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ताळगांव पठार,
गोंय – ४०३ २०६
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GU/Acad –PG/BoS -NEP/2025-26/267 Date: 24.07.2025

CIRCULAR

In continuation to the Circular No. GU/Acad –PG/BoS -NEP/2024/538 dated: 24.09.2024, the syllabus for Semester III & IV of the **Bachelor of Engineering in Electronics and Computer Science** Programme approved by the Standing Committee of the Academic Council in its meeting held on 24th and 25th June 2025 is attached.

The Dean, Faculty of Engineering and Principals of affiliated Colleges offering the **Bachelor of Engineering in Electronics and Computer Science** Programme are requested to take note of the above and bring the contents of the Circular to the notice of all concerned.

ASHWIN VYAS LAWANDE
Digitally signed by ASHWIN VYAS LAWANDE
Date: 2025.07.24 17:09:12 +05'30'

(Ashwin V. Lawande)
Deputy Registrar – Academic

To,

1. The Dean, Faculty of Engineering, Goa University.
2. The Principals of affiliated Engineering Colleges.

Copy to,

1. The Director, Directorate of Technical Education, Govt. of Goa
2. The Chairperson, BoS in Electronics & Computer Engineering.
3. The Controller of Examinations, Goa University.
4. The Assistant Registrar, Prof. Examinations (Technical and Allied), Goa University.
5. Directorate of Internal Quality Assurance, Goa University for uploading the Syllabus on the University website.

ELECTRONICS AND COMPUTER SCIENCE SCHEME AY 2024-25

SEMESTER - III							
Sr. No	**Course Category**	**Course Code**	**Title of the Course**	**L**	**T**	**P**	**Credits**
1	**Major**	**ECM-200**	Data Structures using C++	3	0	0	3
		ECM-201	Data Structures Using C++ Lab	0	0	1	1
		ECM-202	Logic Design	3	0	0	3
		ECM-203	Logic Design Lab	0	0	1	1
2	**Minor/IC/ Pe**	**ECS-221**	Circuits Analysis and Systems	3	0	0	3
		ECS-222	Circuits Analysis and Systems Lab	0	0	1	1
		OR					
		ECM-223	Communication Technology	3	0	0	3
		ECM-224	Communication Technology lab	0	0	1	1
3	**Multi-disciplinary**	**SHM-235**	Mathematics for Engineers	3	0	0	3
4	**AEC**	**AEC-251**	*	0	0	2	2
5	**SEC**	**ECM-241**	Web Design	0	0	3	3
			TOTAL	**12**	**0**	**8**	**20**

***** *AEC Courses shall be notified by the University based on the recommendations of respective Board of Studies in languages.*

Approved by: Standing Committee of the Academic Council on 24th & 25th June 2025

SEMESTER - IV							
Sr. No.	**Course Category**	**Course Code**	**Title of the Course**	**L**	**T**	**P**	**Credits**
1	**Major**	**ITH-204**	Object oriented Programming using JAVA	2	0	0	2
		ITH-205	Object oriented Programming using JAVA Lab	0	0	2	2
		ECS-200	Electronic Devices and Circuits	3	0	0	3
		ECS-201	Electronic Devices and Circuits Lab	0	0	1	1
		ECS-202	Microprocessor and Microcontroller	3	0	0	3
		ECS-203	Microcontroller Lab	0	0	1	1
		ECS-204	Signal Processing	3	1	0	4
2	**Professional Electives**	**ECM-225**	Computer Graphics	3	0	0	3
		ECM-226	Computer Graphics Lab	0	0	1	1
		OR					
		ECS-223	Soft Computing	3	0	0	3
		ECS-224	Soft Computing Lab	0	0	1	1
			TOTAL	**14**	**1**	**5**	**20**

SEMESTER-III

Major Courses

Name of the Programme : B.E. in Electronics and Computer Engineering
Course Code : ECM-200
Title of the Course : Data Structures using C++
Number of Credits : 3
Effective from AY : 2024-25

Pre-requisites for the Course:	Nil	
Course Objectives:	This course will enable students to: 1. To introduce object-oriented programming (OOP) concepts using C++. 2. To understand and implement data structures like arrays, linked lists, stacks, queues, trees, and graphs. 3. To develop efficient algorithms for problem-solving and understand their complexities. 4. To apply C++ concepts in real-world applications.	
Contents:		**No of Hours**
UNIT- 1	**Basics of C++:** Structure of a C++ Program, Data Types, Operators, Expressions and control structures. **Functions in C++:** Function Prototypes, Default Arguments, Function Overloading **Introduction to OOP**: Principles (Encapsulation, Abstraction, Inheritance, Polymorphism) **Classes and Objects:** Defining Classes, Access Specifiers, Constructor and Destructor, Friend Functions and Friend Classes, Static Data Members and Static Member Functions **Inheritance:** derived classes, Types of inheritance, constructors in derived classes, nesting of classes	**12**
UNIT-2	**Concepts of polymorphism:** Function overloading, operator overloading. Overloading types, and rules, explicit &amp: implicit type conversion operators, function overriding. **Pointers:** pointers to objects, this pointer. Virtual functions. **Exceptions**: Exception Objects, Throwing and Catching Exceptions, Exception Specification**.** **Linked list:** Singly (Insertion, Deletion, Traversal), Doubly, Circular linked lists	**11**
UNIT -3	**Stacks**: Implementation (array and linked list), applications of stacks: Expression evaluation (Infix to postfix, Infix to prefix and vice versa) **Queues**: Implementation (array and linked list), Circular **Trees:** Basic terminology, binary trees and their representation,	**11**

	Traversals of a Binary Tree, Reconstruction of Binary Tree.	
UNIT -4	**Graphs:** Basic terminology, The Graph ADT, Data Structures for Graphs, Graph Traversal – Depth First Search, Breadth First Search, Shortest Path Algorithm (Dijkstra's Algorithm, Prims and Kruskal's Algorithm) **Searching Algorithms:** Binary Search, Linear Search. **Sorting Algorithms**: Bubble sort, selection sort, Quick sort, Insertion sort, Merge sort, Heap sort. **Hashing:** Hash Functions, Collision Resolution Techniques.	**11**
Pedagogy:	Interactive, reflective, and inquiry-based methods, with a strong emphasis on critical thinking and problem-solving skills	
References/ Readings:	**TEXTBOOKS:** 1. E. Balagurusamy, Object-Oriented Programming with C++, 5th Edition, Tata McGraw-Hill, 2011.ISBN-13: 978-0070669193 2. Yeshwant Kanetkar, Data Structures Using C++, 1st Edition, BPB Publications, 2011.ISBN-13: 978-8176569408 3. Michael T. Goodrich, Roberto Tamassia, David Mount, Data Structures and Algorithms in C++, 2nd Edition, John Wiley & Sons, 2004.ISBN-13: 978-8126512607 **REFERENCE BOOKS:** 1. S. Sahni, Data Structures, Algorithms and Applications in C++, 2nd Edition, Universities Press, 2005.ISBN-13: 978-8173715543 2. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 4th Edition, Pearson Education, 2013.ISBN-13: 978-0273769385 3. Adam Drozdek, Data Structures and Algorithms in C++, 4th Edition, Cengage Learning, 2013.ISBN-13: 978-8131521267 4. 4.Yeshwant Kanetkar, Let Us C++, 16th Edition, BPB Publications, 2017.ISBN-13: 978-9387284494	
Course Outcomes:	**Upon completion of the course, students will be able to:** CO 1. Implement object-oriented concepts using C++. CO 2. Design basic data structures. CO 3. Develop efficient algorithms for problem-solving. CO 4. Apply C++ concepts in real-world scenarios**.**	

Name of the Programme : **B.E. in Electronics and Computer Engineering**
Course Code : **ECM-201**
Title of the Course : **Data Structures using C++ Lab**
Number of Credits : **1**
Effective from AY : **2024-25**

Pre-requisites for the Course:	Basic Programming skills	
Course Objectives:	This course will enable students to: 1. Understand the generic principles of object-oriented programming using C++. 2. Plan, Design, execute and document sophisticated object-oriented programs to handle different computing problems 3. To use data structures as the foundational base for computer solutions to engineering problems. 4. To plan, design, execute and document sophisticated technical programs to handle various sorts of data structures using object-oriented principles	
Contents:	**List of Programs /Experiments *(Following experiments should be conducted. A certified journal reporting the experiments conducted should be submitted at the end of the term)***	**No of Hours**
	1. Implementing Classes, Objects, and Overloading 2. Friend Function and Friend Classes 3. Implementation of Inheritance 4. Implementation of Singly/Doubly/Circular Linked List 5. Implementation of Stack Using Array/Linked List 6. Implementation of Queue Using Array/Linked List 7. Implementation of Sorting Techniques 8. Implementation of Graph Representations (Adjacency Matrix and Adjacency List) 9. Implementation of Graph Traversal Techniques (BFS and DFS) 10. Implementation of Shortest Path Algorithms (Dijkstra's Algorithm, Prims and Kruskal's Algorithm	**30**
Pedagogy:	Integration of instructional learning, constructive thinking, inquiry-based, collaborative, experiential, and problem-solving approaches.	
References/ Readings:	**TEXTBOOKS:** 1. E. Balagurusamy, Object-Oriented Programming with C++, 5th Edition, Tata McGraw-Hill Education, 2011.ISBN-13: 978-0071072830 2. Yeshavant P. Kanetkar, Data Structures Using C++, 1st Edition, BPB Publications, 2011.ISBN-13: 978-8176569408 3. Aaron M. Tenenbaum, Data Structures Using C++, 2nd Edition, Pearson Education, 2011. ISBN-13: 978-8131726976 **REFERENCE BOOKS:** 1. Robert Lafore, Object-Oriented Programming in Turbo C++, 4th	

	Edition, Pearson Education, 2013.ISBN-13: 978-8131718063 2. E. Balagurusamy, Mastering C++, 1st Edition, McGraw-Hill Education, 2011. ISBN-13: 978-0070701994 3. Yeshavant P. Kanetkar, Let Us C++, 2nd Edition, BPB Publications, 2014.ISBN-13: 978-8176561068
Course Outcomes:	Upon completion of the course, students will be able to: CO 1. Explain object-oriented concepts like classes, objects, overloading, and inheritance. CO 2. Apply linked lists, stacks, and queues for data organization. CO 3. Apply graph algorithms for traversal and shortest path determination. CO 4. Implement searching, sorting, and tree structures for problem-solving.

