Course Structure and Syllabus

under

National Education Policy (NEP)-2020 Scheme

for

M. Sc. Programme in Electronics

(Academic Session 2025 and onwards)

P. G. Department of Electronics and Instrumentation Technology

University of Kashmir, Hazratbal, Srinagar-6, J&K

Introduction:

The M.Sc. Electronics Programme, launched by the University of Kashmir in 1985, aims to foster research and teaching in diverse electronics domains. Unlike traditional engineering or engineering technology programs, it bridges the gap between Science, Engineering, and Technology, focusing on research and development. The programme is designed to meet the growing demand for electronics professionals in R&D, teaching, and both public and private sectors. It provides a comprehensive understanding of contemporary electronics, emphasizing the design, simulation, and construction of electronic devices and systems, with flexibility for students to tailor their studies to their interests.

Features:

The M.Sc. Electronics program has been revised in line with NEP 2020 as a flexible multi-entry multi-exit program, with student-centered curriculum that meets academic and industry needs. The revision introduces the Academic Bank of Credits (ABC), allowing students to transfer credits across institutions and tailor their studies to individual interests. Students can focus on areas such as VLSI, embedded systems, communication technologies, signal processing, and AI. Emphasizing research and interdisciplinary learning, the program fosters collaboration and advances in both theory and application. It also includes opportunities for skill development and industry apprenticeships.

Programme Learning Outcomes (PLOs)

PLO1: Knowledge and Understanding

Develop in-depth knowledge of electronics, including electronic devices and circuit theory, VLSI, signal processing, communication systems, and embedded systems.

PLO2: Skills / Technical Skills

Acquire the ability to use laboratory instruments, simulation software, and programming tools for modeling and analysis of electronic devices, circuits, and systems, and train students for ESDM in tune with National Policy on Electronics 2019.

PLO3: Application of Knowledge

Apply theoretical concepts to design, simulate, and troubleshoot analog and digital electronic circuits and systems for solving real-world problems.

PLO4: Communication Skills

Communicate effectively through technical reports, presentations, and documentation using appropriate scientific and technical language.

PLO5: Critical Thinking

Analyze, interpret, and evaluate circuits and systems, and use the insights to solve complex problems.

PLO6: Ethics

Develop ethical and professional behaviour in experimental work, design decisions, and dissemination of knowledge.

PLO7: Life-long Learning

Recognize the need for continuous learning (upskilling/reskilling) and adopt emerging tools, technologies, and methods in for tackling real-life problems.

PLO8: Creativity

Exhibit innovative thinking and creativity in the design and implementation of electronic circuits, systems, and solutions.

PLO9: Research Aptitude

Develop the ability to plan, conduct, and report on experimental and simulation-based investigations using state-of-the-art.

PLO10: Problem Solving

Identify, formulate, and solve electronic science/engineering problems using a systematic approach based on scientific/engineering principles and practices.

Question Paper pattern and Distribution of marks for External & Internal Examination for PG Programme under NEP 2020:

Course Type	Major/ Minor					
Credits	4		3		2	
Descriptive Questions:	Time: Two and a Half Hours					
Break up of Semester End & Internal Marks in each Course	External	Internal	External	Internal	External	Internal
	Questions× Marks		Questions× Marks		Questions× Marks	
	4× 18=72*	4× 7=28*	3× 18=54*	3× 7=21*	2× 18=36*	2× 7=14*
Section A: 08 Short Answer Type (in about 10 to words)	8× 2=16 Marks	As prescribed by BOS	8× 1=8 Marks	As prescribed by BOS	8× 1=8 Marks	As prescribed by BOS
Section B: 04 Medium Answer Type with alternatives (in about 200 to 250 words)	4× 6=24 Marks		4× 4=16 Marks		4× 3=12 Marks	
Section B: 02 out of 04 Long Answer Type (in about 400 to 500 words) questions to be attempted	2× 16=32 Marks		2× 15=30 Marks		2× 8=16 Marks	
Total Marks in each Course	4× 25=100* Marks		3× 25=75* Marks		2× 25=50* Marks	

*N.B: The distribution of the marks is based on the rationale that 1 (one) credit=25 marks (External 18 + Internal 07)

Framework for Two-Year/ One-Year Master's Programme in Electronics under NEP 2020 as per (CW+CW) Scheme

Semester	Course Type	Credits	Course Code	Course Title	Hours		Credits
					Theory (L)	Lab (P)	
1	Core	(3+1)	MELECEI125	Electronic Instrumentation	3	2	4
	Core	(3+1)	MELECDS125	Digital Signal Processing	3	2	4
	Core	(3+1)	MELECES125	Embedded Systems and Internet of Things	3	2	4
	Core	(3+1)	MELECCE125	Communication Electronics – II	3	2	4
		(Discipline Centric Electives: Select any Two)					
	DCE	(3+1)	MELEDFE125	Foundations of Electronics-I	3	2	4
	DCE	(3+1)	MELEDEF125	Foundations of Electronics-II	3	2	4
	DCE	(3+1)	MELEDEM125	Essential Mathematics for AI	3	2	4
	DCE	(3+1)	MELEDOE125	Opto-Electronics	3	2	4
Total Credits: 24							
2	Core	(3+1)	MELECPE225	Power Electronics	3	2	4
	Core	(3+1)	MELECCS225	Control Systems	3	2	4
	Core	(3+1)	MELECDA225	Digital and Analog IC Design	3	2	4
	Core	(3+1)	MELECEW225	Electromagnetic Waves and Antennas	3	2	4
	(Discipline Centric Electives: Select Any two)						
	DCE	(3+1)	MELEDFE225	Foundations of Electronics-III	3	2	4
	DCE	(3+1)	MELEDAM225	Applied Mathematics and Programming	3	2	4
	DCE	(3+1)	MELEDDS225	Digital System Design and VHDL	3	2	4
	DCE	(3+1)	MELEDAI225	Introduction to AI and Machine Learning	3	2	4
Total Credits: 24							
3	Core	(3+1)	MELECPS325	Physics of Semiconductor Devices	3	2	4
	Core	(3+1)	MELECMS325	Material Sciences and VLSI Technology	3	2	4

Semester	Course Type	Credits	Course Code	Course Title	Hours		Credits
					Theory (L)	Lab (P)	
	Core	(3+1)	MELECMC325	Mobile Communication and Networks	3	2	4
	Core	(3+1)	MELECME325	Microwave Engineering	3	2	4
	(Discipline Centric Electives: Select any Two)						
	DCE	(3+1)	MELEDAM325	Advanced Microprocessors and Microcontrollers	3	2	4
	DCE		MELEDDA325	Introduction to Data Analytics	3	2	4
	DCE		MELEDNN325	Neural Networks and Deep Learning	3	2	4
	DCE		MELEDPA325	Programming for AI	3	2	4
Total Credits 24							
4	Project	(0+6)	MELEPPI425	Project/Internship	0	12	6
		(2)	MELEPIT425	Industrial Training and Seminar Work	0	4	2
	(Discipline Centric Electives: Select Four, One from each Basket)						
	DCE	(3+1)	MELEDES425	Embedded System Design with ARM Cortex Microcontrollers	3	2	4
			MELEDLC425	Lightweight Cryptography	3	2	4
	DCE	(3+1)	MELEDNE425	Nanoelectronics	3	2	4
			MELEDNC425	Neuromorphic Computing	3	2	4
	DCE	(3+1)	MELEDDI425	Digital Image Processing	3	2	4
			MELEDMS425	Multimedia Signal Coding and Communication	3	2	4
	DCE	(3+1)	MELEDCI425	Computational Intelligence and Wireless Communications	3	2	4
			MELEDWE425	Wearable Electronics and Antennas	3	2	4
Total Credits: 24							

Notes:

1. The Department is also offering the program under **(CW + R)** structure for 2-year /1-year PG Program in Electronics. Under this scheme the curricular framework for First Three Semester's would be same however; the structure of Semester 4 would be as follows:
2. The course framework for one year PG Program in Electronics would be same as that of last two semesters of two-year program under the respective schemes.

Syllabus for semester 4 under (CW+R) Scheme

Semester	Course Type	Credits	Course Code	Course Title	Hours		Credits
					Theory (L)	Lab (P)	
4	Project	(2+2)	MELEPPI425	Project/Internship	0	24	12
		(0+12)	MELEPIT425	Industrial Training and Seminar Work	2	4	4
	Discipline Centric Electives (Select two, one from each basket)						
	DCE	(3+1)	MELEDES425	Embedded System Design with ARM Cortex Microcontrollers	3	2	4
			MELEDDI425	Digital Image Processing	3	2	4
			MELEDLC425	Lightweight Cryptography	3	2	4
			MELEDMS425	Multimedia Signal Coding and Communication	3	2	4
	DCE	(3+1)	MELEDNE425	Nanoelectronics	3	2	4
			MELEDCI425	Computational Intelligence and Wireless Communications	3	2	4
			MELEDNC425	Neuromorphic Computing	3	2	4
			MELEDWE425	Wearable Electronics and Antennas	3	2	4
Total Credits: 24							

SEMESTER - I

MELECEI125: Electronic Instrumentation | **Course Type: Core**

Hours			Total Credits	Maximum Marks				Time Allowed for Theory Examination
					End Term			
Lecture	Tutorial	Practical		Internal	Theory	Lab	Total	
3	0	2	4	28	54	18	100	1 ¾ Hours

Course Learning Outcomes (CLOs):

Unit-Wise CLOs	After the completion of this course the students will be able to:
MELECEI125.1	Analyze transduction principles and evaluate the suitability of transducers for measurement applications.
MELECEI125.2	Evaluate display and recording systems to interpret and present measurement data effectively.
MELECEI125.3	Apply oscilloscope techniques to analyze waveforms, frequency, and phase in electronic systems. Examine and utilize signal generators and analyzers to assess circuit and system performance.
MELECEI125.4	Conduct laboratory experiments using instrumentation tools to validate theoretical concepts and system behavior and Analyze measurement systems with respect to their static/dynamic characteristics and error evaluation.

Detailed Syllabus:

THEORY (3 Credits):

Unit I: Measurement and Meters (15 Hrs.)

Measurement and its Significance, methods of measurement. Basic definitions of instruments, Classification of instruments, Performance parameters: Accuracy, Precision, Sensitivity, Resolution, Errors, Significant figure. D'Arsonval movement: Construction and working, DC ammeter and voltmeter, Ammeter and Voltmeter loading, DC ohmmeters (Series and Shunt type). Rectifier type of instruments (half wave and full wave), Multi range AC voltmeter, Peak to peak AC voltmeter, Single phase wattmeter and single-phase watt-hour meter. Digital frequency meters and time meters, Digital Voltmeter: General Characteristics, Ramp type DVM, Staircase ramp DVM, Successive approximation type DVM, Integrating type DVM Digital ohm meter, Digital capacitance meter, Digital modulation index meter, Digital quality factor meter.

Unit II: Bridges and Sensors (15 Hrs.)

Bridges: Types, Condition for Bridge balance. DC Bridges: Wheatstone Bridge, Kelvin double Bridge. AC Bridges: Maxwell Bridge, Hay bridge, Schering Bridge, Wien bridge, Sensors: Classification of sensors, characteristics and choice of sensors; Resistance, Capacitance, Inductive, Piezoelectric, Thermoelectric, Hall effect, Photoelectric, Techogenerators, Measurement of displacement, velocity, acceleration, force, torque, strain, speed, and sound, temperature, pressure, flow, humidity, thickness, pH, position.

Unit III: Oscilloscope and Signal Analyzers (15 Hrs.)

Block diagram of CRO, Electrostatic and electromagnetic focusing (Qualitative), Horizontal and vertical deflection system, Vertical amplifier, Horizontal amplifier, Sweep generators, vertical input and sweep generator, Signal synchronization, Measurement of voltage, Frequency and phase angle. Dual trace Oscilloscope, Dual beam

Oscilloscope, Sampling Oscilloscope, Digital Storage Oscilloscope. Function generator, Harmonic distortion analyzer, Wave analyzer, Spectrum Analyzer, Spectrum Analyzer characteristics.

Unit IV: Laboratory Work (1 Credit: 30 Hrs.)

Note: The student is required to attempt at least 10 experiments

1. Design of single and multi-range ammeters.
2. Design of single and multi-range voltmeters.
3. Design of single and multi-range ohmmeters.
4. Measurement of Resistance by Wheatstone bridge.
5. Measurement of small resistances using Kelvin double bridge
6. Measurement of Inductance using Maxwell Bridge.
7. Measurement of Capacitance using Hay Bridge.
8. Measurement of Capacitance using Schering Bridge.
9. Measurement of Frequency using Wien bridge,
10. Study of Oscilloscope.
11. Measurement of voltage, Frequency and phase angle using Oscilloscope.
12. Measurement of pressure using Strain gauge.
13. Measurement of Force using Piezo- electric transducer,
14. Measurement of Temperature using Thermistor/Thermocouple.
15. Measurement of Displacement using Linear Variable Differential Transformer (LVDT).

Books Recommended:

1. W. D. Cooper, A. D. Helfrick, Modern Electronic Instrumentation and Measurement Techniques, PHI.
2. David E. Bell, Electronic Instrumentation and measurement, Oxford University Press India.
3. Alan S. Morris, Measurement and Instrumentation Principles, Butterworth-Heinemann.
4. T. S. Rathore, Digital Measurement Techniques, Narosa Publishing House, New Delhi

CLO-PLO matrix for the courseMELECEI125(ELECTRONIC INSTRUMENTATION)

Unit-Wise CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	Average CLO
MELECEI125.1	3	3	3	2	3	2	2	2	2	3	2.5
MELECEI125.2	3	3	3	2	3	2	2	2	2	3	2.5
MELECEI125.3	3	3	3	2	3	2	2	2	2	3	2.5
MELECEI125.4	3	3	3	2	3	2	2	3	3	3	2.7
Average PLO	3	3	3	2	3	2	2	2.25	2.25	3	2.55

SEMESTER - I

MELECDS125: Digital Signal Processing — **Course Type: Core**

Hours			Total Credits	Maximum Marks				Time Allowed for Theory Examination
					End Term			
Lecture	Tutorial	Practical		Internal	Theory	Lab	Total	
3	0	2	4	28	54	18	100	1 ¾ Hours

Course Learning Outcomes (CLOs):

Unit-Wise CLOs	After the completion of this course the students will be able to:
MELECDS125.1	Describe discrete-time signals and systems, explain A/D conversion processes (sampling, aliasing, quantization, encoding), and analyze correlation properties of LTI systems.
MELECDS125.2	Apply Fourier, DFT, and Z-transform methods to signals and systems, and implement efficient FFT algorithms for spectral analysis.
MELECDS125.3	Design and evaluate FIR and IIR filters using standard techniques, and compare their frequency responses and structural characteristics.
MELECDS125.4	Use MATLAB DSP toolbox to perform convolution, correlation, spectral analysis, and design/validate digital filters with windowing methods.

Detailed Syllabus:

THEORY (3 Credits):

Unit I: Discrete Time Signals and Systems (15 Hrs.)

Review of Signals and Discrete Time Systems, A/D Conversion Process: Sampling, Frequency Relationships, Aliasing, Quantization, Encoding, Anti-Aliasing Filter. Classification of Discrete Time Signals, Manipulation of Discrete time signals. Systems, Introduction to LTI systems, Correlation: Cross- Correlation and Auto- Correlation, Properties of Auto-Correlation and Cross-correlation.

Unit II: Discrete Time Signal Transforms (15 Hrs.)

Introduction to Fourier Series and Fourier Transform, Frequency Domain Sampling, DTFT, Introduction to DFT, Properties of DFT, Spectrum Analysis using DFT, Efficient Computation of DFT: FFT algorithms, Properties of WN, Radix- 2 FFT algorithms: Decimation in Time and Decimation in Frequency FFT algorithms, Z transform and its properties.

Unit III: Digital Filter Design (15 Hrs.)

Frequency response for rational system functions, Basic structures for IIR systems: Design of IIR from continuous time filters, Frequency transformation of IIR low pass filters, Linear systems with generalized linear phase; Basic network structures for FIR filters; Design of FIR filters; window functions. Frequency sampling technique. Comparison of FIR and IIR filters,

Unit IV: Laboratory Work (1 Credit: 30 Hrs.)

Note: The student is required to attempt at least 10 experiments

1. Generation of basic signals (sine, cosine, square, sawtooth)
2. Sampling and quantization of a signal
3. Demonstration of Aliasing
4. Operations on a signal: Amplitude scaling, Time shifting, Time reversal, Time scaling
5. Signal addition and subtraction, multiplication and division
6. Convolution of two signals
7. Cross-correlation of two signals
8. Auto-correlation of a signal
9. Discrete Fourier Transform (DFT) of a signal and Inverse Discrete Fourier Transform (IDFT)
10. Fast Fourier Transform (FFT) and Inverse FFT
11. Power spectral density calculation
12. Signal filtering using low-pass filter
13. Signal filtering using high-pass filter
14. Study various Window functions
15. FIR filter design (using window method)
16. FIR filter design (using frequency sampling method)
17. IIR filter design

Books Recommended:

1. A. V. Oppenheim and R. W. Shafer, Digital Signal Processing, Prentice Hall.
2. J. G. Proakis and DG Manolakis, Introduction to digital Signal Processing, Prentice Hall
3. Roman Kuc, Introduction to Digital Signal Processing, McGraw Hill Book Co.

