciate co-existence for harmonious ecosystem.

CO6 - Create the perfect professional place and work environment following the ethical practices and strategize to uphold the human values at all the levels and interactions.

TEXT/REFERENCE BOOKS

1. R. R. Gaur, R Sangal, G P Bagaria, A foundation course in Human Values and Professional Ethics, Excel books.
2. A. Nagraj, Jeevan Vidya ek Parichay, Divya Path Sansthan, Amarkantak.
3. A. N. Tripathi, Human Values, New Age Intl. Publishers.
4. M. K. Gandhi. The Story of My Experiments with Truth, Fingerprint Publishing.
5. Ivan Illich, Energy & Equity, The Trinity Press, Worcester, and Harper Collins.
6. E. F. Schumacher, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.
7. Sussan George, How the Other Half Dies, Penguin Press.

2nd Semester

<Course Code>					Mathematics – II					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

1. Understand and apply principles of complex differentiation and integration effectively.
2. Solve systems, find eigenvalues, and apply transformations confidently.
3. Solve various ODEs, apply methods, and tackle engineering problems.
4. Analyze periodic functions, derive series, and apply in diverse applications.

UNIT 1 COMPLEX DIFFERENTIATION AND INTEGRATION **12 Hrs.**

Limit, Continuity, Differentiability of the function of a complex variable, Analytic function, Cauchy-Riemann equation (in Cartesian coordinates), Harmonic function and its significance, Singularities, Definition of a Complex line integral, Contour integrals, Cauchy integral theorem, Cauchy Integral formula (CIF), CIF for derivatives, Taylor's series and Laurent Series , Calculation of residues, Cauchy Residue theorem, Applications of residues to evaluate real definite integrals.

UNIT 2 MATRIX ALGEBRA AND ITS APPLICATIONS **10 Hrs.**

Solution of system of algebraic equation - Rank of a matrix, consistency of system of equation - Characteristic equation of a square matrix- Eigen values and Eigenvectors of a real matrix - Properties of Eigen values and Eigen vectors - Cayley-Hamilton theorem (without proof) - finding inverse of a matrix - Diagonalization of a matrix.

UNIT 3 ORDINARY DIFFERENTIAL EQUATIONS WITH APPLICATIONS **10 Hrs.**

Differential equations of Higher-order differential equations with constant coefficients, Rules for finding C.F. and P.I., Method of variation of parameters, Cauchy and Legendre's linear equations, Linear differential equations of second order with variable coefficients; Simultaneous linear equations with constant coefficients, applications of higher-order differential equations in solving engineering problems.

UNIT 4 FOURIER SERIES **10 Hrs.**

Periodic functions, Odd and even functions, Euler's formulae for Fourier series in an interval of length 2 pi, Change of interval, Dirichlet's conditions, Half range Sine and Cosine series, Complex Fourier series, Parseval's identity and its applications.

TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

On completion of the course, students will be able to

CO1 : Recall fundamental concepts of complex differentiation, matrix algebra, differential equations, and Fourier series.

CO2 : Understand the significance of complex differentiation, integration, Matrix, ODE and Fourier series in respective contexts.

CO3 : Apply the concept of complex function, Matrix, ODE and Fourier series to extract the solutions of engineering problems

CO4 : Analyze the use of complex variable Matrix, ODE and Fourier series in engineering problems.

CO5 : Assess the significance and effectiveness of mathematical concepts and theorems in solving real-world problems, particularly in engineering and scientific applications.

CO6 : Design and construct solutions to complex mathematical problems using a variety of techniques, including transformations, mappings, and advanced methods in differential equations.

TEXT/REFERENCE BOOKS

1. R.V. Churchill and J. W. Brown, Complex variables and Applications, McGraw-Hill.
2. J. M. Howie, Complex Analysis, Springer-Verlag.
3. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, Alpha Science.
4. Erwin Kreyszig, Advanced Engineering Mathematics", John Wiley.
5. G. Strang, Linear Algebra and its Applications, Cengage Learning.
6. K. Hoffman and R. A. Kunze, Linear Algebra", Prentice Hall of India.

<Course Code>					Engineering Chemistry					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. To develop the fundamental understanding about traditional materials.
2. To provide the knowledge about structural features, synthesis, properties of various categories of advanced materials.
3. To develop the knowledge and skills for different characterization techniques of materials.
4. To provide the knowledge about the role of chemistry in modern engineering applications.

UNIT I: CHEMISTRY OF ENGINEERING MATERIALS **12 Hrs.**

Traditional Materials: Introduction and classification of materials; metallic materials, polymeric, ceramic materials Advanced Materials: Introduction to nanomaterials: Properties and application; Carbonaceous materials (fullerene, carbon nanotube, graphene, etc.); Composite materials; Liquid crystals: Classification and Application

UNIT II: MODERN ANALYTICAL TECHNIQUES **10 Hrs.**

Instrumentation, principle and characterization of materials: X-ray diffraction (XRD), Electro analytical techniques; FTIR, UV-visible spectroscopy; Thermal analysis (TGA-DTA-DSC); Chromatographic techniques (GC, HPLC)

UNIT III: ADSORPTION, CATALYSIS AND KINETICS **10 Hrs.**

Adsorption - Characteristics, Classification, Application , Adsorption isotherms- Freundlich, Langmuir & BET Chemical Kinetics - Rate law, Arrhenius equation, Transition state theory, Collision theory; Complex reactions Catalysis - Homogeneous and Heterogeneous Catalysis; Mechanism of Catalysis; Industrial Applications of catalysts

UNIT IV: CHEMISTRY OF ENERGY DEVICES **10 Hrs.**

Principles of primary and secondary batteries, Fuel Cells and their operation principles, Principles and uses of supercapacitors; Photocatalytic hydrogen production: Principles and challenges; Traditional and new generation solar cells.

TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1 : **Remember** the structural features and properties of different classes of traditional materials
CO2 : **Classify** advanced materials like nanomaterials, carbonaceous and composite materials, and liquid crystals
CO3 : **Apply** the skills by understanding various instrumental techniques for characterisation of materials.
CO4 : **Analyze** the key concepts in engineering chemistry viz. adsorption and chemical kinetics and laterally ponder over the applications of such concepts in engineering challenges.
CO5 : **Justify** the important insights into the industrial application of different types of catalysis via analysing mechanisms of catalysis.
CO6 : **Develop** the knowledge on the role of chemistry in various modern engineering applications such as in energy devices.

TEXT/REFERENCE BOOKS

1. W.D. Callister, **"An Introduction to Materials Science & Engineering",** John Wiley & Sons (2007).
2. MW Barsoum, **"Fundamental of Ceramics",** IOP publishing (2003).
3. T. Pradeep, "Text book of Nanoscience and Nanotechnology", Mc. Graw Hill Education (2003).
4. Murty, Shankar, B Raj, Rath, Murday, **"Textbook of Nanoscience and Nanotechnology",** Springer (2013).
5. V. Raghavan, **"Materials Science and Engineering",** Prentice-Hall of India Private Limited (2003).
6. A. Douglas, Donald Skoog, M.West**, "Principles of Instrumental Analysis",** Cengage, 6th Edition, (2014)
7. Jain & Jain, **"Engineering Chemistry"** by Dhanpat Rai Publishing Company

20CH101P					Engineering Chemistry Practical					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

1. To enhance and develop scientific and analytical skills
2. To relate concepts learned in chemistry and engineering to the real-world situations.
3. To acquire skills to perform laboratory experiments.
4. To demonstrate safe and proper use of standard chemistry glassware and equipment.

LIST OF EXPERIMENTS

1 **Iodometry**– To determine the strength of given copper sulphate solution by titrating against N/20 sodium thiosulphate (hypo) solution
2 **Iodimetry**– To determine the strength of given ascorbic acid by titrating against standard N/10 iodine solution
3 **Complexometric Titration**– To determine the total, permanent and temporary hardness of given water by complexometric titration using standard 0.01M EDTA solution
4 **pH metric titration**– To determine the strength of given HCl solution using a standard NaOH solution by performing a pH-metric titration
5 **Conductometric titration**– To determine the strength of given HCl solution using a standard NaOH solution by performing a conductometric titration
6 **Chemical Kinetics**– To study the kinetics of decomposition of sodium thiosulphate by a mineral acid
7 **Drawing chemical structures** - To Draw Chemical Structures of organic molecules using ChemDraw
8 **Colorimetric determination**: To determine the concentration of copper present in the effluent of electroplating industries by using colorimeter.
9 **Detection of biomolecule**: Detection of the presence of carbohydrates in test solution by using Benedict's reagent
10 **Preparation of drug molecule**: Preparation of Aspirin from salicylic acid
11 **Polymerization**– To prepare a polymer (Nylon 6,10), identify the functional groups by FT-IR

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1 : **Recall** the concepts learned in chemistry and engineering to the real-world situations.
CO2 : **Show** the ability to identify, analyze and interpret the results from the experiments
CO3 : **Experiment** with the instrumental method using conductometer and pH meter
CO4 : **Analyze** compounds by titrimetric, gravimetric and instrumental methods
CO5 : **Determine** the concentration of unknown solutions by spectrophotometric method
CO6 : **Predict** the reaction rate and predict the order and rate constant

TEXT/REFERENCE BOOKS

1. V. K. Ahluwalia, S Dhingra, A Gulati, **"College Practical Chemistry",** Universities Press
2. J.B. Baruah, P Gogoi, **"Foundations of Experimental Chemistry",** PharmaMed Press.
3. S.S. Sawhney, M.S. Jassal, S.P. Mittal, "**A Text Book of Chemistry Practical's"** Vol I & II, APH Publishing Corp.

<Course Code>					Elements of Electrical and Electronics Engineering					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. To impart knowledge on DC and AC circuits.
2. To learn construction, working principle and characteristics of transformer and induction machines.
3. To introduce students to various means for electrical safety, protection of electrical installations and Batteries.
4. To understand rectification through p-n junction diode, applications of diode and Transistor Characteristics.

UNIT I: DC CIRCUITS **10 Hrs.**

Electrical circuit elements (R, L and C), voltage and current sources, dependent and independent sources, Ohms Law, temperature co-efficient of resistance, Kirchhoff current and voltage laws, voltage and current divider circuit, Thevenin and Norton Theorems and their equivalents, maximum power transfer and superposition theorems, nodal and mesh analysis, star-delta transformation, Time domain analysis/natural response of first order RL and RC Circuit

UNIT II: AC CIRCUITS **10 Hrs.**

Generation of AC voltage, representation of sinusoidal waveforms, RMS values of different sinusoidal waveforms, Rectangular and Polar representation of phasor, Sinusoid representation in time and frequency domain, Analysis of single-phase ac series circuits consisting of R, L, C, RL, RC, RLC combinations, instantaneous power, average power and reactive power, complex power and power factor.AC parallel circuit and its solution in admittance form, resonance in AC series and parallel circuits, polyphase circuits, star and delta representation of polyphase circuits, power measurement in polyphase circuits.

UNIT III: INTRODUCTION TO ELECTRICAL MACHINES AND ELECTRICAL INSTALLATION **12 Hrs.**

Magnetic materials and its B-H characteristic, Faraday's Law of Electromagnetic Induction; **Single Phase Transformers:** Construction, working principle, types, EMF equation, ideal transformer, practical transformer, Operation of transformer on no-load and load, **Induction Machine:** construction, types of 3-phase induction motors, working principle, production of rotating magnetic field, operation, starting and running torques, Torque-slip characteristics, Power Stages in an induction motor.
Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing, Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, Electrical safety rules.

UNIT IV: BASIC OF ELECTRONICS AND ELECTRICAL INSTALLATION **10 Hrs.**

Semiconductor Diodes and Applications, Diode as a Switch, Diode as a Rectifier, Half Wave and Full Wave Rectifiers with and without Filters; Breakdown Mechanisms, Zener Diode – Operation and Applications; Opto-Electronic Devices–LEDs, Photo Diode and Applications; Silicon Controlled Rectifier (SCR) – Operation, Construction, Characteristics, Ratings, Applications.
Transistor Characteristics covering, Bipolar Junction Transistor (BJT) – Construction, Operation, Amplifying Action, Common Base, Common Emitter and Common Collector Configurations, Field Effect Transistor (FET) – Construction, Characteristics of Junction FET.

TOTAL HOURS 42 Hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Understand electrical circuits using network theorems.
CO2 – Compare the behaviour of R, L and C and their combinations in AC circuits.
CO3 – Analyze balanced polyphase systems in star and delta configurations.
CO4 – Understand the construction, working and basic characteristics of transformer and induction machines.
CO5 – Recognize the importance of protective devices, electrical safety measures and characteristics of Batteries.
CO6 -- Demonstrate application of different diodes in circuits and Understand the Transistor characteristics.

TEXT/REFERENCE BOOKS

1. J. Bird, "Electrical Circuit Theory and Technology", Routledge, Tailor and Francis Group, Sixth Edition.
2. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill.
3. B. L. Theraja, "Electrical Technology", Vol. 1, S. Chand Publication, New Delhi.
4. Surjit Singh, "Electrical Estimating and Costing", Dhanpat Rai and Co.
5. Boylestad and Nashlesky, "Electronic Devices and Circuit Theory", PHI.

24EE101P					Elements of Electrical and Electronics Engineering Laboratory					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE	
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

1. To gain practical knowledge on DC and AC circuits
2. To learn operation of electrical instruments and electrical machines
3. To introduce students to various means for electrical safety, protection of electrical installations
4. To understand characteristics and applications of semiconductor diodes and transistors.

LIST OF EXPERIMENTS

1. Introduction to elements of electrical engineering laboratory and to study different electrical measuring instruments.
2. To Verify Ohm's law with linear resistors and find power dissipation in resistor.
3. To validate Thevenin and Norton theorem for DC circuits.
4. To validate Superposition and Maximum Power Transfer theorem for DC circuits.
5. To evaluate the AC R, L and R-L series circuit performance and to measure the active power, reactive power and apparent power connected with single phase AC supply.
6. To evaluate performance of AC R-L parallel circuit and to measure the active power, reactive power and the apparent power connected with single phase AC supply.
7. To perform a direct load test on a single-phase transformer and determine the efficiency and voltage regulation at different loads.
8. To measure three phase power using two wattmeter method.
9. To draw the time-current characteristics of MCB and study the function of ELCB.
10. To obtain the VI characteristic of silicon and germanium diodes.
11. To obtain reverse characteristics of Zener diode.
12. To study half wave, full wave and bridge rectifiers.
13. To determine the DC Characteristics of BJT in CE Configuration.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1 – To understand the basic operation of electrical equipment's & measuring instruments.

CO2 – To perform various network theorems for DC circuits.

CO3 – To understand the performance of AC circuit with R, L load.

CO4 – To evaluate star and delta configuration of polyphase system and measure power in polyphase system.

CO5 – To evaluate the performance of single phase transformer.

CO6 – To understand the working principle of semiconductor diodes, transistor characteristics and its applications.

<Course Code>					Engineering Graphics - Laboratory					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE	
0	0	4	2	4	--	--	--	50	50	100

COURSE OBJECTIVES

1. To cover the fundamental of engineering drawing and standards used in drawing.
2. To explain the students to communicate ideas using orthographic and isometric projection methods.
3. To help students to use CAD software to prepare drawings.
4. To demonstrate the presentation of drawing using sketching and 3D modelling in CAD tool.

LIST OF EXPERIMENTS

1 Introduction to Engineering Graphics: Principles of engineering graphics and their significance, drawing instruments & accessories, lettering and numbering, types of lines, dimensioning methods, basic geometric drawing, reading a drawing.

2 Orthographic Projection: Introduction to projection, types of projection, 1st angle and 3rd angle projection

3 Isometric Projection: Principles of isometric projection – isometric scale, isometric views, conventions, conversion of isometric views to orthographic views and vice-versa

4 Projection of Solids and Development of Surface: Classification of solids, projections of solids like cylinder, cone, pyramid, and prism with its inclination to reference plane, development of surfaces of right regular solids - prism, pyramid, cylinder and cone.

5 Introduction of Computer Aided Engineering Drawing: Demonstrating knowledge of the theory of CAD software, use of software in drawing, CAD software user interface, commands, Coordinate System, menus and toolbars, planes, dimensioning, saving of files, Select and erase objects, zoom tools, and others

6 Basic sketching using CAD tool: Sketch entities using tools – origin, points, lines, circle, arcs, polygons, fillets and chamfer, trim, extend and offset, copy, cut, delete and others

7 Advanced sketching using CAD tool: Sketching entities using relation constrains, Mirror, Patterning, full definition of drawing and others

8 Basic 3D modelling using CAD tool: Extrude, cut, drawing on different planes, editing, symmetric, revolving, and others

9 Computer aided drawing sheets: Preparing drawing sheets, creating different views, section view, drawing templates, and others

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1 : Recalling the fundamentals of engineering graphics by considering basic rules of drawing, dimensioning, and labelling.

CO2 : Explain the principle of projection using orthographic and isometric projection.

CO3 : Represent the 2-dimensional drawing using CAD tool.

CO4 : Construct the 3-dimensional geometries using CAD tool.

CO5 : Apply the concept of engineering drawing by organizing drawing views and applying necessary dimensions by preparing drawing sheets

CO6 : Analyse the intricate details of solid using projection of solid, sectioning of solid and development of lateral surfaces.

TEXT/REFERENCE BOOKS

1. Bhatt N.D., Panchal V.M. & Ingle P.R., Engineering Drawing, Charotar Publishing.
2. Shah P.J., Engineering Graphics, S. Chand Publishing.
3. Agrawal, B. & Agrawal C. M., Engineering Drawing, Tata McGraw Hill Publishers.
4. Hanifan R, Perfecting Engineering and Technical Drawing, Springer International Publishing Switzerland.
5. Corresponding Set of CAD Software Theory and User Manuals.

<Course Code>					Yoga, Health & Hygiene					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

1. To impart the students with the basic concepts of physical education, sports, and yoga for health and wellness.
2. To familiarize the students with health-related exercises, sports, and yoga for overall growth and development.
3. To create a foundation for professionals in physical education, sports, and yoga.
4. To impart the basic knowledge and skills to teach physical education, sports, and yoga activities.

ACTIVITY I: KINESIOLOGY AND CARDIO FITNESS TEST

Introduction to Kinesiology and the Physiological Basis of Conditioning, Sports Psychology, and the Cooer Cardio Fitness Test 12-Minutes Run/Walk: How to Start Walking/Runing: Get expert tips, tools, and training.

ACTIVITY II: YOGA

Introduction to Yogasana and Yoga Therapy: A Rehabilitation Tool and the Effect of Yoga on Exercise Endurance as Assessed by Cardiorespiratory Efficiency Tests: Studt on yogic practices that promote and improve respiratory and cardiovascular function and enhance physical fitness.

ACTIVITY III:GAMES AND SPORTS LEAGUE

Practice sessions for outdoor and indoor games, event-wise practice, and team games organized on the sport, game-wise practice as per the student's interest: Football, Chess, Cricket, Tennis, Basketball, Volleyball, Athletics (Relay), Pickleball.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1 : Discover the balance of health and happiness through the basic principles and practices of physical education, sports, and yoga.
CO2 : Understand that the students will be able to be instructed on physical activities, sports, yoga practices, theories, and rules of various games for healthy living.
CO3 : Analyze emerging trends and issues in world sports and develop leadership qualities among students to conduct, organize, and officiate physical education, sports, and yoga events at schools, colleges, and the community.
CO4 : Practice on the field and in the indoor yoga hall.
CO5 : Develop a spirit of teamwork and fair play.
CO6 : Demonstrate understanding by participating in games and sports leagues.

TEXT/REFERENCE BOOKS

1. Athletic Track and Court Marking Handbook of Games And Sports – Rajesh Agola.
2. Asana, Pranayama, and Kriyas - Swami Satyanand Swami.Munger.
3. Sports Games and Rule, Regulation - Pankaj Vinayak Pathak
4. Yogic Prakriyanche Margdarshan – Dr.M.L.Gharote - (The Lonavala Yoga Research Institute,Lonavala)

<Course Code>					National Service Scheme (NSS)					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

1. To develop a sense of civic and social responcibility.
2. To identify the needs and problems of the community and involve them in problem-solving.
3. To engage in creative and constructive social action.
4. To develop social character and leadership through NSS.