Name of the Programme : **B.E. in Electronics and Computer Engineering**
Course Code : **ECM-202**
Title of the Course : **Logic Design**
Number of Credits : **03**
Effective from AY : **2024-25**

Pre-requisites for the Course:	Basics of digital systems	
Course Objectives:	This course will enable students to: 1. Master number system conversions and complement arithmetic in digital Systems. 2. Simplify Boolean expressions and design combinational circuits using logic Gates. 3. Understand flip-flops and registers for data storage and sequence control. 4. Design and analyse sequential circuits, including state machines and Counters.	
Contents:		**No of Hours**
Unit - 1	**Introduction**: Digital and Analog Systems, Logic Levels and Pulse Waveforms. **Number Systems:** Decimal, Binary, Octal, Hexadecimal Number System and their interconversions. **Binary Arithmetic:** Binary signed numbers, 1's and 2's Complement Arithmetic. **Binary Codes**: Classification, 8421 code, Excess 3 Code, Gray Code, Parity generation and detection. **Logic Gates**: AND, OR, NOT, Universal Gates, XOR and XNOR Gates.	**11**
Unit -2	**Boolean Algebra:** Logic Operations, Laws of Boolean Algebra, Reducing Boolean Expressions, Introduction to SOP and POS Forms, Boolean Expression and Logic Diagrams, Converting AOI to NAND/NOR Logic. **Minimization of Switching Functions:** 2, 3 and 4 Variable K-map. Don't Care Combinations. **Combinational Logic Design:** Adders, Subtractors, Code converters (Binary to Gray and Gray to Binary), Parity Bit Generator, Comparators, Encoders, Decoders, Multiplexers, Demultiplexers.	**11**
Unit -3	**Flip-flops**: Latch v/s Flip-Flops- D, JK, RS and T Flip-flop. Master Slave Flip-flops, Flip-flop Excitation Tables. **Shift Registers**: Serial In Serial Out (SISO), Serial In Parallel Out (SIPO), Parallel In Serial Out (PISO) and Parallel In Parallel Out (PIPO) Shift Registers.	**11**

Unit -4	**Asynchronous Counters**: Ripple Up counters, Ripple Down Counters (Using Positive and Negative edge triggering) **Synchronous Counters**: Design of synchronous counters, Synchronous up counter and Synchronous down counter. Ring Counter and Johnson counter. Applications of counters. **Sequential Circuits:** Design procedure for sequential circuits using state diagrams, state table, state equations, state reduction and assignment. Moore and Mealy Machine.	**12**
Pedagogy:	Interactive, reflective, and inquiry-based methods, with a strong emphasis on critical thinking and problem-solving skills	
References/ Readings:	**TEXTBOOKS:** 1. Anand Kumar, Fundamentals of Digital Circuits, 2nd Edition, PHI Learning, 2007.ISBN-13: 978-8120330607 2. Thomas L. Floyd, Digital Fundamentals, 11th Edition, Pearson Education, 2017.ISBN-13: 978-9332584600 **REFERENCE BOOKS:** 1. M. Morris Mano, Digital Logic and Computer Design, Pearson Education, 2013.ISBN-13: 978-9332542525 2. Albert Paul Malvino & Donald P. Leach, Digital Principles and Applications, 8th Edition, McGraw Hill Education, 2014.ISBN-13: 978-9339203405 3. R.P. Jain, Modern Digital Electronics, 4th Edition, McGraw Hill Education, 2010.ISBN-13: 978-0070681071.	
Course Outcomes:	**Upon completion of the course, students will be able to:** CO 1. Explain the fundamentals of digital and analog systems, number systems, and binary arithmetic CO 2. Analyze and simplify Boolean expressions, and design combinational logic circuits using Boolean algebra and Karnaugh maps. CO 3. Design sequential circuits, including flip-flops, shift registers, and counters. CO 4. Evaluate state-based sequential circuits using Moore and Mealy machines for practical applications.	

Name of the Programme : **B.E. in Electronics and Computer Engineering**
Course Code : **ECM-203**
Title of the Course : **Logic Design Lab**
Number of Credits : **01**
Effective from AY : **2024-25**

Pre-requisites for the Course:	Nil	
Course Objectives:	**This course will enable students to:** 1. To know the concepts of Combinational circuits. 2. To understand the concepts of flipflops, registers and counters	
Contents:	**List of Programs /Experiments *(Following experiments should be conducted. A certified journal reporting the experiments conducted should be submitted at the end of the term)***	**No of Hours**
	1. Verification and interpretation of truth table for AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR gates. 2. Realization of logic functions with the help of universal gates NAND and NOR Gate. 3. Realization of Boolean expressions in SOP & POS forms 4. Design of Adders and Subtractors 5. Design of Code Converters 6. Design and Implementation and Verification of Encoders and Decoders 7. Design and Implementation of Multiplexers and Demultiplexers 8. Design and Implement Parity Bit Generators & Comparators 9. Verify the truth table of JK and D flip-flops. 10. Design SISO/SIPO Shift register 11. Design of Synchronous Counter 12. Design of Asynchronous Counter	**30**
Pedagogy:	Integration of instructional learning, constructive thinking, inquiry-based, collaborative, experiential, and problem-solving approaches.	
References/ Readings:	**TEXTBOOKS:** 1. Anand Kumar, Fundamentals of Digital Circuits, Fourth Edition, PHI Learning Pvt. Ltd., 2016, ISBN: 9788120352681 2. Thomas L. Floyd, Digital Fundamentals, Eleventh Edition, Pearson Education Limited, 2015, ISBN: 9781292075983 **REFERENCE BOOKS:** 1. Morris Mano, Digital Logic and Computer Design, First Edition, Pearson, 1979, ISBN: 9780132145107 2. Malvino and Leach, Digital Principles and Applications, Fourth Edition, McGraw-Hill, 1986, ISBN: 9780070398832 3. R. P. Jain, Modern Digital Electronics, Third Edition, Tata McGraw-Hill, 2003, ISBN: 9780070494923	

Course Outcomes:	**Upon completion of the course, students will be able to:** CO 1. Apply logic gate operations to verify and interpret truth tables in digital circuits CO 2. Design combinational circuits like adders, subtractors, code converters, and multiplexers using Boolean algebra and logic gates CO 3. Analyze sequential circuits such as flip-flops, counters, and shift registers to ensure correct functionality CO 4. Design a complete digital system, integrating knowledge of logic gates, combinational and sequential circuits.

Professional Electives

Name of the Programme : B.E. in Electronics and Computer Science
Course Code : ECS-221
Title of the Course : Circuit Analysis and Systems
Number of Credits : 03
Effective from AY : 2024-25

Pre-requisites for the Course:	Basics of Electrical and Electronics Engineering	
Course Objectives:	**This course will enable students to:** 1. Ability to analyse linear electrical networks and perform Time domain analysis of electrical networks 2. An understanding of graph theory and its application for network analysis 3. Ability to understand diode circuits 4. Ability to synthesize an electrical network and model it into any equivalent Two port network 5. An understanding of the Construction and working of various types of attenuators and motors	
Contents:		**No of Hours**
Unit - 1	**Network Classification**: Distributed and lumped, passive and active, time variable and time invariant, symmetrical and Asymmetrical networks. **Network Analysis:** Mesh and nodal analysis (ac and dc sources), Super-node and super-mesh analysis. **Network Theorems (AC analysis only):** Thevenin's, Norton's, Superposition, Maximum power transfer. **Diode Circuits:** Series, Parallel, Series-Parallel configurations, Clippers, Clampers	**14**
Unit -2	**Graph Theory**: Basic definitions, Duality, Matrices associated with network graphs: Incidence, Tieset, Cutset matrices. **Time- domain analysis:** Steady State and Transient Response, DC response of RL, RC and RLC circuits **Resonance:** Series resonance-Voltages, Currents, Impedance, Phase angle, Bandwidth, selectivity and Q-factor; Parallel resonance- resonant frequency, Band Width, selectivity and Q-factor	**11**
Unit -3	**Two Port Networks**: Characterization in terms of Z, Y, H and ABCD parameters, Interrelationships between parameters **Filters and Attenuators** – Classification of filters, equations of filter network, Analysis and design of Lattice attenuator, Bridged- T attenuator, T attenuator and pi attenuator (only 4 attenuators)	**10**