CLO-PLO matrix for the courseMELECDS125 (DIGITAL SIGNAL PROCESSING)

Unit-Wise CLOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	Average CLO
MELECDS125.1	3	3	2	1	2	1	2	2	2	2	2
MELECDS125.2	3	3	3	1	3	1	2	2	2	3	2.3
MELECDS125.3	3	3	3	1	3	1	2	2	2	3	2.3
MELECDS125.4	3	3	3	3	3	2	2	3	3	3	2.8
Average PLO	3	3	2.75	1.5	2.75	1.25	2	2.25	2.25	2.75	2.35

SEMESTER - I

MELECES125: Embedded Systems and Internet of Things — **Course Type: Core**

Hours			Total Credits	Maximum Marks				Time Allowed for Theory Examination
				Internal	End Term		Total	
Lecture	Tutorial	Practical			Theory	Lab		
3	0	2	4	28	54	18	100	1 ¾ Hours

Course Learning Outcomes (CLOs):

Unit-Wise CLOs	After the completion of this course the students will be able to:

MELECES125.1	To distinguish embedded Systems from general purpose computer Systems, Classify the Embedded Systems based on functionality and applications, Identify the core components of embedded systems, Quality attributes. Understanding of soft and hard real-time systems. Evaluate the trade off in cost, power performance and reliability
MELECES125.2	Understand the fundamentals of Real-time embedded systems and RTOS, Evaluation of the real-time design issues with respect to timing and scheduling. Evaluate the hardware consideration, Case studies of some real-time operating systems.
MELECES125.3	Understand the fundamentals, architecture and protocols. Identify hardware and software components of IoT systems, Understand IoT communication technologies. Application of IoT principles to real-world applications across various domains.
MELECES125.4	Demonstrate the Proteus for circuit design and simulation of development boards. Conduct the laboratory experiments to integrate various sensors with the various development boards viz. Arduino Uno, Node MCU, Raspberry Pi etc. Integration of cloud for developing IoT applications.

Detailed Syllabus:

THEORY (3 Credits):

Unit I: Introduction to Embedded Systems (15 Hrs.)

Embedded Systems and general-purpose computer systems, Classifications, applications and purpose of embedded systems. Core of Embedded Systems, Application specific ICs, Programmable logic devices, COTS, sensors and actuators, communication interface, embedded firmware, Characteristics and quality attributes of embedded systems: Characteristics, Operational and non-operational quality attributes. Hard and Soft Real time systems, Hardware-software Co-design.

Unit II: Real Time Embedded Systems (15 Hrs.)

Introduction to Real Time Embedded Systems. Real-time operating system for embedded systems. Real time design issues with examples, Hardware considerations (logic states, CPU, Memory. Architectures), Real time building blocks, Real time case studies (Micro C/OSII, RT Linux, VxWorks, Tiny OS).

Unit III: Introduction to Internet of Things (IoT) (15 Hrs.)

IoT fundamentals, IoT Architecture and protocols, Overview of IoT networks, components (Hardware & Software) of IoT, IoT Communication Technologies (3G, 4G & 5G, IEEE 802.15.4, IEEE 802.11), Challenges in IoT. Layering concepts, IoT Services and Standards. Application of IoT.

Unit IV: Laboratory Work (1 Credit: 30 Hrs.)

Note: The student is required to attempt at least 10 experiments

Simulation of basic circuits and development boards using VSM software (Proteus), Sensor integration, Introduction to IoT supported hardware platforms - Arduino, ESP32, Raspberry Pi, Beagle bone and ARM Cortex processors. Operating System installation of Raspberry Pi, Sensor Integration with Arduino Uno and Raspberry Pi, Cloud integration with Hardware development boards.

Books Recommended:

1. K. V. Shibu, Introduction to Embedded Systems, Mc. Graw Hills.
2. Raj Kamal, Embedded Systems, Tata Mc Graw Hill
3. Lyla B. Das, Embedded Systems, Pearson
4. Kamlesh Lakhwani, Internet of Things, BPB Publications.
5. Maneesh Rao, Internet of Things with Raspberry Pi, Packet Publications.

CLO-PLO matrix for the courseMELECES125 (EMBEDDED SYSTEMS and INTERNET of THINGS)

Unit-Wise CLOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	Average CLO
MELECES125.1	3	3	2	1	3	1	1	2	2	3	2.1
MELECES125.2	3	3	3	1	3	1	1	3	2	3	2.3
MELECES125.3	3	3	3	1	3	1	1	3	2	3	2.3
MELECES125.4	3	3	2.5	1.2	3	1	1	2	2	3	2.17
Average PLO	3	3	2.62	1.05	3	1	1	2.5	2	3	2.1

SEMESTER - I

MELECCE125: Communication Electronics-II — **Course Type: Core**

Hours			Total Credits	Maximum Marks				Time Allowed for Theory Examination
Lecture	Tutorial	Practical		Internal	End Term		Total	
					Theory	Lab		
3	0	2	4	28	54	18	100	1 ¼ Hours

Course Learning Outcomes (CLOs):

Unit-Wise CLOs	After the completion of this course the students will be able to:
MELECCE125.1	Analyze analog and digital modulation techniques and evaluate their performance.
MELECCE125.2	Apply principles of noise analysis and channel capacity to communication systems.
MELECCE125.3	Examine transmitter and receiver subsystems for analog and digital communication.
MELECCE125.4	Conduct experiments and simulations on communication systems to validate theoretical principles.

Detailed Syllabus:

THEORY (3 Credits):

Unit I: Analog Modulation techniques (15 Hrs.)

Analog communication systems: AM, FM, PM, DSB-SC, SSB, VSB modulation and demodulation. Performance metrics like power efficiency, SNR, and bandwidth.

Unit II: Digital Modulation techniques (15 Hrs.)

Digital modulation techniques: ASK, FSK, PSK, QPSK, QAM. Error probability, constellation diagrams, BER analysis in noisy channels.

Unit III: Noise in communication systems (15 Hrs.)

Noise in communication systems, system performance under AWGN channels, concepts of Shannon capacity and coding efficiency. Transmitter and receiver architectures: superheterodyne receiver, block diagrams, mixers, oscillators, filters. Introduction to modern communication systems including mobile and satellite communication.

Unit IV: Laboratory Work (1 Credit: 30 Hrs.)

Note: The student is required to attempt at least 10 experiments

1. Generation and detection of AM signals.
2. Generation and detection of FM signals.
3. Study of phase modulation and demodulation.
4. Study of superheterodyne receiver model.
5. Simulation of ASK modulation and demodulation using MATLAB/Simulink.
6. Simulation of PSK modulation and demodulation.
7. Simulation of QPSK modulation and demodulation.
8. BER analysis of digital modulation schemes in noisy channels.
9. Study of mixers and oscillators in transmitter systems.
10. Study of filters and channel equalization techniques.
11. Study of communication system using SDR kits.

Books Recommended:

1. Simon Haykin, Digital Communication, Wiley.
2. K. Shan Mugam, Digital and Analog Communication, Wiley.
3. Wayne Tomasi, Advanced Electronic Communication Systems, Pearson Education.
4. Bernard Sklar, Digital Communications, Pearson Education.
5. John G. Proakis, Digital Communications, McGraw- Hill International Editions.
6. Ranjan Bose, Information Theory Coding and Cryptography, TMH.

CLO-PLO matrix for the course MELECCE125 (Communication Electronics-II)

Unit-Wise CLOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	Average CLO
MELECCE125.1	3	3	3	2	2	1	2	3	2	3	3
MELECCE125.2	3	3	3	2	2	1	2	3	2	3	3
MELECCE125.3	3	3	3	2	2	1	2	3	2	3	3
MELECCE125.4	3	3	3	2	2	1	2	3	2	3	3
Average PLO	3.0	3.0	3.0	2.0	2.0	1.0	2.0	3.0	2.0	3.0	2.4

SEMESTER - I

MELEDFE125: Foundation of Electronics -I — **Course Type: DCE**

Hours			Total Credits	Maximum Marks				Time Allowed for Theory Examination
				Internal	End Term		Total	
Lecture	Tutorial	Practical			Theory	Lab		
3	0	2	4	28	54	18	100	1 ¾ Hours

Course Learning Outcomes (CLOs):

Unit-Wise CLOs	After the completion of this course the students will be able to:
MELEDFE125.1	Apply circuit laws and network theorems to analyze linear and nonlinear circuits, and evaluate diode-based rectifiers and regulators.
MELEDFE125.2	Explain and analyze the construction, characteristics, biasing, and operation of BJTs and JFETs as amplifiers and switches.
MELEDFE125.3	Interpret and design MOSFET-based circuits and operational amplifier applications including amplifiers, integrators, differentiators, and comparators.
MELEDFE125.4	Perform laboratory experiments to verify circuit theorems, study device characteristics, and design analog circuits using diodes, BJTs, FETs, MOSFETs, and op-amps.

Detailed Syllabus:

THEORY (3 Credits):

Unit I: Network Analysis (15 Hrs.)

Network elements – active and passive, linear and nonlinear, unilateral and bilateral; Ohm's law, Kirchhoff's current and voltage laws; Mesh and Nodal analysis; Source transformations and superposition theorem; Thevenin's and Norton's theorems; Maximum power transfer theorem; Star–delta transformation; Semiconductor Materials: Semiconductor diode; Rectifiers – half wave, full wave and bridge; Clipping and clamping circuits; Zener diode and voltage regulation

Unit II: BJT and FET (15 Hrs.)

Bipolar Junction Transistor – construction, operation, input and output characteristics; Transistor configurations – CE, CB, CC; DC biasing methods and stability analysis; BJT as amplifier and switch; Junction Field Effect Transistor – construction and operation, V–I characteristics, pinch-off and saturation region, JFET parameters, biasing techniques, FET as amplifier.

Unit III: MOSFET and Operational Amplifier (15 Hrs.)

MOSFET – depletion and enhancement type, construction and working, transfer and output characteristics, MOSFET as amplifier and switch; Operational amplifier – ideal and practical op-amp parameters, inverting and non-inverting configurations, applications as summing amplifier, difference amplifier, integrator, differentiator, comparator and Schmitt trigger.

Unit IV: Laboratory Work (1 Credit: 30 Hrs.)

Note: The student is required to attempt at least 10 experiments

1. Verification of Kirchhoff's Laws – Experimental verification of KCL and KVL in resistive networks.
2. Thevenin's and Norton's Theorem – Determination of equivalent circuits and verification using experimental setup.
3. Diode Characteristics – Study of forward and reverse bias V–I characteristics of a semiconductor diode.
4. Zener Diode Characteristics and Regulation – Plotting V–I characteristics of Zener diode and study of voltage regulation.
5. Rectifiers – Design and analysis of half-wave and full-wave rectifiers with and without filters.
6. BJT Characteristics – Input and output characteristics of a BJT in CE configuration.

7. JFET Characteristics – Input and output characteristics of JFET
8. MOSFET Characteristics – Study of transfer and output characteristics of enhancement-type MOSFET.
9. Design and implementation of inverting and non-inverting amplifiers, summer, and subtractor using op-amp IC 741.
10. Design and implementation of integrator, and differentiator using op-amp IC 741

Books Recommended:

1. D. R. Choudury, Networks and Systems, Wiley Eastern Ltd: New Delhi.
2. M. E. Valkenburg, Network Analysis, Prentice Hall India.
3. Robert L. Boylestad, Louis Nashelsky, Electronic Devices and Circuit Theory, Prentice Hall.
4. Sedra and Smith, Microelectronic Circuits, Oxford University Press.

CLO-PLO matrix for the courseMELEDFE125 (FOUNDATION of ELECTRONICS-I)

Unit-Wise CLOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	Average CLO
MELEDFE125.1	3	3	3	1	3	1	1	1	2	3	2.1
MELEDFE125.2	3	3	3	1	3	1	1	1	2	3	2.1
MELEDFE125.3	3	3	3	1	3	1	2	2	2	3	2.3
MELEDFE125.4	2	3	3	2	3	2	2	2	2	3	2.4
Average PLO	2.8	3.0	3.0	1.3	3.0	1.3	1.5	1.5	2.0	3.0	2.3

Semester - I

MELEDEF125: Foundations of Electronics -II — **Course Type: DCE**

Hours			Total Credits	Maximum Marks				Time Allowed for Theory Examination
				Internal	End Term		Total	
Lecture	Tutorial	Practical			Theory	Lab		
3	0	2	4	28	54	18	100	1 ¾ Hours

Course Learning Outcomes (CLOs):

Unit-Wise CLOs	After the completion of this course the students will be able to:
MELEDEF125.1	Analyze different types of signals (continuous, discrete, and elementary), demonstrate their transformations (time-shifting, scaling, and amplitude-scaling), and apply Fourier methods and sampling theorem to represent and reconstruct signals.
MELEDEF125.2	Analyze the need for modulation, describe and compare various analog modulation techniques (AM, FM, PM, DSB-SC, SSB, VSB), calculate bandwidth and modulation index, and interpret the working of transmitters and receivers using block diagrams.
MELEDEF125.3	Execute structured C programs using variables, operators, control statements, functions, and arrays, and apply them to solve basic electronics-related problems such as resistor calculations and signal-based computations.
MELEDEF125.4	Perform experiments on signals, sampling, AM and FM modulation/demodulation,

Detailed Syllabus:

THEORY (3 Credits):

Unit I: Signals (15 Hrs.)

Classification of signals: Continuous-time and discrete-time signals, Elementary signals: Unit impulse, unit step, ramp, sinusoidal, exponential Properties of signals: Linearity, time-shifting, time-scaling, amplitude-scaling, Basics of Fourier series and Fourier transform, Concept of Sampling and Aliasing.

Unit II: Analog Communication (15 Hrs.)

Need and importance of communication system, Amplitude Modulation (AM): Principles, waveforms, bandwidth, power relations. Types of AM: DSB-SC, SSB, VSB, Frequency Modulation (FM): Principles, bandwidth (Carson's rule), modulation index Phase Modulation (PM) Comparison of AM, FM, and PM, Introduction to transmitters and receivers (block diagrams only).

Unit III: Brief C Programming (15 Hrs.)

Introduction to C language and its importance in electronics. Structure of a C program: Header files, main function, input/output. Variables, constants, and data types. Operators and expressions. Control statements: if, switch, loops (for, while, do-while) Functions: definition

Unit IV: Laboratory Work (1 Credit: 30 Hrs.)

Note: The student is required to attempt at least 10 experiments

1. Generation and study of basic signals (unit impulse, unit step, ramp, exponential, sinusoidal) using software/kit.
2. Verification of signal properties: linearity, time shifting, time scaling, amplitude scaling.
3. Study of Sampling and reconstruction of a continuous-time signal.
4. Demonstration of Aliasing effect in signal sampling.
5. Amplitude modulation and demodulation experiment.
6. Frequency modulation and demodulation experiment.
7. Phase modulation and demodulation experiment.
8. Study of different types of AM (DSB-SC, SSB, VSB).
9. Study and demonstration of super-heterodyne receiver (block-level experiment).
10. C programs for arithmetic operations and loop-based calculations.
11. C program to generate simple sequences (sine approximation, pulse train, square wave).
12. C program using control statements (if, switch, for/while loops) for problem solving.

Books Recommended:

1. K. Shan Mugam, Digital and Analog Communication, Wiley.
2. Wayne Tomasi, Advanced Electronic Communication Systems, Pearson Education.
3. Alan V, Oppenheim and A.S Wilsky, Signals and Systems, prentice Hall India
4. Simon Hykin, Signals and systems, John Wiley.
5. Paul J. Deitel, Harvey M. Deitel, C How To Program, Pearson.
6. Byron Gottfried "Programming with C, Mc Graw Hill.

CLO-PLO matrix for the course MELEDEF125 (FOUNDATION of ELECTRONICS-III)

Unit-Wise CLOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	Average CLO
MELEDEF125.1	3	3	3	2	2	1	2	3	2	3	2.4

MELEDEF125.2	3	3	3	2	2	1	2	3	2	3	2.4
MELEDEF125.3	3	3	3	2	2	1	2	3	2	3	2.4
MELEDEF125.4	3	3	3	2	2	1	2	3	2	3	2.4
Average PLO	3	3	3	2	2	1	2	3	2	3	2.4

SEMESTER - I

MELEDEM125: Essential Mathematics for AI — **Course Type: DCE**

Hours			Total Credits	Maximum Marks				Time Allowed for Theory Examination
				Internal	End Term		Total	
Lecture	Tutorial	Practical			Theory	Lab		
3	0	2	4	28	54	18	100	1 ¾ Hours

Course Learning Outcomes (CLOs):

Unit-Wise CLOs	After the completion of this course the students will be able to:
MELEDEM125.1	Apply linear algebra concepts to model and solve AI-related problems.
MELEDEM125.2	Analyze probabilistic models and statistical methods for AI applications.
MELEDEM125.3	Evaluate optimization techniques for training and improving AI models and utilize calculus and differential equations to describe dynamic systems and various Distribution Systems in AI
MELEDEM125.4	Conduct computational experiments to validate mathematical models in AI.

Detailed Syllabus:

THEORY (3 Credits):

Unit I: Linear Algebra (15 Hrs.)

Vectors, Vector Space, matrices, determinants, eigenvalues/eigenvectors,)Orthogonally, PSD Matrixes, Singular Value Decomposition (SVD)Applications in dimensionality reduction (PCA)

Unit II: Probability & Statistics (15 Hrs.

Probability distributions (Gaussian, Bernoulli, etc.), Expectation, variance, covariance, Conditional probability, Bayes' theorem, Statistical inference & hypothesis testing

Unit III: Optimization & Calculus for AI (15 Hrs.)

Differentiation and partial derivatives, Gradient Descent, Convex functions, Constrained optimization (Lagrange multipliers), Applications in training ML models

Unit IV: Laboratory Work (1 Credit: 30 Hrs.)

Note: The student is required to attempt at least 10 experiments

1. MATLAB basedlabs on linear algebra operations.
2. Probability simulations (random variables, Monte Carlo methods).
3. Implementing Gradient Descent for regression/classification.
4. PCA implementation for dimensionality reduction.
5. Case study: mathematical foundations behind a simple neural network.

Books Recommended:

1. Gilbert Strang, Linear Algebra and Its Applications, Cengage Learning.
2. Jay L. Devore, Probability and Statistics for Engineering and the Sciences, Cengage Learning.
3. Dimitri P. Bertsekas & John N. Tsitsiklis, Introduction to Probability, Athena Scientific.
4. Stephen Boyd & Lieven Vandenberghe, Convex Optimization, Cambridge University Press.
5. Marc Peter Deisenroth, A. Faisal, C. Ong, Mathematics for Machine Learning, Cambridge University Press.