ACTIVITY I: ENVIRONMENT AND SUSTAINABILITY -WATER - WAST MANAGEMENT

Volunteering work for Environment & Sustainability (water and waste management) and Tree Plantation.

ACTIVITY II: NSS 7 DAYS SPECIAL CAMP

Volunteering for tree planting, agriculture compost, tree guard,Gujarat Skill Development Mission, and social activities in the village as per the government NSS manual.

ACTIVITY III: FIT INDIA MISSION

Volunteering for Cardio Fitness, Yoga, Running, Mission Olympics, Self-Defense, and Agneepath Mission.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1 : Identify the needs and problems of the community.
CO2 : Understand the importance of his / her responsibilities towards society.
CO3 : Analyze the environmental and societal problems/issues.
CO4 : Evaluate the existing system and propose practical solutions for the sustainable development.
CO5 : Develop a government or self-driven projects effectively in the field.
CO6 : Understand the government or self-driven projects effectively in the society.

TEXT/REFERENCE BOOKS

1. NSS Course Manual, Published by NSS Unit,PDEU (https://www.pdpu.ac.in/nssreport.html)
2. Government of Gujarat NSS Cell (https://nss.gov.in/gujarat-1)
3. Government of India NSS Cell, Activities reports and manual (https://nss.gov.in/)

<Course Code>					National Cadet Corps (NCC)					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

1. To develop discipline, character, brotherhood, the spirit of adventure and ideals of selfless service amongst young students
2. To develop youth leadership qualities in the students.
3. To induce social consciousness among students through various NCC camps

ACTIVITY I: INTRODUCTION TO NCC

Introduction to NCC, aims and objectives, structure and organization of NCC, cardinals of NCC, NCC Flag, oath of NCC, NCC Song, incentives of NCC

ACTIVITY II: NATIONAL INTEGRATION

Importance of national integration and awareness, necessity, national interests, objectives, threats and opportunities, unity in diversity

ACTIVITY III: NCC CAMPS, SOCIAL SERVICE, AWARENESS AND COMMUNITY DEVELOPMENT ACTIVITIES

Social awareness & community development, health & hygiene, environment awareness and conservation, cadets will participate in various activities e.g., blood donation camp, swachhata abhiyan, constitution day, etc., participation into NCC camps like ATC, CATC, NIC, COC, TSC, RDC, leadership camps, etc.

ACTIVITY IV: DRILL, WEAPON TRAINING AND ADVENTURE ACTIVITIES

Types of drill, foot drill, general and words of command, saluting, weapon training, map reading, field craft & battle craft, Introduction to infantry weapons & equipment, obstacle and weapon training (during camps), adventure training, participation into Republic and Independence day ceremonial parades at university.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1 : Know about the history of NCC, its organization, and incentives of NCC for their career prospects.
CO2 : Understand the importance of Nation building and individual contribution to the same
CO3 : Maintain discipline and team spirit
CO4 : Build the character and leadership qualities
CO5 : Understand that drill as the foundation for discipline and to command a group for common goal.
CO6 : Develop the sense of self-less social service for better social & community life.

TEXT/REFERENCE BOOKS

1. Cadet's Handbook SD/SW- Common Subjects, all wings by DG NCC, New Delhi

<Course Code>					Computer Programming-II					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
1	0	0	1	1	25	50	25	-	-	100

COURSE OBJECTIVES

1. To impart the basic concepts of Python Programming language
2. To be familiar with data structures available in Python.
3. To understand the concept of function & object-oriented programming.
4. To use the file and exception handling for designing applications

UNIT 1 INTRODUCTION AND LANGAUGE FUNDAMENTALS **4 Hrs.**

Definition and its historical background, Comparison with other programming languages. Python IDEs **Tokens:** Identifiers, Keyword **Data Types:** Int, Float, Bool, Complex, Str, List, Tuple, Dictionary and Set, Type conversion, Concept of mutability, immutability and reusability **Operators:** Arithmetic, Relational, Logical, Identity and Membership, Input and Output methods Control Flow Conditional statements: If, elif and else, nesting, Iterative or loop statement: for, while, for else and while else, Transfer statements: break, continue, pass.

UNIT 2 FUNCTIONS **3 Hrs.**

Function Declaration and calling, Types of Function arguments, scope of variable, Recursive function Recursive function **Types of function:** Anonymous or lambda, Map, Filter, Reduce, Function aliasing, Nested function, Decorator function, Decorator chaining Generator function

UNIT 3 OBJECT ORIENTED PROGRAMMING **4 Hrs.**

Class, Object, Object reference, Constructor and self-variable, Types of variables, Types of method, Destructor, Composition, Aggregation, Inheritance, Polymorphism, Abstract classes.

UNIT 4 FILE AND EXCEPTION HANDLING **3 Hrs.**

File handling Types of files, writing and reading with text file, important functions of file handling, working with directories, CSV file handling, pickling and unpickling **Exception Handling** exceptions handling using try-except blocks. Raising exceptions and custom exception classes.

14 Hrs.

COURSE OUTCOMES

CO1- Understand the basic concepts of programming with python.
CO2- Demonstrate proficiency in using different data types, operators, and control structures in Python programs.
CO3- Demonstrate the usage of both built-in and user-defined functions
CO4- Define and use classes in Python to represent attributes and methods, and demonstrate composition, aggregation, inheritance and polymorphism.
CO5- Implement exception handling mechanisms to deal with errors.
CO6- Demonstrate file operations and exception handling.

TEXT/REFERENCE BOOKS

1. John V Guttag, Introduction to Computation and Programming Using Python, Prentice Hall of India.
2. Allen Downey, Jeffrey Elkner and Chris Meyers, How to think like a Computer Scientist, Learning with Python, Green Tea Press.
3. Al Sweigart, Automate the Boring Stuff with Python
4. Martin C. Brown, Python: The Complete Reference, Osborne, McGraw-Hill
5. R. Nageswara Rao, Core Python Programming, Dreamtech Press

<Course Code>					Computer Programming-II Laboratory					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE	
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

1. To impart the basic concepts of Python programming language
2. To be familiar with data structures available in Python.
3. To understand the concept of function & object-oriented programming.
4. To use file and exception handling for designing applications

List of Experiments:

1. **Language fundamentals**:
   Understanding interpretation, program execution flow, tokens, variables and keywords and identifiers, constants and variables
2. **Input Output Operations:**
   Basic data types, mutability, immutability, Operators, Input /output statements, format specifiers, escape sequences
3. **Decision making, Looping control structures**
   If, elif and else, nesting, Iterative or loop statement: for, while, for else and while else, Transfer statements: break,
4. **Advanced datatypes**
   String, List, Tuples, Dictionary, Set
5. **Functions:**
   Basics of functions, types of arguments
6. **Types of functions**
   Anonymous function, function aliasing, nested function, decorator function and generator function
7. **Object Oriented programming**
   class, object, types of variable and methods, composition, aggregation, inheritance, types of inheritance
8. **File Handling:**
   writing and reading with text file and csv file, working with directories, pickling and unpickling

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1- Apply the concepts of variables, decision making and looping with python.
CO2- Apply various data structures available in Python to solve computational problems.
CO3- Implement advanced function concepts such as decorator chaining and generator functions.
CO4- Design and implement object-oriented solutions to programming problems using composition, aggregation, inheritance and polymorphism.
CO5- Develop Python scripts, for file handling tasks.
CO6- Create and manage files in python.

TEXT/REFERENCE BOOKS

1. John V Guttag. “Introduction to Computation and Programming Using Python”, Prentice Hall of India.
2. Allen Downey, Jeffrey Elkner and Chris Meyers "How to think like a Computer Scientist, Learning with Python", Green Tea Press.
3. Al Sweigart, “Automate the Boring Stuff with Python”
4. Martin C. Brown, “Python: The Complete Reference, Osborne, McGraw-Hill
5. R. Nageswara Rao, “Core Python Programming”, Dreamtech Press

Semester 3

24ICxxxT					Digital Circuits					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	0	0	100

COURSE OBJECTIVES

- To learn the fundamentals of digital logic circuits and digital number systems.
- To analyze and design digital combinational-logic and sequential-logic circuits.
- To impart to student the concepts of sequential circuits, enabling them to analyze sequential systems in terms of state machines.

UNIT-1: NUMBER SYSTEMS AND LOGIC GATES **9 Hrs.**

Digital systems; positional number system; binary, octal and hexadecimal representation of integer/fixed-point numbers; Methods of base conversions; complements; Representation of signed numbers; signed/unsigned binary, octal and hexadecimal arithmetic; Binary coded decimal codes; Gray codes; Excess-3 codes, Logic Gates, and Truth Table; Error detection and correction codes - parity check codes and Hamming codes.

UNIT-2: BOOLEAN ALGEBRA AND COMBINATIONAL CIRCUITS **13 Hrs.**

Boolean Algebra & Simplification of Boolean Algebra: Basic postulates and fundamental theorems of Boolean algebra; Representation of logic functions: canonical and standard forms; Simplification of Boolean functions: K-map and Quine-McCluskey tabular methods.

Definition of combinational circuits; design procedure; Decoders; encoders; multiplexers; demultiplexers and their applications; Parity generator and checker circuits; comparators; Arithmetic modules- ripple carry adder, subtractor, carry look ahead adder; basic multiplier, BCD Adder; Shannon expansion theorem.

UNIT-3: SEQUENTIAL CIRCUITS **14 Hrs**.

Definition of sequential circuits; Latches and flip-flops: SR-latch; D-latch; D flip-flop; JK flip-flop; T flip-flop.
Synchronous sequential circuit; Moore and Mealy Finite State Machines (FSM): state diagram, state table, state assignment; Analysis and implementation of FSM using D flip-flops, JK flip-flops and T flip-flops; Implementation of FSM using Decoders, OR gates, Multiplexors and ROM.
Various Registers and counters: asynchronous counters, synchronous counters; ring counter, Johnson counter.

UNIT 4: INTRODUCTION TO MEMORY AND PROGRAMMABLE LOGIC CIRCUITS **6 Hrs**.

Introduction, Random access memory, read only memory, programmable logic array, programmable array logic, sequential programmable devices, FPGA.

Max. Hrs.: 42

COURSE OUTCOMES

On completion of the course, the student will be able to
CO1: Study the basics of number systems, Boolean algebra and standard digital logic gates.
CO2: Understand the knowledge of Boolean Algebra and simplification of Boolean expressions to deduce optimal digital networks.
CO3: Apply the knowledge to synthesis combinational circuits.
CO4: Analyse the operation and logic circuits of basic storage elements FFs.
CO5: Implement SSI and MSI digital networks given a state diagram based on Mealy and Moore configurations.
CO6: Design and examine the SSI, MSI and Programmable combinational networks.

TEXT/REFERENCE BOOKS

1. Digital Design - M. Morris Mano and Michael Ciletti, 5 th edition, Pearson.
2. Switching Theory and Logic Design - A. Anand Kumar, PHI, 2nd Edition.
3. Fundamentals of Digital Logic with Verilog Design - Stephen Brown and Zvonko Vranesic Tata McGraw Hill.
4. Switching and Finite Automata Theory - Zvi Kohavi & Niraj K. Jha, 3rd Edition, Cambridge.
5. Fundamentals of Logic Design - Charles H. Roth, Cengage LEanring, 5th, Edition.
6. Introduction to Switching Theory and Logic Design – Fredriac J. Hill, Gerald R. Peterson, 3rd Ed, John Wiley & Sons Inc.
7. Digital Fundamentals – A Systems Approach – Thomas L. Floyd, Pearson.

20ECExxxP					Digital Circuits Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	25	25	50

COURSE OBJECTIVES:

- To learn the fundamentals of digital logic design and digital circuits.
- To analyze and design digital combinational-logic and sequential-logic circuits.
- To implement digital combinational-logic and sequential-logic circuits.

List of Experiments

Perform the below mentioned experiments using IC trainer kit and Digital ICs

1. Study of Different types of logic gates and implement them using NAND and NOR gates.
2. Design a simple combinational circuit with four variables and obtain minimal expression and verify the truth table.
3. Study of Half and full adder circuits.
4. Study of Binary and BCD parallel adder circuits.
5. Study of Decoder and Encoder circuits.
6. Study of Multiplexer and De-multiplexer circuits.
7. Study of Different types of flip flops.
8. Study of Asynchronous and synchronous binary counters.
9. Study of Various types of registers.
10. Design a BCD to 7-segment display decoder circuit and interface with a 7-sgment display.

COURSE OUTCOMES

On completion of the course, the student will be able to:

CO1 - Remember digital logic circuit functionalities

CO2 - Understand the design methodologies to utilize them practically.

CO3 - Apply design methods to realize digital circuits practically.

CO4 - Analyze functionalities of digital circuits.

CO5 - Evaluate and report performance of digital circuits.

CO6 - Design and Test elementary digital combinational-logic and sequential-logic circuits.

TEXT/REFERENCE BOOKS

1. M. Morris Mano and Michael Ciletti, "Digital Design: With a Introduction to the Verilog HDL", 5th edition,Pearson.

<Course Code>					Electronics Devices and Circuits					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES –

- To offer profound understanding of the fundamentals of semiconductor devices.
- To impart comprehensive knowledge of device technology.
- To provide a foundation in the physics and technology of semiconductor devices in order to address the challenges of modern electronic devices.

UNIT I: FUNDAMENTALS OF SEMICONDUCTOR DEVICES	**14 Hrs.**
Evolution and scope of semiconductor devices and technology, Drift velocity, Einstein relation, conductivity, resistivity, Drift current, diffusion current density, Types of semiconductors, Energy bands formation in semiconductors, Fermi-Dirac distribution, Fermi level in intrinsic/extrinsic semiconductors and dependency with temperature and doping, Carrier concentrations at equilibrium, Temperature-dependence on carrier concentrations, Mobility, conductivity, Carrier generation and recombination.	
UNIT II: PN JUNCTION DIODE AND IT'S APPLICATIONS	**8 Hrs.**
Junctions: Metal/Semiconductor (Schottky barrier height, rectifying and ohmic contacts), Mathematical derivation of the potential barrier, depletion width, and I-V characteristics, Junction break down (Zener and avalanche effects), Zener diode, Clipper, Clamper, Voltage multiplier, voltage regulator, Passive filters.	
UNIT III: BIPOLAR JUNCTION TRANSISTOR	**6 Hrs.**
Working of a BJT, transistor biasing, different transient circuit configuration (CB, CE and CC), static characteristic for BJT, transistor as switch, amplifier.	
UNIT IV: MOS TRANSISTOR	**12 Hrs.**
Introduction to MOSFET: structure, types and its operation, MOS Capacitor, Threshold voltage, Mathematical derivation for I-V, Transfer and O/P characteristics, Second order effects, Scaling of MOSFET, Short channel effects: DIBL, GIDL, Hot carrier injection, surface scattering impact ionization.	
	TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1	:	Define the basic concepts of semiconductor technology, and the importance of semiconductors in modern electronic devices.
CO2	:	Understand the charge transport mechanism, operation and working principle of PN junction diode.
CO3	:	Apply the various techniques in semiconductor devices and MOS Transistors.
CO4	:	Analyze the various issues of BJT, MOS devices with size scaling and also analyze the theoretical models of MOS transistors.
CO5	:	Evaluate the performance of semiconductor devices.
CO6	:	Build the device analysis framework to improve the semiconductor devices for specific desired real-life applications with considering issues and constraints at research and industry levels.

TEXT/REFERENCE BOOKS

1. B.G. Streetman & S. Banerjee, "Solid State Electronic Devices", PHI.
2. Donald A. Neamen, "Semiconductor Physics and Devices", 4th Edition, McGraw Hill Education.
3. Boylestad and Nashlesky, "Electronic Devices and Circuit Theory", PHI
4. N.N. Bhargava, S.C. Gupta, and D.C. Kulshreshtha, "Basic Electronics And Linear Circuits", McGraw Hill Education.

<Course Code>					Electronics Devices and Circuits Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

- To understand the characteristics of PN junction diodes and their applications.
- To observe properties of MOSFET.
- To illustrate the MOSFET application in different real life circuits.

LIST OF EXPERIMENTS	
1	To study the simulation tool and its features for analog circuit simulation.
2	To study the VI characteristic of silicon and germanium diodes.
3	To study reverse characteristics of zener diode.
4	To design diode Clipper and clamper Circuits
5	To design Voltage doubler circuit
6	To design Voltage tripler and quadrupler circuit
7	To design low and high pass filter.
8	To study BJT as switch.
9	To To study common emitter amplifier.
10	To study transfer and drain characteristics of MOSFET.
11	To study and design MOSFET as a switch.
12	To study and design common source amplifier using MOSFET.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1	:	Study the fundamentals of electronic components.
CO2	:	Understand the working principle of semiconductor devices.
CO3	:	Apply the different techniques for building real time circuits.
CO4	:	Analyze the behaviour of semiconductor devices, PN junction diode and MOSFET
CO5	:	Evaluate different circuit for different device parameters.
CO6	:	Build PN diode and MOSFET based sub-system.

<Course Code>					Networks and Systems					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand classification of signals and systems
- To learn applications of mathematical tools like Laplace Transform and Fourier Transform in circuit analysis.
- To understand the importance of two port networks.

UNIT I: CONTINUOUS TIME SIGNALS, CIRCUITS AND SYSTEMS	**10 Hrs.**
Signal – Definition, Examples, Classifications, Continuous time signals: Energy, power, Periodicity, Signal operations, Elementary Signals, System - Definition, Classification, Continuous time LTI systems models in time domain: Linear Constant Co-efficient Differential Equations, Convolution integral and unit impulse response, Simple circuits using R, L, C and controlled sources as LTI systems and their time domain descriptions, Interconnections of Systems, Stability and Causality.	
UNIT II: LAPLACE TRANSFORM APPLICATIONS TO SYSTEM AND CIRCUIT ANALYSIS	**11 Hrs.**
Review of Laplace transform: Definition, Elementary pairs, Basic properties, Region of convergence (ROC), Inverse Laplace transform, Application to LTI system analysis, System transfer function, poles and zeros: stability and causality, Laplace transform for solution of linear constant co-efficient differential equation, Application to transient analysis of R,L,C circuits with relaxed and non-relaxed conditions, Application to waveform analysis.	
UNIT III: FOURIER TRANSFORM APPLICATIONS TO SYSTEM AND CIRCUIT ANALYSIS	**10 Hrs.**
Review of Fourier series and Fourier transform, Signal spectra, Frequency analysis of LTI systems, Application to sinusoidal steady-state analysis of R,L,C circuits with controlled sources, Frequency response plots and concept of filters.	
UNIT IV: MULTI PORT CIRCUITS ANALYSIS	**11 Hrs.**
Single port and two port circuits with R, L, C and Controlled sources, Source transformations, Driving point functions, Transformed circuits and analysis using Super-position, Thevenin and Norton‟s theorem, Two port network analysis using z, y and h parameters, Transmission line as two port network and ABCD parameters, series and parallel connections of two port circuits and their parameters, Applications in linear electronic circuit and system analysis.	
TOTAL HOURS: 42 Hrs.	

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1	:	Remember properties of continuous time signals and systems in Time domain, s-domain and frequency domain.
CO2	:	Understand concepts and complexity of circuit and system analysis techniques.
CO3	:	Apply concepts to analyze LTI systems and linear circuits.
CO4	:	Analyze LTI systems and linear circuits using mathematical tools.
CO5	:	Evaluate signal response in linear circuit using different techniques.
CO6	:	Create mathematical models for linear circuits and other LTI systems.

TEXT/REFERENCE BOOKS

1. Signals & Systems, Alan V.Oppenheim, Alan S.Willsky with S. Hamid Nawab, Pearson Education.
2. Network Analysis, M E Van Valkenburg, PHI.
3. Circuits, Systems and Signal Processing, A Tutorials Approach, Suhash Chandra Dutta Roy, Springer.
4. Circuits and Systems, K. M. Soni, S. K. Kataria & Sons.