Unit -4	**DC Motors**: Construction, working and types of DC Motors, significance of back emf, voltage equation of a motor, Speed and Torque expressions, Characteristics of DC motors (series and Shunt). **Stepper motors:** Principle, construction and operation of Variable reluctance and permanent magnet stepper motors **Induction Motor:** Classification, General principle, construction, working and types of three phase Induction Motor.	**10**
Pedagogy:	Interactive, reflective, and inquiry-based methods, with a strong emphasis on critical thinking and problem-solving skills	
References/ Readings:	**TEXTBOOKS:** 1. Sudhakar P. Shyamohan, Circuits and Networks- Analysis and Synthesis.4 th edition, Tata McGraw-Hill, 2011.ISBN:9780070699724 2. D. Roy Choudhary,Networks and Systems,2 nd edition, New Age International Publishers,2011.ISBN:9788122427677 3. R. Boylestad and L. Nashelsky, Electronic Devices and Circuit Theory, 10th Edition,PHI, 2009.ISBN 9788131727003 4. B. L. Theraja,A. K. Theraja, A Textbook of Electrical Technology:AC and DC machines, Volume II, 1 st edition, S. Chand Publication, 2012. ISBN:97881219243755 **REFERENCE BOOKS:** 1. F. F. Kuo, Network Analysis and Synthesis. 2 nd edition, Wiley Eastern 2012.ISBN 978-126510016 2. Chakrabarti; Abhijit, Circuit theory Analysis and Synthesis. 7 th edition, Dhanpat Rai Publishing Company,2017.978-8177000009 3. Ashfaq Hussain, Electric Machines-2 nd edition, Dhanpat Rai Publishing Company,2012 ISBN :978-8177001662 4. M.E. Van Valkenburg, Network Analysis. 3 rd edition,Pearson Education,2015,ISBN:9788120301566 5. V. K. Mehta, Principles of Electrical Machines.2nd edition, S. Chand Publication,2020,9788121921616	
Course Outcomes:	**Upon completion of the course, students will be able to:** CO 1. Explain the concepts related to circuits and graph theory. CO 2. Explain the construction and working of the different types of motors CO 3. Apply network theorems, differential equations, to compute steady state and transient response of circuits CO 4. Analyze and design diode circuits clippers and clampers CO 5. Analyse electrical networks to compute two port parameters, design resonant circuits and attenuators	

Name of the Programme : **B.E. in Electronics and Computer Science**
Course Code : **ECS-222**
Title of the Course : **Circuit Analysis and Systems Lab**
Number of Credits : **01**
Effective from AY : **2024-25**

Pre-requisites for the Course:	Basics of Electrical and Electronics Engineering	
Course Objectives:	**This course will enable students to:** 1. Understanding of electrical circuits using various network theorems 2. Understanding of diode circuits 3. Analysing resonance circuits for different parameters 4. Analysis of two port network parameters 5. Understanding the performance characteristics of 3 phase induction motors and the speed control of DC Motors	
Contents:	**List of Programs /Experiments *(Following experiments should be conducted. A certified journal reporting the experiments conducted should be submitted at the end of the term)***	**No of Hours**
	1. Experimental verification of electrical circuits using Superposition Theorem 2. Experimental verification of electrical circuits using Maximum Power Transfer Theorem 3. Experimental verification of electrical circuits using Reciprocity Theorem 4. To study series,parallel and series-parallel diode configurations 5. To analyze and design clipper circuits 6. To analyze and design clamper circuits 7. Series or Parallel Resonance 8. Experimental Determination and Simulation of Z or Y parameters of a two port network 9. To study the performance characteristics of a 3-Phase Induction Motor (Load Test) 10. Speed Control of DC Shunt Motor	**30**
Pedagogy:	Integration of instructional learning, constructive thinking, inquiry-based, collaborative, experiential, and problem-solving approaches.	
References/ Readings:	**TEXTBOOKS:** 1. Sudhakar P. Shyamohan, Circuits and Networks- Analysis and Synthesis.4 th edition, Tata McGraw-Hill,2011.ISBN:9780070699724 2. D. Roy Choudhary,Networks and Systems,2 nd edition, New Age International Publishers,2011.ISBN:9788122427677 3. R. Boylestad and L. Nashelsky, Electronic Devices and Circuit Theory, 10th Edition, PHI, 2009.ISBN 9788131727003 **REFERENCE BOOKS** 1. V. K. Mehta, Principles of Electrical Machines.2nd edition, S. Chand Publication,2020,9788121921616	

	2. B. L. Theraja,A. K. Theraja, A Textbook of Electrical Technology: AC and DC machines, Volume II, ,2012 First edition, S.Chand Publication ISBN:9788121924375
Course Outcomes:	**Upon completion of the course, students will be able to:** CO 1. Analyze electrical circuits using fundamental network theorems; Determine two-port network parameters for both theoretical and practical circuits. CO 2. Analyze resonant circuits to calculate resonant frequency, quality factor, and bandwidth, and understand their applications. CO 3. Design and analyze diode-based electronic circuits including series/parallel diode configurations, clippers, and clampers for signal shaping applications. CO 4. Evaluate the performance characteristics of three-phase induction motors and implement speed control techniques for DC motors.

Name of the Programme : **B.E. in Electronics and Computer Science**
Course Code : **ECM-223**
Title of the Course : **Communication Technology**
Number of Credits : **03**
Effective from AY : **2024-25**

Pre-requisites for the Course:	Nil	
Course Objectives:	**This course will enable students to:** 1. Understand the fundamentals of data communication, including its components, data representation, and network types. 2. Analyze data transmission, signal processing, transmission impairments, and performance measurement. 3. Explore different transmission media, multiplexing techniques, and their applications in communication systems. 4. Examine mobile communication systems and multiple access techniques	
Contents:		**No of Hours**
Unit- 1	**Introduction to Data Communication:** Components of data communication, data representation, data flow. Networks- Criteria and physical Structures, Network types (LAN, WAN, Switching, The Internet) **Data and Signals:** Periodic Analog Signals, Digital Signals, Transmission impairment (Attenuation, distortion, Noise), Data Rate limits and Performance Measurement. Transmission Media: Guided Media (Twisted Pair, Coaxial, Fiber Optic), Unguided wireless media (Radio waves, Microwaves, Infrared)	**11**
Unit-2	**Digital Transmission:** Digital-to-Digital Conversion, Analog-to-Analog Conversion (PCM, DM), Transmission Modes **Analog Transmission:** Digital-to-Analog Conversion (ASK, FSK, PSK, QAM), Analog-to-Digital Conversion (AM, FM, PM). **Multiplexing:** FDM, WDM, TDM, Spread Spectrum- FHSS, DSSS	**12**
Unit -3	**Mobile Communication Cellular Systems:** Frequency Reuse, Channel Assignment strategies, Handoff strategies, Interface and system capacity, Improving coverage and capacity **Multiple Access Techniques:** FDMA, TDMA, FHMA, CDMA, SDMA, Packet radio (Pure and Slotted ALOHA, CSMA)	**12**
Unit -4	**Electromagnetic Wave Propagation:** Electromagnetic Waves and Polarization, Radiation, Free-space impedance, Spherical wave front and inverse Square Law, Wave Attenuation and Absorption, Optical Properties of Radio Waves, Terrestrial propagation of Electromagnetic Waves, Propagation Terms and	**10**

	Definitions, Free-space path loss, Fading and Fade Margin.	
Pedagogy:	Interactive, reflective, and inquiry-based methods, with a strong emphasis on critical thinking and problem-solving skills	
References/ Readings:	**TEXTBOOKS:** 1. Behrouz A. Forouzan, Data Communications and Networking, 5th Edition, McGraw Hill Education, 2012, ISBN: 9780073376226 2. Theodore S. Rappaport, Wireless Communications: Principles and Practice, 2nd Edition, Pearson Education, 2002, ISBN: 780130422323 3. Wayne Tomasi, Electronic Communications Systems: Fundamentals Through Advanced, 5th Edition, Pearson Education, 2004, ISBN: 9788131719534 **REFERENCE BOOKS:** 1. Jochen Schiller, Mobile Communications, 2nd Edition, Pearson Education, 2009, ISBN: 9788131724262 2. William Stallings, Wireless Communications & Networks, 2nd Edition, Pearson Education, 2009, ISBN: 9788131720936 3. Andrew S. Tanenbaum & David J. Wetherall, Computer Networks, 5th Edition, Pearson Education, 2011, ISBN: 9789332531772 4. William Stallings, Data and Computer Communications, 10th Edition, Pearson Education, 2013, ISBN: 9789332586932	
Course Outcomes:	**Upon completion of the course, students will be able to:** CO 1. Explain key components of Data and Mobile Communication CO 2. Differentiate between Analog and Digital transmission. CO 3. Apply multiple access techniques in Communication systems to optimize data transmission. CO 4. Evaluate transmission impairments and performance of Communication systems	

Name of the Programme : **B.E. in Electronics and Computer Science**
Course Code : **ECM-224**
Title of the Course : **Communication Technology Lab**
Number of Credits : **01**
Effective from AY : **2024-25**

Pre-requisites for the Course:	Nil	
Course Objectives:	This course will enable students to: 1. To understand and implement various modulation techniques. 2. To explore multiplexing techniques to enhance data transmission efficiency. 3. To model and simulate line encoding and wireless communication systems using MATLAB/open source software 4. To design, analyze, and evaluate wireless communication standards, multiple access techniques and Spread Spectrum modulation.	
Contents:	**List of Programs /Experiments *(Following experiments should be conducted. A certified journal reporting the experiments conducted should be submitted at the end of the term)***	**No of Hours**
	1. Implementation and Comparison of Line Encoding Techniques: Unipolar, Polar, Bipolar 2. Design and Analysis of Pulse Code Modulation (PCM) / Delta Modulation (DM) 3. Generation and Analysis of ASK/FSK/ PSK/QAM Signals 4. Implementation of Frequency Division Multiplexing (FDM) 5. Implementation of Time Division Multiplexing (TDM) 6. Modeling of Wireless Communication Systems Using MATLAB/Open-Source Tools 7. Simulation of Multipath Fading Channels and Their Effects on Signal Quality 8. Design and Simulation of Direct Sequence Spread Spectrum (DSSS) Modulation and Demodulation 9. Simulation of Multiple Access Techniques: FDMA/ TDMA/ CDMA/ SDMA 10. Modelling and Comparison of Random Access Techniques: Pure ALOHA/ Slotted ALOHA/ CSMA	**30**
Pedagogy:	Integration of instructional learning, constructive thinking, inquiry-based, collaborative, experiential, and problem-solving approaches.	
References/ Readings:	**TEXTBOOKS:** 1. Theodore S. Rappaport, Wireless Communications: Principles and Practice, 2nd Edition, Pearson Education, 2010, ISBN 9788131731864 2. E.S. Gopi, MATLAB and Simulink for Wireless Communications, Springer, 2016, ISBN 978-9811006117 3. Behrouz A. Forouzan, Data Communications and Networking, 5th	

	Edition, McGraw Hill Education, 2017, ISBN 978-1259064753 **REERENCE BOOKS:** 1. Jochen Schiller, Mobile Communications, 2nd Edition, Pearson Education, 2008, ISBN 9788131724262 2. John G. Proakis, Masoud Salehi, Gerhard Bauch, Contemporary Communication Systems Using MATLAB, 3rd Edition, Wadsworth Publishing Co Inc, 2012, ISBN 978-0495082514 3. Holly Moore, MATLAB for Engineers, 5th Edition, Pearson Education, 2017, ISBN 978-0134688287 4. B.P. Lathi & Zhi Ding, Modern Digital and Analog Communication Systems, 4th Edition, Oxford University Press, 2009, ISBN 9780195384932
Course Outcomes:	**Upon completion of the course, students will be able to:** CO 1. Analyse Digital and Analog modulation techniques CO 2. Analyse and apply multiplexing techniques. CO 3. Model line encoding and wireless communication systems using MATLAB/Open source Software CO 4. Design, test, and evaluate wireless standards, multiple access techniques, and Spread Spectrum modulation.