CLO-PLO matrix for the courseMELEDEM125 (ESSENTIAL MATHEMATICS for AI)

Unit-Wise CLOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	Average CLO
MELEDEM125.1	3	3	3	2	2	1	2	3	3	3	2.5
MELEDEM125.2	3	3	3	2	2	1	2	3	3	3	2.5
MELEDEM125.3	3	3	3	2	2	1	2	3	3	3	2.5
MELEDEM125.4	2	2	2	2	2	1	2	2	3	3	2.1
Average PLO	2.75	2.75	2.75	2	2	1	2	2.75	3	3	2.4

SEMESTER - I

MELEDOE125: Opto-Electronics — **Course Type: DCE**

Hours			Total Credits	Maximum Marks				Time Allowed for Theory Examination
					End Term			
Lecture	Tutorial	Practical		Internal	Theory	Lab	Total	
3	0	2	4	28	54	18	100	1 ¾ Hours

Course Learning Outcomes (CLOs):

Unit-Wise CLOs	After the completion of this course the students will be able to:
MELEDOE125.1	Analyze light–matter interaction, semiconductor band structures, and p–n junction behavior under illumination to explain the fundamentals of optoelectronics.
MELEDOE125.2	Design and evaluate optoelectronic devices such as LEDs, laser diodes, photodiodes, phototransistors, and solar cells based on their principles, characteristics, and efficiency.
MELEDOE125.3	Examine and compare applications of optoelectronic devices in sensors, displays, and solar energy systems, while identifying emerging trends such as perovskites, quantum dots, and wearable optoelectronics.
MELEDOE125.4	Demonstrate and verify the characteristics of basic optoelectronic devices through laboratory experiments including LED, LD, PD, APD, solar cell, laser diffraction, polarization, photoconductivity, and optical sensor circuits.

Detailed Syllabus:

THEORY (3 Credits):

Unit I: Fundamentals: (15 Hrs.)

Wave–particle nature of light, photon energy, quantization, Light–matter interaction: absorption, emission (spontaneous, stimulated), scattering, Radiative vs non-radiative processes, Direct vs indirect bandgap semiconductors, Carrier recombination mechanisms: radiative, Auger, trap-assisted, Photoconductivity, luminescence (fluorescence, phosphorescence), Quantum efficiency, carrier lifetime, recombination dynamics.
Semiconductor basics: energy bands, density of states, Fermi level, p–n junction: equilibrium, forward & reverse bias, depletion region, I–V characteristics under dark and illumination

Unit II: Devices (15 Hrs.)

Light emitters: LEDs – materials, efficiency, spectra, applications, Laser diodes – types, principle, threshold condition, optical feedback, characteristics. Detectors: Photodiodes – p–n, PIN, avalanche types; responsively & quantum efficiency, Phototransistors – principle and applications.
Solar cells: principle, equivalent circuit, V–I characteristics, fill factor, Shockley–Queisser efficiency limit, solar cell materials (Si, GaAs, perovskites – introduction). Modulators and Switches (intro): electro-optic, acousto-optic, magneto-optic effects. Noise in optoelectronic devices.(introductory): shot noise, thermal noise

Unit III: Applications (15 Hrs.)

Sensors: photoconductive, infrared, LDR-based, temperature & displacement sensing.
Displays: LCD, OLED (principles and applications). Energy applications: solar photovoltaics, building-integrated PV, portable solar devices. Latest trends: organic optoelectronics, quantum dots, perovskite LEDs/solar cells, wearable optoelectronic.

Unit IV: Laboratory Work (1 Credit: 30 Hrs.)

Note: The student is required to attempt at least 10 experiments

1. Characteristics of LED (V–I characteristics, optical output vs current)
2. Characteristics of Laser Diode (threshold current, output power vs input current)
3. Characteristics of Photodiode (dark current, responsivity under illumination)
4. Characteristics of Avalanche Photodiode (breakdown voltage, multiplication factor)
5. I–V characteristics of Solar Cell under illumination and in the dark
6. Efficiency, fill factor, and maximum power point measurement of Solar Cell
7. Interference fringes experiment using Laser source (Young's double slit / wedge method)
8. Diffraction pattern study using single slit and grating with Laser source
9. Polarization of light – verification using Polaroids / laser and polarizer-analyzer setup
10. Study of Photoconductivity of a semiconductor sample (resistance vs light intensity)
11. Design and testing of a simple optical sensor circuit using LDR
12. Design and testing of a photodiode-based light intensity measurement system

Books Recommended:

1. J. Wilson and J.F.B. Hawkes, Optoelectronics: An Introduction, Prentice Hall of India.
2. S.O. Kasap, Optoelectronics and Photonics: Principles and Practices, Pearson Education.
3. Pallab Bhattacharya, Semiconductor Optoelectronic Devices, Pearson Education.
4. Bahaa E.A. Saleh and Malvin Carl Teich, Fundamentals of Photonics, Wiley.
5. Ajoy Ghatak and K. Thyagarajan, Optical Electronics, Cambridge University Press.

CLO-PLO matrix for the courseMELEDOE125 (OPTO-ELECTRONICS)

Unit-Wise CLOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	Average CLO
MELEDOE125.1	3	1	1	1	2	1	2	2	2	3	1.8
MELEDOE125.2	3	3	2	1	3	1	3	2	2	3	2.3
MELEDOE125.3	3	3	3	1	3	1	3	3	3	3	2.6

MELEDOE125.4	3	3	3	2	3	2	3	3	3	3	2.8
Average PLO	3	2.5	2.25	1.25	2.75	1.25	2.75	2.5	2.5	3	2.375

SEMESTER - II

MELECPE225: Power Electronics — **Course Type: Core**

Hours			Total Credits	Maximum Marks				Time Allowed for Theory Examination
				Internal	End Term		Total	
Lecture	Tutorial	Practical			Theory	Lab		
3	0	2	4	28	54	18	100	1 ¾ Hours

Course Learning Outcomes (CLOs):

Unit-Wise CLOs	After the completion of this course the students will be able to:
MELECPE225.1	Explain and analyze the switching characteristics, construction, and applications of power diodes, BJTs, thyristors, DIACs, and TRIACs, including protective circuits.
MELECPE225.2	Apply and evaluate controlled rectifiers, AC voltage controllers, and commutation techniques for power conversion in various load conditions.
MELECPE225.3	Design and analyze DC–DC converters, inverters, cycloconverters, and power supplies (SMPS, UPS) for different applications using performance parameters.
MELECPE225.4	Perform laboratory experiments to verify characteristics of power devices, commutation techniques, and implement DC–DC converters through hardware.

Detailed Syllabus:

THEORY (3 Credits):

Unit I: Power Semiconductor Devices (15 Hrs.)

Review of switching characteristics of Power Diodes and BJTs, characteristics of an ideal switch, and types of electronic switches. Thyristor construction, characteristics, device specifications and ratings; methods of turning on and turning off; effects of high di/dt and dv/dt; snubber circuits and gate triggering circuits. Introduction to DIAC and TRIAC with construction, characteristics, and applications.

Unit II: Controlled Rectifiers and AC Voltage Controllers (15 Hrs.)

Controlled rectifiers: principle of operation, classification, single-phase half-wave and full-wave controlled rectifiers, and single-phase bidirectional controllers with resistive loads. Commutation techniques including natural, impulse, complementary, external pulse, load-side and line-side commutation. Series and parallel connection of SCRs. AC voltage controllers: principle of ON–OFF control and phase control.

Unit III: DC–DC Converters, Inverters, and Cycloconverters (15 Hrs.)

DC–DC converters: principle of step-down and step-up operation, performance parameters, and design of Buck, Boost, and Buck–Boost converters. Forward, half-bridge, and full-bridge converters. Inverters: principle of operation, performance parameters, pulse width modulation techniques, design and analysis of single-phase half-bridge and full-bridge inverters with resistive and inductive loads. Cycloconverters: step-up and step-down operation, design of single-phase step-down cycloconverter. Power supplies: SMPS and UPS.

Unit IV: Laboratory Work (1 Credit: 30 Hrs.)

Note: The student is required to attempt at least 10 experiments

1. Verify switching action of a Power BJT.
2. Study characteristics of MOSFET.
3. Study IV characteristics of SCR.
4. Study IV characteristics of DIAC.
5. Study IV characteristics of TRIAC.
6. Study IV characteristics of UJT.
7. Calculation of Holding and latching currents of SCR.
8. Study various Commutation Techniques.
9. Study half wave and full wave AC voltage Control.
10. Study half wave and full wave-controlled rectification.
11. Design of BUCK Converter.
12. Design of BOOST Converter.
13. Design a Buck-Boost converter.

Books Recommended:

1. M. H. Rashid, Power Electronics, Circuits, Devices and Applications, PHI.
2. Mohan, Undeland, Robbins, Power Electronics, John Wiley and Sons.
3. P. C. Sen, Power Electronics, Tata McGraw Hill, Pub. Co.
4. M. Ramamorty, Introduction to Thyristors and their Applications, Affiliated east-West Press.

CLO-PLO matrix for the courseMELECPE225 (POWER ELECTRONICS)

Unit-Wise CLOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	Average CLO
MELECPE225.1	3	3	2	1	2	1	1	1	2	2	1.8
MELECPE225.2	3	3	3	1	3	1	2	2	2	3	2.3
MELECPE225.3	3	3	3	1	3	2	2	2	2	3	2.4
MELECPE225.4	2	3	3	2	3	2	2	2	2	3	2.4
Average PLO	2.8	3.0	2.8	1.3	2.8	1.5	1.8	1.8	2.0	2.8	2.26

SEMESTER - II

MELECCS225: Control Systems — **Course Type: Core**

Hours			Total Credits	Maximum Marks				Time Allowed for Theory Examination
				Internal	End Term		Total	
Lecture	Tutorial	Practical			Theory	Lab		
3	0	2	4	28	54	18	100	1 ¾ Hours

Course Learning Outcomes (CLOs):

Unit-Wise CLOs	After the completion of this course the students will be able to:
MELECCS225.1	Model dynamic systems and use various control strategies to improve system performance
MELECCS225.2	Apply time domain analysis to control systems and use PID-based controllers to improve system stability and accuracy. Apply methods of stability to control systems

MELECCS225.3	Apply frequency domain analysis and Develop and interpret state-space representations of dynamic systems and apply state transition methods to analyze system response
MELECCS225.4	Apply theoretical and practical concepts of control perform stability analysis using hardware (breadboard circuits) and software tools (MATLAB)

Detailed Syllabus:

THEORY (3 Credits):

Unit I: Introduction to Control System (15 Hrs.)

Control Systems, System Representation and Time Domain Analysis Control Systems, types of control systems, feedback & its effects, linear & non-linear systems, superposition in linear systems, cascade and feed-forward control, Signal Flow Graph modelling of electrical and electronic systems, SISO and MIMO systems, Transfer function calculation using block diagram algebra and signal flow graph methods.

Unit II: Time domain analysis and Stability (15 Hrs.)

Standard test signals, time response of first order and second control systems, Steady- state and transient response, Transient response specifications, S-plane root location & the transient response, Error analysis, Static and dynamic error coefficients, Controllers: Proportional, PI, PD and PID controllers. Stability : Conditional an absolute stable systems, location of poles and stability, Routh-Hurwitz criterion, Root-locus plot , effect of addition of poles and zeros on root locus.

Unit III: Frequency Analysis and State Space Analysis (15 Hrs.)

Advantages of state space techniques, State space representation of electrical networks, state transition matrix, state transition equations, Frequency domain analysis, advantages and disadvantages, Frequency domain specifications, Polar plot, Bode plot, gain margin and phase margin, Nyquist criterion.

Unit IV: Laboratory Work (1 Credit: 30 Hrs.)

Note: The student is required to attempt at least 10 experiments

1. Calculate RC time constant using RC circuit on breadboard.
2. Design and analyze the first order circuit.
3. Design and analyze the second order system.
4. Analyze the PID controller using active and passive elements (breadboard)
5. Calculate rise time, peak time, maximum overshoot and settling time using PID controller.
6. Design and analyze PI controller using op-amp on breadboard.
7. Design and analyze PD controller using op-amp on breadboard.
8. Design and analyze PID controller using op-amp on breadboard.
9. Study of Root Locus Plot, Polar Plot, using MATLAB
10. Study of Bode plot, Gain Margin and Phase Margin using MATLAB.
11. Study of Nyquist Plot using MATLAB

Books Recommended:

1. K-Ogata, Modern Control Engineering, Prentice Hall.
2. Distefino, Stubberud and Williams, Feedback & Control Systems, McGraw Hill International.
3. B. C. Kuo, Automatic Control systems, McGraw Hill Professional.
4. D. Azzo, Houfil, Linear Control System Analysis & Design, CRC Press.
5. Ramakant Gayakwad Leonard Sokoloff, Analog and Digital Control Systems, Prentice Hall

CLO-PLO matrix for the courseMELECCS225 (CONTROL SYSTEMS)

Unit-Wise CLOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	Average CLO
MELECCS225.1	3.0	3.0	3.0	3.0	2.5	2.0	2.5	2.5	2.3	3.0	2.68
MELECCS225.2	3.0	3.0	2.5	2.0	2.3	2.0	2.3	2.0	2.0	2.5	2.36
MELECCS225.3	3.0	2.3	3.0	1.7	2.5	1.5	1.0	2.0	2.0	3.0	2.20
MELECCS225.4	3.0	3.0	3.0	2.0	2.5	1.0	2.0	2.0	2.5	3.0	2.40
Average PLO	3.00	2.83	2.88	2.18	2.45	1.63	1.95	2.13	2.20	2.88	2.41

SEMESTER - II

MELECDA225: Digital and Analog IC Design — **Course Type: Core**

Hours			Total Credits	Maximum Marks				Time Allowed for Theory Examination
				Internal	End Term		Total	
Lecture	Tutorial	Practical			Theory	Lab		
3	0	2	4	28	54	18	100	1 ¾ Hours

Course Learning Outcomes (CLOs):

Unit-Wise CLOs	After the completion of this course the students will be able to:
MELECDA225.1	Explain and analyze CMOS inverter characteristics, combinational logic styles, transistor sizing, and power dissipation in digital ICs.
MELECDA225.2	Design and implement CMOS sequential logic circuits, registers, memory blocks, and apply digital VLSI design methodologies using PLA, PAL, CPLD, and FPGA.
MELECDA225.3	Evaluate and design analog and mixed-signal CMOS blocks including current mirrors, amplifiers, op-amps, references, DACs, and ADCs with various architectures.
MELECDA225.4	Design, simulate, and analyze digital and analog CMOS circuits (logic gates, SRAM, latches, current mirrors, amplifiers) using CAD tools (Cadence/HPICE), including schematic entry, layout design, and performance verification.

Detailed Syllabus:

THEORY (3 Credits):

Unit I: CMOS Combinational Logic Design (15 Hrs.)

Digital IC: Quality metrics of Digital Design – Trends in IC Technology; Review of MOSFET – Static C-MOS Inverter and its characteristics, CMOS Design Consideration Transistor Sizing, Power Dissipation – Dynamic Design and its issues – Ratioed Logic – Pass Transistor Logic.

Unit II: CMOS Sequential Logic Design and Implementation Strategies for Digital ICs (15 Hrs.)

Static Latches and registrars, Dynamic Latches and Registers, Alternative Register Styles, Pipelining, Memory Classification, Memory Architecture and Building Block, Read only Memories, Read Write Memories, Digital VLSI design methodologies, Stick Diagrams and Layout, Introduction to PLA, PAL, CPLD, FPGA.

Unit III: CMOS Analog and Mixed Blocks (15 Hrs.)

Current Mirrors: The Basic Current Mirror, Cascoding the Current Mirror; Single stage Amplifier: Common Source Amplifier (CSA) with resistance load, diode connected load, current source load, CSA with source degeneration, source follower. Differential Amplifier, Operational Amplifier, Voltage and Current References.
Sample-and-Hold (S/H) Characteristics; Digital-to-Analog Converter (DAC) and Analog-to-Digital Converter (ADC) Specifications; DAC Architectures: R-2R Ladder Network DAC, Cyclic DAC, Pipeline DAC; ADC Architectures: Flash ADC, Two-Step Flash ADC, Pipeline ADC.

Unit IV: Laboratory Work (1 Credit: 30 Hrs.)

Note: The student is required to attempt at least 10 experiments

1. Design and simulate CMOS logic gates using static technique in Cadence/HPICE.
2. Design the layout of CMOS logic gates using static technique in Cadence/HPICE.
3. Design and simulate CMOS logic gates using dynamic technique in Cadence/HPICE.
4. Design the layout of CMOS logic gates using dynamic technique in Cadence/HPICE.
5. Design and simulate CMOS logic gates using ratioed logic technique in Cadence/HPICE.
6. Design and simulate CMOS logic gates using pass transistor logic technique in Cadence/HPICE.
7. Design and simulate SRAM cell and design the layout in Cadence/HPICE.
8. Design and simulate static latches in Cadence/HPICE.
9. Design and simulate basic and cascade current mirror and design the layout in Cadence/HPICE.
10. Design and simulate common source amplifier with different loads and source degeneration design the layout in Cadence/HPICE. Analyze the input impedance, output impedance, gain and bandwidth.

Books Recommended:

1. J. M. Rabaey, A. Chandrakasan and B. Nikolic: Digital Integrated Circuits- A Design Perspective, 2nd ed., PHI, 2003
2. N.H.E. Weste and K. Eshraghian, Principles of CMOS VLSI Design - a System Perspective, 2nd ed., Pearson Education Asia.
3. D. A. Pucknell and K. Eshraghian, Basic VLSI Design, PHI.
4. R. Jacob Baker, CMOS, Circuit Design, Layout, and Simulation, JOHN WILEY & SONS.
5. Behzad Razavi, Design of Analog CMOS Integrated Circuits, TMH.
6. Allen, CMOS Analog Circuit Design, Oxford.