Semester 4

<Course Code>					Analog Electronics					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To introduce circuit realizations with bjts.
- To give understanding of various types of amplifier circuits such as small signal, cascaded, large signal and tuned amplifiers.
- To familiarize the concept of feedback in amplifiers so as to differentiate between negative and positive feedback.
- to evolve the students as oscillator designers.

UNIT I: BJT AMPLIFIER	**8 Hrs.**
Introduction to biasing of BJT, operating point, bias stability for different circuits, stabilization against V_{BE}, I_{CO} and β, bias compensation techniques, thermal runaway, thermal stability.	
UNIT II: SMALL SIGNAL MODEL	**14 Hrs.**
Two port device and Hybrid model, Analysis of CE, CC, and CB Amplifiers, CE Amplifier with emitter resistance, low frequency response of BJT Amplifiers, Miller‟s Theorem, Dual of Miller‟s theorem, Differential amplifier using BJT.	
UNIT III: MULTISTAGE AMPLIFIER	**10 Hrs.**
Multistage amplifier, coupling mechanism, effect of coupling and bypass capacitors, Design of single stage and multistage RC coupled amplifier, Analysis of Cascaded RC Coupled amplifiers, Cascode amplifier, Darlington pair, Current mirrors, High frequency pi Model, High frequency analysis.	
UNIT IV: FEEDBACK AMPLIFIER AND OSCILLATORS	**10 Hrs.**
Introduction, types of amplifier, concept of feedback, feedback topology, effect on gain, bandwidth, input and output resistance, Use of positive feedback, Barkhausen criterion for oscillations, sinusoidal oscillators, phase shift, resonant circuit oscillators, crystal oscillator. Different oscillator circuits-tuned collector, Hartley Colpitts, phase shift, Wien‟s bridge, and crystal oscillator.	
TOTAL HOURS: 42 Hrs.	

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1	:	Remember the concepts bjt related design issues.
CO2	:	Understand the analog circuit and its design.
CO3	:	Apply small signal amplifier model for different circuits.
CO4	:	Analyse cascaded amplifier configurations to obtain the required overall specifications.
CO5	:	Design different amplifiers.
CO6	:	Build analog subsystem using amplifier and oscillator.

TEXT/REFERENCE BOOKS

1. Integrated electronics, jacob millman, christos c halkias, mcgraw hill education
2. Electronic devices and circuits theory– robert l. Boylestead, louis nashelsky, 11th edition, 2009, pearson.
3. Electronic devices conventional and current version -thomas l. Floyd 2015, person
4. Electronic devices and circuits, david a. Bell – 5th edition, oxford.
5. Electronic devices and circuits, s. Salivahanan, n. Suresh kumar, a vallvaraj, 5th edition, mc graw hill education.
6. Electronics circuits and applications, md. H rashid, cengage, 2014.

<Course Code>					Analog Electronics Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

- To experiment with circuit realizations with bjts.
- To give understanding of various types of amplifier circuits such as small signal, cascaded, large signal and tuned
- Amplifiers.
- To familiarize the concept of feedback in amplifiers so as to differentiate between negative and positive feedback.
- To design different oscillator

LIST OF EXPERIMENTS	
1	To study components of ae-1 lab.
2	To study common emitter amplifier.
3	To study different biasing circuits of bjt.
4	To study transfer and drain characteristic of fet and mosfet.
5	To obtain operating point of the given circuit.
6	To study thermal stability of the given circuit.
7	To measure the hybrid parameter of bjt.
8	To obtain frequency response of single stage ce amplifier.
9	To study the effect of negative feedback with and without bypass capacitor.
10	To obtain frequency response of two stage rc coupled amplifier.
11	To study feedback amplifier.
12	To study rc phase shift oscillator.
13	To study resonant oscillator.
14	To design of mini project in a group of 4-5 students.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1	:	Remember the concepts bjt related design issues.
CO2	:	Understand the analog circuit and its design.
CO3	:	Apply small signal amplifier model for different circuits.
CO4	:	Analyse cascaded amplifier configurations to obtain the required overall specifications.
CO5	:	Design different amplifiers.
CO6	:	Build analog subsystem using amplifier and oscillator.

TEXT/REFERENCE BOOKS

1. Integrated electronics, jacob millman, christos c halkias, mcgraw hill education
2. Electronic devices and circuits theory– robert l. Boylestead, louis nashelsky, 11th edition, 2009, pearson.
3. Electronic devices conventional and current version -thomas l. Floyd 2015, person
4. Electronic devices and circuits, david a. Bell – 5th edition, oxford.
5. Electronic devices and circuits, s. Salivahanan, n. Suresh kumar, a vallvaraj, 5th edition, mc graw hill education.
6. Electronics circuits and applications, md h rashid, cengage 2014.

24ECE***T					Analog Communication					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To learn the fundamentals of a communication system.
- To be able to understand, analyze, and design analog communication systems
- To implement analog transmitter-receiver modules and analyze its performance.
- To study different analog communication systems in the presence of noise in channel.

UNIT I: RANDOM VARIABLE AND RANDOM PROCESS	**10 Hrs.**
Classical and axiomatic definitions of probability, probability of an event, addition rule and conditional probability, multiplication rule, Bayes‟ theorem and independence, Discrete and continuous random variable: definitions and examples, Probability density function and cumulative distribution functions of continuous random variables, Probability mass function of discrete random variables, expected values and variance of discrete random variable, Statistical averages: Function of Random variables, Moments, Mean, Correlation and Covariance function: Principles of autocorrelation function, cross – correlation functions. Central limit theorem, Properties of Gaussian process. Measure of central tendency:	
UNIT II: AMPLITUDE MODULATION	**14 Hrs.**
Introduction: General architecture of a communication system, AM: Time-Domain description, Frequency – Domain description. Generation of AM wave: square law modulator, switching modulator. Detection of AM waves: square law detector, envelop detector. Double side band suppressed carrier modulation (DSBSC): Time-Domain description, Frequency-Domain representation, Generation of DSBSC waves: balanced modulator, ring modulator. Coherent detection of DSBSC modulated waves, Superheterodyne Receiver, Costas loop. Quadrature carrier multiplexing, Hilbert transform, Pre-envelope, Canonical representation of band pass signals, Single Side Band (SSB) and Vestigial Side Band (VSB): Generation and Detection, comparison of amplitude modulation techniques.	
UNIT III: ANGLE MODULATION	**10 Hrs.**
Basic definitions, Phase Modulation and Frequency Modulation (PM and FM), Narrow band FM, Wide band FM, spectrum analysis of NBFM and WBFM, transmission bandwidth of FM waves, generation of FM waves: indirect FM and direct FM. Demodulation of FM waves, FM stereo multiplexing, Phase-locked loop, Nonlinear effects in FM systems	
UNIT IV: NOISE IN ANALOG COMMUNICATION SYSTEMS	**8 Hrs.**
Introduction, shot noise, thermal noise, white noise, Noise equivalent bandwidth, Noise Figure, Equivalent noise temperature. Noise in DSB-SC receivers, Noise in SSB receivers, Noise in AM receivers, Noise in FM receivers, Pre-emphasis and De-emphasis in FM, Auto correlation, Cross relation , Energy spectral density, Power spectral density and their applications in communication signal/noise analysis.	
TOTAL HOURS: 42 Hrs.	

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1	:	Understand the basics of communication systems, analog transmitter and receiver design issues.
CO2	:	Analyze the functionality of various blocks of an analog communication system.
CO3	:	Design analog transmitter and receiver modules both at the block and circuit levels.
CO4	:	Evaluate various design issues and possible solution methods of analog communication systems.
CO5	:	Implement analog communication systems using BJT, FET and other electronic modules.
CO6	:	Build analog communication circuits, find design related issues, and measure its performance.

TEXT/REFERENCE BOOKS

1. Simon Haykins & Michael Moher, “Communication Systems”, 5th Edition, John Willey, India Pvt. Ltd, 2010
2. B. P. Lathi, “Modern Digital and Analog Communication Systems”, Oxford University Press., 4th edition.
3. Simon Haykins & Michael Moher, “An Introduction to Analog and Digital Communication”, John Wiley India Pvt. Ltd., 2008.
4. H.Taub & D.L.Schilling, “Principles of Communication Systems”, TMH, 2011.

24ECE***P					Analog Communication Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

- To learn the fundamentals of analog communication systems and its application for voice communications.
- To be able to analyze and design analog communication circuits.
- To be able to implement analog communication blocks using simulator (such as MATLAB) and analog circuit design simulators such as MultiSim and TINA.

LIST OF EXPERIMENTS	
1	Generation of Amplitude Modulated (AM) Signals for different values of modulation index
2	Demodulation of AM signals
3	Generation of DSBSC signal
4	Demodulation of DSBSC signal
5	Generation of SSBSC signal
6	Demodulation of SSBSC signal (Phase-shift method)
7	Generation of FM signal and finding its bandwidth using spectrum analysis
8	FM demodulation
9	Study the operation of Superheterodyne receiver
10	Study the operation of Phase-locked-loop (PLL)
11	Design and implementation of Pre Emphasis - De Emphasis Circuits
12	Design and implementation of Analog mixer

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1	:	Remember analog communication circuit design methodologies.
CO2	:	Understand the design methodologies to utilize them practically.
CO3	:	Apply design methods to realize analog communication circuits practically.
CO4	:	Analyze functionalities of the basic building blocks of analog communication system.
CO5	:	Evaluate and report performance of different analog communication techniques.
CO6	:	Design modulator and demodulator circuits using software.

TEXT/REFERENCE BOOKS

1. Simon Haykins & Michael Moher, "Communication Systems", 5th Edition, John Willey, India Pvt. Ltd, 2010
2. B. P. Lathi, "Modern Digital and Analog Communication Systems", Oxford University Press., 4th edition.
3. Simon Haykins & Michael Moher, "An Introduction to Analog and Digital Communication", John Wiley India Pvt. Ltd., 2008.
4. H.Taub & D.L.Schilling, "Principles of Communication Systems", TMH, 2011.

20ECE201T					Electromagnetics and Transmission Lines					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	0	0	100

COURSE OBJECTIVES

- To develop the fundamental understanding about electromagnetic waves.
- To provide the knowledge about concepts related to electrostatics and magneto statics.
- To understand electromagnetic wave characteristics.
- To provide knowledge of transmission line theory.

UNIT 1 Electrostatics	**10 Hrs**
Co-ordinate systems, Coulomb,,s law, Electric field Intensity, Fields due to different charge distributions, Electric Flux Density, Gauss law and its Applications, Electric Flux Density, Gauss law and its Applications, Electric Potential, Relation Between E and V, Maxwell,,s Two equations for Electrostatic Fields, energy Density, Maxwell,,s Two equations for Electrostatic Fields, energy Density, Illustrative Problems. Convection and Conduction Currents, Dielectric Constant, Isotropic and Homogeneous Dielectrics, Continuity Equation and Relaxation Time, Poisson,,s and Laplace,,s Equations, Capacitance- Parallel plate, Co-axial and Spherical capacitors, Illustrative Problems.	
UNIT 2: Magneto-statics	**10 Hrs.**
Biot-Savart Law, Ampere,,s circuital Law and Applications, Magnetic Flux Density, Maxwell‟‟s Two Equations for Magneto static fields, Magnetic Scalar and Vector Potentials, Forces due to Magnetic Fields, Ampere,,s force Law, Forces due to Magnetic Fields, Ampere,,s force Law, Forces due to Magnetic Fields, Ampere,,s force Law, Inductances and Magnetic Energy, Illustrative Problems. Maxwell,,s Equations (Time Varying Fields): Faraday,,s Law and Transformer emf, Inconsistence of Ampere,,s Law and Displacement Current density, Maxwell,,s Equations indifferent Final Forms and Word Statements, Conditions at a boundary Surface: Dielectric-dielectric, dielectric-conductor Interfaces, Illustrative Problems	
UNIT 3: EM Wave Characteristics	**11 Hrs.**
Wave Equations for conducting and Perfect Dielectric Media, Uniform Plane Waves-Definition, All Relations between E and H, Sinusoidal Variations, Wave Propagation in Lossless and Conducting Media, Conductors and Dielectrics-Characterization, Wave Propagation in good conductors and Good Dielectrics, Polarization, Illustrative Problems. Reflection and Refraction of Plane waves-Normal and Oblique Incidences for Perfect Dielectric, Brewster angle, Critical Angle, Total Internal Reflection, Surface Impedance, Poynting Vector Poynting Theorem-Applications, Power Loss in Plane Conductor, Illustrative Problems	
UNIT 4: Transmission Lines	**11 Hrs.**
Types, Parameters, Transmission line Equations, Primary and Secondary Constants, Expressions for Characteristic Impedance, Propagation Constant, Phase and Group Velocities, Infinite Line Concepts, Lossless ness/Low Loss Characterization, Distortion-Condition for Distortionlessness and Minimum Attenuation, Loading- Types of loading, Illustrative Problems. Input Impedance Relations, SC and OC Lines, Reflection Coefficient, VSWR, UHF Lines as Circuit Elements, λ/4, λ/2 and λ/8 Lines-Impedance Transformations, Significance of Zmin and Zmax, Smith Chart-Configuration and Applications, Single and Double Stub Matching, Illustrative Problems.	
	Max 42 Hrs.

COURSE OUTCOMES (CO):

CO1 - Remember different laws of electromagnetics
CO2 - Understand different concepts of electromagnetics and transmission lines
CO3 - Apply different concepts of electromagnetics and transmission lines to solve problems
CO4 - Analyze the different concepts electromagnetic and transmission line
CO5 - Evaluate the different electromagnetic and transmission line scenarios
CO6 – Create the application of electromagnetics and transmission lines

TEXT/REFERENCE BOOKS

1. Engineering electromagnetic-, William H. Hayt Jr. and John A. Buck, 7thEd. 2006, TMH.
2. Elements of electromagnetics, Matthew Sadiku, Oxford university press, 7th edition, 2018
3. Electromagnetic waves and radiating systems, E.C.Jordan, K.G.Balmain, 2nd edition, 2000, PHI
4. Electromagnetic Field Theory and Transmission Lines, G. S. N. Raju, Pearson Education India, 2006
5. Microwave Engineering, David M. Pozar, Wiley.

24ECE***T					Digital Signal Processing					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To introduce mathematical ideas for analysis of discrete time signals and systems.
- To study various digital signal processing systems and its architecture.
- To understand methodology to analyze, design and implement various digital filters.
- To understand need and development of efficient algorithms for various DSP tasks.

UNIT I: DISCRETE TIME SIGNALS AND SYSTEMS	**11 Hrs.**
Continuous Time and Discrete Time Signals, Analog and Digital Signals – Definition and Examples, Classification of Discrete Time Signals, Energy, Power, Periodicity, Signal operations, Discrete time elementary signals, Discrete Time Systems - Definition, Classification, Discrete time LTI system and unit impulse (sample) response, Convolution sum, Linear constant co-efficient difference equation representation, Block Diagram Representation, Interconnections, Stability and causality, Sampling and Sampling theorem, Reconstruction, Aliasing, Concept of quantization, A to D and D to A conversion, Discrete time vs. digital signal processing.	
UNIT II: TRANSFORMED DOMAIN ANALYSIS OF DISCRETE TIME SIGNALS AND SYSTEMS	**10 Hrs.**
Z-transform, ROC and Properties, Poles- Zeros, Inverse z-transform, LTI System Analysis using Z-transform, Discrete Time Fourier Transform (DTFT) and Important Properties, Frequency Response of Discrete Time Systems, Correlation of Discrete Time Signals, Parseval‟s relation, Energy and Power Spectral Density.	
UNIT III: DFT AND FFT ALGORITHMS	**10 Hrs.**
Effect of periodicity and discretization on spectra of a signal, Sampling of DTFT, DFT and IDFT, Important Properties of DFT, Linear and Circular Convolution, Application of DFT in Linear Filtering, Efficient Computation of DFT, Radix2 FFT Algorithms, Geortzel Algorithm.	
UNIT IV: DIGITAL FILTERS: DESIGN AND STRUCTURES	**11 Hrs.**
Ideal Digital Filters, Practical Filters: Stability and Causality, FIR and IIR Filters, Linear Phase and Implications, Filter Design Steps, Design of Linear Phase FIR Filters, Window Method, IIR Filter Design, Pole-Zero Placement Method, Overview of Laplace Transform and Analog Filter Design, Analog Filter Standard Frequency Responses and Design Equations, IIR Filter Coefficients from Analog Filter, Bilinear Transformation, Basic Structures for FIR and IIR Systems implementation, Direct, Transposed Cascade and Parallel form Structures, Effects of Co-efficient Quantization.	
	TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1	:	Remember properties of discrete time signals and systems in Time domain, Z-domain and frequency
CO2	:	Understand concepts and complexity of digital signal processing techniques.
CO3	:	Apply concepts to realize discrete time systems and digital signal processing algorithms.
CO4	:	Analyze discrete time systems, algorithms and digital filters.
CO5	:	Evaluate performance of discrete time systems and digital signal processing algorithms.
CO6	:	Design and implement practical DSP applications.

TEXT/REFERENCE BOOKS

1. Proakis, Manolakis, “Digital Signal Processing: Principles, Algorithm & Application”, Pearson Education.
2. Emmanuel Ifeacher,, Barrie W..Jervis, “Digital Signal processing-A Practical Approach”, Pearson Education.
3. Allen V. Oppenheim, Ronald W. Schafer, “Discrete Time Signal Processing”, Prentice Hall.
4. P. Ramesh Babu, “Digital Signal Processing”, Scitech Publications (India) Pvt Ltd

24ECE***P					Digital Signal Processing Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

- To impart knowledge of flow process of digital signal processing.
- To implement digital signal processing algorithms on software and hardware platforms.
- To evaluate performance of digital signal processing systems and algorithms.
- To analyze the performance of DSP algorithms on DSP processors.

LIST OF EXPERIMENTS	
1	Introduction to simulation tool and environment: Command Window, Variables, Constants, Scalars, Matrices and Vectors, Functions, Comments, Command History, Workspace, Editor, Script file etc.
2	Discrete time signal generation.
3	Discrete time system analysis in Z-domain and frequency domain.
4	Linear Convolution using Overlap-add and overlap-save method.
5	Circular convolution of two given sequence.
6	Moving average filter analysis.
7	FIR filter design.
8	IIR filter design –I.
9	IIR filter design – II and analysis.
10	Implementation of Decimation and Interpolation processes.
11	Introduction to DSP Processor, DFT of a discrete time signal using DSP Processor.
12	Implementation of FFT of a given sequence using DSP processor.
13	Implementation of LP and HP IIR/FIR filter using DSP Processor.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1	:	Remember representation of discrete time signals and systems in Time domain, Z-domain and frequency domain.
CO2	:	Understand the methodologies to utilize digital signal processing techniques practically.
CO3	:	Apply concepts to realize discrete time systems and digital signal processing algorithms practically.
CO4	:	Analyze and report the behaviour of discrete time systems and digital signal processing algorithms.
CO5	:	Evaluate and report performance of discrete time systems and digital signal processing algorithms.
CO6	:	Design and implement practical applications using various tools.

TEXT/REFERENCE BOOKS

1. Proakis, Manolakis, **"**Digital Signal Processing: Principles, Algorithm & Application", Pearson Education.
2. Emmanuel Ifeacher,, Barrie W..Jervis, "Digital Signal processing-A Practical Approach", Pearson Education.
3. Allen V. Oppenheim, Ronald W. Schafer, "Discrete Time Signal Processing", Prentice Hall.
4. P. Ramesh Babu, "Digital Signal Processing", Scitech Publications (India) Pvt Ltd

Semester 5

<Course Code>					Linear Integrated Circuits and Applications					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To study the basic principles, configurations and practical limitations of op-amp.
- To understand the various linear and non-linear applications of op-amp.
- To understand and design op-amp based active filters.
- To analyze and design op-amp oscillators and waveform.
- to analyze and design circuits based on 555 timer ic and ota.