Multidisciplinary Courses

Name of the Programme : B.E. in Electronics and Computer Science
Course Code : SHM-235
Title of the Course : Mathematics for Engineers
Number of Credits : 3
Effective from AY : 2024-25

Pre-requisites for the Course:	Basic calculus and algebra, Introduction to sets and logic and Fundamental probability concepts	
Course Objectives:	This course will enable students to: 1. Identify and solve first order and first degree ordinary differential equations using various methods including separation of variables, homogeneous forms, exact equations, and integrating factors. 2. Acquire the ability to classify and solve linear higher order ordinary differential equations with constant coefficients, both homogeneous and non-homogeneous. 3. Explore the foundational concepts of relations and functions, including equivalence relations and partial orderings, and also learn to formulate and solve recurrence relations using the characteristic root method. 4. Understand the fundamental concepts of probability including definitions, theorems, as well as key types of random variables and their distributions.	
Contents:		**No of Hours**
Unit - 1	**First Order First Degree Ordinary Differential Equations** **Introduction to differential equations:** definitions, order, degree. **First-order ODEs:** method of separation of variables, homogeneous differential equations, equations reducible to homogeneous form. Exact differential equations, equations reducible to exact form by using integrating factors. Linear differential equations, equations reducible to linear form, Bernoulli's equation.	**11**
Unit -2	**Linear Higher Order ODE with Constant Coefficients** **Introduction to higher order linear ODEs:** Constant vs variable coefficients, homogeneous & non-homogenous DE, D-operator, Rule to find Complementary function, Rule to find Particular solutions, Solution of ODE, $\varphi(D) = f(x)$, where $f(x) = e^{ax}, sin(ax), cos(ax), X(i.e. polynomial\ in\ x)$, $e^{ax}\ sin(ax)$, $e^{ax}cos(ax), X\ e^{ax}, X\ sin(ax)\ , X\ cos(ax)$ where a is a constant	**11**
Unit -3	**Relation & Functions, Recurrence Relation** Relations and their properties, Equivalence Relations, partial orderings (POSET), Hasse Diagram. **Functions:** One-to-One and Onto Functions, Inverse Function, Composition of functions, Graphs of functions and some	**11**

	important functions. **Advanced Counting Techniques:** Formulation of Recurrence relations, Solution of recurrence relations (using characteristic root method only).	
Unit -4	**Probability & Standard Probability Distributions** Definitions - Probability, Axioms of probability, conditional probability, Independent/dependent events, theorems in probability (without proof) (all at review level). Random variables - definitions, types, mean and variance using Mathematical expectations, discrete probability distributions: Bernoulli, Binomial, Poisson and Geometric distribution, Continuous probability distributions: Uniform, Normal, and Exponential distribution.	**12**
Pedagogy:	Interactive, reflective, and inquiry-based methods, with a strong emphasis on critical thinking and problem-solving skills	
References/ Readings	**TEXTBOOKS:** 1. B.S. Grewal. Higher Engineering Mathematics. 42nd edition, Khanna Publications, 2017, ISBN 9788174091955 2. J. P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, 1st edition, New York McGraw Hill, 1975, ISBN 978-0070651425 3. Kenneth H. Rosen. Discrete Mathematics and Its Applications. 6th edition, Tata McGraw Hill, 2006, ISBN 9780073229720 4. Kreyszig E. Advanced Engineering Mathematics. 8th edition, Wiley India (P) Ltd,.2009, ISBN 9788126508273 5. Sheldon Ross. A First Course in Probability. 6th edition, Pearson Education, 2001, ISBN 978-0130338518 6. Willam W. Hines, Douglas C. Montgomery, David M. Goldsman and Connie M.Borror. 4th edition , Probability and Statistics in Engineering, 2009, ISBN 9788126516469 **REFERENCE BOOKS**: 1. B. Kolman, R.C. Busby and Sharon C. Ross. Discrete Mathematical Structures. 6th edition, Prentice Hall, 2011, ISBN 9788120336896 2. Kandasamy P. Engineering Mathematics, Chand & Co., New Delhi, 1986, ISBN 978-8121927970 3. Srimanta Pal, Subodh C. Bhunia. Engineering Mathematics. Oxford University Press, 2015, ISBN 978-0199099153 4. Veerarajan T. Engineering Mathematics-III. Tata McGraw Hill Publications, 2017, ISBN 978-0070593589 5. Swapan Kumar Sarkar. Text Book of Discrete Mathematics. 9th edition, S.Chand Publication, 2016, ISBN 978-9385676451	
Course Outcomes:	**Upon completion of the course, students will be able to:** CO 1. Apply methods to solve first-order differential equations in real-world problems. CO 2. Analyze higher-order linear differential equations using the D-	

	operator method. CO 3. Evaluate relations, functions, and recurrence relations using mathematical techniques. CO 4. Interpret and calculate probabilities and standard probability distributions.

Skill Enhancement Courses

Name of the Programme : B.E. in Electronics and Computer Engineering
Course Code : ECM-241
Title of the Course : Web Design
Number of Credits : 03
Effective from AY : 2024-25

Pre-requisites for the Course:	Nil	
Course Objectives:	**The subject aims to provide the student with:** 1. Ability to design and implement static and dynamic website. 2. Illustration of the implementation of JavaScript for dynamic effects. 3. Ability to choose best technologies for solving web client/server problems. 4. Implementation aspects of server-side technologies like PHP and MySQL.	
Contents:	**List of Programs /Experiments *(Following experiments should be conducted. A certified journal reporting the experiments conducted should be submitted at the end of the term)***	**No of Hours**
	1. Create a webpage using basic elements of HTML 2. Create class timetable using table tags in HTML 3. Design forms using HTML and CSS. 4. Create a web page with all types of Cascading style sheets. 5. Implementation of different JavaScript functions. 6. Implementation of different JavaScript functions for validation. 7. Implementation of JavaScript functions for validation of user login and registration form. 8. Implementation of JSON on the client framework. 9. Implementation of JSON on the server side. 10. Implementation of XML 11. Implementation of XML & XSL 12. Implementation of basic PHP Programs. 13. Implementation of PHP HTTP request methods. 14. Implementation of PHP and connection to MySQL 15. Implementation of PHP (Insert and View operation) 16. Implementation of PHP (Update operation) 17. Implementation of PHP (Delete operation) 18. Implementation of AJAX 19. Implementation of cookies using PHP. 20. Implementation of sessions using PHP Mini-Project Demonstrating the use of HTML, CSS, JS and Php	**90**

Pedagogy:	Integration of instructional learning, constructive thinking, inquiry-based, collaborative, experiential, and problem-solving approaches.
References/ Readings:	**TEXT BOOKS** 1. N. P. Gopalan and J. Akhilandeswari; Web Technology: A Developer's Perspective; PHI; ISBN: 978-81-203-5006-9 2 2. DT Editorial Services; Web Technologies Black Book;dreamtechpress; ISBN: 9788177229974 3 3. Kogent Learning Solutions; HTML5 Black Book; dreamtechpress; ISBN: 978-93-5004- 4 095-9 **REFERENCE BOOKS** 1. Smith, Ben; Beginning JSON, Apress; ISBN 978-1-4842-0202-9 2. Lindsay Bassett; Introduction to JavaScript Object Notation;O'Reilly Media; ISBN: 978-1- 491-92948-3
Course Outcomes:	**Upon completion of the course, students will be able to:** CO 1. Analyse the role of languages like HTML and CSS to solve real world problems. CO 2. Design and transform data using XML and JSON. CO 3. Design Dynamic Webpages using JavaScript. CO 4. Develop interactive web pages using PHP.