CLO-PLO matrix for the courseMELECDA225 (DIGITAL and ANALOG IC DESIGN)

Unit-Wise CLOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	Average CLO
MELECDA225.1	3	2	2	1	2	1	2	2	2	2	1.9
MELECDA225.2	3	3	3	2	3	1	2	2	3	3	2.5
MELECDA225.3	3	3	3	2	3	1	3	2	3	3	2.6
MELECDA225.4	3	3	3	2	3	1	3	3	3	3	2.7
Average PLO	3.0	2.8	2.8	1.8	2.8	1.0	2.5	2.3	2.8	2.8	2.6

SEMESTER - II

MELECEW225: Electromagnetic Waves and Antennas — **Course Type: Core**

Hours			Total Credits	Maximum Marks		
Lecture	Tutorial	Practical		Internal	End Term	Total

					Theory	Lab		Time Allowed for Theory Examination
3	0	2	4	28	54	18	100	1 ¼ Hours

Course Learning Outcomes (CLOs):

Unit-Wise CLOs	After the completion of this course the students will be able to:
MELECEW225.1	Analyze propagation of electromagnetic waves in free space and guided media.
MELECEW225.2	Apply transmission line and waveguide theory for impedance matching and wave propagation.
MELECEW225.3	Evaluate radiation parameters and performance of various antenna types.
MELECEW225.4	Conduct laboratory experiments and simulations on antennas and transmission lines to validate theoretical concepts.

Detailed Syllabus:

THEORY (3 Credits):

Unit I: Electromagnetic Field and Maxwell's Equation **(15 Hrs.)**

Divergence and curl of vector fields, Concept of conduction and displacement current, Surface Current, Equation of continuity, Maxwell Equation in differential and Integral forms, Boundary conditions, Electromagnetic wave equations, plane waves in free space and matter, Poynting vector, polarization of plane waves, reflection and refraction at boundaries, standing wave ratio, skin effect.

Unit II: Radiation Integrals and Auxiliary Potential Functions (15 Hrs.)

Vector Potential A for an Electric Current Source J, The Vector Potential F for a Magnetic Current Source M, Electric and Magnetic Fields for Electric(J) and Magnetic(M) Current sources, Solution of the Inhomogeneous Vector Potential Wave Equation, Far Field Radiation, Duality Theorem, Reciprocity and Reaction Theorems

Unit III: Antenna Theory (15 Hrs.)

Antenna parameters: radiation resistance, directivity, gain, efficiency, effective aperture, bandwidth, polarization. Types of antennas: Hertzian dipole, half-wave dipole, arrays, Yagi-Uda, horn, reflector antennas. Microstrip antennas, patch antennas, broadband antennas, antenna measurements, radiation patterns and Radiated field of Dipole Antenna, Friis transmission formula, applications in wireless communication and radar.

Unit IV: Laboratory Work (1 Credit: 30 Hrs.)

Note: The student is required to attempt at least 10 experiments

1. Horizontal Polarization of dipole antenna
2. Vertical Polarization of dipole antenna
3. Measurement of standing wave ratio and reflection coefficient.
4. Measurement of radiation pattern of dipole antennas.
5. Measurement of radiation pattern of horn antennas.
6. Measurement of radiation pattern of reflector antennas.
7. Simulation of antenna radiation patterns using HFSS/CST.

8. Design and simulation of microstrip patch antenna.
9. Measurement of HPBW of antennas.
10. Measurement of antenna gain and efficiency.
11. Study of antenna arrays and their beam patterns.
12. Measurement of return loss and bandwidth of antennas.

Books Recommended:

1. Balanis, C. A., Antenna Theory: Analysis and Design, Wiley.
2. Jordan, E. C., and Balmain, K. G., Electromagnetic Waves and Radiating Systems, Prentice Hall.
3. Rao, K. D. Prasad, Antennas and Wave Propagation, PHI.
4. Stutzman, W. L., and Thiele, G. A., Antenna Theory and Design, Wiley.

CLO-PLO matrix for the course MELECEW225 (ELECTROMAGNETIC WAVES AND ANTENNAS)

Unit-Wise CLOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	Average CLO
MELECEW225.1	3	3	3	2	2	1	2	3	2	3	3
MELECEW225.2	3	3	3	2	2	1	2	3	2	3	3
MELECEW225.3	3	3	3	2	2	1	2	3	2	3	3
MELECEW225.4	3	3	3	2	2	1	2	3	2	3	3
Average PLO	3.0	3.0	3.0	2.0	2.0	1.0	2.0	3.0	2.0	3.0	3.0

SEMESTER - II

MELEDFE225: Foundations of Electronics-III — **Course Type: DCE**

Hours			Total Credits	Maximum Marks				Time Allowed for Theory Examination
				Internal	End Term		Total	
Lecture	Tutorial	Practical			Theory	Lab		
3	0	2	4	28	54	18	100	1 ¾ Hours

Course Learning Outcomes (CLOs):

Unit-Wise CLOs	After the completion of this course the students will be able to:
MELEDFE225.1	Explain number systems, binary arithmetic, Boolean algebra postulates, and analyze the behaviour of basic logic gates and universal gates.
MELEDFE225.2	Design and implement combinational circuits using SOP/POS forms, apply Karnaugh map simplification, and realize arithmetic and data handling circuits.
MELEDFE225.3	Describe and analyze sequential circuits including latches, flip-flops, shift registers, and counters, and evaluate their applications in digital systems.
MELEDFE225.4	Construct and test combinational and sequential circuits in the laboratory using logic gates, flip-flops, multiplexers, and counters.

Detailed Syllabus:

THEORY (3 Credits):

Unit I: Number System and logic Gates (15 Hrs.)

Number Systems: Decimal, Binary, Octal, Hexadecimal, base conversions. Representation of signed and unsigned numbers, BCD code. Binary arithmetic, subtraction by 2's complement method. Logic Gates: Truth Tables of OR, AND, NOT, NOR, NAND, XOR and XNOR gates, Universal Gates. Boolean algebra: Basic postulates and fundamental theorems of Boolean algebra. Introduction to logic families and related definitions.

Unit II: Combinational Logic Analysis and Design (15 Hrs.)

Implementation of Boolean expressions using logic gates, Standard representation of logic functions (SOP and POS), Minimization Techniques (Karnaugh map minimization up to 4 variables for SOP). Arithmetic Circuits: Half Adder, Full Adder, Half Subtractor, Full Subtractor, 1-bit comparator. Multiplexers, De-multiplexers, Decoders, Encoders.

Unit III: Sequential Circuits (15 Hrs.)

Latches: SR, gated SR and D. Flip-flops: SR, D, T and JK. Preset and Clear operations. Race-around conditions in JK Flip-Flop. Master-slave JK Flip-Flop. Shift registers: Serial-in- Serial-out, Serial-in-Parallel-out, Parallel-in-Serial-out and Parallel-in-Parallel-out Shift Registers (only up to 4 bits). Counters: Asynchronous counters, Synchronous Counter. Decade Counter, Ring Counter.

Unit IV: Laboratory Work (1 Credit: 30 Hrs.)

Note: The student is required to attempt at least 10 experiments

1. To design a combinational logic system for a specified Truth Table.
2. To convert Boolean expressions into logic circuits and design circuits using logic gate ICs.
3. To minimize a given Boolean Expression and design Circuits using logic gates.
4. To design Half Adder and Full Adder Circuits.
5. TO Design Half Subtractor and Full Subtractor Circuits.
6. To design binary adder and adder-subtractor Circuits using Full adder IC.
7. To design seven-segment decoder Circuit.
8. To build Flip-Flop (RS, Clocked RS) circuits using NAND gates.
9. To build Flip-Flop (D-type and JK) circuits using NAND gates.
10. To build JK Master-slave flip-flop using Flip-Flop ICs.
11. To build a Counter using D-type/JK Flip-Flop ICs and study timing diagram.
12. To make a Shift Register (serial-in and serial-out) using D-type/JK Flip-Flop ICs.

Books Recommended:

1. A.P. Malvino, D. P. Leach and Saha, Digital Principles and Applications, Tata McGraw.
2. Anand Kumar, Fundamentals of Digital Circuits, PHI Learning Pvt. Ltd.
3. R. J. Tocci, N. S. Widmer, Digital Systems: Principles & Applications, PHI Learning.
4. Thomas L. Flyod, Digital Fundamentals, Pearson Education Asia.
5. R. L. Tokheim, Digital Principles, Schaum's Outline Series, Tata McGraw- Hill.

CLO-PLO matrix for the course MELEDFE225 (FOUNDATIONS of ELECTRONICS-III)

Unit-Wise CLOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	Average CLO
MELEDFE225.1	3	2	2	1	2	1	2	1	2	3	1.9
MELEDFE225.2	3	3	3	1	3	1	2	2	2	3	2.3
MELEDFE225.3	3	3	3	1	3	1	2	2	2	3	2.3
MELEDFE225.4	2	3	3	2	3	2	2	2	3	3	2.5
Average PLO	2.75	2.75	2.75	1.25	2.75	1.25	2	1.75	2.25	3	2.25

SEMESTER - II

MELEDAM225: Applied Mathematics and Programming — **Course Type: DCE**

Hours			Total Credits	Maximum Marks				Time Allowed for Theory Examination
					End Term			
Lecture	Tutorial	Practical		Internal	Theory	Lab	Total	
3	0	2	4	28	54	18	100	1 ¾ Hours

Course Learning Outcomes (CLOs):

Unit-Wise CLOs	After the completion of this course the students will be able to:
MELEDAM225.1	Use Fourier series &transforms to analyze periodic and non-periodic signals and apply these concepts to analyze electronic systems.
MELEDAM225.2	To solve differential equations and analyze electronic circuits using Laplace transformation.
MELEDAM225.3	To solve algebraic, transcendental, and simultaneous equations using curve fitting techniques and numerical methods. Develop C programs using its fundament concepts of 'c'
MELEDAM225.4	Apply C programming concepts to solve mathematical problems, perform data processing, implement numerical methods, and execute matrix and curve fitting operations

Detailed Syllabus:

THEORY (3 Credits):

Unit I: Fourier Series and Fourier Transform (15 Hrs.)

Dirichlet's Condition, Determination of Fourier Coefficients, Fourier Series for functions of arbitrary period, Half-wave expansion, Fourier Integral Theorem, Fourier Sine and Cosine integrals, Fourier Transforms: Properties of Fourier Transforms, Fourier Transform and Dirac delta function, Application of Fourier Transformation in Electronics.

Unit II: Laplace Transformation (15 Hrs.)

Laplace transforms, Properties of Laplace transforms, Laplace transform of some elementary functions, Shifting theorems, Laplace Transform of a derivative, Laplace transforms of integrals, Inverse of Laplace transform by partial fractions, Heavisize's expansion formula, Solving differential equation using Laplace transform, Applications of Laplace transform in the field of Electronics.

Unit III: Numerical Methods & C Programming (15 Hrs.)

Empirical laws & Curve fitting methods, Method of group averages, Method of least squares, Solution of Algebraic & transcendental equations: Bisection Method, Newton –Raphson method. Solution of simultaneous algebraic equations Character set, Variables and Identifiers, Data Types, Variables, operators and Expressions, Constants and Literals, assignment and Basic input/output statement, Conditional Statements and Loops- Relational Operators, Logical, Switch Statement, Arrays and their processing; Functions and their processing, Pointer Arithmetic. Introduction to files and their processing.

Unit IV: Laboratory Work (1 Credit: 30 Hrs.)

Note: The student is required to attempt at least 10 experiments

1. Write a C program to generate the Fibonacci series up to the given limit N and also print the number of elements in the series.

2. Write a C program to find minimum and maximum of N numbers.
3. Write a C program to find the GCD of two integer numbers.
4. Write a C program to Calculate factorial of a given number
5. Write a C program to add two and multiply two Matrices Using Multi-Dimensional Arrays.
6. Write a program to evaluate the sine series using recursive and non-recursive functions.
7. Write programs to create files, and read and write on these files.
8. Write a C program to find the solution of a non-linear equation using repetitive substitution method.
9. Write a C program to find the solution of a non-linear equation using Bisection method.
10. Write a C program to find the solution of a non-linear equation using Regula Falsi method.
11. Write a computational program for solving algebraic equations by Newton Rapson method.
12. Write a computational program for solving simultaneous algebraic equations by Gaussian Elimination method.
13. Write a C program of fitting a straight line, exponential curve, geometric curve, hyperbola and a polynomial

Books Recommended:

1. Edwin Kreyzing, Advanced Engineering Mathematics, Wiley Eastern Ltd.
2. Pipes and Harvill, Applied Mathematics for Engineers and Physicist, McGraw Hill Book Company.
3. Fourier Transformation and Laplace Transformations, Schaum Series Book, TMH Course.
4. E. Balaguruswamy, Numerical Methods, TMH.
5. S. S. Sastry, Introductory Methods of Numerical Analysis, PHI
6. R.S. Salaria, Computer Oriented Numerical Methods, Khanna Publishing House
7. B. S. Grewal, Numerical Methods in Engineering and Science, Walter de Gruyter GmbH & Co KG.
8. Kandasamy, K. Thilagavathy, K. Gunavathy, Numerical Methods, S. Chand Publications.

CLO-PLO matrix for the courseMELEDAM225 (APPLIED MATHEMATICS and PROGRAMMING)

Unit-Wise CLOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	Average CLO
MELEDAM225.1	3.0	2.5	2.5	1.5	2.0	1.0	1.3	1.8	2.0	3.0	2.06
MELEDAM225.2	3.0	3.0	3.0	1.0	2.5	1.0	1.0	2.5	1.5	3.0	2.15
MELEDAM225.3	3.0	2.5	2.7	1.5	2.3	1.2	1.3	1.5	1.5	3.0	2.05
MELEDAM225.4	3.0	2.5	3.0	2.6	2.7	1.5	2.0	2.0	2.5	2.5	2.43
Average PLO	3.0	2.62	2.80	1.65	2.37	1.17	1.40	1.95	1.87	2.87	2.20

SEMESTER - II

MELEDDS225: Digital System Design and VHDL — **Course Type: DCE**

Hours			Total Credits	Maximum Marks				Time Allowed for Theory Examination
					End Term			
Lecture	Tutorial	Practical		Internal	Theory	Lab	Total	
3	0	2	4	28	54	18	100	1 ¾ Hours

Course Learning Outcomes (CLOs):

Unit-Wise CLOs	After the completion of this course the students will be able to:
MELEDDS225.1	Analyze the structure of VHDL programs, data types, operators, and modelling styles to determine appropriate coding strategies for digital design.

MELEDDS225.2	Design and synthesize finite state machines and digital circuits using concurrent and sequential constructs in VHDL.
MELEDDS225.3	Develop and implement combinational and sequential systems (adders, multiplexers, decoders, flip-flops, counters, ALU, etc.) through VHDL coding on FPGA/CPLD platforms.
MELEDDS225.4	Evaluate and verify digital circuit designs using industry-standard EDA tools (Quartus Altera / Xilinx ISE Suite) for correctness, efficiency, and performance.

Detailed Syllabus:

THEORY (3 Credits):

Unit I: Introduction to VHDL (15 Hrs.)

Fundamental units of VHDL, Library declaration, Entity declaration, Architecture declaration, Data types, Primitive programming Data flow programming, Structural Programming, Signals and variables, Test benches, State machines.

Unit II: Computer Structure and Arithmetic (15 Hrs.)

Computer types, Functional units, Basic operational concepts, Von-Neumann Architecture, Bus Structures, Software, Performance, Multiprocessors and Multicomputer, Data representation, Fixed and Floating point, Computer Arithmetic's: Addition and Subtraction, Multiplication and Division algorithms, Floating-point Arithmetic. Implementation of Arithmetic circuits in VHDL.

Unit III: Registers, Memory, and Organization (15 Hrs.)

Register transfer language, arithmetic, logic and shift micro-operations, arithmetic logic &shift unit. Memory systems: RAM, ROM, cache, and virtual memory basics. Instruction formats, addressing modes, memory-reference and I/O instructions. Introduction to CISC and RISC. Simple register and memory modeling in VHDL. Complex Instruction Set Computer (CISC), Reduced Instruction Set Computer (RISC), CISC vs RISC.

Unit IV: Laboratory Work (1 Credit: 30 Hrs.)

Note: The student is required to attempt at least 10 experiments

1. Implementation of various logic gates using VHDL.
2. Design a 3 x 8-line decoder using VHDL.
3. Implement the HALF Adder using VHDL.
4. Implement the FULL Adder using VHDL.
5. Using VHDL to implement Subtractors circuits using 2's compliment method.
6. Implement the 4 x 1 and 8 x 1 Multiplexer using VHDL.
7. Implement the Binary to Gray and Gray to Binary code converters using VHDL.
8. Implement the various flip-flops using VHDL and verify the excitation tables.
9. Design an 8-bit ALU using VHDL.
1. Implementation of Booth's Algorithm using VHDL.
2. Implementation of synchronous counters using VHDL.
3. Implementation of Ripple Carry Ahead (RCA) using VHDL.
4. Verification of the designed circuits using FPGA.

Books Recommended:

1. William Stallings, Computer Organization and Architecture- designing for performance, Prentice Hall, New Jersy.
2. M. Moris Mano, Computer System Architecture, Pearson/PHI, India.
3. Carl Hamacher, ZvonksVranesic, SafeaZaky, Computer Organization, McGraw Hill, New Delhi, India.

4. Anrew S. Tanenbaum, Structured Computer Organization, 5th edition, Pearson Education Inc,
5. John P. Hayes, Computer Architecture and Organization, Tata McGraw Hill
6. NikrouzFaroughi, Digital Logic Design and Computer Organization with computer architecture for security, McGraw Hill Education.

CLO-PLO matrix for the courseMELEDDS225 (DIGITAL SYSTEM DESIGN and VHDL)

Unit-Wise CLOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	Average CLO
MELEDDS225.1	2	3	3	1	3	1	2	2	3	3	2.3
MELEDDS225.2	2	3	3	2	3	1	3	3	3	3	2.6
MELEDDS225.3	3	3	3	2	3	1	3	3	3	3	2.7
MELEDDS225.4	3	3	3	2	3	1	3	3	3	3	2.7
Average PLO	2.5	3	3	1.75	3	1	2.75	2.75	3	3	2.575

SEMESTER - II

MELEDAI225: Introduction to AI &Machine Learning — **Course Type: DCE**

Hours			Total Credits	Maximum Marks				Time Allowed for Theory Examination
Lecture	Tutorial	Practical		Internal	End Term		Total	
					Theory	Lab		
3	0	2	4	28	54	18	100	1 ¾ Hours

Course Learning Outcomes (CLOs):

Unit-Wise CLOs	After the completion of this course the students will be able to:
MELEDAI225.1	Analyze the foundations of Artificial Intelligence and evaluate knowledge representation techniques using predicate logic and rules.
MELEDAI225.2	Conduct machine learning experiments by implementing linear regression and evaluating supervised and unsupervised learning approaches.
MELEDAI225.3	Analyze and implement classification and clustering algorithms to evaluate their performance on real-world datasets.
MELEDAI225.4	Conduct practical experiments in Python to implement regression, classification, clustering, and dimensionality reduction techniques on real-world datasets.