UNIT I: BASICS OF OPAMP	**8 Hrs.**
Introduction to Op-Amp: Differential amplifier using BJT, Block diagram of op-amp, pin diagram of 741 IC, characteristics of ideal Op-Amp, equivalent circuit of Op-Amp, ideal voltage transfer curve, Op-Amp ac and dc parameters, Virtual ground	
UNIT II: OPAMP APPLICATIONS	**14 Hrs.**
Inverting and non- inverting amplifiers, Voltage follower, Differential amplifier using single and two op-amp, Instrumentation amplifier using Op-Amp, Adder, Voltage to current with floating & grounded load, current to voltage converter, practical integrator & differentiator, Clipping & Clamping circuits, Comparators, log/antilog circuits using Op-Amps, precision rectifiers (half & full wave), Peak detector, Inverting & non inverting Schmitt trigger circuit. Active RC Filters: Idealistic & Realistic response of filters (Low pass, High pass, Band pass and Band reject), Notch Filter.	
UNIT III: WAVEFORM GENERATORS:	**10 Hrs.**
Barkhausen criteria of oscillations, conditions for oscillation, Sine wave generator (Phase shift, Wein bridge, Hartley, Colpitts, and Crystal oscillator), Square and triangular waveform generators (period and frequency analysis), Saw tooth wave generator, Astable, Monostable and Bistable Multivibrators.	
UNIT IV: ADVANCED LICs	**10 Hrs.**
555 Timer IC: Pin-Diagram of 555 Timer IC, Functional block diagram of 555 Timer, Application of 555 Timer as Astable, Bistable and Monostable Multivibrators. Introduction to OTA, OTA as Integrator & Differentiator, IC Analog Multiplier, IC phase locked loops, IC Voltage Regulators, IC VCO, Analog-to-Digital Converter, Digital-to-Analog Converter	
	TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1	:	Remember basic characteristics of opamp and 555 timer.
CO2	:	Understand op-amp properties and limitations.
CO3	:	Apply the knowledge earned to design current mirrors and instrumental amplifiers.
CO4	:	Analyze the circuit performance of op-amp based filter circuits.
CO5	:	Evaluate the design of op-amp‟s linear and non-linear applications.
CO6	:	Create the op-amp based oscillators, filters, waveform generators and ota.

TEXT/REFERENCE 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.
3. Robert f. Coughlin, and driscoll,” operational amplifiers and linear integrated circuits”, 6/e, pearson education. Reprint 2007.
4. P. R. Gray and r. G. Meyer,” analysis and design of analog integrated circuit,” john wiley, 4th ed, reprint 2009.

<Course Code>					Linear Integrated Circuits and Applications Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

- To study the basic principles, configurations and practical limitations of op-amp.
- To understand the various linear and non-linear applications of op-amp.
- To understand and design op-amp based active filters.
- To analyze and design op-amp oscillators and waveform.
- To analyze and design circuits based on 555 timer ic and ota.

LIST OF EXPERIMENTS	
1	Introduction of lab and simulation tool.
2	To measure non idealities in op-amp such as non-infinite input impedance, non-zero output impedance, common-mode rejection ratio etc.
3	To design inverting non inverting op-amp amp amplifier.
4	To design op-amp based rectifiers.
5	To design op-amp comparators.
6	To design op-amp log/antilog amplifier.
7	To design wilson & widlar current mirrors.
8	To design op-amp wave shaping circuits.
9	To design waveform generators: using op-amp.
10	To design 1^{st} and 2^{nd} order lpf and hpf.
11	To design 1^{st} and 2^{nd} order bpf and brf.
12	To design and simulate ic voltage regulators.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1	:	Remember basic characteristics of opamp and 555 timer
CO2	:	Understand op-amp properties and limitations
CO3	:	Apply the knowledge earned to design current mirrors and instrumental amplifiers.
CO4	:	Analyze the circuit performance of op-amp based filter circuits.
CO5	:	Evaluate the design of op-amp‟s linear and non-linear applications.
CO6	:	Create the op-amp based oscillators, filters and waveform generators.

TEXT/REFERENCE 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.
3. Robert f. Coughlin, and driscoll,” operational amplifiers and linear integrated circuits”, 6/e,pearson education. Reprint 2007
4. P. R. Gray and r. G. Meyer,” analysis and design of analog integrated circuit, john wiley, 4th ed, reprint 2009.

24ICxxxT					Digital Communication					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	0	0	100

COURSE OBJECTIVES

- ➢ To impart basic knowledge of digital modulation and demodulation techniques.
- ➢ To Understand coding and multiple access principles.
- ➢ Understand basic principles of spread spectrum communication system.

UNIT-1: FUNDAMENTAL DIGITAL COMMUNICATION PARAMETERS 12 Hrs.
Sources and Signals, Basic Signal Processing, Sampling Theorem; Quadrature Sampling of Band-Pass Signals. Practical Aspects of Sampling and Signal Recovery, Time-Division Multiplexing, Uncertainty, Information, Entropy, Source Coding Theorem, Huffman Coding, Discrete Memoryless Channels, Mutual Information, Channel Capacity, Channel Coding Theorem.

UNIT-2: OPTIMAL DESIGN OF DIGITAL RECEIVER AND WAVEFORM CODING TECHNIQUES 11 Hrs.
Model of Digital Communication System, Gram-Schmidt Orthogonalization, Geometric Interpretation of Signals, Detection of known Signal in Noise, Correlation Receiver, Matched Filter Receiver, Probability of Errors, Pulse Amplitude Modulation, Pulse Width Modulation, Pulse Position Modulation, Pulse Code Modulation, Differential Pulse-Code Modulation, Delta Modulation, Inter-symbol Interference, Eye Pattern.

UNIT-3: DESIGN OF DIGITAL COMMUNICATION TRANSCEIVER SYSTEM 10 Hrs.
Coherent Binary Modulation Techniques, Quadrature Amplitude Modulation, M-ary Modulation, Effect of Inter-symbol Interference, Bit and Symbol Error Probabilities, Synchronization, Linear Block Codes, Cyclic Codes, Convolution Codes, Maximum-Likelihood Decoding of Convolution Codes.

UNIT 4: ADVANCED CONCEPTS AND WAY FORWARD 9Hrs.
Spread Spectrum Communication, Direct Sequence Spread Spectrum (DSSS), Frequency Hopping Spread Spectrum (FHSS), Introduction to multi-carrier communication systems (OFDM and MIMO), Introduction to Software Defined Radio (SDR).

Max. Hrs.: 42

COURSE OUTCOMES

CO1- Remember principles of various digital communication methods.
CO2 - Understand digital modulation, detection, coding, digital transmission and access techniques.
CO3 - Apply mathematical concepts to model digital communication system.
CO4 - Analyze digital communication systems to obtain various parameters like bandwidth, data rate etc.
CO5 - Evaluate and compare performance of digital communication systems.
CO6 - Design digital communication system at block diagram level.

TEXT/REFERENCE BOOKS

1. Digital Communication - Simon Haykin, 2007, Wiley.
2. Digital Communications-John G Proakis, 2001
3. B. P. Lathi, Modern Digital and Analog Communication Systems, Oxford University Press., 4th edition.

					Digital Communication Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

- To impart knowledge of digital modulation, demodulation and coding techniques.
- To verify performance of various baseband and carrier digital communication systems.
- To compare various digital communication systems and understand their applications.

LIST OF EXPERIMENTS	
1	PAM, PPM, PWM baseband techniques
2	Sampling, Quantization, PCM and variants
3	Digital carrier communication (ASK, FSK, PSK etc.) techniques
4	TDM techniques and synchronization
5	Generation of digital modulated/demodulated waveforms such as, BPSK, and QPSK using MATLAB and Simulink.
6	System performance in presence of noise. Probability of error calculation and scatterplot.
7	Generation of digital modulated/demodulated QAM waveform and its performance using MATLAB and Simulink.
8	Investigation of the characteristics of Matched Filter and implement Matched Filter based signal detection. Investigations of the eye diagrams.
9	Simulation of baseband and band-pass digital communication system in MATLAB and Simulink.
10	Convolution Codes and Viterbi Detection
11	Spread spectrum communication
12	OFDM Implementation

COURSE OUTCOMES

CO1- Remember principles of various digital communication methods.
CO2 - Understand digital modulation, detection, coding, digital transmission and multiplexing techniques.
CO3 - Apply theoretical and mathematical concepts to practical digital communication system.
CO4 - Analyze and report the characteristics of various modulation, demodulation, multiplexing, synchronization, coding techniques.
CO5 - Evaluate and report performance of digital communication systems.
CO6 - Design and implement small scale digital communication system using development tools.

TEXT/REFERENCE BOOKS

1. B.P.Lathi, Zhi Ding "Modern Digital and Analog Communication Systems", Oxford University Press.
2. P. Chakrabarti, "Analog and Digital Communication", Dhanpat Rai & Co.
3. Wayne Tomasi "Electronic Communications Systems", Pearson education India.
4. Ranjan Bose, "Information Theory, Coding and Cryptography", PHI.
5. T. Rappaport, "Wireless Communications – Principles and Practice",Prentice Hall.

20ECE309T					Control Systems					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To impart fundamental concepts of linear control theory
- To understand the concept of stability of control system and methods of stability analysis in time and frequency domain.
- To facilitate the understanding of design of linear controllers.

UNIT I: INTRODUCTION AND MATHEMATICAL MODELLING OF LINEAR CONTROL SYSTEMS	10 Hrs.
Introduction to Linear and Non-linear control systems, Notion of feedback, Open-loop and closed-loop control systems, Examples of Control Systems, Design and Compensation of Control Systems; Block diagram and signal-flow graphs representations and simplifications; Mathematical modelling and analogy, Differential equations, Transfer Function and Impulse-Response Function, Systems with transport lag, Linearization.	
UNIT II: TIME DOMAIN PERFORMANCE AND STABILITY ANALYSIS	**12 Hrs.**
Time response, Transient response, Steady-state response, Responses of first- and second-order systems to standard test signals and related specifications, Stability definition and meaning, Routh-Hurwitz stability criterion, Analysis of control systems using root locus plots.	
UNIT III: FREQUENCY DOMAIN ANALYSIS AND DESIGN	**12 Hrs.**
Nyquist stability criterion – Gain and Phase margins, Bode plots, Frequency domain specifications and their correlations with time response, Design and performance goals - Steady-state, transient and robustness specifications, Introduction to P, PD, PI and PID controllers and their design, Introduction to Lag and Lead compensator design, Analogy with electronic systems analysis and design.	
UNIT IV: INTRODUCTION TO STATE SPACE ANALYSIS AND WAY FORWARD	**08 Hrs.**
Modelling in State Space, State-Space Representation and Analysis, Canonical state variable model, Equivalence to transfer function model and conversions, Solution of state equations, Concepts of Controllability and Observability, Introduction to modern control systems, and way forward.	
	TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1	:	Identify types of control systems.
CO2	:	Understand analysis tools for linear control systems.
CO3	:	Analyze linear control systems using various mathematical tools
CO4	:	Apply concepts in design of linear control systems.
CO5	:	Evaluate performance of linear control systems.
CO6	:	Design linear controllers and compensators.

TEXT/REFERENCE BOOKS

1. I.J. Nagrath and M. Gopal, " Control System Engineering," Wiley Eastern.
2. K. Ogata, “Modern control engineering”, PHI.
3. B C Kuo, “Automatic control systems”, PHI.
4. Norman S. Nise, " Control Systems Engineering," John Wiley.
5. G. F. Franklin, J. D. Powell, and A. E. Emami-Naeini, “Feedback Control of Dynamic Systems”, Pearson.

20ECEXXXP					Control Systems Laboratory					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	-	-	-	50	50	100

Course Objective (CO)

- To make the students acquainted with the use of computational software such MATLAB, Simulink, and Python to use the control systems analysis and design aspects
- To study the dynamical systems of an interdisciplinary nature and model it in the simulations.
- To impart knowledge on practical aspects of the design of any control system from start to end
- To examine the system performance and modify the system behavior for its states and outputs as desired.
- To impart knowledge of control systems aspects for automation systems

List of Experiments

1. Introduction to MATLAB with respect to Control Systems Applications and Analysis
2. Introduction to Python Programming and Libraries for Control Systems
3. Mathematical modeling of a simple pendulum system using Python and MATLAB
4. Mathematical modeling of a spring-mass damper system using Python and MATLAB
5. Modeling of a slosh-container system in Simulink and Understanding its Mechatronics implementation
6. Transient response analysis of first and second-order control systems
7. Simulating open loop systems using their linear and nonlinear state equations by ODE solvers in MATLAB
8. Design, realize, and simulate an open-loop state-space model for linear and nonlinear systems in Simulink
9. Study the stability analysis using root locus and bode plots using MATLAB
10. Implement Linear Control Systems in MATLAB/Simulink using Libraries and Control System toolbox
11. Design and Implement a PID Controller in Python and Simulink for a linear dynamical system
12. Simulate a simple 2D mobile robot Ground/Aerial in Python and MATLAB/Simulink in an open loop
13. Design and implement a simple State-feedback controller for a robot
14. Implementation of Simulink-based Kinematic model of an autonomous vehicle.
15. Implementation of a Control algorithm for an Industrial Automation System
16. Build an autonomous system with Control principles

Course Outcome (CO)

After the completion of the course, students will be able to,

CO1. Remember the basic concepts of control systems.
CO2. Understand the use of various programming paradigms for control systems different types of coding
CO3. Apply various control system specific tools and functions to model the dynamical system
CO4. Analyze the control system behaviors and its performance through simulations
CO5. Evaluate and compare various specified system responses and its stabilities
CO6. Develop, implement and build various controllers to perform the closed-loop analysis for practical control systems and robots.

Semester 6

24ECE***T					Computer Communication and Networking					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To learn the fundamentals of networking layers and protocols.
- To be able to understand, analyze, and design computer communication systems.
- To develop various networking algorithms for enhancing the efficiency of existing networking protocols.
- To study real-life applications of different networking protocols.

UNIT I: PHYSICAL AND DATA LINK LAYERS	**12 Hrs.**
Introduction: Nuts and Bolts, Performance parameters: throughput, delay, etc., Layered Architecture (OSI and TCP/IP), Data link layer: Introduction, Media access protocols (ALOHA, CSMA based) , Ethernet 802.3, Token, ring 802.5, Reliability Issue: sliding window, Internetworking and Routing: Best effort Service, Virtual Circuits, IP Addressing, introduction to physical layer services, different types of modulation schemes, multiplexing and de-multiplexing techniques, parity, cyclic redundancy check.	
UNIT II: NETWORK LAYER	**12 Hrs.**
Internetworking and Routing: Routing Issues, Distance Vector and Link State routing, Intra and Inter Autonomous System Routing (OSPF, RIP, BGP), Broadcast and Multicast Routing Issues. Network layer data plane: Concept of data forwarding, Longest prefix matching, switching fabrics, packet scheduling, IP addressing: IPV4 and IPV6, concept of subnet, NAT.	
UNIT III: TRANSPORT LAYER AND APPLICATION LAYER	**10 Hrs.**
Transport Layer: End to end delivery issues, Reliable data transfers, Congestion Control, Traffic engineering and Quality of service, TCP, UDP, Socket Programming, Client-server applications, Echo and Chat applications, DHCP, HTTP, FTP, DNS, Peer to Peer file sharing application.	
UNIT IV: ADVANCED TOPICS	**8 Hrs.**
QoS over IP, IPV6, and Infrastructure-less networks: wireless ad hoc and sensor networks, and Internet of Things (IoT), Green computer networking, OFDM, 5G cellular network architecture, Flexible Optical Networks	
TOTAL HOURS: 42 Hrs.	

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1	:	Remember concepts of protocol design at different network layers
CO2	:	Understand design and implementation of different networking protocols
CO3	:	Apply computer networking concepts to solve problems
CO4	:	Analyze computer networking protocols at different layers
CO5	:	Evaluate performance of different computer network protocols
CO6	:	Create computer networking applications

TEXT/REFERENCE BOOKS

1. James Kurose and Keith Rose, "Computer Networking: A Top Down Approach", Pearson Education
2. Larry L Peterson and Bruce S Davie, "Computer Networks: A Systems Approach", Elsevier
3. Andrew S Tanenbaum, "Computer Networks", Pearson Education
4. Behrouz A Forouzan, "Data Communication and Networking", McGraw Hill

24ECE***P					Computer Communication and Networking Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

- To learn the fundamentals of networking layers and protocols.
- To be able to analyze and design computer communication systems.
- To be able to implement various networking algorithms and analyze the performance using network simulators.

LIST OF EXPERIMENTS	
1	To study and prepare LAN cables (cross and straight), to configure LAN and perform Static Routing
2	Introduction to Socket Programming- Design and Implement client-server elements of a few network applications e.g. TCP/UDP client server, Echo client and server, Time client and server, Online Quiz and Buzzer Application, etc
3	Configure DHCP in a small LAN and understand its functionality using Wireshark/ Packet Tracer
4	Configure DNS in a small LAN and understand its functionality using Wireshark/ Packet Tracer
5	Understand functionality of HTTP using Wireshark/ Packet Tracer
6	Understand functionality of TCP and UDP using Wireshark/ Packet Tracer
7	Configure virtual LAN and understand its functionality using Wireshark/ Packet Tracer
8	Configure a wired network with Hosts, switches, hubs and routers using Packet Tracer
9	Configure a wireless LAN (Wi-Fi) using Packet Tracer.
10	Simulation of TCP/UDP connections and performance analysis
11	Simulation of a vehicular network using network simulator (NS3/NETSIM) and performance analysis
12	Simulation of 5G network using network simulator (NS3/NETSIM) and performance analysis

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1	:	Remember concepts of functionality of layered network architecture.
CO2	:	Understand various types of network topologies, network devices and their functions within a network.
CO3	:	Apply computer networking concepts to solve problems.
CO4	:	Analyze computer networking scenarios using network simulator tools.
CO5	:	Evaluate different computer network protocols practically.
CO6	:	Create computer networking applications and scenarios.

TEXT/REFERENCE BOOKS

1. James Kurose and Keith Rose, “Computer Networking: A Top Down Approach”, Pearson Education
2. Larry L Peterson and Bruce S Davie, “Computer Networks: A Systems Approach”, Elsevier
3. Andrew S Tanenbaum, “Computer Networks”, Pearson Education
4. Behrouz A Forouzan, “Data Communication and Networking”, McGraw Hil

24ICxxxT					Computer Organization and Microprocessor					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand the design aspects of basic computer systems
- To explore the advanced features for throughput improvement
- To apply concepts in microprocessor system development
- To make a basis for operating systems by understanding memory management concepts.

UNIT 1: BASIC COMPUTER ORGANIZATION	**11 Hrs.**
Introduction to FSM, Moore, and Mealy machines. The basic architecture of micro-computer and Central processing unit, the concept of data, address and control bus, register transfer language, Stored program organization, instruction format, common bus system, instruction set completeness, timing, and control, instruction cycle, types of instructions, design of Basic central processing unit. Hardwired and microprogrammed control Units, Interrupts in basic computer.	
UNIT 2: ADVANCED FEATURES OF COMPUTER SYSTEM	**10 Hrs.**
Flynn's classification of computer systems, Parallel processing, pipelining, vector processing, arithmetic and instruction pipeline. Memory organization, cache and virtual memory management.	
UNIT 3: 8086 MICROPROCESSOR	**11 Hrs.**
Evolution of microprocessor, Pin diagram, signals, and register set of 8086. Addressing modes, instruction set, assembly language programming, Counters and Time delays, Stack, subroutine, Restart, Conditional Call and Return Instructions, interrupts of 8086.	
UNIT 4: 8 INTERFACING USING 8086	**10 Hrs.**
Address decoding techniques, interfacing concepts, IO mapped IO, Memory-mapped IO, interfacing of basic devices, interfacing PPI 8255, and Interrupt controller 8259.	

Total: 42 Hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1: Recall and describe the basic components of computer architecture, including the CPU, memory, and I/O devices, and understand their respective functions and interactions within a computer system.

CO2: Demonstrate the understanding of basic computer design, architecture and functionalities of the 8085 microprocessor, including its instruction set, addressing modes, and interfacing with peripherals.

CO3: Practice and debug assembly language programs for the 8085 microprocessor to perform specific tasks, demonstrating their ability to apply the knowledge of microprocessor architecture in practical programming scenarios.