SEMESTER-IV

Major Courses

Name of the Programme : B.E. in Electronics and Computer Engineering
Course Code : ITH-204
Title of the Course : Object-Oriented Programming Using Java
Number of Credits : 2
Effective from AY : 2024-25

Pre-requisites for the Course:	Basic knowledge of programming	
Course Objectives:	**This course will enable students to:** 1. Understand the various concepts of object-oriented programming. 2. Illustrate competency in object-oriented programming by effectively utilizing basic OOP constructs. 3. Apply advanced OOP principles to design and implement applications 4. Develop event driven GUI applications	
Contents:		**No of Hours**
Unit - 1	**Introduction to Java:** Basics of Java programming, Data types, Variables, Operators, Control structures including selection, Looping, Java methods, Overloading, Math class, Arrays in java. **Objects and Classes:** Basics of objects and classes in java, Constructors, Finalizer, Visibility modifiers, Methods and objects, Inbuilt classes like String, Character, StringBuffer, File, this reference	**9**
Unit - 2	**Inheritance and Polymorphism**: Inheritance in java, Super and sub class, Overriding, Object class, Polymorphism, Dynamic binding, Generic programming, Casting objects, Instance of operator, Abstract class, Interface in java, Package in java.	**7**
Unit - 3	**I/O programming:** Text and Binary I/O, Binary I/O classes, Object I/O, Random Access Files. **Multithreading in java:** Thread life cycle and methods, Runnable interface, Thread synchronization, Exception handling with try-catch-finally, Collections in java. **Introducing Swing:** Features of Swing, Swing Components: Buttons, Labels, Text Fields, and Containers, Event Handling in Swing, Advanced Swing Components: JScrollPane, JTabbedPane, JTable, and JTree.	**7**
Unit - 4	**Introduction to Java Web Development:** Servlets and JSP Basics (optional, for understanding legacy web apps), Introduction to Spring Boot (Dependency Injection, REST APIs) **Database Connectivity in Java:** JDBC Basics, Using JPA	**7**

	(Hibernate) for ORM.	
Pedagogy:	Interactive, reflective, and inquiry-based methods, with a strong emphasis on critical thinking and problem-solving skills	
References/ Readings:	**Text Books** 1. Cay S. Horstmann, Core Java: Fundamentals, 13th Edition, Oracle Pr, 2024. 2. Herbert Schildt and Danny Coward, Java: The Complete Reference, 13th Edition, McGraw Hill Education, 2023. **Reference Books** 1. Joyce Farrell, Java Programming, 10th Edition, Cengage Learning India Private Limited, 2018. 2. Joshua Bloch, Effective Java, 3rd Edition, Addison-Wesley Professional, 2017.	
Course Outcomes:	**Upon completion of the course, students will be able to:** CO 1. Explain the concepts of object-oriented programming. CO 2. Demonstrate competency in object-oriented programming by effectively utilizing basic OOP constructs. CO 3. Apply OOP principles to design and implement applications that solve real- world problems efficiently. CO 4. Develop interactive GUI-based applications.	

Name of the Programme : **B.E. Electronics and Computer Engineering**
Course Code : **ITH-205**
Title of the Course : **Object-Oriented Programming Using Java Lab**
Number of Credits : **2**
Effective From AY : **2024-25**

Pre-requisites for the Course:	Basic knowledge of programming	
Course Objectives:	**The course will enable students to:** 1. Understand core OOP concepts and basic Java syntax. 2. Apply inheritance, polymorphism, and multithreading techniques. 3. Develop GUI and web-based applications using Java technologies. 4. Create and manage Java packages, exception handling, and file operations	
Content:	**List of Programs** ***(Following experiments should be conducted. A certified journal reporting the experiments conducted should be submitted at the end of the term)***	**No of Hours**
	1. Implement basic concepts of OOP: Classes and Objects, Constructors and Overloading 2. Implement different forms of inheritance and demonstrate multiple inheritance using interfaces 3. Implement Java program to demonstrate method overriding and dynamic method dispatch. 4. Implement multithreading using Thread class and Runnable interface. 5. Design a GUI based application using Java Swing controls. 6. Implement a web-based database application. 7. Implement Java programs using decision making and looping statements. 8. Implement java programs using Arrays 9. Implement java programs using Strings 10. Implement Java program to perform file IO 11. Implement Java program that demonstrates the use of Random-Access File class for file IO 12. Implement Java program to demonstrate Generics 13. Implement Java program to create a user-defined package and access it in another program. 14. Implement Java program to create your own exception and handle it. 15. Create a web application using Java servlet.	**60**
Pedagogy:	Integration of instructional learning, constructive thinking, inquiry-based, collaborative, experiential, and problem-solving approaches.	

References/ Readings:	**Text Books** 1. Cay S. Horstmann, Core Java: Fundamentals, 13th Edition, Oracle Pr, 2024. 2. Herbert Schildt and Danny Coward, Java: The Complete Reference, 13th Edition, McGraw Hill Education, 2023. **Reference Books** 1. Joyce Farrell, Java Programming, 10th Edition, Cengage Learning India Private Limited, 2018. 2. Joshua Bloch, Effective Java, 3rd Edition, Addison-Wesley Professional, 2017.
Course Outcomes:	**Upon completion of the course, students will be able to:** CO 1. Demonstrate class design, constructors, and method overriding. CO 2. Implement inheritance, interfaces, and multithreading programs. CO 3. Design GUI applications and build simple web database apps. CO 4. Develop Java programs for file I/O, generics, packages, and exception handling.

Name of the Programme : **B.E. in Electronics and Computer Science**
Course Code : **ECS-200**
Title of the Course : **Electronic Devices and Circuits**
Number of Credits : **03**
Effective from AY : **2024-25**

Pre-requisites for the Course:	Elements of Electrical and Electronics Engineering	
Course Objectives:	**This course will enable students to:** 1. Expertise in designing and analyzing diode-based filters, RC integrators, and differentiator circuits for signal processing applications. 2. A strong foundation in transistor circuit analysis, covering DC biasing of JFET and MOSFET, small-signal analysis of BJT, and multi-stage and large- signal amplifier performance. 3. An understanding of feedback in BJT circuits, including positive and negative feedback mechanisms and their impact on stability and performance. 4. Exposure to transistor switching circuits, multivibrators, and thyristor operation, focusing on turn-on and turn-off methods and power electronics applications.	
Contents:		**No of Hours**
Unit- 1	**Rectifiers and Filters:** L, C, LC analysis and design **Small Signal Analysis** (approximate hybrid model): Fixed bias, Voltage divider bias and Emitter Stabilized bias circuits. **Multistage Amplifiers:** Cascading basics, Coupling techniques (Construction, Working, Frequency response and Comparison) – RC, transformer and direct. **Power amplifiers:** Classification, Class A (Direct coupled with resistive load, transformer coupled with resistive load), Class B, Push-pull amplifier, crossover distortion, complementary Symmetry, Class C, Class D.	**11**
Unit -2	**Negative feedback in amplifiers:** Introduction, block diagrams for various amplifiers, Feedback Concept, Transfer gain with feedback, Effect of negative feedback on stability, noise, input impedance, output impedance and bandwidth. **Positive feedback in amplifiers:** Barkhausen criterion, block diagram of an oscillator, LC oscillators – General form, Colpitt's Oscillator, Clapp's Oscillator; Audio Oscillators – RC phase shift, Wein bridge; Crystal Oscillator – Basics, Oscillator operating in series; parallel resonance.	**11**
Unit -3	**Linear Wave-shaping**: RC Low pass and high pass circuits, Steady state response of RC differentiator and integrator circuits to square wave.	**12**

	BJT as a Switch: Working, Switching characteristics, Improving switching times. **Multivibrators:** Analysis and Design of BJT Astable, Monostable and Bistable Multivibrator. **Field Effect Transistors (FETs)**: Construction, Schematic Symbols, Operation and Characteristics of JFETs and MOSFETs.	
Unit -4	**FET Biasing:** JFET and MOSFET (Depletion and Enhancement types) – Voltage Divider Bias Configuration. **Introduction to Thyristors:** Terminal Characteristics, Switching Characteristics **Firing Circuits for Thyristors** (Circuit, operation and waveforms only): R, RC – half wave and full wave. **Thyristor Commutation:** Forced (Class C, D) and Natural (Class F) **Phase Controlled Rectifiers (Circuit, operation and waveforms only):** Single Phase Half-Wave with RL Load and Full-Wave Mid-Point.	**11**
Pedagogy:	Interactive, reflective, and inquiry-based methods, with a strong emphasis on critical thinking and problem-solving skills	
References/ Readings:	**TEXTBOOKS:** 1. R. Boylestad and L. Nashelsky; Electronic Devices and Circuits; PHI, 11th Edition, 2013, ISBN: 978-0132622264 2. J.B Gupta; Electronic Devices and Circuits; S. K. Kataria and Sons, 6th Edition, 2016, ISBN: 978-9350143148 3. David Bell; Solid state Pulse circuits; Oxford University Press, 2nd Edition, 1981, ISBN: 978-0835970570 4. P.S. Bhimbra; Power Electronics; Khanna Publishers,7th Edition, 2022, ISBN: 9788195123124 **REFERENCE BOOKS:** 1. Mottershead; Electronic Devices and Circuits; PHI, 1st Edition, 1979, ISBN : 9788120301245 2. A. Anandkumar; Pulse digital circuits; PHI, 2nd Edition, 2008, ISBN : 9788120333567 3. J. S. Chitode; Power Electronics; Technical Publications, 1stEdition, 2020, ISBN: 978-8184314182	
Course Outcomes:	**Upon completion of the course, students will be able to:** CO 1. Design and analyze diode-based filters, RC integrator and differentiator circuits, and transistor switching circuits, and multivibrators. CO 2. Investigate the characteristics of thyristors, including turn-on and turn-off mechanisms, for power control applications. CO 3. Analyze the performance of multi-stage , large-signal BJT amplifiers, and feedback circuits for stability and gain control. CO 4. Examine and evaluate DC biasing techniques for JFET and MOSFET, and perform small-signal analysis for BJT amplifiers.	