Detailed Syllabus:

THEORY (3 Credits):

Unit I: Foundations of AI and Knowledge Representation (15 Hrs.)

Definition of Artificial Intelligence (AI), AI techniques and applications, predicate logic, knowledge representation as facts and rules, procedural vs. declarative knowledge, logic programming, computable functions and predicates, and basics of mathematical foundations for ML (matrix theory and statistics).

Unit II: Fundamentals of Machine Learning and Linear Regression (15 Hrs.)

Idea of machines learning from data, supervised vs. unsupervised learning, classification vs. regression, fundamentals of model building, single-variable linear regression, cost function, and gradient descent methods.

Unit III: Classification and Clustering Algorithms (15 Hrs.)

Classification algorithms: Logistic regression, decision trees, k-NN, support vector machines, multi-classification strategies, overfitting, and optimization.
Clustering algorithms: K-Means clustering and applications, hierarchical clustering (agglomerative/divisive), and basics of PCA for dimensionality reduction.

Unit IV: Laboratory Work (1 Credit: 30 Hrs.)

Note: The student is required to attempt at least 10 experiments

1. Implementation of logical rules in Python.
2. Using any data apply the concept of:
3. Liner regression
4. Gradient decent
5. Logistic regression
6. To add the missing value in any data set.
7. Perform and plot under fitting and overfitting in a data set.
8. Build a linear regression model to predict house prices using a dataset. Evaluate the model using Mean Squared Error (MSE).
9. Implement logistic regression to classify emails as spam or not spam. Visualize the decision boundary and evaluate accuracy.
10. Apply K-Means to cluster customer data based on purchasing behavior.
11. Use the Elbow Method to find the optimal number of clusters.
12. Build a decision tree model to classify iris flower species. Visualize the tree structure and analyze decision rules.
13. Train a random forest model on the MNIST dataset for digit recognition. Compare performance with a single decision tree.
14. Use Support Vector Machines (SVM) to classify two classes in a synthetic dataset. Experiment with different kernels (linear, polynomial, RBF).
15. Perform PCA for dimensionality reduction on a high-dimensional dataset. Visualize data in a reduced 2D or 3D space.

Books Recommended:

1. Saroj Kaushik, Artificial Intelligence, Cengage Learning.
2. Anindita Das Bhattacharjee, Practical Workbook Artificial Intelligence and Soft Computing for beginners, Shroff Publisher-X team Publisher.
3. Yuxi (Hayden) Liu, Python Machine Learning by Example, Packet Publishing Limited.
4. Tom Mitchell, Machine Learning, McGraw Hill.
5. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer.
6. T. Hastie, R. Tibshirani, J. Friedman. The Elements of Statistical Learning, 2e.

CLO-PLO matrix for the courseMELEDAI225 (INTRODUCTION to AI &MACHINE LEARNING)

Unit-Wise CLOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	Average CLO
MELEDAI225.1	3	3	3	2	3	2	1	2	3	3	2.5
MELEDAI225.2	3	2	3	1	3	2	1	1	2	2	2
MELEDAI225.3	3	3	3	2	3	2	2	3	3	2	2.6
MELEDAI225.4	3	3	3	1	3	1	3	3	3	3	2.6
Average PLO	3	2.75	3	1.5	3	1.75	1.75	2.25	2.5	2.5	2.425

SEMESTER - III

MELECPS325: Physics of Semiconductor Devices								Course Type: Core
Hours			Total Credits	Maximum Marks				Time Allowed for Theory Examination
Lecture	Tutorial	Practical		Internal	End Term		Total	
					Theory	Lab		
3	0	2	4	28	54	18	100	1 ¾ Hours

Course Learning Outcomes (CLOs):

Unit-Wise CLOs	After the completion of this course the students will be able to:
MELECPS325.1	Explain crystal structures, solid-state materials, quantum models (Schrödinger equation, Kronig-Penney model), carrier statistics, and transport phenomena (mobility, lifetime, Hall effect).
MELECPS325.2	Analyze the working principles, I-V characteristics, capacitances, and breakdown mechanisms of semiconductor diodes; evaluate transistor action, gain parameters, and current distributions in bipolar junction transistors using physical models.
MELECPS325.3	Interpret the physics and device design considerations of MOSFETs, microwave semiconductor devices (IMPATT, TEDs), and optoelectronic devices (LEDs, solar cells, photodetectors); apply models to assess device performance and propose design optimizations.
MELECPS325.4	Conduct laboratory experiments to characterize semiconductor devices (diodes, BJTs, MOSFETs, LEDs, and solar cells), verify theoretical models, and analyze experimental data using measurement and simulation tools.

Detailed Syllabus:

THEORY (3 Credits):

Unit I: Solid-state Materials, Crystal Structure and Carrier Transport (15 Hrs.)

Introduction to solid-state materials – optical and thermal properties, Crystal Structure: Space lattices, Primitive and Unit Cell, Index system for crystal planes, Separation between the parallel planes of a cubic crystal, Description of Schrödinger wave equation: Physical interpretation of wave function, Kronig Penney Model, K-space diagram, Effective mass, Concept of Hole, Derivation of Density of state functions, Fermi-Dirac Distribution function, Carrier concentration at thermal equilibrium, Carrier transport Equation, Decay of photo excited carriers, carrier lifetime, Hall effect.

Unit II: Semiconductor Diodes and Bipolar Junction Transistor (15 Hrs.)

Semiconductor junctions: Homo and hetero Junction, Abrupt and Graded junction, P-N Junction: depletion region, diffusion, generation-recombination, Current-Voltage characteristics of PN junction, Depletion capacitance, Diffusion capacitance, Junction breakdown phenomenon, Metal-Semiconductor Contacts: equilibrium, idealized metal semiconductor junctions, non-rectifying (ohmic) contacts, Schottky diode, tunneling. Bipolar junction transistors: transistor action and dependence on device structure, current gain parameters, minority carrier distribution and terminal currents, Eber-Moll model.

Unit III: Field Effect Transistors, Microwave and Opto Electronic Devices (15 Hrs.)

Metal-Oxide-Silicon System: MOS structure, capacitance, oxide and interface charge (charging of traps, tunneling through oxide), MOS Field-Effect Transistor: threshold voltage, derivation of current-voltage characteristics, dependence on device structure. Small-geometry effects: mobility degradation due to channel and oxide fields, velocity saturation, ballistic transport, hot-electron effects, State-of-the-Art MOS Technology: Fin-FETs. Microwave Devices:

IMPATT - Static and Dynamic Characteristics, Small signal analysis, Transferred Electron Device, Negative differential resistivity, Transferred Electron Model, Modes of operation. Opto-Electronic Devices: LED - Radiative transition, Emission spectra, Luminous efficiency and LED materials, Solar cell and photodetectors: Ideal conversion efficiency, Fill factor, Equivalent circuit, Voc, Isc and Load resistance, Spectral response, Reverse saturation current in photodetector.

Unit IV: Laboratory Work (1 Credit: 30 Hrs.)

Note: The student is required to attempt at least 10 experiments

1. Study of Hall Effect.
2. Study of the effect of material parameters on the conductivity of the material.
3. Design a diode in ATLAS TCAD/Synopsis Sentaurus and study its I-V characteristics.
4. Study of depletion and diffusion capacitances of a diode in ATLAS TCAD/Synopsis Sentaurus.
5. Design a Schottky diode in ATLAS TCAD/Synopsis Sentaurus and study its I-V characteristics.
6. Design a BJT in ATLAS TCAD/Synopsis Sentaurus and study its I-V characteristics.
7. Study of the effect of parameters of three regions on the characteristics of BJT.
8. Design a MOSFET in ATLAS TCAD/Synopsis Sentaurus and study its I-V characteristics.
9. Study of the effect of parameters of different regions on the characteristics of MOSFET.
10. Study the characteristics of Nano-MOSFET.
11. Study the characteristics of IMPATT diode.
12. Study the characteristics of Gunn diode.
13. Design a Solar cell in ATLAS TCAD/Synopsis Sentaurus and study its I-V characteristics.
14. Design a photodetector in ATLAS TCAD/Synopsis Sentaurus and study its I-V characteristics.

Books Recommended:

1. Ben G. Streetman, Solid State Electronic Devices, Prentice Hall of India Ltd, N. Delhi.
2. Donald E. Neaman, Semiconductor Physics and Devices, Basic Principles, McGraw Hill Publishing, 3rd Edition.
3. S. M. Sze, Physics of Semiconductor Devices, Wiley eastern Ltd.
4. Azeroff and Brophy, Electronic Processes in Semiconductors, McGraw Hill Publishing Company.
5. A. S. Grove, Physics and Technology of Semiconductor Devices, John Wiley and Sons, New York.

CLO-PLO matrix for the courseMELECPS325 (PHYSICS of SEMICONDUCTOR DEVICES)

Unit-Wise CLOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	Average CLO
MELECPS325.1	3	3	2	1	3	1	1	1	2	3	2.0
MELECPS325.2	3	3	3	2	3	1	2	2	2	3	2.4
MELECPS325.3	3	3	3	2	3	2	2	2	3	3	2.6
MELECPS325.4	2	2	3	2	3	2	2	3	3	3	2.5
Average PLO	2.75	2.75	2.75	1.75	3	1.5	1.75	2	2.5	3	2.4

SEMESTER - III

MELECMS325: Material Sciences and VLSI Technology				Course Type: Core				
Hours			Total Credits	Maximum Marks				Time Allowed for Theory Examination
Lecture	Tutorial	Practical		Internal	End Term		Total	
					Theory	Lab		

3	0	2	4	28	54	18	100	1 ¾ Hours

Course Learning Outcomes (CLOs):

Unit-Wise CLOs	After the completion of this course the students will be able to:
MELECMS325.1	Classify materials based on their microscale & nanoscale properties, and evaluate the significance of emerging materials for future electronic devices.
MELECMS325.2	Grasp the basic concepts of various steps involved in the fabrication of an integrated circuit.
MELECMS325.3	Understand MOS/VLSI fabrication processes, scaling, and device structures, and apply characterization techniques for material and device analysis
MELECMS325.4	Analyze material properties, device characteristics, and VLSI design techniques by using experimental methods, CAD tools, and MATLAB to model, simulate, and evaluate the performance of semiconductor devices and digital circuits.

Detailed Syllabus:

THEORY (3 Credits):

Unit I: Materials and Their Properties (15 Hrs.)

General classification of Materials, An overview of Electrical, Dielectric, Magnetic and Optical properties of materials. Introduction to nanotechnology, Classification of Low Dimensional Materials, Influence of physical dimension on different properties. Emerging materials for future Devices: Graphene, Carbon Nano tubes (CNT), ZnO, SiC etc.

Unit II: IC Fabrications (15 Hrs.)

Steps IC fabrication: Crystal Growth and Wafer Preparation, Epitaxy, Oxidation, Diffusion, Lithography, Etching. Isolation Methods, Metallization, Bonding.

Unit III: VLSI and Characterization Techniques (15 Hrs.)

MOS technology and VLSI, scaling of MOS devices, NMOS and CMOS structures and fabrication. Characterization Techniques: XRD, TEM, SEM, EDX.

Unit IV: Laboratory Work (1 Credit: 30 Hrs.)

Note: The student is required to attempt at least 10 experiments

1. Finding the Electrical, magnetic and optical properties of material.
2. Study about Microwind tool and λ (Lambda) Rules for Layout Generation.
3. Study the temperature dependence of resistivity of a semiconductor using four probe method.
4. Study C-V characteristics of MOSFET.
5. Finding the performance parameters of CMOS inverter.
6. Design of basic and universal gates using static design technique.
7. Design of basic and universal gates using dynamic design technique.
8. Design of combinational logic circuits using static design technique.
9. Design of combinational logic circuits using dynamic design technique.
10. Design of sequential logic circuits using static design technique.
11. Design of sequential logic circuits using dynamic design technique.
12. Design of arithmetic circuits using static design technique.
13. Design of arithmetic logic circuits using dynamic design technique

Books Recommended:

1. S. M. Sze, VLSI Technology, Megraw Hill Publishing Company.
2. Azeroff and Brophy, Electronic Processes in Semiconductors, McGraw Hill Publishing Company.
3. Jan M. Rabaey, Digital Intended Circuits: A Design Perspective, Pearson Education.
4. N Weste. D Hams & A. Bannerper, CMOS VLSI Design: A Circuits & Systems Perspective, Pearson.
5. Sorab K Ghandhi, VLSI Fabrication Principles, Wiley India.

CLO-PLO matrix for the courseMELECMS325 (MATERIAL SCIENCES and VLSI TECHNOLOGY)

Unit-Wise CLOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	Average CLO
MELECMS325.1	3.0	2.5	2.5	1.5	2.0	1.3	1.5	1.5	2.5	2.0	2.03
MELECMS325.2	3.0	2.6	2.5	1.5	2.0	1.0	2.0	2.0	2.5	2.0	2.11
MELECMS325.3	3.0	2.5	3.0	1.7	2.5	1.5	2.0	2.5	2.5	2.5	2.37
MELECMS325.4	3.0	3.0	3.0	2.0	3.0	1.0	2.5	2.5	3.0	3.0	2.60
Average PLO	3.00	2.65	2.75	1.67	2.37	1.20	2,00	2.12	2.62	2.37	2.28

SEMESTER - III

MELECMC325: Mobile Communication and Networks — **Course Type: Core**

Hours			Total Credits	Maximum Marks				Time Allowed for Theory Examination
				Internal	End Term		Total	
Lecture	Tutorial	Practical			Theory	Lab		
3	0	2	4	28	54	18	100	1 ¾ Hours

Course Learning Outcomes (CLOs):

Unit-Wise CLOs	After the completion of this course the students will be able to:
MELECMC325.1	Explain the fundamentals of cellular communication systems, frequency reuse, interference, handover, GSM architecture, logical channels, call flows, and 2.5G/2.75G standards.
MELECMC325.2	Analyze spectral efficiency of FDMA, TDMA, and CDMA; evaluate link budgets, power spectrum, and propagation models for wireless networks in indoor/outdoor environments.
MELECMC325.3	Apply equalization and diversity techniques in wireless communication systems; understand CDMA, 3G, 4G, and emerging 5G standards with protocols and call flows.
MELECMC325.4	Conduct experiments and simulations on mobile communication systems, including channel modeling, BER analysis, link budget, fading, diversity, equalization, 4G/5G standards, and communication experiments using LabView.

Detailed Syllabus:

THEORY (3 Credits):

Unit I: Cellular Communication Fundamentals and Architecture (15 Hrs.)

Cellular Communication Fundamentals: Cellular system design, Frequency reuse, cell splitting, handover concepts, Co channel and adjacent channel interference, interference reduction. Techniques and methods to improve cell coverage, Frequency management and channel assignment. GSM architecture and interfaces, GSM architecture details, GSM subsystems, GSM Logical Channels, Data Encryption in GSM, Mobility Management, Call Flows in GSM.2.5 G

Standards: High speed Circuit Switched Data (HSCSD), General Packet Radio Service (GPRS), 2.75 G Standards: EDGE.

Unit II: Wireless System Planning (15 Hrs.)

Spectral efficiency analysis based on calculations for Multiple access technologist, FDMA and CDMA, Comparison of these technologies based on their signal separation techniques, advantages, disadvantages and application areas. Wireless network planning (Link budget and power spectrum calculations. Mobile Radio Propagation: Large Scale Path Loss, Free Space Propagation Model, Reflection, Ground Reflection (Two-Ray) Model, Diffraction, Scattering, Practical Link Budget Design using Path Loss Models, Outdoor Propagation Models, Indoor Propagation Models, Signal Penetration into Buildings. Small Scale Fading and Multipath Propagation.

Unit III: Wireless Networks and Equalization (15 Hrs.)

Equalization, Diversity: Equalizers in a communications receiver, Algorithms for adaptive equalization, diversity techniques, space, polarization, frequency diversity, Interleaving. Module 5: Code Division Multiple Access. Higher Generation Cellular Standards: 3G Standards: evolved EDGE, enhancements in 4G standard, Architecture and representative protocols, call flow for LTE, VoLTE, UMTS, introduction to 5G.

Unit IV: Laboratory Work (1 Credit: 30 Hrs.)

Note: The student is required to attempt at least 10 experiments

1. Hand on training on Mobile communications using kits
2. To simulate wireless channels
3. To study BER using different channel models
4. Study of Link and power budgets
5. To study different propagation models
6. To study fading
7. To study diversity
8. To Study equalizers
9. To study polarization
10. To study signal processing in 5G
11. To study FBMC and NOMA
12. To study various 4G and 5G standards
13. Some communication experiments using LabView

Books Recommended:

1. V. K. Garg, J. E. Wilkes, Principle and Application of GSM, Pearson Education.
2. V. K. Garg, IS-95 CDMA & CDMA 2000, Pearson Education.
3. T. S. Rappaport, Wireless Communications Principles and Practice, PHI.

CLO-PLO matrix for the courseMELECMC325 (Mobile Communication and Networks)

Unit-Wise CLOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	Average CLO
MELECPE225.1	3	2	2	1	2	1	1	1	2	2	1.7
MELECPE225.2	3	3	3	2	3	1	2	2	2	3	2.4
MELECPE225.3	3	3	3	2	3	1	2	2	2	3	2.4
MELECPE225.4	3	3	3	2	3	1	3	2	3	3	2.6
Average PLO	3.0	2.8	2.8	1.8	2.8	1.0	2.0	1.8	2.3	2.8	2.3

SEMESTER - III								
MELECME325: Microwave Engineering							Course Type: Core	
Hours			Total Credits	Maximum Marks				Time Allowed for Theory Examination
Lecture	Tutorial	Practical		Internal	End Term		Total	
					Theory	Lab		
3	0	2	4	28	54	18	100	1 ¾ Hours

Course Learning Outcomes (CLOs):

Unit-Wise CLOs	After the completion of this course the students will be able to:
MELECME325.1	Analyze microwave transmission line parameters and propagation characteristics.
MELECME325.2	Apply microwave network theory to evaluate S-parameters and system behavior.
MELECME325.3	Examine the operation of microwave passive and active components and performance of microwave tubes and semiconductor devices.
MELECME325.4	Conduct and interpret microwave measurements for practical applications and perform experiments on microwave devices and systems to validate theoretical principles.