CO4: Apprise the concept of programming, including data types, control structures, functions, and algorithms, and will be able to analyze and explain the functionality of different programming constructs

CO5: Evaluate the advanced architectural features and innovations in modern CPUs, such as pipelining, caching, multi-core processing, and parallel computing, and understand their impact on performance and efficiency.

CO6: Integrate and apply their knowledge of basic computer architecture design, 8085 microprocessor architecture, programming, and advanced CPU features to design, develop, and optimize a basic computer system or program, demonstrating their ability to create and innovate in the field of computer architecture and design.

TEXT/REFERENCE BOOKS

1. Morris M. Mano, "Computer System Architecture", Pearson Education, 3rd edition, 2017.
2. John P. Hayes, "Computer Architecture and Organization", McGraw Hill Education, 3rd edition, 1998.
3. William Stallings, "Computer Organization & Architecture", Pearson Education, 11th Edition, 2022.
4. Ramesh S. Gaonkar, "Microprocessor Architecture, Programming, and Applications with 8085", Penran International, 6th edition, 2013.

5. N. Senthil Kumar, M. Saravanan, S. Jeevanathan, S. K. Shah, “Microprocessors and Interfacing”, Oxford University Press, 2012.
6. Douglas Hall, “Microprocessor and Interfacing”, Mcgraw Hill Higher Education, 2005.

24ICxxxP					Computer Organization and Microprocessor Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	25	25	50

COURSE OBJECTIVES

- To understand design aspects of basic computer systems through simulation
- To apply concepts in microprocessor system development
- To do assembly language programming using 8086 instruction set to complete different tasks.

List of Experiments:

Following is the list of experiments, but it is not limited to:

1. To design a FSM with given sequence
2. To design and demonstrate the working of a massage on 7-segmnet display.
3. To design register with synchronous control inputs like clear, load and increment and with provision to handle different no of bit than common bus.
4. To design common bus systems using multiplexor
5. To design ALU with given specification
6. To design control unit for given CPU specification
7. To Write an assembly language code to implement data transfer instruction.
8. To write an assembly language code to store numbers in reverse order in memory location.
9. To write an assembly language code to implement arithmetic instruction.
10. To write an assembly language code to implement logical instruction set to carry out a task.
11. To write an assembly language code to implement the subroutine call.
12. To write an assembly language code to implement RIM and SIM to interface a peripheral.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1: Recall and describe the basic components of computer architecture, including the CPU, memory, and I/O devices, and understand their respective functions and interactions within a computer system.

CO2: Demonstrate the understanding of basic computer design, architecture and functionalities of the 8085 microprocessor, including its instruction set, addressing modes, and interfacing with peripherals.

CO3: Practice and debug assembly language programs for the 8085 microprocessor to perform specific tasks, demonstrating their ability to apply the knowledge of microprocessor architecture in practical programming scenarios.

CO4: Apprise the concept of programming, including data types, control structures, functions, and algorithms, and will be able to analyze and explain the functionality of different programming constructs

CO5: Evaluate the advanced architectural features and innovations in modern CPUs, such as pipelining, caching, multi-core processing, and parallel computing, and understand their impact on performance and efficiency.

CO6: Integrate and apply their knowledge of basic computer architecture design, 8085 microprocessor architecture, programming, and advanced CPU features to design, develop, and optimize a basic computer system or program, demonstrating their ability to create and innovate in the field of computer architecture and design.

TEXT/REFERENCE BOOKS

1. Morris M. Mano, “Computer System Architecture”, Pearson Education, 3rd edition, 2017.
2. John P. Hayes, “Computer Architecture and Organization”, McGraw Hill Education, 3rd edition, 1998.
3. William Stallings, “Computer Organization & Architecture”, Pearson Education, 11th Edition, 2022.
4. Ramesh S. Gaonkar, “Microprocessor Architecture, Programming, and Applications with 8085”, Penran International, 6th edition, 2013.
5. N. Senthil Kumar, M. Saravanan, S. Jeevanathan, S. K. Shah, “Microprocessors and Interfacing”, Oxford University Press, 2012.
6. Douglas Hall, “Microprocessor and Interfacing”, Mcgraw Hill Higher Education, 2005.

<Course Code>					Microwave and Antennas Engineering					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand the concept of antenna radiation and fundamental parameters
- To analyze the wire, aperture, reflector, and microstrip antennas, and microwave devices.
- To design antennas and microwave components to meet given specifications.
- Test antennas and microwave components using the standard instruments/test benches.

UNIT I: INTRODUCTION TO ANTENNA AND MICROWAVE ENGINEERING	**8 Hrs.**
Microwave frequency bands, radiation mechanism, Near- and far-field regions, Fields and Power Radiated by an Antenna, Antenna Pattern Characteristics, Radiation mechanism, single wire, two wire, dipole, current distribution of thin wire antenna. Fundamental Parameters and Figures-of-Merit of Antennas, Friis Transmission Equation	
UNIT II: WIRE, APERTURE AND PRINTED ANTENNAS	**14 Hrs.**
Linear wire antennas: analysis, field equations, folded Dipole, Yagi-Uda antenna, image theory and monopole antenna. Aperture antennas: waveguide, horn and reflector antennas. Basic characteristics of microstrip antennas, feeding methods, methods of analysis, design of rectangular and circular patch antennas. Antenna Array: Two element arrays, N-element linear array, broadside array, ordinary end fire array, phased array.	
UNIT III: PASSIVE AND ACTIVE MICROWAVE DEVICES	**12 Hrs.**
Scattering parameters, waveguides, scattering parameters of wave-guide tees, directional couplers, circulators, and isolators. Microwave filters. Microwave Semiconductor Devices: Gunn Diodes, IMPATT diodes, Schottky Barrier diodes, PIN diodes, Microwave tubes: Klystron, TWT, Magnetron. Characteristics of Gunn Diode, Mode Characteristics of Klystron	
UNIT IV: MICROWAVE MEASUREMENTS	**8Hrs.**
Measuring Instruments: Principle of operation and application of VSWR meter, Power meter, Spectrum analyzer, Network analyzer, Measurement of Gain, Measurement of Impedance, Frequency, Power, VSWR, Q-factor, Dielectric constant, Scattering coefficients, Attenuation, S-parameters.	
	TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1	:	Remember the basic fundamentals of electromagnetics, Maxwell‟s equations and Transmission Lines
CO2	:	Understand the concept of the basic antenna structures and microwave measurement
CO3	:	Apply the various figure of merits for antenna and microwave devices
CO4	:	Analyze the working of wire, aperture and microstrip antennas
CO5	:	Evaluate performance of the antenna structures and microwave components
CO6	:	Design antenna and microwave devices for modern wireless applications

TEXT/REFERENCE BOOKS:

1. C. A. Balanis, “Antenna Theory, Analysis and Design”, Wiley India Edition
2. D. Krauss, Antennas, McGraw Hill
3. Samuel Liao, Microwave Devices and Circuits, PHI
4. David M Pozar, Microwave Engineering, Wiley India Edition

24ICTxxxP					Microwave and Antenna Engineering Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	0	0	0	50	50	100

COURSE OBJECTIVES:

- To Impart electromagnetic and transmission line concepts
- To learn the radiating body behavior for wireless communication system
- To introduce the wave propagation mechanism in different modes
- To elaborate and familiarize the different modern RF technologies

List of Experiments:

Following is the list of experiments of experiments but it is not limited to it.

1. To measure position of fault in cable
2. To measure the frequency and wavelength using slotted line section and frequency meter.
3. To measure the Isolation and Insertion loss of Isolator and Circulator.
4. To study E-plane/H-plane/Magic Tee.
5. To measure Coupling Factor, Directivity and Isolation of directional coupler.
6. To measure VSWR and Reflection coefficient of different loads.
7. To study the characteristics of Klystron and Gunn diode.
8. To study the behavior of Transmission line: Waveguide/Coaxial cable/microstrip line.*
9. To study the S-parameter of directional coupler.*
10. To study the S-parameter of E-plane/H-plane Tee.*
11. To design and study MIC Based LPF.*

*** Some of these experiments need to be using simulation software.**

COURSE OUTCOMES:

On completion of the course, student will be able to

CO1: Remembering the fundamentals of electromagnetics, radiating structures, wag=ve propagation and modern RF techniques.

CO2: Understanding effect and outcome of RF waves propagating in different mediums including transmission line, free space and the under influence of RF Techniques.

CO3: Applying the concepts of transmission medium, radiating elements and wave propagation in developing new systems.

CO4: Analyzing the behaviour of wave and its impact on passive component properties in different transmission conditions

CO5: Evaluating different RF Technologies, components and mediums for RF Waves.

CO6: Design RF subsystems utilizing the radiating elements, passive components utilizing different mediums for developing different technologies.

TEXT/REFERENCE BOOKS

1. Samuel Y. Liao, “Microwave Devices and Circuits”, Pearson Education, 3rd edition, 2012.
2. C. A. Balanis, “Antenna theory: analysis and design”, John Wiley and sons, 3rd Edition, 2005.
3. M. L. Skolnik, “Introduction to Radar Systems”, Mc Graw Hill, 3rd edition, 2016.
4. K. D. Prasad, “Antenna and wave Propagation”, Satya Prakashan, 3rdedition, 2009.

Semester 7

24ICxxxT					Modern Wireless Communications					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- Understand wireless communication evolution, cellular concepts, and system design.
- Analyze radio wave propagation and multipath fading in wireless systems.
- Evaluate performance of wireless communication systems in the presence of fading.
- Explore diversity, multiplexing, and access techniques for enhanced wireless communication.

UNIT 1: Introduction to Wireless Communications	**09 Hrs.**
Evaluation of Wireless Communications (2G to 5G); Cellular Concept: System Design Fundamentals, Frequency Reuse, Handoff, Cochannel Interference and System Capacity	
UNIT 2: Mobile Radio Propagation	**12 Hrs.**
Path Loss and Shadowing: Radio Wave Propagation, Transmit & Receive Signal Models, Free-Space Path Loss, Shadow Fading; Statistical Multipath Channel Models: Narrowband and Wideband Fading, Rayleigh and Rician Fading Distribution; Channel Equalizer; Performance Analysis over Fading Channel: Outage Probability, Average Probability of Error, Capacity	
UNIT 3: Space-Time Diversity and Multiplexing	**11 Hrs.**
SIMO, MISO and MIMO Models; Receiver Diversity: Selection Combining, Equal Gain Combining, Maximal-Ratio Combining, Transmit Diversity: Alamouti Space-Time Coding Scheme. Spatial Multiplexing.	
UNIT 4: Multiple Access Techniques	**10 Hrs.**
Spread Spectrum Communication: Spread Spectrum Principles, Direct Sequence Spread Spectrum, Frequency Hoping Spread Spectrum; Multicarrier Modulation Schemes: Orthogonal Frequency Division Multiplexing (OFDM), Cyclic Prefix, Case Study: The IEEE 802.11a Wireless LAN Standard; Introduction to Next Generation Wireless Communication Technologies.	

Total: 42 Hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1: Comprehend wireless system evolution, cellular concepts, and design fundamentals.

CO2: Analyze radio wave propagation, path loss, fading models, and multipath effects.

CO3: Evaluate wireless communication system performance under fading conditions.

CO4: Apply diversity, multiplexing, and access techniques for enhanced communication.

CO5: Understand multiple antenna systems to improve communication performance.

CO6: Utilize various multiple access techniques in modern wireless communication systems.

TEXT/REFERENCE BOOKS

1. A. Goldsmith, “Wireless Communications,” Cambridge University Press, 2005.
2. D. Tse and P. Viswanath, “Fundamentals of Wireless Communications,” Cambridge University Press, 2005.
3. T. S. Rappaport, “Wireless Communications: Principles and Practice,” 2nd Ed., Prentice Hall, 2002.
4. Yifei Yuan, Zhifeng Yuan, “5G New Radio Non-Orthogonal Multiple Access”, CRC Press, 2023.

<Course Code>					Modern Wireless Communication Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	0	0	0	50	50	100

COURSE OBJECTIVES:

- Understand wireless communication evolution, cellular concepts, and system design.
- Analyze radio wave propagation and multipath fading in wireless systems.
- Evaluate performance of wireless communication systems in the presence of fading.
- Explore diversity, multiplexing, and access techniques for enhanced wireless communication.

List of Experiments:

Following is the list of experiments of experiments, but it is not limited to it.

1. Generating PDF and CDF of diverse random variables and validating with Histogram analysis.
2. Simulating and analyzing path loss and shadowing models in wireless communication systems.
3. Investigating the impact of AWGN noise on data transmission quality.
4. Simulating and exploring different fading channel models in wireless communication scenarios.
5. Analyzing the outage probability for a SISO wireless communication system through simulation.
6. Evaluating the ASER of wireless communication systems under Rayleigh fading conditions.
7. Implementing the OFDM scheme with integrated channel equalization for performance evaluation.
8. Investigating and contrasting spatial diversity techniques such as SISO, MISO, SIMO, and MIMO.
9. Generating BER plots for different spatial diversity techniques to analyze their performance.
10. Studying various combining techniques including MRC, EGC, and Selection Combining for wireless systems.
11. Implementing and analyzing the Alamouti space-time coding scheme.

COURSE OUTCOMES:

On completion of the course, student will be able to:

CO1: Understand the principles of modern wireless communication systems.
CO2: Analyze and model the propagation characteristics of wireless channels.
CO3: Design and evaluate diversity techniques to enhance wireless communication reliability.
CO4: Implement advanced modulation and coding schemes for efficient data transmission.
CO5: Investigate the impact of noise and fading on wireless communication system performance.
CO6: Develop and optimize wireless systems for maximum capacity and coverage.

TEXT/REFERENCE BOOKS

1. A. Goldsmith, “Wireless Communications,” Cambridge University Press, 2005.
2. D. Tse and P. Viswanath, “Fundamentals of Wireless Communications,” Cambridge University Press, 2005.
3. T. S. Rappaport, “Wireless Communications: Principles and Practice,” 2nd Ed., Prentice Hall, 2002.
4. Yifei Yuan, Zhifeng Yuan, “5G New Radio Non-Orthogonal Multiple Access”, CRC Press, 2023.

24ICxxxT					Embedded Systems					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To introduce the foundational principles of embedded systems design and development.
- To acquire proficiency in programming microcontrollers and interfacing them with sensors, actuators, and other peripherals.
- To explore interfacing techniques for sensors, actuators, and other peripherals in embedded systems.
- To design and implement embedded systems solutions for real-world challenges through hands-on projects.

UNIT 1: EMBEDDED SYSTEMS – INTRODUCTION AND ARCHITECTURE	11 Hrs.
Introduction to embedded system (ES); Characteristics and functionalities; Classification of Embedded Systems; Microcontroller for Embedded Systems: microcontroller architecture, pin diagram and basic connections – clock, reset, brown-out, etc.; General register set; Special function registers; On-chip memories; General Purpose Inputs and Outputs (GPIOs)	
UNIT 2: ASSEMBLY PROGRAMMING FOR EMBEDDED SYSTEMS	**10 Hrs.**
Instruction Set and Assembly language programing: Data transfer, arithmetic, logic and branch instructions, addressing Modes; Basic programming concepts: Looping, branching, memory-access, time-delays, using assembly instructions; Stack and related operations; Subroutines and interrupts.	
UNIT 3: PERIPHERAL PROGRAMMING USING EMBEDDED C	**11 Hrs.**
Programming the on-chip modules/capabilities of the microcontroller using Embedded C: GPIOs, Timers/Counters, Waveform generation, EEPROM, ADC, Interrupt functionalities, Watchdog timer. Basics of parallel and serial communication; Programming the serial communication modules: USART, Serial Peripheral Interface (SPI), I2C Inter-integrated Circuit (I2C).	
UNIT 4: I/O INTERFACING IN EMBEDDED SYSTEM	**10 Hrs.**
Interfacing of I/O devices, LED and switches, 4x4 Keypad, 16x2 LCD, Motor drivers and opto-couplers, Stepper Motor, Servo Motor, DC Motors, Relays, Buzzers, Proximity sensor, temperature sensor, DAC, RTC. Interfacing wireless modules: Bluetooth, Wi-Fi, Zigbee.	

Total: 42 Hrs.

COURSE OUTCOMES

On completion of the course, the student will be able to:

CO1- Describe the basic components/functionalities, and architecture of microcontroller based embedded system. CO2- Write simple programs using assembly language, and summarize the instruction set architecture for microcontroller.

CO3- Apply the syntax and constructs of the C language, to write Embedded C programs.

CO4- Analyze the functionality of on-chip modules/capabilities of the microcontroller: timers/counters, interrupts, basic communication protocols, EEPROM, ADC, waveform generator.

CO5- Comprehend and demonstrate the working of external input-output devices (interfacing of sensors and actuators) to the microcontroller.

CO6- Develop simple embedded system, utilizing Embedded C programming for interfacing input-output devices with the microcontroller and/or the related on-chip modules.

TEXT/REFERENCE BOOKS

1. Muhammad Ali Mazidi, Sarmad Naimi, and Sepehr Naimi. "AVR Microcontroller and Embedded Systems: Using Assembly and C", (2015), Pearson India.
2. Raj Kamal, "Embedded Systems: Architecture, Programming, and Design", 2nd Edition, Tata McGraw-Hill.
3. Wayne Wolf, "Computers as Components: Principles of Embedded Computing System Design" – (second edition), Morgan Kaufmann
4. K.V. Shibu, "Introduction To Embedded Systems" - 2nd Edition, Tata McGraw-Hill

24ICxxxP					Embedded Systems Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	25	25	50

COURSE OBJECTIVES

- To impart knowledge of embedded system development.
- To familiarize with Microcontroller Boards and IDEs for Embedded System Development.
- To interface peripherals to Embedded Systems.
- To build a small scale Embedded System.

Laboratory Sessions would be based on following topics but not limited to:

1. Familiarization with IDE and trainer kits/boards.
2. Program for blinking LED pattern generation.
3. Program for interfacing multi-digit 7 segment display and implementing counter.
4. Program for interfacing toggle and push button switches, simple keypad, and matrix keypad.
5. Program for interfacing Buzzer, Relay, DC motor, Servo motor, Stepper motor.
6. Program for interfacing LCD and displaying text on it.
7. Program for interfacing various sensors and displaying quantity on LCD.
8. Program for interfacing speech and voice recognition modules and controlling peripherals.
9. Program for interfacing camera modules.
11. Program for interfacing RS 232 serial modules and file transfer using it.
12. Program for interfacing Ethernet module and transferring files using it.
13. Program for interfacing wireless modules: Zig bee, Bluetooth, GSM modem, GPS module, RFID etc.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1- Remember the basic components, and architecture of embedded systems.

CO2- Understand programs using assembly language and C programming.

CO3- Apply the concepts of interfacing for embedded systems.

CO4- Analyze different scenarios of embedded systems.

CO5- Evaluate the working of different embedded systems.

CO6- Create a small-scale embedded system for real world applications.

TEXT/REFERENCE BOOKS

1. Shibu K. V, Introduction to Embedded Systems, TMH.
2. Frank Vahid, Tony Givargis, Embedded system design: A unified Hardware/Software introduction, Wiley.
3. Rajkamal, Embedded System: Architecture, Programming and Design, TMH.
4. Wayne Wolf, Morgan, Computer as Components: Principles of Embedded Computing System Design, Kaufmann Publication.
5. Muhammad Ali Mazidi, 8051 Microcontroller and Embedded Systems: Using Assembly and C, Pearson education India.
6. Muhammad Ali Mazidi, AVR Microcontroller and Embedded Systems: Using Assembly And C, Pearson education India.
7. Muhammad Ali Mazidi, PIC Microcontroller and Embedded Systems: Using Assembly And C, Pearson education India.

XXXX					Digital CMOS VLSI Design					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	0	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand the characteristics and concepts related to the design of digital CMOS VLSI circuits/gates.
- To explore various CMOS logic styles, and design CMOS VLSI circuits/gates at the transistor level and layout level.
- To analyze the performance/power of digital CMOS VLSI circuits/gates.