Name of the Programme : **B.E. in Electronics and Computer Science**
Course Code : **ECS-201**
Title of the Course : **Electronic Devices and Circuits Lab**
Number of Credits : **01**
Effective from AY : **2024-25**

Pre-requisites for the Course:	Elements of Electrical and Electronics Engineering	
Course Objectives:	**This course will enable students to:** 1. concepts, working, design, characteristics of Diodes, BJT, FET and SCRs, Transistors, amplifiers, and biasing techniques of transistors	
Contents:	**List of Programs /Experiments *(Following experiments should be conducted. A certified journal reporting the experiments conducted should be submitted at the end of the term)***	**No of Hours**
	1. Analysis of Rectifier with and without filters. 2. Design and Analysis of BJT Amplifiers 3. Analysis of RC-coupled Amplifier for Voltage Gain and its Frequency response 4. Design & analysis of BJT as a switch 5. Analysis of RC Integrator and Differentiator circuits 6. Design & analysis of BJT Astable multivibrator 7. Study of SCR (thyristor) characteristics 8. Study of FET characteristics 9. Design of Oscillators 10. Small Signal Analysis of BJT Amplifiers 11. Measurement of the DC parameters of FET biasing circuits 12. Demonstrate the effect of feedback in amplifiers	30
Pedagogy:	Integration of instructional learning, constructive thinking, inquiry-based, collaborative, experiential, and problem-solving approaches.	
References/ Readings:	**TEXTBOOKS:** 1. Mottershead; Electronic Devices and Circuits; PHI, 1st Edition, 1979, ISBN : 9788120301245 2. R. Boylestad and L. Nashelsky; Electronic Devices and Circuits; PHI, 11th Edition, 2013, ISBN: 978-0132622264 **Reference Books** 1. David Bell; Solid state Pulse circuits; Oxford University Press, 2nd Edition, 1981, ISBN: 978-0835970570 2. P.S. Bhimbra; Power Electronics; Khanna Publishers,7th Edition, 2022, ISBN: 9788195123124	
Course Outcomes:	**Upon completion of the course, students will be able to:** CO 1. Design and analyze diode-based filters, integrators, and differentiators for signal processing applications. CO 2. Investigate and implement transistor switching applications, multivibrators and thyristor circuits, emphasizing turn-on and turn-	

	off characteristics. CO 3. Analyze and design BJT-based amplifiers, including RC-coupled, multi-stage, power, and feedback amplifiers, along with oscillator circuits. CO 4. Examine and develop biasing techniques for BJT and FET circuits, including DC biasing, cascode amplifiers, and Darlington pairs.

Name of the Programme : **B.E. in Electronics and Computer Science**
Course Code : **ECS-202**
Title of the Course : **Microprocessor and Microcontroller**
Number of Credits : **03**
Effective from AY : **2024-25**

Pre-requisites for the Course:	Digital Electronics	
Course Objectives:	**This course will enable students to:** 1. An understanding of the Intel 8085 architecture. 2. An in-depth understanding of the 8051 Microcontroller architecture. 3. An ability to write Assembly language programs for a given task. 4. An ability to interface various I/O devices with the 8051 microcontroller.	
Contents:		**No of Hours**
Unit - 1	**Core of the Embedded System:** General Purpose and Domain Specific Processors, Microprocessors v/s Microcontrollers, Big-Endian vs. LittleEndian, RISC v/s CISC Architectures, Von Neumann v/s Harvard Architecture. **8085 Microprocessors:** 8085 MPU: Pin description, signals, Generating control signals, Detailed architecture of 8085A microprocessor, Communication and Bus Timings. **8085 Machine Cycles and Bus Timings**: Opcode Fetch machine cycle, Memory Read/Write machine cycle and I/O Read/Write machine cycle.	**10**
Unit -2	**8051 Architecture:** Introduction, 8051 Microcontroller Hardware: 8051 Oscillator and clock, Program counter and data pointer, A and B CPU register, Flags and PSW, Internal Memory, Internal RAM, Stack and Stack Pointer, SFRs, Internal ROM, Input/output Pins, ports and circuits, External Memory, Pipelining. **8051 Instruction Set & Programming:** Addressing Modes, Data movement instruction: External Data moves, Code memory Read-Only Data moves, PUSH and POP opcodes, Data exchanges. Example programs. Logic operation: Bit and Byte level, Rotate and Swap. Example Programs. Arithmetic operations: Flags, incrementing, decrementing, addition, subtraction, multiplication and division, decimal arithmetic. Bit manipulation instructions, example Programs.	**11**
Unit -3	**8051 Instruction Set & Programming:** Jump and Call instruction: Range, Jumps, Calls and subroutines, **8051 Interrupts:** Interrupts and Return, Interrupts SFRs, Interrupt Priority, Basic programming on Interrupts. **8051 Timers and Counters:** Timer/Counter SFRs and modes of	**12**

	operation, Calculating delay Problem using Timers. Programming on Timers and Counters. **8051 Serial Data input/output:** Serial Communication SFRs and modes of operations, Basic Programming.	
Unit -4	**Interfacing with 8051 based Microcontroller system:** I/O port programming, Interfacing LEDs, matrix keyboard, LCD, ADCs, DACs: Generating Triangular, Staircase and Sine wave using DACs, Temperature sensors, Relay, Opto-isolators & Stepper Motors. Interfacing of external Memory	**12**
Pedagogy:	Interactive, reflective, and inquiry-based methods, with a strong emphasis on critical thinking and problem-solving skills.	
References/ Readings:	**TEXTBOOKS:** 1. Gaonkar R. S.; "Microprocessor Architecture, Programming and Applications"; 5th Ed.; Penram International; 2007. ISBN-13: 9789380578040 2. Muhammad Ali Mazidi, Janice Gillispie Mazidi, The 8051 Microcontroller and Embedded Systems, 2nd Edition, Pearson Education, 2005. ISBN-13: 978-01311940213. 3. Kenneth J. Ayala; The 8051 Microcontroller, Architecture, Programming & applications, second edition; Penram International, 2004. ISBN-13: 9788131502006 4. Shibu K V; Introduction to Embedded Systems; McGraw Hill, 2nd Edition 2017. ISBN-13: 978-9339219680 **REFERENCE BOOKS:** 1. Hall D. V.; "Microprocessor and Interfacing-Programming and Hardware"; 2nd Ed.; Tata McGraw-Hill Publishing Company Limited; 2008. ISBN-13: 9780070601673 2. Subrata Ghoshal, Embedded Systems and Robots: Projects Using the 8051 Microcontroller, Cengage Learning, 2009. ISBN-13: 978-8131509890	
Course Outcomes:	**Upon completion of the course, students will be able to:** CO 1. Explain the microcomputer system concepts and architecture and working of 8085 CO 2. Explain the architecture of 8051 and analyze its instruction Set CO 3. Analyze Timers and Counters, Serial Communication and Interrupts and code the various applications based on these Concepts CO 4. Create Assembly language programs for 8051 & interface it with the hardware for a given application.	

Name of the Programme : **B.E. in Electronics and Computer Science**
Course Code : **ECS-203**
Title of the Course : **Microcontroller Lab**
Number of Credits : **01**
Effective from AY : **2024-25**

Pre-requisites for the Course:	Digital Electronics, Digital Electronics Lab	
Course Objectives:	**This course will enable students to:** 1. To develop in students assembly language programming skills and understanding of programming a microcontroller (8051). 2. To interface peripherals with 8051	
Contents:	**List of Programs /Experiments *(Following experiments should be conducted. A certified journal reporting the experiments conducted should be submitted at the end of the term)***	**No of Hours**
	1. Block transfer of data in memory using 8051 2. Searching numbers from a set of numbers in 8051 Internal RAM 3. Arithmetic Operations in 8051 4. Logic operations in 8051 5. Timers and Counters in 8051 6. Serial port programming using 8051 7. Interrupt programming using 8051 8. Interfacing of LEDs/ 7-Segment Display/ Switches to 8051 9. Interfacing of LCD to 8051 10. Interfacing of Relays/ Opto-isolators/ Keyboard to 8051 11. Interfacing of Motors to 8051	**30**
Pedagogy:	Integration of instructional learning, constructive thinking, inquiry-based, collaborative, experiential, and problem-solving approaches.	
References/ Readings:	**TEXTBOOKS:** 1. Gaonkar R. S.; "Microprocessor Architecture, Programming and Applications"; 5th Ed.; Penram International; 2007. ISBN-13: 9789380578040 2. Muhammad Ali Mazidi, Janice Gillispie Mazidi, The 8051 Microcontroller and Embedded Systems, 2nd Edition, Pearson Education, 2005. ISBN-13: 978-01311940213. 3. Kenneth J. Ayala; The 8051 Microcontroller, Architecture, Programming & applications, second edition; Penram International, 2004. ISBN-13: 9788131502006 4. Shibu K V; Introduction to Embedded Systems; McGraw Hill, 2nd Edition 2017. ISBN-13: 978-9339219680 **REFERENCE BOOKS:** 1. Hall D. V.; "Microprocessor and Interfacing-Programming and Hardware"; 2nd Ed.; Tata McGraw-Hill Publishing Company Limited; 2008. ISBN-13: 9780070601673	

	2. Subrata Ghoshal, Embedded Systems and Robots: Projects Using the 8051 Microcontroller, Cengage Learning, 2009. ISBN-13: 978-8131509890
Course Outcomes:	**Upon completion of the course, students will be able to:** CO 1. Develop and implement 8051 assembly language programs for tasks like data manipulation, sorting, and arithmetic/logic operations. CO 2. Design and implement embedded systems utilizing timers, counters, interrupts, and serial communication in the 8051. CO 3. Interface LEDs, switches, motors, sensors, displays, ADCs, and DACs with the 8051 microcontroller. CO 4. Analyze, debug, and optimize assembly language programs for 8051 microcontroller-based systems.