Detailed Syllabus:

THEORY (3 Credits):

Unit I: Microwave Transmission lines (15 Hrs.)

Transmission Line and Distributed parameters, Basic Transmission line equations, Solutions of Transmission line equations, Physical significance of Transmission line equations, Distortions in Transmission line, Condition for Distortion less line, Characteristic impedance, Propagation Constant, Reflection and Transmission coefficients, Velocity of propagation, Standing wave and Standing wave ratio, Reflection of line terminated in impedance other than characteristic impedance, Single stub impedance matching, Smith Chart.

Unit II: Microwave Network Analysis (15 Hrs.)

Impedance and Equivalent Voltages and Currents, Equivalent Voltages and Currents, The Concept of Impedance, Even and Odd Properties of Z (ω) and (ω), Impedance and Admittance Matrices, Reciprocal Networks Lossless Networks, The Scattering Matrix, Reciprocal Networks and Lossless Networks, A Shift in Reference Planes , Power Waves and Generalized Scattering Parameters, The Transmission (ABCD) Matrix, Relation to Impedance Matrix, Equivalent Circuits for Two-Port Networks.

Unit III: Microwave Waveguides and Devices (15 Hrs.)

Rectangular Waveguides, Solution of Wave Equations in Rectangular Coordinates, TE modes in rectangular magnitudes, TM Modes in Rectangular waveguide, Power Transmission in Rectangular Waveguides, Power Losses in Rectangular Waveguides, Excitations of Modes in Rectangular waveguides, Circular Waveguides, TEM Modes in Circular Waveguide, Klystrons: Multi-cavity Klystron and Reflex Klystron, Microwave Tunnel Diode Gunn Oscillator, Travelling Wave Tube, Characteristic Impedance of Micro strip Lines and Quality factor of Micro-strip lines, Characteristic impedance of Parallel strip lines and Attenuation losses, MMIC Fabrication techniques.

Unit IV: Laboratory Work (1 Credit: 30 Hrs.)

Note: The student is required to attempt at least 10 experiments

1. Study of different Microwave guide components.

2. Determination the frequency and wavelength in a rectangular wave guide working on TE10 mode.
3. Finding the standing wave ratio and reflection coefficient.
4. Measurement of unknown impedance with smith chart.
5. Study the VI characteristics of Gunn diode.
6. Finding the O/P power and frequency as a function of voltage in case of Gunn diode.
7. Finding the O/P power and frequency as a function of voltage in case of Magic tee.
8. To study insertion loss and attenuation of an attenuator.
9. Study the Characteristics of various modes of Klystron
10. Various experiments using MATLAB and HFSS Tool

Books Recommended:

1. G. S. Raghuvanshi, Microwave Engineering; Cengage.
2. S.Y. Liao, Microwave Devices & Circuits; PHI 3rd Ed.
3. A Das and S.K. Das, Microwave Engineering; McGraw Hill Education.
4. S. Vasuki, D Margaret Helena, R Rajeswari, Microwave Engineering; MHE.
5. Om P. Gandhi, Microwave Engineering and Applications; Pergamon Press.
6. David M. Pozar, Microwave Engineering, John Wiley & Sons.

CLO-PLO matrix for the courseMELECME325 (MICROWAVE ENGINEERING)

Unit-Wise CLOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	Average CLO
MELECME325.1	3	3	3	2	2	1	2	3	2	3	2.4
MELECME325.2	3	3	3	2	2	1	2	3	2	3	2.4
MELECME325.3	3	3	3	2	2	1	2	3	2	3	2.4
MELECME325.4	3	3	3	2	2	1	2	3	2	3	2.4
Average PLO	3	3	3	2	2	1	2	3	2	3	2.4

SEMESTER - III

MELEDAM325: Advanced Microprocessors and Microcontrollers — **Course Type: DCE**

Hours			Total Credits	Maximum Marks				Time Allowed for Theory Examination
				Internal	End Term		Total	
Lecture	Tutorial	Practical			Theory	Lab		
3	0	2	4	28	54	18	100	1¾ Hours

Course Learning Outcomes (CLOs):

Unit-Wise CLOs	After the completion of this course the students will be able to:
MELEDAM325.1	Understand the architecture, working, addressing modes and segmentation of 8086 microprocessor. Knowledge of Pin layout and functional signals of 8086. Comparison of features of advanced microprocessors. Understanding the recent trends in microprocessor design and evolution.

MELEDAM325.2	Understand the 8086-instruction set, the role of processor in execution and control. Develop assembly language programs for computational and control tasks. Demonstrate problem solving using 8086 assembly programming.
MELEDAM325.3	Understand 8086 interrupts, interrupt service routines and interrupt vector tables. Implementation of ALPs using interrupts. Evaluate the 8259-interrupt controller and 8284A clock generator. Differentiate the minimum and maximum mode operation with 8288 bus controller.
MELEDAM325.4	Write assembly programs for 8086 utilizing various addressing modes in TASM, MASM etc. Interfacing various modules like 8255, 8259 and other modules with stepper motor, 7-sgement, LCD. Keypad. Conduct of assembly programs using PIC16F84A.

Detailed Syllabus:

THEORY (3 Credits):

Unit I: Introduction to x86 Microprocessor family (15 Hrs.)

Introduction to 8086 Microprocessor, Working and Architecture of 8086, Register organization of 8086 Microprocessor, Addressing Modes and memory segmentation in 8086. Pin Description of 8086. Features and comparison of 80186, 80286, 80386, 80486 and Pentium Processors.

Unit II: 8086 Instructions set and Assembly language Programming (15 Hrs.)

Instruction set of 8086 Microprocessor: Data transfer instructions, Arithmetic and Logical instructions, Branch Instructions, Processor control instruction, String operation instructions. Assembly language Programming for 8086 microprocessors. Use of Macros and Procedures in ALP.

Unit III: Interrupts, Timing of 8086 and PIC Microcontroller15 Hrs.)

Interrupts and interrupt service subroutines, 8086 Interrupt Structures, Interrupt Vector table, various types of Interrupts. ALP using interrupts, 8259 Programmable Interrupt Controller, Interfacing & Programming, Architecture and operation of 8284A Clock Generator, Minimum and Maximum Mode 8086 System Introduction to PIC Microcontroller families (8/16 and 32 bit), PIC 16F series family overview of architecture and peripherals, Pin diagram and Architecture of PIC16F84/PIC16F84A Microcontroller and addressing modes.

Unit IV: Laboratory Work (1 Credit: 30 Hrs.)

Note: The student is required to attempt at least 10 experiments

The laboratory work shall be based on units I-III. Writing assembly for 8086, 16-bit addition, subtraction. Addressing modes using TASM, MASM and PIC simulator. Interfacing of 8255, 8259, Stepper Motor, 7-segmant display, keypad controller. Writing Assembly programs for PIC 16F84A demonstrating the addressing modes (direct, indirect, immediate, etc.

Books Recommended:

1. B. Bray, Introduction to 8086, 80186,80286, 80386, 80486, Pentium and Pentium Pro Processors, TMG
2. Daniel Tabak, Advanced Microprocessors, McGraw-Hill.
3. A. P. Godse, D. A. Godse, Advanced Microprocessors, Technical Publications.
4. K. M. Burchandi, A. K. Ray, Advanced Microprocessors and Peripherals, Tata McGraw Hill Education.
5. Tim Wilmshurst, Designing Embedded Systems with PIC Microcontrollers: Principles and Applications, Elsevier Publication.
6. Martin Bates, Interfacing PIC Microcontrollers Embedded Design by Interactive Simulation, Elsevier Publication.

CLO-PLO matrix for the courseMELEDAM325: ADVANCED MICROPROCESSORS and MICROCONTROLLERS)											
Unit-Wise CLOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	Average CLO
MELEDAM325.1	3	3	2	1	3	1	1	2	2	3	2.1
MELEDAM325.2	3	3	3	1	3	1	1	3	2	2	2.2
MELEDAM325.3	3	3	3	1	3	1	1	3	2	2	2.2
MELEDAM325.4	3	3	2.5	1.2	3	1.5	1.7	2.2	2.2	3	2.33
Average PLO	3	3	2.62	10.5	3	1.12	1.15	2.55	2.05	2.5	2.2

SEMESTER - III

MELEDDA325: Introduction to Data Analytics — **Course Type: DCE**

Hours			Total Credits	Maximum Marks				Time Allowed for Theory Examination
				Internal	End Term		Total	
Lecture	Tutorial	Practical			Theory	Lab		
3	0	2	4	28	54	18	100	1 ¼ Hours

Course Learning Outcomes (CLOs):

Unit-Wise CLOs	After the completion of this course the students will be able to:
MELEDDA325.1	Analyze the process of data science and conduct exploratory data analysis using quantitative and graphical techniques to draw conclusions and predictions.
MELEDDA325.2	Evaluate feature generation and selection methods to extract meaningful insights from data and apply them to real-world applications such as customer retention.
MELEDDA325.3	Conduct effective data visualization and analyze ethical issues in data science, including privacy, security, and bias, while exploring industry applications and future trends.
MELEDDA325.4	Conduct hands-on experiments in Python for data manipulation, visualization, regression, and clustering to analyze and interpret real-world datasets.

Detailed Syllabus:

THEORY (3 Credits):

Unit I: Introduction to Data Science and Data Analytics (15 Hrs.)

Introduction to Data Science, Different Sectors using Data science, Purpose and Components of Python in Data Science. Data Analytics Process, Knowledge Check, Exploratory Data Analysis (EDA), EDA- Quantitative technique, EDA- Graphical Technique, Data Analytics Conclusion and Predictions.

Unit II: Feature Generation and Selection in Data Science (15 Hrs.)

Feature Generation and Feature Selection (Extracting Meaning from Data) - Motivating application: user (customer) retention- Feature Generation (brainstorming, role of domain expertise, and place for imagination)- Feature Selection algorithms.

Unit III: Data Visualization and Ethical considerations of data Science (15 Hrs.)

Data Visualization- Basic principles, ideas and tools for data visualization, Examples of inspiring (industry) projects- Exercise: create your own visualization of a complex dataset. Applications of Data Science, Data Science and Ethical Issues- Discussions on privacy, security, ethics- A look back at Data Science- Next-generation data scientists.

Unit IV: Laboratory Work (1 Credit: 30 Hrs.)

Note: The student is required to attempt at least 10 experiments

1. Python Environment setup and Essentials.
2. Mathematical computing with Python (NumPy).
3. Scientific Computing with Python (SciPy).
4. Data Manipulation with Pandas.
5. Prediction using Scikit-Learn
6. Data Visualization in python using matplotlib
7. Use Python libraries like Pandas to clean the data (removing duplicates, filling or dropping missing values, converting data types, etc.).
8. Calculate basic summary statistics (mean, median, mode), visualize data distributions, and identify trends or patterns.
9. Create scatter plots, line graphs, or heatmaps to visualize correlations of a dataset containing multiple variables (e.g., product price, customer age, and purchase frequency).
10. Analyze the frequency distribution of each category and visualize it using bar plots of a dataset with categorical variables (e.g., survey responses or product categories).
11. On a dataset with missing values, apply different strategies like imputing missing values using the mean/median, forward filling, or removing rows with missing data.
12. Provide Apply linear regression to predict sales on a dataset with independent variables like advertising budget and product price, and the dependent variable as sales.
13. Apply K-means clustering to group similar data points together (e.g., customer segmentation based on purchasing behavior) in a data set.
14. Apply time series analysis techniques like moving averages, and ARIMA models to forecast future values on stock market data.

Books Recommended:

1. Joel Grus, Data Science from Scratch, Shroff Publisher Publisher /O'Reilly Publisher Media
2. Annalyn Ng, Kenneth Soo, Numsense! Data Science for the Layman, Shroff Publisher Publisher
3. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk from The Frontline. O'Reilly Publisher Media.
4. Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press.
5. Jake VanderPlas, Python Data Science Handbook, Shroff Publisher Publisher /O'Reilly Publisher Media
6. Philipp Janert, Data Analysis with Open Source Tools, Shroff Publisher Publisher /O'Reilly Publisher Media.

CLO-PLO matrix for the courseMELEDDA325 (INTRODUCTION to DATA ANALYTICS)

Unit-Wise CLOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	Average CLO
MELEDMS425.1	3	3	3	2	3	2	2	3	3	2	2.6
MELEDMS425.2	3	3	3	1	3	1	2	2	3	3	2.4
MELEDMS425.3	3	3	3	2	3	2	1	2	3	3	2.5
MELEDMS425.4	3	2	3	1	3	2	2	2	3	3	2.4
Average PLO	3	2.75	3	1.5	3	1.75	1.75	2.25	3	2.75	2.475

SEMESTER - III

MELEDNN325: Neural Networks and Deep Learning — **Course Type: DCE**

Hours			Total Credits	Maximum Marks				Time Allowed for Theory Examination
				Internal	End Term		Total	
Lecture	Tutorial	Practical			Theory	Lab		
3	0	2	4	28	54	18	100	1 ¾ Hours

Course Learning Outcomes (CLOs):

Unit-Wise CLOs	After the completion of this course the students will be able to:
MELEDNN325.1	Understand the fundamental principles of neural networks, learning techniques & network architectures to design and evaluate efficient neural models
MELEDNN325.2	Analyze, design, and apply advanced neural network models for solving complex learning tasks
MELEDNN325.3	Implement deep learning models using popular frameworks and apply appropriate optimization techniques to improve model performance.
MELEDNN325.4	Design, train, evaluate, and deploy deep learning models—including CNNs, RNNs, and DNNs and critically compare model architectures, activation functions, and transfer learning approaches (e.g. via Kaggle)

Detailed Syllabus:

THEORY (3 Credits):

Unit I: Introduction to Artificial Neural Networks (15 Hrs.)

Introduction: Biological Neuron, Idea of computational units, McCulloch–Pitts unit and Threshold logic, Linear Perceptron, Perceptron Learning Algorithm, Linear separability, Convergence theorem for Perceptron Learning Algorithm, Type of network architecture, Gradient Descent learning, Back propagation

Unit II: Advanced Neural Networks and Deep Learning Models 15 Hrs.)

Recurrent Neural Networks: Back propagation through time, Long Short-Term Memory Bidirectional LSTMs, Bidirectional RNNs; Difficulty of training deep neural networks, Greedy layer wise training. Introduction to Generative models: Restrictive Boltzmann Machines (RBMs), Introduction to Convolutional Neural Networks: LeNet, Alex Net, ZF-Net, VGGNet, GoogLeNet, ResNet, Deep Reinforcement Learning.

Unit III: Deep Learning Frameworks and Optimization Techniques (15 Hrs.)

Deep Learning Tools: Caffe, Theano, Torch, Parameter Tuning: Newer optimization methods for neural networks (Adagrad, adadelta, rmsprop, adam, NAG), second order methods for training, Saddle point problem in neural networks, Regularization methods (dropout, drop connect, batch normalization).

Unit IV: Laboratory Work (1 Credit: 30 Hrs.)

Note: The student is required to attempt at least 10 experiments

1. Introduction to Kaggle and how it can be used to enhance visibility.
2. Build general features to build a model for text analytics.
3. Build and deploy your own deep neural network on a website using tensor flow
4. Implement the perceptron learning algorithm for a simple binary classification problem, such as classifying linearly separable data,
5. Train a neural network with multiple layers using back propagation to solve the XOR problem.
6. Build and train a CNN on a dataset like MNIST for handwritten digit classification
7. Train a deep neural network with more than 5 hidden layers on the CIFAR-10 dataset, a benchmark for image classification.
8. Compare the performance of ReLU and Sigmoid activation functions in a neural network on a simple classification task.
9. Implement an RNN to predict the next word in a sentence or a character sequence (e.g. Predicting text or time-series data).
10. Use a re-trained CNN model (e.g., VGGNet or ResNet) on a new dataset for a classification task.

Books Recommended:

1. Simon Haykin, Neural Networks and Learning Machines, Pearson.
2. Christopher M Bishop, Pattern Recognition & Machine Learning, Springer.
3. Goodfellow, I., Bengio, Y., and Courville, A., Deep Learning, MIT Press.
4. Bishop, C. M., Pattern Recognition and Machine Learning, Springer.
5. John D Kelleher Deep Learning, MIT Press.
6. Hao Dong, Zihan Ding, Shanghan Zhang, Deep Reinforcement Learning: Foundations, Algorithms, and Applications, Springer.

CLO-PLO matrix for the courseMELEDNN325 (NEURAL NETWORKS and DEEP LEARNING)

Unit-Wise CLOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	Average CLO
MELEDNN325.1	3.0	2.5	2.0	1.5	2.0	1.5	2.5	2.0	2.5	2.0	2.15
MELEDNN325.2	3.0	3.0	2.5	2.0	2.5	1.5	1.5	2.0	2.5	2.5	2.30
MELEDNN325.3	3.0	3.0	3.0	1.5	2.5	1.5	2.0	2.5	2.5	3.0	2.45
MELEDNN325.4	3.0	3.0	3.0	1.5	3.0	1.5	2.5	3.0	3.0	3.0	2.65
Average PLO	3.00	2.87	2.62	1.62	2.50	1.50	2.12	2.37	2.62	2.62	2.38

SEMESTER - III

MELEDPA325: Programming for AI — **Course Type: DCE**

Hours			Total Credits	Maximum Marks				Time Allowed for Theory Examination
				Internal	End Term		Total	
Lecture	Tutorial	Practical			Theory	Lab		
3	0	2	4	28	54	18	100	1 ¾ Hours

Course Learning Outcomes (CLOs):

Unit-Wise CLOs	After the completion of this course the students will be able to:

MELEDPA325.1	Familiarize with Python development environments (Jupyter, PyCharm, VS Code). Understand Python syntax, variables, data types, and control structures. Develop modular programs using functions and modules. Implement Python data structures. Apply file handling techniques for reading and writing data.
MELEDPA325.2	Understand the object-oriented concepts. Applying the object-oriented principles in Python. Able to differentiate between composition and inheritance in software modelling. Perform data aggregation, statistical analysis and array manipulation.
MELEDPA325.3	Apply the pandas for data handling using series and Data frames. Perform indexing, selection and filtering and manipulation of data. Create visualization using matplotlib and 3D plots
MELEDPA325.4	Writing basic programs in python demonstrating basic data types, conditional statements, loops, functions and other data structures using Jupyter notebook. Classes and objects, Object oriented programming, arrays and other data structures using Numpy.