UNIT 1 INTRODUCTION TO DIGITAL CMOS VLSI	08 Hrs.
Trends in VLSI/Semiconductor industry, related to technology (Moore‟s) scaling; ITRS Roadmap; Overview of semiconductor devices inherent in the MOSFET: MOSFET I/V Characteristics, MOSFET C/V Characteristics, Second Order Effects. DC Transfer Characteristics: CMOS inverter DC Characteristics, Beta Ratio Effects, Noise Margins, Pass Transistor DC Characteristics	
UNIT 2: CIRCUIT CHARACTERIZATION AND PERFORMANCE ESTIMATION	12 Hrs.
RC Delay Model, Linear Delay Model, Logical Effort, Parasitic Delay, Delay in a Logic Gate, Delay in Multistage Logic Networks. Timing analysis delay models Power: Sources of power, Dynamic Power, Static Power, Energy-Delay optimization, Low-power design techniques.	
UNIT 3: DESIGN OF DIGITAL CMOS VLSI STANDARD AND COMPOUND GATES	14 Hrs.
Combinational Design: Circuit Families: Pass-transistor tree-based logic gates (and similar other logic styles – CPL, transmission gates, DPL, etc); Pseudo-NMOS logic; CVLS logic; Dynamic logic (domino, NP domino, Zipper); Hybrid logic style and examples (Full-Adder, MUX, XOR), Pitfalls of various families, Stick diagram. Sequential Design: Sequencing Static Circuits, Max-Delay Constraints, Min-Delay Constraints, Time Borrowing, Clock Skew, Circuit Design of Latches and Flip-Flops	
UNIT 4: Datapath and array subsystem design	8 Hrs.
Carry ripple adder, carry look ahead adder, Manchester carry chain adder, carry skip adder, carry select adder, shifters, multipliers, SRAM, DRAM, and other memories.	

Total: 42 Hours

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Identify the pros and cons, and the trends related to scaling of the CMOS VLSI technology.
CO2 - Understand the characteristics, sub-parts, and regions of operation of the MOSFET, and use their I-V equations.
CO3 – Design of the combinational and sequential circuits using digital CMOS VLSI standard gates and compound gates, at the transistor –level.
CO4 - Estimate the performance/power of digital CMOS VLSI standard and compound gates.
CO5 - Analyze and compare various digital CMOS logic styles and gates/circuits.
CO6 - Create layouts of digital CMOS VLSI standard gates and compound gates, based on Lambda rules.

TEXT/REFERENCE BOOKS

1. Neil Weste, David Harris, Ayan Banerjee, “CMOS VLSI Design: A circuits and systems perspective”, 3rd Edition, Pearson.
2. Sung-Mo Kang, Yusuf Leblebici, “CMOS Digital Integrated Circuits”, 3rd Edition, Tata McGraw Hill.
3. Robert F. Pierret, “Semiconductor Device Fundamentals”, 1st Edition, Pearson.Prentice Hall.

XXXX					Digital CMOS VLSI Design Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	0	0	0	50	50	100

COURSE OBJECTIVES

- To learn how to create layout designs for CMOS circuits. This involves understanding the physical aspects of CMOS, like transistor placement, routing, and metal layers.
- To Use CAD (Computer-Aided Design) tools to simulate and verify the functionality of CMOS designs.
- To Gain proficiency in designing digital integrated circuits using CMOS technology. This includes understanding the basics of CMOS design, such as logic gates, flip-flops, and other digital building blocks.

Laboratory Sessions would be based on following topics:

1. To derive the CMOS INV gate noise margins using DC analysis.
2. To design layout of the CMOS INV and perform the RCX extraction and measure the delays.
3. To design layout of the CMOS NAND2 and perform the RCX extraction and measure the delays.
4. To design layout of the CMOS NOR2 and perform the RCX extraction and measure the delays.
5. To measure the dynamic and static power consumption of the CMOS NAND gate.
6. To understand the FO4 delay and measure the FO4 delay of the INV.
7. To apply the Logical effort technique to reduce the path delay.
8. To design layout of the Pass transistor AND2 and perform the RCX extraction and measure the delays.
9. To design layout of the DOMINO NAND2 and perform the RCX extraction and measure the delays.
10. To design layout of the Psuedo-NMOS NOR2 and perform the RCX extraction and measure the delays.

COURSE OUTCOMES

On completion of the course, students will be able to
CO1: Identify the pros and cons, and the trends related to VLSI Design.
CO2: Create layout designs for CMOS circuits and measure the performance metrics.
CO3: Understand the physical aspects of CMOS, including transistor placement, routing, and the use of metal layers.
CO4: Use CAD tools to simulate and verify the functionality of CMOS designs.
CO5: Perform static timing analysis to ensure that CMOS circuits meet their timing constraints.
CO6: Use techniques for minimizing power consumption in CMOS circuits. Understand the trade-offs between speed, power, and area.

TEXT/REFERENCE BOOKS

1. Neil Weste, David Harris, Ayan Banerjee, “CMOS VLSI design: A circuits and systems perspective”, 3rd Edition, Pearson.
2. Sung-Mo Kang, Yusuf Leblebici , “CMOS Digital Integrated Circuits”, 3rd Edition, Tata McGraw Hill.

Core Electives

Semester 5

<20ECE305T >					Optoelectronics and Optical Communication					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To introduce the students to various optical fiber modes, configurations, and various signal degradation factors associated with optical fiber
- To understand various optical sources and optical detectors
- To understand the optical communication system, optical amplifiers.
- To study different fiber network elements and basic optical components.

UNIT I: BASICS OF OPTICAL FIBER	**10 Hrs.**
Introduction to Optical Fiber and Waveguides, TEM, TE and TM mode in wave guide, Wave Propagation in Step-Index & Graded-Index Fiber, Modes & Rays. Basic Optical Communication System, Advantage and applications of Optical Communication System.	
UNIT II: LOSSES IN OPTICAL FIBERS	**10 Hrs.**
Introduction, Absorption, Scattering, Overall Fiber Dispersion-Single Mode Fibers, Multimode Fibers, Dispersion-Shifted Fiber, Dispersion-Flattened Fiber, Polarization.	
UNIT III: SOURCES & DETECTORS	**10 Hrs.**
Couplers, Isolators and Circulators, Multiplexers and Filters, Lasers, Light-Emitting Diodes, Photodetectors, Switches, Wavelength Converters.	
UNIT IV: OPTICAL NETWORKS	**12 Hrs.**
SONET/SDH, Optical Transport Network, Optical Access Network, Ethernet, Network Topologies. Advanced Multiplexing Strategies- OFDM, SDM. Subcarrier Multiplexing, WDM Network Architectures, Few Advanced Topics: Flexible Optical Networks, Optical Neural Network, Cognitive Optical Network.	
TOTAL HOURS: 42 Hrs.	

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1	:	Remember the basic concepts of optical fiber structure and optical communication systems.
CO2	:	Understand different design aspects of optical fiber including its advantages and limitations.
CO3	:	Apply optical fiber and optical communication concepts.
CO4	:	Analyze the system performance of optical transmitters, receivers, and optical amplifiers.
CO5	:	Evaluate the design of optical fiber communication systems.
CO6	:	Create optical communication applications in the recent technological trends.

TEXT/REFERENCE BOOKS

1. Gerd Keiser, “Optical Fiber Communications”, 4th Edition McGraw Hill.
2. John M. Senior, “Optical Fiber Communication” PHI/Pearson.
3. G. P. Agrawal, “Fiber optic Communication Systems”, John Wiley and sons.
4. John Gowar, “Optical Communication Systems” Pearson.

24XXXXXX					Digital Systems Design Using HDL					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	0	0	100

COURSE OBJECTIVES

- To Learn and understand the basics of Hardware description language its use in designing digital circuits.
- To get an in-depth knowledge Digital system design options and trade-offs.

UNIT 1: REVIEW OF COMBINATIONAL AND SEQUENTIAL DESIGN **10 Hrs**

Review of Combinational and Sequential logic design, Moore and Mealy machine, Design of synchronous sequential circuits – state diagram, state table, state table assignment and reduction, design of iterative circuits – ASM chart and realization of ASM chart, Timing issues in sequential circuits.

UNIT 2: INTRODUCTION TO VERILOG HDL AND MODELLING STYLE: GATE LEVEL AND DATA FLOW **10 Hrs**

Introduction, Language Elements, Expressions, Modules and Ports, Built-in Primitives, User Defined Primitives, Different Modelling Styles, Tasks and Functions, Test bench., **Gate level modelling:** Introduction, AND Gate Primitive, Module Structure, Other Gate Primitives, Illustrative Examples, Tri-State Gates, Array of Instances of Primitives, Additional Examples, Design of Flipflops with Gate Primitives, Delays, Strengths and Contention Resolution, Net Types, Design of Basic Circuits, **Dataflow modelling:** Introduction, Continuous Assignment Structures, Delays and Continuous Assignments, Assignment to Vectors, Operators.

UNIT 3: MODELLING STYLE: BEHAVIOURAL MODELLING **11 Hrs**

Introduction, Operations and Assignments, Functional Bifurcation, Procedural Assignments: Initial and Always Construct, Examples, Assignments with Delays, wait construct, Multiple Always Blocks, Designs at Behavioural Level, Blocking and Non-blocking Assignments, The case statement, Simulation Flow. if and if-else constructs, assign-deassign construct, repeat construct, for loop, the disable construct, while loop, forever loop, parallel blocks, force-release construct, Event, Memory modelling: RAM, ROM.

UNIT 4: DESIGNING WITH FPGAS **11 Hrs**

Introduction to FPGA architectures: Overview, programming technologies, Logic block architecture: FPGA logic cells, timing models, power dissipation, I/O block architecture: Input and Output cell characteristics, clock input, Timing, Power dissipation, Programmable interconnect - Partitioning and Placement, Routing resources, delays, RTL Coding Styles for Synthesis, Analysing the RTL Design, Timing Closure Challenges, Design Sign-off.

Max. Hrs.: 42 Hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Remember the concept of digital logic design.
CO2 - Understand the basics of Verilog HDL, program structure and basic language elements.
CO3 – Explain various modelling styles to Verilog HDL.
CO4 – Analyse the efficient modelling style to model various combinational and sequential circuits.
CO5 - Evaluate the performance parameters for a digital circuit.
CO6 – Design efficient digital circuits on a FPGA platform.

TEXT/REFERENCE BOOKS

1. Samir Palnitkar, “Verilog HDL A Guide to Digital Design and Synthesis”, Pearson Education.
2. Michael D. Ciletti, "Advanced Digital Design with the VERILOG HDL”, Pearson Education.
3. Stephen Brown, Zvonko Vranesic, "Fundamentals of Digital Logic with Verilog", McGraw-Hill-2007.
4. Richard C. Dorf, John V. Oldfield “Field-Programmable Gate Arrays: Reconfigurable Logic for Rapid Prototyping and Implementation of Digital Systems”. Wiley, 2008

Semester 6

24ECEXXXX					Machine Learning and Applications					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- Introduce principles, algorithms, and applications of Machine Learning from mathematically motivated perspective.
- Work with different machine learning paradigms.
- Learn tools to apply machine learning algorithms to real data and performance evaluation.

UNIT 1 FUNDAMENTALS OF MACHINE LEARNING **11 Hrs.**

Concept of Data, Dimensionality, Concept of Features, Subset selection, Curse of dimensionality, PCA, Linear Discriminant
Analysis (LDA), various learning techniques, Statistical Decision Theory, Convex optimization, introduction

UNIT 2 FUNDAMENTALS REGRESSIONS AND CLASSIFICATION **11 Hrs.**

Neural Network, Back Propagation, Concept of Regression and classification, (One class classification, Multiclass Classification), KNN, , Convolutional Neural Network

UNIT 3 IMPROVING CLASSIFICATION **10 Hrs.**

Boosting, Bagging, Ensemble methods, Gradient boosting, Random Forests, HMM, Belief propagation

UNIT 4 CLUSTERING **10 Hrs.**

Clustering- Partitioning, Hierarchical, Density based, Gaussian Mixture Model, Expectation Maximization, K- Means clustering

Max. 42 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1: List machine learning algorithm for the problem domain.
CO2: Compare different machine learning algorithms for the problems.
CO3: Carryout machine learning technique for classification and decision problems.
CO4: Analyse important parameters and structure of the machine learning algorithms.
CO5: Judge efficacy of machine learning algorithm.
CO6: Design and apply machine learning algorithm.

TEXT/REFERENCE BOOKS

1. Simon Haykin, Neural Networks and Learning Machines, Third Edition, Paper Back, Pearson India
2. Ethem Alpaydin, Introduction to Machine Learning, Third edition, PHI, 2015
3. Hastie, T., Tibshirani, R. and Friedman, J. The Elements of Statistical Learning. Springer. 2001
4. Karl Astrom, Richard Murray, „Feedback Systems: An Introduction to Scientists and Engineers*'*, Princeton University Press, 2008.
5. Kuo B.C., „Automatic Control Systems", PHI Pvt Ltd., New Delhi, 6th edition, 1991.
6. K. Hoffman and R. Kunze, „Linear Algebra", Prentice Hall, NJ, 1971.
7. P.R.Halmos, *'Finite Dimensional Vector Space'*, Springer, 1958.

<Course Code>					Information Theory and Coding					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To impart knowledge of information theory and source coding.
- To impart knowledge of channel coding methods.
- To impart knowledge of secure communication methods.

UNIT I: INFORMATION THEORY & SOURCE CODING	**12 Hrs.**
Concept & Measure of information, Entropy, Source Coding, Huffman and Shanon Fano coding, Uniqueness Property, Channel Models, Error Free Communication Over a noisy channel, Shannon‟s Theorem, Differential Entropy and Mutual information, Channel Capacity, Practical Communication System In Light of Shannon‟s Equation, Introduction to MIMO communication and Channel Capacity for MIMO Systems, Random Selection of Codes.	
UNIT II: ERROR CONTROL CODING (CHANNEL CODING)	**12 Hrs.**
Introduction, Linear block codes, Matrix Description, Syndrome Decoding, Error Probability, Hamming distance, Perfect codes and Hamming codes, Low Density Parity Check (LDPC) codes, Cyclic codes, Polynomial representation, Generation and Decoding of Cyclic codes, Burst Error Correcting and detecting code, Golay Codes, Cyclic Redundancy Check (CRC) Codes, Circuit Implementation of Cyclic Codes, Introduction to BCH codes, Reed-Solomon Codes.	
UNIT III: CONVOLUTION CODES & TRELLIS CODED MODULATION	**11 Hrs.**
Tree Codes and Trellis Codes, Polynomial Description, Generating Function, Matrix Descriptions, Viterbi Decoding Algorithms, Distance Bounds, Performance Bounds, Turbo Codes and Decoding, Trellis Coded Modulation, Decoder and Performance Evaluation, Space Time Trellis Codes.	
UNIT IV: CODING FOR SECURE COMMUNICATIONS	**07 Hrs.**
Introduction to Cryptography, An Overview of Encryption Techniques, Symmetric and Asymmetric Algorithms, Introduction to Advance Algorithms, Cryptanalysis.	
	TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1	:	Remember basic concepts of information theory and coding.
CO2	:	Understand different types of coding techniques.
CO3	:	Apply various coding techniques for different applications.
CO4	:	Analyze encoding and decoding process of coding methods.
CO5	:	Evaluate and compare performance of various coding techniques.
CO6	:	Develop an error resilience, efficient and secure communication using coding schemes.

TEXT/REFERENCE BOOKS

1. Ranjan Bose, “Information Theory, Coding and Cryptography”, PHI.
2. B.P.Lathi, Zhi Ding “Modern Digital and Analog Communication Systems”, Oxford University Press.
3. Thomas M. Cover, Joy. A. Thomas, “Elements of Information Theory”, John Wiley.
4. Shu Lin and D.J. Costello Jr., “Error Control Coding”, Prentice Hall.

<Course Code>					Database Management Systems					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To learn the fundamentals of data models and to conceptualize and depict a database system using an ER diagram.
- To make a study of SQL and relational database design.
- To understand the internal storage structures which will help in physical DB design.
- To know the fundamental concepts of transaction processing- concurrency control techniques and recovery procedure.

UNIT I: CONCEPTUAL MODELING INTRODUCTION	**12 Hrs.**
Introduction - General introduction to database systems; Database - DBMS distinction, approaches to building a database, data models, database management system, three-schema architecture of a database, challenges in building a DBMS, various components of a DBMS.E/R Model - Conceptual data modeling - motivation, entities, entity types, various types of attributes, relationships, relationship types, E/R diagram notation, examples. Relational Data Model - Concept of relations, schema-instance distinction, keys, referential integrity, and foreign keys. Converting the database specification in E/R notation to the relational schema.	
UNIT II: RELATIONAL APPROACH and SQL QUERY - BASICS	**10 Hrs.**
Relational algebra operators: selection, projection, cross product, various types of joins, division, example queries, tuple relation calculus, domain relational calculus, Introduction to SQL, Data Definition of SQL, Basic structure of SQL queries, Basic SQL operations (rename, string operations, order by, where clause), Set operations, Null values, Aggregate functions, Nested Subqueries, Modification of Database, JOIN expressions, Views, Integrity constraints, Data types and Schemas,	
UNIT III: RELATIONAL DATABASE DESIGN	**10 Hrs.**
Dependencies and Normal forms, dependency theory - functional dependencies, Armstrong's axioms for FD's, closure of a set of FD's, minimal covers, definitions of 1NF, 2NF, 3NF and BCNF, decompositions and desirable properties of them, algorithms for 3NF and BCNF normalization, 4NF, and 5NF	
UNIT IV: TRANSACTION MANAGEMENT AND CONCURRENCY	**10 Hrs.**
Transaction processing: Transaction concept, transaction State, implementation of atomicity and durability, concurrent executions, serializability, recoverability. Concurrency Control: Lock-based protocols, timestamp-based protocols, validation-based protocols, multiple granularity, multiversion schemes, deadlock handling. Recovery: Failure classification, storage structure, recovery and atomicity, Log-Based recovery, shadow paging, recovery with concurrent transactions buffer management.	
	TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1	:	Understand the data models, schemas, instances, view levels and database architecture for voluminous data storage
CO2	:	Remember the concept of Relational Algebra and Relational Calculus from set theory to represent queries
CO3	:	Apply the concepts of SQL queries for data aggregation, calculations, views, sub-queries, embedded queries manipulation
CO4	:	Illustrate the definition of Functional Dependencies, Inference rules, and minimal sets of FD¨s to maintain data integrity.
CO5	:	Design the concepts of transaction, states, and ACID properties in data manipulation.
CO6	:	Design Build a database management system that satisfies relational theory and provides users with business queries.

TEXT/REFERENCE BOOKS

1. Silberschatz, Henry F. Korth, and S. Sudharshan, "Database System Concepts", 7th Ed, Tata McGraw Hill.
2. J. Date, A. Kannan and S. Swamynathan, "An Introduction to Database Systems", 8thed, Pearson Education
3. RamezElmasri and Shamkant B. Navathe, "Fundamentals of Database Systems", 7thEdition, Pearson/Addison-Wesley.

24ECExxxT					Introduction to Robotics					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- Learn about diverse robotic systems, their types, key components, and significant applications.
- Grasp fundamental robot modeling principles and derive models using various methods.
- Understand concepts of control systems, controller design, operational principles in different robotics applications, and various estimation and motion planning techniques.
- Apply dynamic modeling and control to real robots in simulations and practical settings. Gain proficiency in robot programming and using open-source simulators for multi-robot applications.