Name of the Programme : **B.E. in Electronics and Computer Science**
Course Code : **ECS-204**
Title of the Course : **Signal Processing**
Number of Credits : **04**
Effective from AY : **2024-25**

Pre-requisites for the Course:	Nil	
Course Objectives:	**This course will enable students to:** 1. Introduction to fundamental concepts of signals and systems, including their classifications and properties. 2. Developing an understanding of Fourier and sampling techniques for analyzing continuous-time and discrete-time signals. 3. Exploring the Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT) for efficient signal computation. 4. Knowledge on designing and analysing digital filters, including IIR and FIR filters. 5. Skills for implementing and realizing digital signal processing techniques in real-world applications	
Contents:		**No of Hours**
Unit - 1	**Introduction:** Definitions and concept of different types of signals; classification of signals: continuous time and discrete time signals; Causal and Non-Causal, Periodic and Non-periodic signals, Signal Energy and Power, Even and Odd Signals. Basic signal types: Exponential and Sinusoidal signal; Unit impulse and Unit step, Unit Ramp functions, Sinc function. Transformations of independent and dependant variable; **Systems:** Continuous time and Discrete time system and basic system properties. Linear time invariant (LTI) systems: Introduction, Discrete time LTI system, the convolution sum, Impulse Response of LTI system.	**11**
Unit -2	**Continuous-Time Fourier Transform (CTFT)**: Representation of aperiodic signals: Fourier transform of aperiodic signals and their properties; linearity, time shifting, differentiation, integration, conjugation and conjugate symmetry, time, frequency scaling, duality, Parseval's relation, convolution. (No derivation expected) **Discrete-Time Fourier Transform (DTFT)**: Representation of aperiodic signals; Fourier transform of aperiodic signals. Properties (No derivations expected) Relationship between Laplace and CTFT and relationship between Z Transform and DTFT. **Sampling of continuous time signals:** Periodic sampling, Frequency domain representation of sampling, Reconstruction	**11**

	of a Band limited Signal from its samples, Discrete-time processing of Continuous time signals.	
Unit -3	**The Discrete Fourier transform**: Introduction, Properties of Discrete Fourier Transform, Linear Convolution and Circular convolution using the DFT. Computation of the Discrete Fourier transform using classical formula method, circle method and matrix method. **Fast Fourier Transform**: Efficient computation of DFT, Decimation-in-time FFT (in-place computations), Decimation-in-Frequency FFT (in-place computations) (Radix – 2 only) (No derivations expected) **Realization of Discrete Structures:** Direct Form I and Direct Form II cascade and parallel.	**12**
Unit -4	**IIR Filters**: IIR Filter design techniques: Design of Discrete-time IIR filters from continuous-time filters. IIR Filter design by impulse invariant method and bilinear transformation. Design of IIR Filters: Butterworth low pass filter design using impulse invariance and bilinear transformation. **FIR Filters:** Magnitude and phase response of digital filters, frequency response of linear phase FIR filters. Design techniques for FIR filters: Windowing techniques (Rectangular, Hanning, Hamming, Blackman).	**11**
Pedagogy:	Interactive, reflective, and inquiry-based methods, with a strong emphasis on critical thinking and problem-solving skills	
Instructions	One or more assignments to be carried out on topics covered in each unit above- Total time allotted 15 hours for tutorials.	
References/ Readings:	**TEXTBOOKS:** 1. Oppenheim, A.V., Willsky, A.S., & Nawab, S.H. Signals and Systems *2nd* edition. Pearson, 1996.ISBN-13: 978-0138147570. 2. Oppenheim, A.V., & Schafer, R.W. Discrete-Time Signal Processing,3rd edition, Pearson, 2009.ISBN-13: 978-0131988422 3. Haykin, S., & Van Veen, B.V.*Signals and Systems,* 2nd edition. Wiley India, 2007.ISBN-13: 978-8126512652 4. Proakis, J.G., & Manolakis, D.G.*Digital Signal Processing:* Principles, Algorithms, and Applications, 4th edition. Pearson, 2007.ISBN-13: 978-0131873742 5. Sudhakar, A., & Shyammohan, *S.P.*Circuits and Networks: Analysis and Synthesis, 4th edition, Tata McGraw-Hill, 2002.ISBN-13: 978-0070699724 6. Salivahanan, S.Digital Signal Processing, 3rd edition. McGraw Hill Education (India), 2017.ISBN-13: 978-9332902831 **REFERENCE BOOKS:** 1. V. Krishnaveni & A. Rajeswari*,* Signals and Systems*.* Wiley India*, 2012.*	

	ISBN-13: 978-8126522897 2. D. Ganesh Rao & S. Tunga Signals and Systems: A Simplified Approach. Pearson Education, 2010.ISBN-13: 978-8131732298 3. R.E. Ziemer, W.H. Tranter & D.R. Fannin Signals and Systems: Continuous and Discrete, 4th edition. Prentice Hall, 1998, ISBN-13: 978-0130953230 4. S. Poornachandra & B. Sasikala ,Digital Signal Processing,3rd edition. Tata McGraw Hill Education Pvt Ltd., 2010.ISBN-13: 978-0070672796 5. P. Ramesh Babu , Digital Signal Processing (4th ed.). Scitech Publications (India) Pvt Ltd., 2012.ISBN-13: 978-8183710817 6. Sanjit K. Mitra, Digital Signal Processing: A Computer-Based Approach ,2nd edition, McGraw Hill Education, 2001.ISBN-13: 978-0072321050
Course Outcomes:	**Upon completion of the course, students will be able to:** CO 1. Apply Fourier transform techniques to analyse signals in the frequency domain. CO 2. Compute the Discrete Fourier Transform (DFT) and implement efficient FFT algorithms CO 3. Analyse different types of signals and their fundamental properties. CO 4. Design digital filters (IIR and FIR) for signal processing applications

Professional Electives

Name of the Programme : B.E Electronics and Computer Engineering
Course Code : ECM-225
Title of the Course : Computer Graphics
Number of Credits : 3
Effective from AY : 2024-25

Prerequisites for the Course:	Knowledge of Basic Mathematics	
Course Objectives:	The subject aims to provide the student with: 1. An introduction to fundamental concepts and theory of Computer Graphics. 2. Knowledge about computer graphics hardware and software used. 3. An understanding of drawing algorithms, polygon filling, clipping and transformation both in 2D and 3D graphics. 4. Ability to understand methods used in modelling motion in the virtual world.	
Content:		**No of Hours**
Unit-1	**Overview of graphics systems:** Raster scans systems, Random scan systems. **Output Primitives:** Points and lines, Line drawing algorithms, DDA, Bresenham's line algorithm, Circle generating algorithms, Properties of circles, Midpoint circle algorithm, Ellipse generating algorithm, Properties of Ellipses, Midpoint ellipse algorithm. **Filled area primitives:** Scan line polygon Fill algorithm, Inside – outside tests, Scan line fill of curved boundary, Boundary fill algorithm, Flood fill algorithm, Fill area functions.	**12**
Unit-2	**Two Dimensional Geometric Transformations:** Basic Transformations, Translation, Rotation, Scaling, Composite transformation: Translations, Rotations, Scaling, Other transformations- Reflection, Shear. **Two-Dimensional Viewing:** The viewing pipeline, Viewing coordinate reference frame, Window to viewport coordinate transformation, 2-D viewing functions. **Clipping operations:** Point Clipping, Line clipping, Cohen-Sutherland Line Clipping, Polygon Clipping, Sutherland Hodgeman Polygon clipping, Weiler-Atherton Polygon Clipping, Curve clipping, Text clipping.	**11**
Unit-3	**Three Dimensional Concepts:** 3-Dimensional display methods, Parallel projections, Perspective projection, Depth cueing, Surface rendering, Exploded and cutaway views. **Three-Dimensional Object representations:** Polygon surfaces, Polygon tables.	**11**

	Three Dimensional Geometric and Modeling transformations: Translation Rotation, Coordinate Axes, rotations, Scaling, Reflections, Shears **Curves and surfaces:** Shape description requirements, Parametric functions, Bezier methods, B-Spline methods.	
Unit- 4	**Visible surface detection algorithms:** Back – Face detection, Depth buffer method, A – Buffer method, Scan – Line method, Depth Sorting method, BSP- Tree method, Area Sub-division method. **Color Models and Color Applications:** Properties of light, Standard primaries, Chromaticity Diagram, XYZ Color model, CIE Chromaticity Diagram, RGB color model, YIQ Color Model, CMY Color Model, HSV Color Model, HLS Color Model. **Computer Animation:** Design of animation sequences, General computer animation functions, Raster Animations, Motion specification, Direct motion specification, Goal directed systems Kinematics and dynamics.	**11**
Pedagogy:	Interactive, reflective, and inquiry-based methods, with a strong emphasis on critical thinking and problem-solving skills	
References/ Readings:	**TEXTBOOKS:** 1. Donald Hearn, M. P. Baker, Computer Graphics, 2nd Edition; Prentice Hall of India Pvt. Ltd. 1999. **ISBN-10**: 8120309448 2. William Newman, Robert Sproull, Principles of Interactive Graphics, 2nd Edition, Tata McGraw hill publishing company Ltd.1979. ISBN-10: 0070463387 **REFERENCES**: 1. Rajiv Chopra, Computer Graphics: A Practical Approach, S. Chand publications, Revised Edition. ISBN-13: 978-8121935814 2. N. Krishnamurthy, "Introduction to Computer Graphics", Tata McGraw Hill. ISBN-13: 978-0070435360 3. Steven Harrington, Computer Graphics: A Programming Approach, 2nd Edition, Tata McGraw Hill. ISBN-13: 978-0071004725 4. Foley, Van Dam, Feiner, Hughes, "Computer Graphics: Principles and Practice", 2nd Edition, Addison- Wesley Publishing Company, 1997**. ISBN-13**: 978-0201848403	
Course Outcomes:	**Upon completion of the course, students will be able to:** CO 1. Identify and apply various graphic primitives used in generating computer graphics. CO 2. Illustrate and Apply techniques of 2d and 3d transformation and clipping used in graphical applications. CO 3. Analyse the basics of curves and surfaces used to represent graphical models. CO 4. Analyse techniques involved in visible surface detection, color models and computer animation.	