Detailed Syllabus:

THEORY (3 Credits):

Unit I: Basic Python Programming (15 Hrs.)

Introduction to Development Environments: Familiarization with Jupyter Notebooks and Python IDEs like PyCharm and Visual Studio Code. Python Basics: Syntax, Variables, Data Types, and Control Structures. Functions and Modules: Defining Functions, Scope, and Importing Modules. Data Structures: Lists, Tuples, Sets, Dictionaries, and Comprehensions. File Handling: Techniques for Reading from and Writing to Files.

Unit II: OOP and NumPy (15 Hrs.)

Introduction to OOP Concepts, Classes and Objects, Attributes and Methods, Constructors method), Encapsulation, Inheritance, Polymorphism, Special Methods, Class and Static Methods, Property Decorators, Composition vs Inheritance.

NumPy: Understanding arrays, Data Types and Attributes, Array Creation and Properties, Indexing and Slicing, Array Mathematics (Addition, Subtraction, Scalar Multiplication, Division), Aggregation and Statistical Functions, Array Manipulation (Reshape, Concatenate, Split).

Unit III: Data Operations and Plotting (15 Hrs.)

Pandas: Series and Data-Frames, Data Importing and Exporting, Data Cleaning and Preparation, Data Manipulation (Indexing, Selection, Filtering), Working with Missing Data, Group by Operations, Merging and Joining DataFrames, Reshaping and Pivoting.

Basic Plotting with Matplotlib (Line Graphs, Bar Charts, Histograms, Scatter Plots), Customizing Plots (Colors, Labels, Legends), Advanced Plotting Techniques (Subplots, 3D Plots, Interactive Visualizations), Introduction to Seaborn, Seaborn's Built-In Datasets, Statistical Plotting with Seaborn (Distribution Plots, Categorical Plots, Pair Plots, Heatmaps).

Unit IV: Laboratory Work (1 Credit: 30 Hrs.)

Note: The student is required to attempt at least 10 experiments

The laboratory work shall be based on units I-III. Writing simple python script, creating variable of different types, programs using if, if-else, loops (for, while), nested loops. Defining user functions and the functions from the standard library. Object oriented programs using python. Numpy for arrays, sets and lists. Data manipulation (indexing, selection and filtering). Basic plotting with matplotlib.

Books Recommended:

1. A. Downey, Think python. "O'Reilly Media, Inc.".
2. Z. A. Shaw, Learn Python The Hard Way. Addison-Wesley Professional.
3. A. Sweigart, Invent your own computer games with python.
4. P. Barry, Head first Python: A brain-friendly guide. "O'Reilly Media, Inc.".
5. E. Matthes, Python crash course: A hands-on, project-based introduction to programming, No Starch Press.

CLO-PLO matrix for the courseMELEDPA325 (PROGRAMMING for AI)

Unit-Wise CLOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	Average CLO
MELEDPA325.1	3	3	2	1	3	1	1	2	2	3	2.1
MELEDPA325.2	3	3	3	1	3	1	1	3	2	3	2.3
MELEDPA325.3	3	3	3	1	3	1	1	3	1	3	2.2
MELEDPA325.4	3	3	2.5	1.2	3	1.6	1.3	2.3	2.1	3	2.3
Average PLO	3	3	2.62	1.05	3	1.15	1.07	2.57	1.77	3	2.22

SEMESTER - IV

MELEPPI425: Project/ Internship — **Course Type: Project**

Hours			Total Credits	Maximum Marks				Time Allowed for Theory Examination
				Internal	End Term		Total	
Lecture	Tutorial	Practical			Theory	Lab		
0	0	12	6	42	0	108	150	0

Course Learning Outcomes (CLOs):

Unit-Wise CLOs	After the completion of this course the students will be able to:
MELEPPI425.1	Identify and define a research or industry-relevant problem in electronics, and formulate clear objectives for project execution.
MELEPPI425.2	Apply theoretical knowledge and technical skills to design and implement a solution through hardware or simulation tools.
MELEPPI425.3	Analyze and interpret experimental/simulation results, and validate solutions against expected outcomes.
MELEPPI425.4	Prepare and present a project dissertation/report that demonstrates technical writing, documentation, and effective communication of results.
MELEPPI425.5	Demonstrate professional ethics, teamwork, and independent learning while completing project tasks within the given timeframe.
MELEPPI425.6	Write and present research outputs in the form of a conference/journal paper or draft a patent application based on project outcomes.

Detailed Syllabus:

THEORY (3 Credits):

Unit I: Problem Identification & Literature Survey (15 Hrs.)

- Selection of research/industry problem in electronics.
- Literature review and gap analysis.
- Formulation of problem statement and objectives.

Unit II: Research Methodology & Project Planning (15 Hrs.)

- Understanding research methodology in electronics.
- Project planning, milestones, and resource allocation.
- Selection of tools (hardware platforms, MATLAB, Python, simulation software, PCB tools, etc.).

Unit III: Design & Implementation

- Application of theoretical knowledge.
- Design and simulation of circuits, systems, or algorithms.
- Hardware implementation (if applicable).

Unit IV: Testing & Validation

- Experimental setup, data collection, and performance evaluation.
- Comparison with existing methods.
- Validation of results against objectives.

Unit V:Documentation & Dissertation Writing

- Structure of dissertation/report (introduction, methodology, results, discussion, conclusion).
- Technical writing and referencing styles (IEEE, APA).
- Plagiarism checks and ethics in reporting.

Unit VI: Research Dissemination & Presentation

- Writing a conference/journal paper.
- Preparing oral/poster presentations.
- Communication skills for defense/viva-voce.

Books Recommended:

1. C.R. Kothari & Gaurav Garg – Research Methodology: Methods and Techniques (New Age International)
2. R. Panneerselvam – Research Methodology (PHI Learning)
3. G.S. Sawhney – Fundamentals of Electrical and Electronics Engineering (I.K. International)
4. A.R. Senthil Kumar – Research Methodology (University Science Press)
5. Rajasekar, Philominathan & Chinnathambi – Research Methodology

CLO-PLO matrix for the courseMELEPPI425 (PROJECT/ INTERNSHIP)

Unit-Wise CLOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	Average CLO
MELEPPI425.1	3	2	3	1	2	2	3	2	2	3	2.3
MELEPPI425.2	3	3	3	1	3	2	3	2	2	3	2.5
MELEPPI425.3	3	3	3	2	3	2	3	2	2	3	2.7
MELEPPI425.4	2	2	2	3	3	2	3	3	2	2	2.4
MELEPPI425.5	2	2	2	2	2	3	3	3	2	2	2.3
MELEPPI425.6	3	2	3	3	3	3	3	3	2	3	2.8
Average PLO	2.7	2.3	2.7	2.0	2.7	2.3	3.0	2.5	2.0	2.7	2.49

SEMESTER - IV

MELEPPI425: Project/ Internship								Course Type: Project
Hours			Total Credits	Maximum Marks				Time Allowed for Theory Examination
Lecture	Tutorial	Practical		Internal	End Term		Total	
					Theory	Lab		
2	0	4	4	28	0	80	72	0

Course Learning Outcomes (CLOs):

Unit-Wise CLOs	After the completion of this course the students will be able to:
MELEPPI425.1	Identify a relevant research/industry problem in electronics, conduct literature survey, perform gap analysis, and define problem statement, objectives, and scope.
MELEPPI425.2	Apply appropriate research methodology and prepare a detailed project plan with defined milestones, resource allocation, and selection of suitable hardware/software tools.
MELEPPI425.3	Design and implement a system/circuit/algorithm through hardware or simulation, conduct experiments, evaluate performance, and validate results against objectives.
MELEPPI425.4	Prepare project dissertation/report following academic and ethical standards, write technical papers for conference/journal, and deliver effective oral/poster presentations with confidence.

Detailed Syllabus:

THEORY (3 Credits):

Unit I: Problem Identification & Literature Survey (15 Hrs.)

- Selection of research/industry problem in electronics.
- Literature review, gap analysis, and defining research motivation.
- Formulation of problem statement, objectives, and scope.

Unit II: Research Methodology & Project Planning (15 Hrs.)

- Research methodology in electronics.
- Project planning: milestones, scheduling, and resource allocation.
- Selection of tools: hardware platforms, MATLAB, Python, simulation software, PCB tools, etc.

Unit III: Design, Implementation & Validation (15 Hrs.)

- Application of theoretical knowledge in circuit/system/algorithm design.
- Simulation and hardware implementation (if applicable).
- Experimental setup, data collection, and performance evaluation.
- Comparison with existing methods and validation against objectives.

Unit IV: Documentation & Research Dissemination (15 Hrs.)

- Dissertation/report writing: structure (introduction, methodology, results, discussion, and conclusion).
- Technical writing, referencing styles (IEEE, APA), plagiarism checks, and ethics.
- Writing conference/journal papers, preparing oral/poster presentations.
- Communication skills for defense/viva-voce.

Books Recommended:

1. C. R. Kothari & Gaurav Garg – Research Methodology: Methods and Techniques, Age International.
2. R. Panneerselvam – Research Methodology, PHI Learning.
3. G. S. Sawhney – Fundamentals of Electrical and Electronics Engineering, I. K. International.
4. A. R. Senthil Kumar – Research Methodology, University Science Press,
5. Rajasekar, Philominathan & Chinnathambi – Research Methodology.

CLO-PLO matrix for the courseMELEPPI425 (PROJECT/ INTERNSHIP)

Unit-Wise CLOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	Average CLO
MELEPPI425.1	3	2	2	1	2	2	3	1	2	3	2.1
MELEPPI425.2	2	3	3	1	2	2	3	2	3	3	2.4
MELEPPI425.3	3	3	3	1	3	2	3	2	3	3	2.7
MELEPPI425.4	2	2	2	3	3	3	2	2	3	2	2.4
Average PLO	2.5	2.5	2.5	1.5	2.5	2.3	2.8	1.8	2.8	2.8	2.4

SEMESTER - IV

MELEPIT425 :Industrial Training and Seminar — **Course Type: Project**

Hours			Total Credits	Maximum Marks				Time Allowed for Theory Examination
				Internal	End Term		Total	
Lecture	Tutorial	Practical			Theory	Lab		
0	0	4	2	14	0	36	50	½ Hours

Course Learning Outcomes (CLOs):

Unit-Wise CLOs	After the completion of this course the students will be able to:
MELEPIT425.1	Deliver an effective technical presentation on a recent advancement in Electronics & Communication, demonstrating clarity of thought, content organization, communication skills, and ability to respond to queries
MELEPIT425.2	Apply theoretical knowledge to practical scenarios during industrial training, gain hands-on exposure to emerging technologies, and prepare a comprehensive training report with evaluation from the host institute.

Detailed Syllabus:

THEORY (3 Credits):

Unit I: Seminar Work (1 Credit)

Each student shall be required to deliver a power point presentation on any topic pertaining to some latest area in the field of Electronics & Communication. Each student shall be evaluated for his/her Seminar Work by a team of faculty members headed by the Seminar Incharge.

Unit II: Industrial Training (1 Credit)

The students are required to undergo training at some centre of excellence, outside the State, to get additional exposure in the new and emerging areas in the field of Electronics. Training Incharge/s from the Department shall accompany the students for making necessary academic and other arrangements at the host institute. At the end of the training

programme, the performance of the students shall be evaluated by the host institute in collaboration with the Training Incharge.

CLO-PLO matrix for the courseMELEPIT425 (INDUSTRIAL TRAINING AND SEMINAR)

Unit-Wise CLOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	Average CLO
MELEPIT425.1	3	1	2	3	2	2	1	2	2	1	1.9
MELEPIT425.2	3	3	3	2	2	2	2	2	3	3	2.5
Average PLO	3.0	2.0	2.5	2.5	2.0	2.0	1.5	2.0	2.5	2.0	2.1

SEMESTER - IV

MELEPIT425 : Industrial Training and Seminar — **Course Type: Project**

Hours			Total Credits	Maximum Marks				Time Allowed for Theory Examination
				Internal	End Term		Total	
Lecture	Tutorial	Practical			Theory	Lab		
0	0	24	12	84		216	300	½ Hours

Course Learning Outcomes (CLOs):

Unit-Wise CLOs	After the completion of this course the students will be able to:
MELEPIT425.1	Identify and select seminar topics in emerging areas of Electronics.
MELEPIT425.2	Prepare and deliver structured seminar presentations with clarity.
MELEPIT425.3	Demonstrate effective communication, discussion, and listening skills during seminars.
MELEPIT425.4	Apply theoretical knowledge to practical problems encountered during industrial training.
MELEPIT425.5	Analyze industrial workflows, methodologies, and technologies observed during training.
MELEPIT425.6	Demonstrate use of modern tools and techniques relevant to Electronics & Communication industries.
MELEPIT425.7	Exhibit professional ethics, responsibility, and adherence to workplace practices.
MELEPIT425.8	Work effectively both as an individual and as part of a team in an industrial environment.
MELEPIT425.9	Prepare structured industrial training reports with appropriate analysis and documentation.
MELEPIT425.10	Demonstrate problem-solving abilities by correlating industrial experience with academic knowledge.
MELEPIT425.11	Propose innovative solutions, improvements, or project ideas inspired by industrial exposure.
MELEPIT425.12	Integrate seminar and training learnings into a holistic understanding of Electronics as a discipline.

Detailed Syllabus:

THEORY (3 Credits):

Unit I: Seminar Work (Credit)

Each student shall be required to deliver a power point presentation on any topic pertaining to some latest area in the field of Electronics & Communication. Each student shall be evaluated for his/her Seminar Work by a team of faculty members headed by the Seminar Incharge.

Unit II: Industrial Training (Credit)

The students are required to undergo training at some centre of excellence, outside the State, to get additional exposure in the new and emerging areas in the field of Electronics. Training Incharge/s from the Department shall accompany the students for making necessary academic and other arrangements at the host institute. At the end of the training programme, the performance of the students shall be evaluated by the host institute in collaboration with the Training Incharge.

CLO-PLO matrix for the courseMELEPIT425 (INDUSTRIAL TRAINING AND SEMINAR)

Unit-Wise CLOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	Average CLO
MELEPIT425.1	2	2	2	1	2	1	1	2	2	2	1.7
MELEPIT425.2	2	2	2	2	2	1	1	2	2	3	1.9
MELEPIT425.3	2	2	2	2	2	1	1	2	2	3	1.9
MELEPIT425.4	3	3	3	2	3	2	2	3	3	3	2.7
MELEPIT425.5	3	3	3	2	3	2	2	3	3	3	2.7
MELEPIT425.6	3	3	3	3	3	2	2	3	3	3	2.9
MELEPIT425.7	2	2	2	2	2	3	3	3	2	2	2.3
MELEPIT425.8	2	2	2	2	2	2	3	3	3	2	2.3
MELEPIT425.9	2	2	3	2	2	2	2	2	2	3	2.2
MELEPIT425.10	3	3	3	3	3	2	2	3	3	3	2.8
MELEPIT425.11	3	3	3	3	3	2	2	3	3	3	2.8
MELEPIT425.12	3	3	3	3	3	3	3	3	3	3	3.0
Average PLO	2.5	2.5	2.6	2.4	2.6	2.0	2.2	2.8	2.7	2.7	2.5

SEMESTER - IV

MELEDES425: Embedded System Design with ARM Cortex Microcontrollers — **Course Type: DCE**

Hours			Total Credits	Maximum Marks				Time Allowed for Theory Examination
					End Term			
Lecture	Tutorial	Practical		Internal	Theory	Lab	Total	
3	0	2	4	28	54	18	100	1 ¾ Hours

Course Learning Outcomes (CLOs):

Unit-Wise CLOs	After the completion of this course the students will be able to:
MELEDES425.1	Familiarize with history and evolution of ARM architecture and Thumb ISA, Identifying the ARM processor naming conventions and ARM ecosystem. Applications of Corte-M processors across various embedded domains. Knowledge of interrupt handling and exception support in Cortex-M
MELEDES425.2	Understanding of Programmers model of ARM Cortex-M processors, Memory system and bit band operations. Evaluation of low-power design of Cortex-M processors. Utilization of NVIC and SCB for exception and interrupt management.

MELEDES425.3	Understanding ARM instruction set and various addressing modes, Develop and debug C and Assembly programs using ARM Cortex -M instruction set. Evaluation of Enhanced DSP instructions in cortex-M4
MELEDES425.4	Conduct of lab experimentation using ARM Keil and C compiler for assembly programming (Cortex-M3). Interfacing accelerometer, LCD, Keypad, Micro-SD card, RS-232 with LPC1768.

Detailed Syllabus:

THEORY (3 Credits):

Unit I: Introduction to ARM (15 Hrs.)

A brief history of ARM, evolution, Architecture versions and Thumb ISA, Processor naming and ARM ecosystem, Cortex - M processor family, Advantages of the Cortex -M processors, Applications of the ARM Cortex-M processors, Introduction to Cortex-M3 and Cortex-M4 processors (Processor architecture, Instruction set, Block diagram, Memory system, Interrupt and exception support).

Unit II: Architecture of Cortex M3 and M4 Processors (15 Hrs.)

Programmer's model, Operation modes, Registers, Memory System, features, stack memory, memory requirements, endianness, bit band operations, access permissions and attributes, memory barriers, Low power design and features, low power application development, overview of exceptions and interrupts, exception types and interrupt management, vector table, exception sequence, use of NVIC register, SCB register and other special registers for exception and interrupt control, configuration control and auxiliary control registers. Review of other Cortex M Processor Architectures.