UNIT I: ROBOTIC SYSTEMS AND TYPES	**08 Hrs.**
Introduction to robotics and autonomous systems, Common laws of robotics, Sensors and actuators, Perception and vision, Control systems and coordination approaches with real-world applications, Path and trajectory generation, Navigation and mapping. Types of robots: Stationary and Mobile robots, Manipulators and Industrial Robots, Unmanned Ground Vehicles (UGV), Wheeled mobile robots, Unmanned Aerial Vehicles (UAVs)/Drones: Fixed-wing & multirotor drones, Autonomous Underwater Vehicles (AUV), Bio- mimicking robots.	
UNIT II: ROBOT MODELLING	**10 Hrs.**
Basics: Configuration space, DOFs, Fully actuated, underactuated & overactuated robots; Kinematic modeling: Motions in 3D, Positions & rotations, Coordinate frames & transformations, Euler angles, Forward & inverse kinematics; Dynamical modeling: Kinetic & potential energy, Robot motions using Euler-Lagrange formulation; Modelling examples: 2-link robotic manipulators, Inverted pendulum on a cart, Slosh-container; Input-Output modeling: Transfer functions; State-space modeling: State variables, Linear & nonlinear system equations, Eigen structure.	
UNIT III: PLANNING AND CONTROL TECHNIQUES FOR ROBOTS	**13 Hrs.**
Controls: Disturbance effects, Uncertainties in models, Linear systems: Stability & time domain analysis, State-feedback control, Regulation & tracking, Nonlinear systems stability, Lyapunov based control design, Robust control designs, Optimization problems, Estimation techniques, Control in CPS & IoT systems, Using AI/ML for control systems. Motion Planning: Motivating examples, Basic ingredients of planning, Algorithms, Trajectory v/s path planning, Sensor-based motion planning, Motion planning via decomposition, Search algorithms using Graph theory, Shortest path & logic-based planning, Collision detection & avoidance.	
UNIT IV: EXPERIENCING THE ROBOTICS WORLD: SIMULATIONS, EXPERIMENTS &	**11 Hrs.**
Simulations: 2DOF underactuated robot, Quadrotor drone; Experimental robotics: How to build a robot using Arduino like microcontrollers, Practical aspects for ground & flying robots/drones. Introduction to Spark V and Firebird robots; Programming & simulators: Introduction to ROS: Concepts & basic programming, Introduction to Gazebo Simulator: The environment, Building a simple robot in Gazebo; Multiple robots based applications: Multi-agent systems, Surveillance, Monitoring, Package delivery, Agriculture, Smart solutions – Problem statements & challenges.	
	TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

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

CO1	:	Remember and know about various real- world robotic systems & understand their types with their use.
CO2	:	Understand the system models using different modelling techniques for robotic systems .
CO3	:	Apply various control systems concepts for different robotics systems and in general.
CO4	:	Analyze the types of motion planning algorithms used in robotics.
CO5	:	Evaluate simulation based models, familiarize with practical robots and learn basic programming.
CO6	:	Create various cutting-edge single and multi-robot based application scenarios in new age

TEXT/REFERENCE BOOKS

1. Mark W. Spong, Seth Hutchinson, M. Vidyasagar, „Robot Modelling and Control", Wiley, 2006.
2. Roland Sigwart, Illah R. Nourbakhsh, „Introduction to Autonomous Mobile Robots", MIT Press, , 2004.
3. Bruno Siciliano, Lorenzo Sciavicco, Luigi Villani, Giuseppe Oriolo, 'Robotics: Modelling, Planning and Control", Springer, 2011.
4. Steven M. LaValle, „Planning algorithms", Cambridge University Press, 2006.

24ICxxxT					Satellite Communication					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	0	0	100

COURSE OBJECTIVES

- To introduce the basics and benefits of satellite communication.
- To understand orbital mechanics principles of satellite communication systems and solve problems related to them.
- To understand the design of a satellite link and identify ways to improve the link performance.
- To study new technologies of satellite communication systems as per given specifications.
- To examine advanced technologies of satellite launching and describe the Indian satellite system.

UNIT-1: Introduction to Satellite Communication **12 Hrs.**

History, Overview of Satellite Communication, Types of Satellite, Types of Orbits, Satellite services, Advantages & Applications of Satellite communication, Satellite Life phases, Space Debris, Introduction to Geo-synchronous and Geo-stationary satellites. Orbital Mechanics, Kepler‟s Three Laws of Planetary Motion, Developing the Equations of the orbit, Look Angle Determination, Earth Stations, Orbital Perturbations, Orbital effects in Communication system performance.

UNIT-2: Optimal Design of Digital Receiver and Waveform Coding Techniques: **11 Hrs.**

Seven segments of Satellite communication, Attitude and Orbit control systems, Telemetry, Tracking and command control system, and Power supply system. Satellite Link Design: Basic transmission theory, System noise temperature and G/T ratio, Design of downlink and uplink, Design of satellite links for specified C/N.

UNIT-3: Design of Digital Communication Transceiver System **10 Hrs**.

VSAT, Direct broadcast satellite television, and radio, Satellite navigation and the Global positioning systems, GPS position location principle, GPS receivers and codes, Satellite Signal Acquisition, GPS navigation Message, GPS Signal Levels, Timing Accuracy, GPS Receiver Operation.

UNIT 4: Advanced Concepts and Way Forward: **9Hrs**.

Mechanism of Satellite launching, Launch Vehicles, Advanced launching techs like Space X, Intelligent Testing, Control and Decision making for Space, Inter Satellite Link. Indian Satellite Systems: History and Overview of Indian Satellite System, Achievements, GSLV, PSLV, Satellite in Cellular Communication.

Max. Hrs.: 42

COURSE OUTCOMES:

At the end of this course, students will be able to

CO1 - Remember thorough information on the conventional and upcoming satellite communication technology.

CO2 - Understand the fundamental aspects of satellite communications.

CO3 - Apply the knowledge of satellite communication systems to solve problems.

CO4 - Analyze the system performance of satellite communication systems.

CO5 - Evaluate the design of a satellite link and suggest enhancements to improve the link performance.

CO6 - Create satellite communication applications in the recent technological trends.

TEXT/REFERENCE BOOKS

1. T. Pratt, C. Bostian, and J. Allnutt, “Satellite Communications,” 2nd Ed., Wiley India, 2006. 2.
2. W. L. Pritchart, H. G. Suyderhoud, and R. A. Nelson, “Satellite Communication Systems Engineering,” 2nd Ed., Pearson Education, 2012.
3. G. Maral, M.Bousquet, and Z.Sun, “Satellite Communications Systems: systems, techniques and technology”, 5th edition, John Willy and sons
4. Tri T. Ha, “Digital Satellite Communications” McGraw-Hill, 2nd Edition
5. D. Roddy, “Satellite Communications,” 4th Ed., Tata McGraw-Hill Education, 2006.

23ECE305T					Modern Control Systems					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand various basic structures and tools of modern control system.
- To apply the knowledge state variable analysis in the analysis of control systems.
- To acquire the familiarity of some modern control techniques.
- To perform stability analysis and design capabilities of modern control systems for practical systems.

UNIT I: BASIC TOOLS AND STRUCTURES	08 Hrs.
Review of Feedback control Systems, Closed loop Transfer function and Disturbance rejection, Equilibrium and Stability notions, Degrees of Freedom and Configuration Space, Mathematical Structures: Rings, Groups, Vector Space, Subspace, Span, Linear dependence and independence, Basis, Dimension, Direct sum, Linear functional, Matrix differential Equations and State-space equations, Linear Systems Theory : Linearity, Time-invariance, Matrix exponential, System solutions, Eigen values and Eigen vectors, Similarity transformations, Jordan form, Controllability and Observability.	
UNIT II: DYNAMIC MODELLING AND BEHAVIORS OF MODERN CONTROL SYSTEMS	**10 Hrs.**
System engineering aspects, Cause and response in static and dynamic systems, Various modern control systems with examples, Dynamical equations of Modern control Systems, State-space models of various practical systems, Solving system equations, Energy based modelling of modern control systems, Nonlinear Systems, Qualitative analysis, Linearization, Local behaviour of nonlinear systems, Feedback Linearization.	
UNIT III: MODERN APPROACHES IN STABILITY ANALYSIS	**13 Hrs.**
Stability of linear approximations and phase portraits, Global and local stabilities, Lyapunov stability analysis, Stability theorems and corollaries, LaSalle‟s invariance principle, ISS stable, Analysis of real world modern control systems with examples.	
UNIT IV: MODERN CONTROLLERS AND ESTIMATORS	**11 Hrs.**
Review of PID control, State feedback control with pole placement, Output feedback control with pole placement, System uncertainties and its effects: Parametric, Functional, External disturbances, Need and types of robust controllers, Robust PID control, Robust control using Lyapunov methods, Sliding Mode Control, Basics of optimization methods for control design, LQR control, State estimation Problem: Kalman Filter, Observers, Luenberger observer, High-gain observer and Sliding mode observer. Future trends and the way forward - Control and estimation for modern applications like robotics, drones and Multi-agent systems, Data-driven control in AI applications.	
	TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

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

CO1	:	Identify various foundational concepts and tools for modern control systems.
CO2	:	Understand the system modelling approaches used in model based control designs.
CO3	:	Apply various tools for linearizations & tools for local analysis of nonlinear systems.
CO4	:	Analyze system stabilities for linearized systems & nonlinear systems using modern control tools.
CO5	:	Evaluate different types of modern controllers for robust & optimised control designs.
CO6	:	Create control designs using state-estimation algorithms.

TEXT/REFERENCE BOOKS

1. Chi-Tsong Chen, „Linear System Theory and Design‟, Oxford press, 1999.
2. Hassan K. Khalil, „Nonlinear Control*'*, Pearson, 2019.
3. Norman S. Nise, „Control Systems Engineering*'*, Wiley, 2015.
4. K. Ogata, „Modern Control Engineering*'*, PHI Pvt Ltd., New Delhi, 3rd Ed, 2000.

5. Karl Astrom, Richard Murray, „Feedback Systems: An Introduction to Scientists and Engineers*',* Princeton University Press, 2008.
6. Kuo B.C., „Automatic Control Systems", PHI Pvt Ltd., New Delhi, 6th edition, 1991.
7. K. Hoffman and R. Kunze, „Linear Algebra", Prentice Hall, NJ, 1971.
8. P.R.Halmos, *'Finite Dimensional Vector Space'*, Springer, 1958.

<Course Code>					Power Electronics					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES –

- To introduce basic theory of power semiconductor devices and their application in power electronics circuits and systems
- To familiarize the working principle of AC-DC, DC-DC, DC-AC, AC-AC conversion circuits and their applications.
- To provide the basis for further study of power electronics circuits and systems.

UNIT I: POWER AMPLIFIERS AND POWER SEMICONDUCTOR DEVICES	**12 Hrs.**
Operation and analysis of power Amplifiers: Class A, B, C and push-pull configurations. Introduction to power electronics and its applications; overview of power electronic circuits and Systems Power semiconductor devices: Diodes, SCR, GTO and transistors (BJT, MOSFET and IGBT): Ratings, static and dynamic characteristics, drive and switching aid circuits; protection and cooling of power semiconductor devices	
UNIT II: AC-DC CONVERTERS	**11 Hrs.**
Principle of phase control AC-DC converter; single phase and three phase converter circuits with different types of loads; performance parameters analysis: power factor, ripple factor, form factor, harmonics, distortion and effect of source Inductance on performance; dual converters and their operation; power factor improvement techniques; applications of AC DC converter circuits.	
UNIT III: DC-DC AND AC-AC CONVERTERS	**12 Hrs.**
Introduction to DC-DC converters; working principle of step up and step-down chopper circuits; Design of chopper-based Buck converter, Boost converter, Buck-Boost and Cuk converter: circuit configuration and steady state time domain Analysis with different kinds of loads; design of inductors for DC-DC converters; AC-AC converter: single phase AC Voltage controllers, AC chopper; single phase cycloconverters; applications.	
UNIT IV: DC-AC CONVERTERS (INVERTERS):	**7 Hrs.**
Classification of inverters, single phase voltage source bridge inverter; performance parameter analysis with various loads; voltage control of single-phase inverters: PWM techniques; Three- phase bridge inverter: 180o and 120o conduction mode of operation with various loads; applications of inverter circuits.	
TOTAL HOURS: 42 Hrs.	

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1	:	Identify the power devices as per the usage of energy conversion and control.
CO2	:	Understand internal structure and operation of various power semiconductor devices.
CO3	:	Illustrate various converter topology/configuration with different types of loads.
CO4	:	Analyze the performance parameters for power electronic converters.
CO5	:	Select proper converter configurations for various power applications.
CO6	:	Develop a power converter topology for a specific industrial or domestic application.

TEXT/REFERENCE BOOKS

1. M. H. Rashid, “Power electronics: circuits, devices, and applications”, Pearson Education India, 2009
2. N. Mohan, T. M. Undeland, W.M. Robbins, “Power Electronics: Converters, Applications and Design”, Wiley India Edition, 2007.
3. M. D. Singh, K. B. Khanchandani, “Power Electronics”, 2nd Edn., Tata McGraw-Hill, 2007.
4. P.S. Bimbhra, “Power Electronics”, Khanna Publishers, New Delhi
5. P C Sen, “ Modern Power Electronics”, S Chand Publisher, 2013

<Course Code>					Analog IC Design					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand analysis and design of MOSFET circuits, current mirrors, and feedback.
- To understand analysis and design of CMOS operational amplifiers.
- To understand analysis and design of CMOS oscillators.

UNIT I: MOSFET-CIRCUITS CONFIGURATIONS AND CURRENT MIRRORS	**12 Hrs.**
Introduction to MOSFETs, MOSFET-Circuits Configurations: Common-Source, Source Follower, Common- Gate, Cascode, and Basic Differential Pair; Current Mirrors: Basic Current Mirrors, Cascode Current Mirrors, and Active Current Mirrors; Biasing Techniques: CS Biasing, CG Biasing, Source Follower Biasing, Differential Pair Biasing	
UNIT II: FEEDBACK	**10 Hrs.**
General Considerations: Properties of Feedback Circuits, Types of Amplifiers, Sense and Return Mechanisms, Feedback Topologies: Voltage-Voltage Feedback, Current-Voltage Feedback, Voltage-Current Feedback, Current-Current Feedback, Effect of Loading in Feedback	
UNIT III: OPERATIONAL AMPLIFIERS	**10 Hrs.**
Performance Parameters, Two- Stage Operational Amplifier (Op Amp) Design, Gain Boosting Op Amp Design, Comparison, Stability and Frequency Compensation in Op Amps	
UNIT IV: OSCILLATORS	**10 Hrs.**
General Considerations, Ring Oscillators, LC Oscillators, Voltage-Controlled Oscillators, Concept of PLL.	
TOTAL HOURS: 42 Hrs.	

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1	:	Identify large-signal and small signal analysis of different MOSFET-based circuit configurations.
CO2	:	Understand the current mirrors.
CO3	:	Apply the CMOS feedback amplifier circuits.
CO4	:	Analyze the design of application-specific CMOS operational amplifiers.
CO5	:	Evaluate the design of robust and high-performance CMOS oscillators.
CO6	:	Create the design of advanced analog integrated circuits as per the application-specific requirements.

TEXT/REFERENCE BOOKS

1. Behzad razavi, “Design of analog CMOS integrated circuits,” 2nd edition, MC Graw hill, 2017.
2. J. Michael jacob, “Applications and design with analog integrated circuits,” phi, 2nd edition, 2004.
3. Paul r. Gray, paul j. Hurst, stephen h. Lewis, robert g. Meyer, “Analysis and design of analog integrated circuits,” 5th edition, wiley, 2009.
4. Sedra and smith, “Microelectronic Circuits,” oxford university press, 5th edition, 2005.

Semester 7

24ECE***T					Advanced Processors and SoC					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To study the architecture of ARM series processors & DSP Processors.
- To understand the architecture and features of typical ARM7 microcontrollers and SoC devices.
- To understand memory and interconnect architecture for SoC.

UNIT 1: ARM family of processors	**12 Hrs.**
32/64-bit processors; introduction to ARM series processors and its versions: architectures, features, advantages & suitability in SoC design; ARM instruction set; ARM 7 based Microcontroller: features, architecture (block diagram and its description),Memory Map, GPIO, Pin Connect Block, Instruction set, programming in assembly language; Real-world interfacing with ARM7-basedMicrocontroller; overview of Cortex-A9 and Cortex-A15	
UNIT 2: Digital Signal Processors	**9 Hrs.**
Hardware architecture of DSP Processor: desirable features of DSP processors, types of architectures, internal architecture, features, system interface and instruction set of ADSP21xx, ADSP-21xx Development tools; TMS DSP processors; Overview of OMAP and AM57x series processors.	
UNIT 3: Memory Design for SoC	**10 Hrs.**
Introduction of SoC architecture; SoC external memory; Internal Memory: size, Scratchpads and Cache memory, Cache Organization, Cache data, Write Policies, Strategies for line replacement at miss time, Types of Cache, Split – I, and D –Caches, Multilevel Caches, SoC Memory System; Models of Simple Processor – memory interaction	
UNIT 4: Configuration and Interconnect Customization	**11 Hrs.**
An overview, Customizing Instruction Processor, Reconfiguration Technologies, Mapping design onto Reconfigurable devices, Reconfiguration – overhead analysis and trade-off analysis on reconfigurable Parallelism. Inter Connect Architectures: Basic Bus Architectures, Analytical Bus Models, Bus transactions and contention time; SoC Standard Buses (AMBA, Core connect).	
	TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1	:	Define various advanced processors and their architectures.
CO2	:	Understand SoC Architectural features.
CO3	:	Illustrate memory and bus architecture for a SoC.
CO4	:	Analyze a computational task; characterize its computational requirements for a SoC
CO5	:	Select proper processor, memory and bus architecture for SoC configuration.
CO6	:	Develop an SoC framework for real world applications.

TEXT/REFERENCE BOOKS

1. Andrew Sloss, Dominic Symes, Chris Wright, "ARM System Developer"s Guide – Designing and Optimizing System Software", ELSEVIER
2. Phil Lapsley et al, "DSP Processor Fundamentals: Architectures and Features" Wiely India Pvt. Ltd
3. B. Venkataramani and M. Bhaskar, "Digital Signal Processors, Architecture, Programming and Applications" TMH.
4. Michael J. Flynn and Wayne Luk, "Computer System Design: System-on-Chip", Wiely India Pvt. Ltd.
5. Steve Furber, "ARM System on Chip Architecture", Addison Wesley Professional.
6. Ricardo Reis, "Design of System on a Chip: Devices and Components" Springer.

24ECE***T					Advance Communication Networks					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES:

- To learn 5G Technology advances and their benefits for next generation cellular networks
- To develop an intuitive understanding of various key wireless technologies unique to 5G networks.
- To know the propagation channel models and design characteristics of 5G.
- To learn 5G network architecture, enabling technologies, and supported services.
- To know the design and implementation issues of 5G networks.

UNIT-1: INTRODUCTION TO 5G BROADBAND WIRELESS COMMUNICATIONS. 11 Hrs.

Evaluation of mobile technologies 1G to 4G (LTE, LTEA, LTEA Pro), 5G Standardization, An Overview of 5G requirements, Regulations for 5G, Spectrum for 5G, Introduction to. LTE.

UNIT-2: 5G PHYSICAL LAYER AND APPLICATION 12 Hrs.

NR Physical layer overview, Propagation and Channel Modeling, Multi-carrier Waveforms, LTE/NR Interworking and Co-existence, NR in Unlicensed Spectrum, Industrial IoT and URLLC enhancements, 5G V2V Communication, 5G D2D Communication.

UNIT-3: 5G CHANNEL MODELING 10 Hrs.

V2V Channel Modeling in 5G communication; Geometric based Statistical MIMO Channel Modeling; 3D Scattering Channel Modeling for Microcell Environments; 3D Non-stationary Wideband UAV Channel.

UNIT-4: INTRODUCTION TO 6G 9 Hrs.

Moving towards 6G and Beyond cellular networks, 6G Key enabling technologies, CF-mMIMO, Introduction to mmWaves, AI in physical layer wireless communication 6G Use Cases and its key enabling technologies.

Max. Hrs.: 42

COURSE OUTCOMES:

After completion of this course, the student will be able to

CO1 - Remember the terminologies of cellular networks, their advances and benefits for next generation cellular networks.
CO2 - Understand the key RF, PHY, MAC layer and air interface changes required to support the requirements of 5G
CO3 - Apply various propagation channel models and design characteristics on 5G cellular architecture.
CO4 - Analyze different blocks of 5G network architecture and examine their functionalities.
CO5 - Evaluate the performance of Device-to-Device communication and millimeter wave communication in 5G.
CO6 - Understand the use cases for 6G Communications

TEXT/REFERENCE BOOKS:

1. Martin Sauter "From GSM From GSM to LTE–Advanced Pro and 5G: An Introduction to Mobile Networks and Mobile Broadband", Wiley-Blackwell.
2. Afif Osseiran, Jose.F.Monserrat, Patrick Marsch, "Fundamentals of 5G Mobile Networks" , Cambridge University Pres
3. Paulo Ramjee Prasad, Paulo Sergio Rufino Henrique, "6G The Road to the Future Wireless Technologies 2030" River Publishers.