Name of the Programme : **B.E Electronics and Computer Engineering**
Course Code : **ECM-226**
Title of the Course : **Computer Graphics Lab**
Number of Credits : **01**
Effective from AY : **2024-25**

Prerequisites for the Course:	Knowledge of Programming like C, C++ and Basic Mathematics	
Course Objectives:	The subject aims to provide students with: 1. An introduction to the fundamental practical concepts of Computer Graphics. 2. Knowledge of computer graphics hardware and software. 3. The ability to develop effective programs to solve graphics programming challenges, including rendering different shapes. 4. Ability to implement methods used in modelling motion in the real world.	
Content:	**List of Programs /Experiments *(Following experiments should be conducted. A certified journal reporting the experiments conducted should be submitted at the end of the term)***	**No of Hours**
	1. Implement the Digital Differential Analyzer (DDA) Line Drawing Algorithm 2. Implement Bresenham's Line Drawing Algorithm 3. Implement the Midpoint Circle Generation Algorithm 4. Display Text in Various Sizes, Colors, and Fonts Using Graphics Functions 5. Create Simple 2D Shapes (House, Car, Fish, or Human) Using Basic Primitives 6. Implement Basic 2D Transformations: Translation, Scaling, Rotation, Shearing, and Reflection 7. Implement Flood Fill Algorithm to Fill a Closed Shape with Color 8. Implement the Scanline Polygon Fill Algorithm 9. Implement Cohen-Sutherland Line Clipping Algorithm 10. Implement Bézier Curve Generation Using Control Points	**30**
Pedagogy:	Interactive, reflective, and inquiry-based methods, with a strong emphasis on critical thinking and problem-solving skills	
References/ Readings:	**TEXTBOOKS:** 1. Donald Hearn, M. P. Baker, Computer Graphics, 2nd Edition; Prentice Hall of India Pvt. Ltd. 1999. 2. William Newman, Robert Sproull, Principles of Interactive Graphics, 2nd Edition, Tata McGraw hill publishing company Ltd.1979. **REFERENCES**: 1. Er. Rajiv Chopra, Computer Graphics (A Practical Approach), S. Chand publications, Revised Edition. 2. N. Krishnamurthy, Introduction to Computer Graphics, Tata McGraw	

	Hill 3. Steven Harrington, Computer Graphics, 2nd Edition, Tata McGraw Hill. 4. Foley, Van Dam, Feiner, Hughes, Computer Graphics: Principles and Practice, 2nd Edition, Addison- Wesley Publishing Company, 1997
Course Outcomes:	**Upon completion of the course, students will be able to:** CO 1. Implement Line drawing algorithm, circle generating algorithm and ellipse generating algorithm. CO 2. Apply clipping and filling techniques for modifying an object. CO 3. Implement programs that demonstrate geometrical transformations. CO 4. Implement curves, colour modelling and animation.

Name of the Programme : **B.E. in Electronics and Computer Science**
Course Code : **ECS-223**
Title of the Course : **Soft Computing**
Number of Credits : **03**
Effective from AY : **2024-25**

Pre-requisites for the Course:	Mathematical background, Proficiency with Algorithms	
Course Objectives:	This course will enable students to: 1. An Introduction to Soft Computing Techniques and it's applications 2. An Understanding of Neural Networks and its training methodologies 3. An Understanding of Fuzzy Logic and Fuzzy Inference Systems 4. An Understanding of Genetic Algorithms and Evolutionary Algorithms 5. An Introduction to Deep Learning, Expert Systems	
Contents:		**No of Hours**
Unit - 1	**Introduction to Soft Computing:** Soft Computing versus Hard Computing, Types of Soft-Computing Techniques and Hybrid Systems. Types of Problems: Classification, Functional Approximation, Optimizations. Expert Systems: Expert System Design. **Introduction to Neural Networks:** Mc-Culloch Pitts neuron model, Activation functions & basic gates. Training algorithms- Hebbian learning rule, perceptron learning rule, Delta learning rule, Widrow-Hoff learning rule **Multilayer Networks:** Error back propagation algorithm or generalized delta rule. Setting parameter values and design considerations for Neural Networks.	**12**
Unit -2	**Unsupervised Learning:** Clustering, simple competitive learning algorithm, LVQ algorithm, Self-Organizing Maps, Adaptive resonance theory **Associative Memories:** Hopfield network, Brain-state-in-a-box network, Bi-directional associative memory **Deep Neural Networks:** What is deep learning? Common architectural principles of Deep Networks, Autoencoders and its types, Convolutional neural networks: Architecture, Convolution operation, Motivation and Pooling, Variants of Basic Convolution Function	**12**
Unit -3	**Fuzzy Logic:** Crisp vs Fuzzy Logic, Classical (Crisp) Sets: Operations & Properties, Fuzzy Sets: Operations & Properties, Membership Functions and types, Fuzzy Logic Operators, Classical relations (Cartesian product) and Fuzzy relations: Cardinality, Operations, Properties and Composition, Tolerance and Equivalence Relations. Fuzzy Implication, Aggregation, Defuzzification & types,	**11**

	Lambda-cuts or Alpha-cuts for fuzzy, Design of Fuzzy Inference Systems.	
Unit -4	**Genetic Algorithms:** Concept & Working- Solution, Initial Population, Genetic Operators, Fitness Function, Stopping Condition. Fitness Scaling, Selection, Mutation, Crossover, Other Genetic Operators, Diversity. **Other Evolutionary Algorithms:** Particle Swarm Optimization, Ant Colony Optimizations, Artificial Bee Colony & Cuckoo Search Algorithm, Differential Evolution, Travelling Salesman Problem.	**10**
Pedagogy:	Interactive, reflective, and inquiry-based methods, with a strong emphasis on critical thinking and problem-solving skills	
References/ Readings:	**TEXTBOOKS:** 1. Anupam Shukla, Ritu Tiwari, Rahul Kala; Real Life Applications of Soft Computing; 2010, CRC Press,1st Edition,ISBN:9781439822876 2. S. N. Sivanandan and S. N. Deepa, Principles of Soft Computing, 3rd Edition, WileyIndia,3rd Edition,ISBN:9788126527410 3. Kishan Mehrotra, Chilukuri Mohan, Sanjay Ranka; Elements of Artificial Neural Network; Penram Publications. ISBN:9788187972204 4. Patterson, Josh, and Adam Gibson. Deep learning: A practitioner's approach. O'Reilly Media, Inc. ISBN: 9781491914250 **REFERENCE BOOKS:** 1. Rajasekaran, G. A. Vijayalakshmi Pai; Neural Networks, Fuzzy Logic and Genetic Algorithm, PHI Learning Pvt. Ltd June 2013. ISBN: 9788120321860 2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press. ISBN:9780262035613 3. J. Zurada; Introduction to Artificial neural network; Jaico Publications, 2012, 1st Edition. ISBN: 9788172249322 4. Charu C. Aggarwal, Neural Networks and Deep learning, Springer Publications. ISBN:9783319944623 5. Timothy J. Ross; Fuzzy Logic with Engineering Applications, 3 rd Ed., Wiley-India, ISBN: 9788126531264	
Course Outcomes:	**Upon completion of the course, students will be able to:** CO 1. Explain different types of Soft Computing techniques, Expert Systems and its applications CO 2. Apply Evolutionary Algorithms to optimization problems CO 3. Design Fuzzy Inference Systems to solve Real-Life Problems CO 4. Design Neural Networks and understand deep neural networks and its applications	

Name of the Programme : **B.E. in Electronics and Computer Science**
Course Code : **ECS-224**
Title of the Course : **Soft Computing Lab**
Number of Credits : **01**
Effective from AY : **2024-25**

Pre-requisites for the Course:	Basics of Mathematics and Python/MATLAB/Octave	
Course Objectives:	**This course will enable students to:** 1. Be proficient in implementing various neural network models and training algorithms. 2. Develop fuzzy inference systems 3. Master in employing optimization techniques for solving optimization problems efficiently. 4. Be competent in implementing deep learning models such as auto encoders and convolutional neural networks.	
Contents:	**List of Programs /Experiments j*(Following experiments should be conducted. A certified journal reporting the experiments conducted should be submitted at the end of the term)***	**No of Hours**
	Neural Network Fundamentals: 1. Study and Implementation of Activation Functions in Neural Networks 2. Implement McCulloch-Pitts (MCP) and Perceptron Networks for Basic Logic Gates 3. Implement Various Learning Rules in Neural Networks (e.g., Hebbian, Delta Rule, Widrow-Hoff) 4. Implement the Error Backpropagation Algorithm for Multi-Layer Perceptron (MLP) **Unsupervised Learning and Clustering:** 5. Implement Self-Organizing Feature Maps (SOFM), SCL, or Learning Vector Quantization (LVQ) for Clustering 6. Implement Adaptive Resonance Theory (ART) Network for Pattern Clustering **Fuzzy Logic Systems:** 7. Implement Basic Fuzzy Logic Operations (Union, Intersection, Complement) 8. Implement and Visualize Various Fuzzy Membership Functions Design a Fuzzy Inference System (FIS) for a Real-World Problem **Optimization Algorithms:** 9. Implement a Genetic Algorithm for Solving Optimization Problems 10. Implement Particle Swarm Optimization (PSO) Algorithm/ Ant Colony Optimization (ACO) Algorithm	**30**

	11. Design and Implementation of Deep Learning Models (Autoencoders/CNN)	
Pedagogy:	Integration of instructional learning, constructive thinking, inquiry-based, collaborative, experiential, and problem-solving approaches.	
References/ Readings:	**TEXTBOOKS:** 1. Sivanandam, S.N., Deepa, S.N. "Principles of Soft Computing", Second Edition, Wiley Publication. ISBN:9788126527410 2. Rajasekaran, S., Vijayalakshmi Pai, G.A. "Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI Learning. ISBN: 9788120321860 3. Hagan, M.T., Demuth, H.B., Beale, M.H. "Neural Network Design", Cengage Learning, India Edition. ISBN: 9788131519774 **Reference Books** 1. Kumar, Satish. "Neural Networks – A Classroom Approach", Second Edition, TMH. ISBN: 9781259006168 2. Patterson, Josh, and Adam Gibson. Deep learning: A practitioner's approach. " O'Reilly Media, Inc.", 2017. ISBN: 9781491914250	
Course Outcomes:	**Upon completion of the course, students will be able to:** CO 1. Explain different types of Soft Computing techniques, Expert Systems and its applications CO 2. Apply Evolutionary Algorithms to optimization problems CO 3. Design Fuzzy Inference Systems to solve Real-Life Problems CO 4. Design Neural Networks and understand deep neural networks and its applications	