XXXXXX					IC Technology					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Mark
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES:

- To provide understanding of common trends and techniques in semiconductor manufacturing.
- To develop an in-depth understanding of the mechanism and physics of semiconductor manufacturing processes.
- To provide a foundation in semiconductor technology to address the challenges of advanced electronic devices.

UNIT I: INTRODUCTION, CRYSTAL STRUCTURE AND GROWTH, AND CLEANROOM 10 Hrs.

Moore‟s law, CMOS scaling, Overview of key semiconductor technologies, Crystal Structure: Bravais lattice, Miller‟s indices, Crystal planes; Crystal defects - point defects, Linear defects, and volume defects; Raw materials and purification, Crystal growth: Czochralski and Float-Zone processes, Silicon wafers, their specifications and measurements; Contamination Control: Cleanrooms - features, classifications and guidelines; Wafer Cleaning, Gettering.

UNIT II: LITHOGRAPHY AND OXIDATION PROCESSES 10 Hrs.

Photolithography: introduction and its application to IC manufacturing, Light sources, Photomask, Wafer exposure system: contact proximity and projection printing, Immersion lithography, Resolution and depth of focus, Photoresists: types, and issues; Process flow for lithography; EUV and electron-beam lithography. Oxidation: Dry vs wet oxidation, LOCOS, Thermal oxidation furnaces: Horizontal vs. vertical - their mechanism, Si/SiO2 interface, Oxide growth charges; growth kinetics, Deal-Grove model, Physical measurement: ellipsometry, measurement by CV method.

UNIT III: DIFFUSION, ION-IMPLANTATION AND THIN-FILM DEPOSITION 12 Hrs.

Doping process: doping profile of PN-junction, Trends in diffusion, Solid solubility, Fick‟s second law and its analytical solution, Gaussian solutions, Diffusion furnaces - horizontal vs. vertical; Ion implantation process: Dose, Energy and Angle considerations, Implantation damage and annealing - RTA, Channeling and shadowing effect, Diffusion vs. ion-implantation and their applications. Thin film deposition: requirements, characteristics and step coverage; PVD techniques: thermal and e-beam, Sputtering: types - DC and RF sputtering, process parameters and applications; CVD techniques and types: APCVD, LPCVD, PECVD, MOCVD; Atomic layer deposition (ALD) techniques: thermal and PEALD; Epitaxy.

UNIT IV: ETCHING AND BACK-END TECHNOLOGY 10 Hrs.

Etching: types - wet and dry etch, anisotropic and isotropic, selectivity, plasma etching and RIE; Wafer testing and sorting: Probe card setup, Electrical testing, Test data collection, Yield analysis, Defect mapping and diagnosis, Die sorting. Back-end technology: Interconnects in CMOS technology, Metallic interconnects, Copper interconnects – Advantages, Challenges posed, Interconnect fabrication process. Packaging assembly technology: Wafer thinning, Dicing, Die-attach, Wire-bond & Flip-chip process, Encapsulation, Laser marking, Solder ball attach, Singulation.

Max Hrs.: 42 Hrs.

COURSE OUTCOMES:

After completion of this course, the student will be able to

CO1: Understand the general trends and common techniques in semiconductor manufacturing.
CO2: Learn about cleanroom protocols, safety, gowning, and contamination control techniques.
CO3: To gain a comprehensive understanding of lithography, oxidation, diffusion, and ion implantation processes.
CO4: Analyze the fabrication techniques, trade-offs, and key considerations in developing a device.
CO5: Gain the understanding of front-end and back-end process altogether to apply this in an industry environment.
CO6**:** Build upon a foundation to pursue research and development of future semiconductor technologies.

TEXT/REFERENCE BOOKS:

1. J. D. Plummer, M. D. Deal & P. B. Griffin, Silicon VLSI Technology, Prentice-Hall, 2000.
2. C. Y. Chang and S. M. Sze –ULSI Technology, McGraw-Hill series, 1996.
3. R.C. Jaeger, Introduction to microelectronic fabrication, Prentice Hall, Second Edition, 2013.

24ECExxxT					Drones: Design, Theory and Applications					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- Identify drone types and their respective use cases.
- Describe sensor, control, and communication system integration in drone design.
- Apply concepts to design drone systems and subsystems.
- Analyze the integration of sensors, actuators, and controls in drone design.

UNIT I: INTRODUCTION TO DRONES and ITS MECHATRONIC COMPONENTS	**08 Hrs.**
Overview of drone technology: history, evolution, and current trends, Types of drones: fixed-wing, rotary-wing (quadcopters, hexa and octacopters, etc.), hybrid. Components of a drone: frame, motors, propellers, electronic flight controllers, electronic speed controllers, sensors, communication systems, power source, etc. Drone Design Aspects, Regulations in drone operations. Safety measures and best practices for drone operation.	
UNIT II: DRONE DESIGN ASPECTS	**10 Hrs.**
Quadrotors, Key components of Autonomous flight, State estimation, Controls, Applications, Basic Mechanics, Dynamics and 1-D Linear Control, Design Considerations, Agility and Manoeuvrability, Component Selection, Effects of Size, Dynamical Systems and Rates of Convergence	
UNIT III: DRONE MODELLING & SIMULATION TOOLS	**13 Hrs.**
Transformations, Rotations, Euler Angles, Axis/Angle Representations For Rotations, Angular Velocity, Rigid-Body Displacements, Properties Of Functions, Symbolic Calculations in Matlab, Eigenvalues And Eigenvectors of Matrices, Quaternions, Matrix Derivative, Skew-Symmetric Matrices and the Hat Operator, Formulation, Newton-Euler Equations, Principal Axes And Principal Moments of Inertia, Quadrotor Equations Of Motion, Linear and Nonlinear State-Space Forms, Drone Modelling in Python and MATLAB/Simulink, ROS and its Libraries for Drones, Gazebo environment for Aerial robots.	
UNIT IV: AUTONOMOUS DRONE FLIGHT IN PRACTICAL APPLICATIONS	**11 Hrs.**
2-D Quadrotor Control, 3-D Quadrotor Control, Time, Motion, and Trajectories, Time, Motion, and Trajectories, Motion Planning for Quadrotors, Minimum Velocity Trajectories from the Euler-Lagrange Equations, Solving for Coefficients of Minimum Jerk Trajectories, Linearization of Quadrotor Equations of Motion, Multi-drone Applications: Inspection, Surveillance, Monitoring, Transportation, Agriculture. Drone with Mobile Robot operations.	
	TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

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

CO1	:	Identify various types of drone and classify their use cases.
CO2	:	Describe the integration of sensors, control and communication systems in drone design.
CO3	:	Apply concepts in modelling and simulation of drone systems and subsystems
CO4	:	Analyse the integration of sensors, actuators communication systems in drone design.
CO5	:	Evaluate the suitability of different control algorithms and navigation systems for specific drone missions.
CO6	:	Design innovative solutions to real-world challenges in drone design, operation, and applications.

TEXT/REFERENCE BOOKS

1. Randal W. Beard and Timothy W. McLain " Small Unmanned Aircraft: Theory and Practice", Princeton University Press, 2012.
2. Kenzo Nonami "Autonomous Flying Robots: Unmanned Aerial Vehicles and Micro Aerial Vehicles" , Springer, 2010
3. Quan Quan, Xunhua Dai, Shuai Wang "Multicopter Design and Control Practice - A Series Experiments based on MATLAB and Pixhawk" , Springer, 2020

<Course Code>					Radar and Navigation systems					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES-

- Understand the basic principles of different types of RADAR
- Gaining in-depth knowledge of radar transmitter and receivers
- Exhibit RADAR navigation techniques

UNIT I: 1RADAR FUNDAMENTALS	**10 Hrs.**
Introduction to Radar: Basic Radar – The Origins of Radar, radar system (block diagrams), Radar range Equation, Applications of Radar. Radar types: MTI, Doppler and Pulse, PRF, Delay, Line Cancellers, Staggered Pulse Repetition Frequencies, Doppler Filter Banks, Digital MTI Processing, Moving Target Detector, Limitations to MTI Performance, Pulse Doppler Radar. Tracking with Radar-Monopulse Tracking, Conical Scan and Sequential Lobing, Limitations to Tracking Accuracy, Low-Angle Tracking - Tracking in Range, Comparison of Trackers, Automatic Tracking with Surveillance Radars	
UNIT II: RADAR RECEIVERS	**10 Hrs.**
Introduction, Superheterodyne Receiver, Receiver noise Figure, Duplexers and Receiver Protectors, Radar Displays. Matched Filter Receiver, Detection Criteria, Detectors, Automatic Detector, Integrators, Constant-False-Alarm Rate Receivers, The Radar operator, Signal Management, Propagation Radar Waves, Atmospheric Refraction, Standard propagation, Nonstandard Propagation, The Radar Antenna, Reflector Antennas, Electronically Steered Phased Array Antennas, Phase Shifters, Frequency-Scan Arrays.	
UNIT III: RADAR TRANSMITTERS AND SIGNAL DETECTION	**10 Hrs.**
Introduction –Linear Beam Power Tubes - Solid State RF Power Sources - Magnetron -Crossed Field Amplifiers - Other RF Power Sources – Other aspects of Radar Transmitter. Detection of Signals in Noise –Detection of Signals in Noise, Receiver Noise and the Signal-to-Noise Ratio, Probability Density Functions, Probabilities of Detection and False Alarm, Integration of Radar Pulses, Radar Cross Section of Targets, Radar cross Section fluctuations, Transmitter Power	
UNIT IV: NAVIGATION	**12 Hrs.**
Introduction, Four methods of Navigation, Radio Direction Finding, The Loop Antenna, Loop Input Circuits, An Aural Null Direction Finder, The Goniometer, Errors in Direction Finding, Adcock Direction Finders, Direction Finding at Very High Frequencies, Automatic Direction Finders, The Commutated Aerial Direction Finder, Range and Accuracy of Direction Finders, Radio Ranges, Doppler Navigation, component, Beam Configurations, Track Stabilization, introduction to Satellite Navigation System, Global Positioning System(GPS).Instrument landing system, microwave landing system	
	TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES-

On completion of the course, student will be able to:

CO1	:	Remember the basic fundamentals of communication receiver.
CO2	:	Understand the different types of RADAR and their working.
CO3	:	Apply the basic concept to understand the detection of signal.
CO4	:	Analyze the working of RADAR Transmitter, receiver and RADAR
CO5	:	Evaluate various RADAR and Navigation systems and components.
CO6	:	Design components for RADAR and Navigation system.

TEXT/REFERENCE BOOKS -

1. Merrill I. Skolnik ," Introduction to Radar Systems", Tata McGraw-Hill.
2. Peyton Z. Peebles:, "Radar Principles", John Wiley Publication.
3. J.C Toomay, " Principles of Radar", PHI.

<Course Code>					Internet of Things					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Mark
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To impart knowledge about components of IoT, architecture, and platforms of IoT.
- To apprise students with basic knowledge of IoT that paves a platform to understand physical, logical design, and business models.
- To teach a student how to analyse requirements of various industrial systems for cost-effective design of IoT applications on different IoT platforms.
- To explain the students how to design IoT applications in different domains and real time scenarios

UNIT 1 INTRODUCTION	**11 Hrs.**
Definition & Characteristics of IoT, Technology evolution, IoT Architectures, Physical and Logical Design of IoT, IoT Functional Blocks, IoT Communication Models- Publish-subscribe, Push-Pull, exclusive-pair models, Resource management, IoT Security, Current challenges and issues.	
UNIT 2 IoT DEVICES AND TECNOLOGIES	**12 Hrs.**
Introduction to various types of sensors, Working principles of sensors, Actuators, Control Units-Microcontrollers and Microprocessors, I/O interfaces, Communication Technologies for IoT, RFID, IoT Enabling Technologies – AI, Bigdata Analytics, Cloud Computing, and Embedded Systems.	
UNIT 3 INDUSTRIAL IoT	**9 Hrs.**
Introduction to Industrial IoT, Role of Industrial Internet of Things (IIoT), Difference between IoT and IIoT, Business Models, IoT- based real-time control systems and Human-Machine Interface, Supervisory Control & Data Acquisition (SCADA), Case studies on Smart Factories with IIoT.	
UNIT 4 IoT SYSTEMS AND APPLICATIONS	**10 Hrs.**
Applied Internet of Things, Smart Cities, Smart Agriculture, Intelligent Transportation Systems, IoT Applications for Smart Health Care, Home Automation, Environment Monitoring, and Surveillance, Case Studies Illustrating IoT Design.	

Max. 42 Hrs.

COURSE OUTCOMES

On completion of the course, students will be able to

CO1	:	Remember the Internet of Things and its technological aspects.
CO2	:	Comprehend advanced IoT devices and technologies for different IoT applications.
CO3	:	Apply the knowledge of control units and communication technologies in designing IoT systems.
CO4	:	Analyse the Industrial systems with IoT components.
CO5	:	Evaluate efficiency trade-offs among alternative models for an efficient IoT application design
CO6	:	Design different IoT systems for various real-life problems and application domains

TEXT/REFERENCE BOOKS

1. Pethuru Raj and Anupama C. Raman. The Internet of Things: Enabling Technologies, Platforms, and Use Cases. CRC Press.
2. Adrian McEwen. Designing the Internet of Things. Wiley publications.
3. Vijay Madisetti, Arshdeep Bahga. İnternet of Things: A Hands-on Approach. University Press.
4. Raj Kamal. Internet of Things: Architecture and Design. McGraw Hill

<Course Code>					Mixed Signal VLSI Design					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To learn the fundamentals of mixed-signal circuit design.
- To study of data converters (adc/dac) for interfacing of analog and digital systems.
- To know the various methods for the co-existence of analog and digital circuits on a single chip.

UNIT I: INTRODUCTION TO MIXED-SIGNAL	10 Hrs.
Definition of Mixed-signal ICs, Challenges, Applications, Basic to data conversion and processing, Sampling, Switched capacitors circuits: MOSFET as switches, Diode as Switch, Switched Capacitor Integrator, MOS sample-hold circuits, Current mirror, Voltage-Controlled Oscillators (VCO), Phase Locked Loop (PLL), non- ideal effect in PLL, Jitter and phase	
UNIT II: ANALOG TO DIGITAL CONVERTERS	**12 Hrs.**
Performance Metric, Flash Architectures, Two-Step Architectures, Interpolative and Folding Architectures, Pipelined Architectures, Successive Approximation Architectures, Interleaved Architectures, Over sampling ADC – Noise shaping, Sigma- Delta modulator.	
UNIT III: DIGITAL TO ANALOG CONVERTERS	**10 Hrs.**
Performance Metrics, Reference Multiplication and Division: Voltage Division, Current Division, Charge Division, Switching and logical Functions in DACs, Switching Functions in Resistor-Ladder DACs, Switching Functions in Current-Steering DACs, Switching Functions in Capacitor DACs, Binary-to-Thermometer Code Conversion, **Architectures:** Resistor-Ladder DAC Architectures, Ladder Architecture with Switched Sub-divider, Intermeshed Ladder Architectures, Current-Steering Architectures, R-2R-Network Based Architectures, Segmented Architectures	
UNIT IV: NOISE AND TESTING OF ICs	**10 Hrs.**
Noise: Types of noise: Shot, Thermal, Flicker (1/f), Burst, and avalanche noise, Noise Models of IC components: Diode, BJT, MOS transistor, Resistor, capacitors, and inductors, Noise power trade-off, Noise Bandwidth, Noise Figure, Noise Temperature, Total harmonic distortion. **Testing:** General Consideration, Sampling circuits, D/A converters, A/D convertors: static and dynamic testing. **Project**	
TOTAL HOURS: 42 Hrs.	

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1	:	Define the importance of mixed-signal circuits in ic design.
CO2	:	Understand the principles and mathematical concepts of different mixed-signal circuit architectures.
CO3	:	Apply the appropriate amplifier circuit to amplify analog and discrete signals.
CO4	:	Analyze and compare the performance metrics of data converters.
CO5	:	Evaluate the various a/d and d/a converters for a given data acquisition system.
CO6	:	Design the mixed-signal circuit ic for real-life applications.

TEXT/REFERENCE BOOKS

1. Behzad razavi, "design of analog cmos integrated circuits," mcgraw-hill international edition 2016.
2. Behzad razavi, "principles of data conversion system design," wiley-ieee press, 1995
3. R. Jacob baker, "cmos mixed-signal circuit design," wiley india, ieee press, and reprint 2008.
4. Tony chan carusone, david a. Johns, kenneth w. Martin, "analog integrated circuit design," wiley, 2nd edition.

24ECxxxT					Deep Learning and Applications					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- Introduce concepts of artificial neural networks.
- Understand concepts and applications of deep learning using artificial neural networks.
- Understand concepts and requirements of adaptive learning techniques.

UNIT 1: Introduction To Artificial Neural Networks	**10 Hrs.**
Introduction to Neural networks, Perceptron, McCulloch Pitts Neuron, Models of Neuron, Artificial Neural Network (ANN) Architectures, Classification of ANNs, ANN learning, analysis and applications, Single Layer & Multi-Layer Perceptron (MLP) Network, Optimization of neural networks (GS, SGD, Adagrad, Adadelta, RMSprop, Adam, NAG). Bias vs. variance trade-off, Regularization.	
UNIT 2: Convolutional Neural Networks	**11 Hrs.**
Introduction to Deep Learning (DL) Techniques, Convolutional Neural Networks (CNN), Basic architecture, Convolutional Layers, Pooling Layers, Activation functions, Handling vanishing gradient problem, Dropout, Batch Normalization; Different CNN Models: LeNet, AlexNet, VGGNet, GoogleNet, ResNet, DenseNet, Training of Deep neural Networks, Hyper parameter tuning, transfer learning, Dataset augmentation.	
UNIT 3: Deep Learning Neural Networks for Time Series Data	**11 Hrs.**
Feedforward and Recurrent Neural Networks (RNN), Back propagation through time (BPTT), Vanishing and Exploding Gradients, Truncated BPTT, Bidirectional RNNs, Deep RNN, Long Short-Term Memory Networks (LSTMs), Bidirectional LSTMs, Gated Recurrent Unit (GRU), Application of Deep Learning Networks in Various Forecasting Problems.	
UNIT 4: Neural Networks for Special Applications	**10 Hrs.**
Introduction to Encoder Decoder Models, Variational Autoencoders, GAN and Different Type of GAN"s, Implementation on GAN"s, Siamese network, Attention and Transformers, Types and Applications.	

Total: 42 Hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1: Define the basic concepts and terminology associated with neural networks, including neurons, activation functions, and network architectures.

CO2: Explain the fundamental principles underlying neural network operation, including forward and backward propagation, gradient descent, and optimization techniques.

CO3: Implement and train simple feedforward neural networks for tasks such as classification and apply appropriate preprocessing techniques and hyperparameter tuning to improve the performance of neural networks on real-world datasets.

CO4: Evaluate the strengths and weaknesses of different neural network architectures and activation functions for specific applications.

CO5: Evaluate the performance of advanced neural network architectures (e.g., convolutional neural networks, recurrent neural networks) on challenging tasks like image recognition, natural language processing, and time series prediction.

CO6: Design and implement novel neural network architectures or modifications to existing architectures to address specific challenges or improve performance on specialized tasks.

TEXT/REFERENCE BOOKS

1. Simon Haykin, Neural Networks and Learning Machines, Third Edition, Paper Back, Pearson India.

2. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, Deep Learning, MIT Press.
3. Josh Patterson and Adam Gibson, Deep Learning A Practitioner‟s Approach, O‟Reilly Media, Inc.
4. Antonio Gulli, Sujit Pal, Deep Learning with Keras, Packt Publishing.
5. Christopher Bishop, “Deep Learning: Foundations and Concepts”, Springer.