Unit III: Instruction Set ARM Processors and Floating-point Operations (15 Hrs.)

OS support features, Shadowed stack pointer, SVC and PendSV exception, Context switching, Exclusive accesses and embedded OS, MPU overview, MPU registers (type, control, region number, region base attribute, region base address, alias), Overview of memory barrier configuration, memory management faults, fault handlers, exception handling faults.
Review of floating-point numbers, Cortex M4 floating point unit (FPU), floating point registers,
Lazy stacking, interrupt of lazy stacking, Floating point exceptions. Introduction to advanced features of Cortex M3 and M4 processors. Introduction to Debug and trace, Debug architectures

Unit IV: Laboratory Work (1 Credit: 30 Hrs.)

Note: The student is required to attempt at least 10 experiments

The laboratory work shall be based on units I-III. Writing C and assembly programs for LPC1768 using ARM Keil. Exploring GPIO lines of LPC1768 and interfacing it with LEDs and blinking it in different fashion, Interfacing Seven Segment Display to LPC1768. Interfacing TFT display to LPC1768. Interfacing LPC1768 with accelerometer, LCD, Keypad, Micro-SD card, and RS-232.

Books Recommended:

1. Joseph Yiu, The Definitive Guide to ARM Cortex M3 and Cortex-M4 Processors, Elsevier Publication.
2. Vincent Mahout, Assembly Language Programming ARM Cortex-M3, Wiley Publication.
3. Yifeng Zhu, Embedded Systems with ARM Cortex-M Microcontrollers in Assembly Language and C, E-Man Press LLC Publication.
4. William Hohl and Christopher Hinds, ARM Assembly Language Fundamentals and Techniques, CRC Press.
5. Jonathan W Valvano, Embedded Systems: Introduction to Arm(r) Cortex -M Microcontrollers.

CLO-PLO matrix for the courseMELEDES425 (EMBEDDED SYSTEM DESIGN with ARM CORTEX MICROCONTROLLERS)

Unit-Wise CLOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	Average CLO
MELEDES425.1	3	3	2	1	3	1	1	2	2	3	2.1
MELEDES425.2	3	3	3	1	3	1	1	3	2	3	2.3
MELEDES425.3	3	3	3	1	3	1	1	3	1	2	2.1
MELEDES425.4	3	3	2.5	1.3	3	1.6	1.5	2.3	2.1	3	2.3
Average PLO	3	3	2.63	1.07	3	1.15	1.12	2.57	1.77	2.75	2.2

SEMESTER - IV

MELEDLC425: Lightweight Cryptography — **Course Type: DCE**

Hours			Total Credits	Maximum Marks				Time Allowed for Theory Examination
				Internal	End Term		Total	
Lecture	Tutorial	Practical			Theory	Lab		
3	0	2	4	28	54	18	100	1 ¾ Hours

Course Learning Outcomes (CLOs):

Unit-Wise CLOs	After the completion of this course the students will be able to:
MELEDLC425.1	Knowledge of IoT architectures and need of light weight cryptography for resource limited IoT devices. Familiarization of light weight cryptographic algorithms. Application of lightweight cryptographic algorithms in real world IoT applications
MELEDLC425.2	Understanding the working principles of Block and stream ciphers. Perform security evaluations of stream ciphers. Understanding the principles of authenticated encryption with associated data.
MELEDLC425.3	Implementation of lightweight cryptographic algorithms on microcontrollers and perform benchmarking. Resilience of lightweight ciphers against side-channel attacks. Develop the ability to evaluate cryptographic choice for specific IoT use cases.
MELEDLC425.4	Implementation of various types of ciphers (stream and Block) using python. Implementation of SPN, PRESENT, GIFT, CLEFIA.

Detailed Syllabus:

THEORY (3 Credits):

Unit I: Introduction to Lightweight Cryptography (15 Hrs.)

Overview of IoT architecture and constraints in IoT devices, Importance of lightweight cryptography in IoT for resource-limited environments, Overview of NIST's Lightweight Cryptography Standardization Process, Introduction to key algorithms and standards: ASCON, PRESENT, and GIFT.

Unit II: Core Lightweight Cryptographic Algorithms (15 Hrs.)

Block Ciphers: PRESENT, GIFT, and LED (Lightweight Encryption Device) – Design principles, encryption modes, and performance metrics, Comparison of security levels and efficiency across IoT applications
Stream Ciphers: Grain, Trivium, and Spritz - Analysis of lightweight stream ciphers for constrained environments, Security evaluation and application-specific performance

Authenticated Encryption with Associated Data (AEAD): ASCON, TinyJAMBU, and PHOTON-Beetle - Use of AEAD for secure IoT communications, Evaluating authentication and integrity capabilities.

Unit III: Advanced Lightweight Cryptography (15 Hrs.)

Implementation and benchmarking: microcontroller and hardware-software performance Resistance to side-channel and fault attacks in lightweight cryptography. Exploring other cryptographic protocols: SPARX (lighrweight block cipher) and PRINCE Practical considerations in deploying lightweight algorithms: energy efficiency, memory footprint, and processing speed. Extended functionalities: hashing, eXtendable Output Functions (XOF), and key exchange. NIST profiles for lightweight cryptography in IoT and constrained applications

Unit IV: Laboratory Work (1 Credit: 30 Hrs.)

Note: The student is required to attempt at least 10 experiments

The laboratory work shall be based on units I-III. Writing python programs to implement the various cryptographic algorithms (Stream cipher and Block ciphers, Monoalphabetic and poly alphabetic ciphers). Implementation of SPN, PRESENT, GIFT, CLEFIA and eXtendable Output Function (XOF) using Geeko, Giant-Geeko and Nucleo Boards.

Books Recommended:

1. William Stallings, Cryptography and Network Security, Prentice Hall.
2. Tim Güneysu, Gregor Leander, Amir Moradi, Lightweight Cryptography for Security and Privacy, Springer.
3. Fei Hu, Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations, CRC Press.
4. NIST Internal Reports on Lightweight Cryptography (IR 8454)

CLO-PLO matrix for the courseMELEDLC425 (LIGHTWEIGHT CRYPTOGRAPHY)

Unit-Wise CLOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	Average CLO
MELEDLC425.1	3	3	2	1	3	1	1	2	2	3	2.1
MELEDLC425.2	3	3	3	1	3	1	1	3	2	2.3	2.23
MELEDLC425.3	3	3	3	1	3	1	1	3	1	2.1	2.11
MELEDLC425.4	3	3	2.3	1.3	2.4	1.3	1.1	2.3	2.1	2.8	2.16
Average PLO	3	3	2.57	10.7	2.85	1.07	1.02	2.57	1.77	2.3	2.15

SEMESTER - IV

MELEDNE425: Nanoelectronics — **Course Type: DCE**

Hours			Total Credits	Maximum Marks				Time Allowed for Theory Examination
					End Term			
Lecture	Tutorial	Practical		Internal	Theory	Lab	Total	
3	0	2	4	28	54	18	100	1 ¾ Hours

Course Learning Outcomes (CLOs):

Unit-Wise CLOs	After the completion of this course the students will be able to:

MELEDNE425.1	Explain the principles of nanotechnology and quantum confinement effects in low-dimensional semiconductor structures (wells, wires, and dots).
MELEDNE425.2	Analyze semiconductor quantum nanostructures including heterojunctions, superlattices, and quantum transport phenomena such as Quantum Hall Effect.
MELEDNE425.3	Evaluate and compare nanoscale electronic and optoelectronic devices (MOSFETs, CNTFETs, Spin-FETs, quantum lasers, and nanowire-based devices).
MELEDNE425.4	Perform simulations and experiments to study band structures, DOS, quantum transport, I–V characteristics of nanoscale devices, and design QCA-based logic circuits.

Detailed Syllabus:

THEORY (3 Credits):

Unit I: Nanotechnology and Nanoelectronics (15 Hrs.)

Introduction to Nanotechnology: size dependent physical properties, Melting point, solid state phase transformations, The Physics of Low-Dimensional Semiconductors: Overview of Schrodinger wave equation, Square quantum well of finite depth, Parabolic and triangular quantum wells, Quantum wires, Quantum dots, Strained layers, band-gap variations-quantum confinement, excitons.

Unit II: Semiconductor Quantum Nanostructures (15 Hrs.)

Hetero-junctions - Modulation-doped heterojunctions, SiGe strained heterostructures; Quantum wells - Modulation-doped quantum well, Multiple quantum wells (MQW), Super-lattices, Electric Field Transport in Nanostructures: Parallel transport, Perpendicular transport, Quantum transport in nanostructures, Transport in Magnetic Fields and the Quantum Hall Effect.

Unit III: Electronic and Optoelectronic Devices Based on Nanostructures (15 Hrs.)

Nano scale MOSFET - MODFETs - Heterojunction bipolar transistors, Resonant Tunnelling Transistor, Hot electron transistors, Single-Electron Transistor, 2D FET, Carbon nanotube (CNT) FET, Magnetic Tunnel Junction (MTJ), Spin-FET and silicon nanowire (SiNW) FET. Quantum Dots and Quantum Cellular Automata (QCA), Quantum Well Lasers (QW Lasers), Quantum Dot Lasers (QD Lasers), Photodetectors based on Quantum Dots and Nanowires, Light Emitting Diodes (LEDs) using Nanostructures for enhanced efficiency.

Unit IV: Laboratory Work (1 Credit: 30 Hrs.)

Note: The student is required to attempt at least 10 experiments

1. Study the Band-diagrams and Density of State (DOS) Function of Bulk Semiconductor for different nano-materials.
2. Study the Band-diagrams and DOS of Quantum Well Structure for different nanomaterials.
3. Study the Band-diagrams and DOS of Quantum Wire Structure for different nanomaterials.
4. Study the Band-diagrams and DOS of Quantum Dot Structure for different nanomaterials.
5. Study of Quantum Hall Effect.
6. Study the I-V characteristics of Resonant Tunnelling FET.
7. Study the I-V characteristics of Single- Electron Transistor.
8. Study the I-V characteristics of CNTFET.
9. Study the I-V characteristics of Organic Field Effect Transistor (OFET).
10. Study the I-V characteristics of silicon nanowire (SiNW) FET.
11. Study the I-V characteristics of HEMT.
12. Study the operation and characteristics of MTJ and Spin-FET.
13. Design logic structures in QCA.
14. Study the efficiency of different solar cells.
15. Study the characteristics of Photodetector.

Books Recommended:

1. Hari Singh Nalwa, Encyclopedia of Nanotechnology, American Scientific Publishers.
2. J. M. Martínez-Duart, R.J. Martín-Palma and F. Agulló-Rueda, Nanotechnology for Microelectronics and Optoelectronics, Elsevier B.V.
3. Bharat Bhusan, Handbook of Nanotechnology, Springer.
4. A. A. Balandin, K. L. Wang, Handbook of Semiconductor Nanostructures and Nanodevices, American Scientific Publishers.

CLO-PLO matrix for the courseMELEDNE425 (NANOELECTRONICS)

Unit-Wise CLOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	Average CLO
MELEDNE425.1	3	2	2	1	2	1	2	2	2	2	1.9
MELEDNE425.2	3	3	2	1	3	1	3	2	3	2	2.3
MELEDNE425.3	3	3	3	2	3	1	3	3	3	3	2.8
MELEDNE425.4	2	3	3	2	3	2	3	3	3	3	2.8
Average PLO	2.8	2.8	2.5	1.5	2.8	1.3	2.8	2.5	2.8	2.5	2.5

SEMESTER - IV

MELEDNC425: Neuromorphic Computing — **Course Type: DCE**

Hours			Total Credits	Maximum Marks				Time Allowed for Theory Examination
				Internal	End Term		Total	
Lecture	Tutorial	Practical			Theory	Lab		
3	0	2	4	28	54	18	100	1 ¾ Hours

Course Learning Outcomes (CLOs):

Unit-Wise CLOs	After the completion of this course the students will be able to:
MELEDNC425.1	Explain the foundations of neuromorphic computing, including biological inspiration, neuron models, and spiking neural networks.
MELEDNC425.2	Analyze and evaluate neuromorphic devices, circuits, and architectures for energy-efficient and brain-inspired computation.
MELEDNC425.3	Apply spiking neural network algorithms for AI, robotics, and real-time applications in sensing and edge computing.
MELEDNC425.4	Design, simulate, and implement neuromorphic circuits and spiking neural networks using tools such as Python, Cadence, FPGA, and TCAD.

Detailed Syllabus:

THEORY (3 Credits):

Unit I: Foundations of Neuromorphic Computing (15 Hrs.)

Overview and Motivation: Neuromorphic Computing, Importance in modern technology and potential impact on computing, Challenges of traditional computing and the Von Neumann bottleneck.

Biological Inspiration and Principles: Basic neuroscience concepts: structure and function of neurons and synapses, Understanding brain-inspired computing models and biological processing, Differences between neuromorphic and conventional computing.
Computational Models: Introduction to neuron models: Leaky Integrate-and-Fire (LIF) model, Hodgkin-Huxley, Spiking Neural Networks (SNNs). Learning in spiking neural networks – Stochastic computing – Convolutional spiking neural networks – Reservoir computing – Computing with spikes

Unit II: Devices, Circuits, and Hardware for Neuromorphic Systems (15 Hrs.)

Materials for Neuromorphic Systems: Introduction to key materials: phase-change memory (PCM), ferroelectric and spintronic materials, 2D materials, organic materials, and nanowires used in neuromorphic devices.
Neuromorphic Device Basics: Basics of device functionality in brain-inspired computing systems, General introduction to devices capable of spiking behaviour and emulating neuron functions.
Circuit Design and Energy Efficiency: CMOS-based circuit design principles for implementing neuromorphic systems. Crossbar arrays for neuromorphic computation: matrix-vector multiplication. Importance of low-power design and basic strategies for energy-efficient neuromorphic circuits.
Integrated Neuromorphic Systems: Overview of neuromorphic chips and hardware architectures – Intel Loihi, IBM TrueNorth.

Unit III: Algorithms and Applications of Neuromorphic Computing (15 Hrs.)

Spiking Neural Network (SNN) Algorithms: Fundamental algorithms for SNNs, applying algorithms to simple spike-based learning tasks.
Applications in AI and Robotics: Neuromorphic computing for robotics and autonomous systems, Role in self-driving cars and real-time sensor data processing.
Neuromorphic Sensing and Edge Computing: Event-based sensors and neuromorphic sensory systems – Visual, Olfactory, and Gustatory. Neuromorphic computing in IoT and wearable devices, emphasizing real-time and low-power processing benefits.

Unit IV: Laboratory Work (1 Credit: 30 Hrs.)

Note: The student is required to attempt at least 10 experiments

1. To design, simulate, and analyze spiking neurons, synapses, and networks using tools like Python and Cadence.
2. Design Mc Cullock Pitts Neuron model in Cadence/HSPICE/FPGA.
3. Design Axon Hillock circuit in Cadence/HSPICE.
4. Using the Axon Hillock circuit, reason what happens to the membrane potential, Vmem, when a DC input current is injected in the node Vmem itself, and charges up the membrane. Also explain how the spike output Vout of the circuit behaves.
5. Design a FDSOI based single spiking neuron in ATLAS TCAD/Synopsis Sentaurus and study relationship of spiking frequency with different parameters.
6. Design a TFET based single spiking neuron in ATLAS TCAD/Synopsis Sentaurus and study relationship of spiking frequency with different parameters.
7. Analysis of a memristor/RRAM/MTJ based 1T1M crossbar architecture
8. Design and analysis of crossbar arrays for neuromorphic computation in Cadence/HSPICE/FPGA.
9. Design of Spiking Neural Network for image classification using python.
10. Design of Spiking Neural Network for signal classification using python.
11. Design of Spiking Neural Network for image classification on FPGA.
12. Design of Spiking Neural Network for signal classification on FPGA.
13. Design of artificial Visual system for in-sensor computing.
14. Design of artificial Olfactory system for in-sensor computing.
15. Design of artificial Gustatory system for in-sensor computing.

Books Recommended:

1. Sabina Spiga, Abu Sebastian, Damien Querlioz and Bipin Rajendran, Memristive Devices for Brain-Inspired Computing: From Materials, Devices, and Circuits to Applications—Computational Memory, Deep Learning, and Spiking Neural Networks, Elsevier.
2. Min Gu, Yangyundou Wang, Yibo Dong and Haoyi Yu Neuromorphic Photonic Devices and Applications, Elsevier.
3. Farooq A. Khanday, Energy-Efficient Devices and Circuits for Neuromorphic Computing, Elsevier.

CLO-PLO matrix for the courseMELEDNC425 (NEUROMORPHIC COMPUTING)

Unit-Wise CLOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	Average CLO
MELEDNC425.1	3	2	2	1	2	1	2	2	2	2	1.9
MELEDNC425.2	3	3	3	1	3	1	2	2	2	3	2.3
MELEDNC425.3	3	3	3	2	3	1	2	3	2	3	2.5
MELEDNC425.4	3	3	3	3	3	2	3	3	3	3	2.9
Average PLO	3.0	2.8	2.8	1.8	2.8	1.3	2.3	2.5	2.3	2.8	2.5

SEMESTER - IV

MELEDDI425: Digital Image Processing — **Course Type: DCE**

Hours			Total Credits	Maximum Marks				Time Allowed for Theory Examination
				Internal	End Term		Total	
Lecture	Tutorial	Practical			Theory	Lab		
3	0	2	4	28	54	18	100	1 ¼ Hours

Course Learning Outcomes (CLOs):

Unit-Wise CLOs	After the completion of this course the students will be able to:
MELEDDI425.1	Explain digital image fundamentals including representation, perception, sampling, quantization, and transforms (2D-DFT, FFT).
MELEDDI425.2	Implement and analyze spatial and frequency domain image enhancement techniques, including intensity transformations, histogram processing, and filtering methods.
MELEDDI425.3	Analyze image compression methods (lossless and lossy) and implement standards such as JPEG and MPEG.
MELEDDI425.4	Demonstrate proficiency in MATLAB image processing toolbox by using fundamental commands and applying it for image manipulation, filtering, restoration, and compression.

Detailed Syllabus:

THEORY (3 Credits):

Unit I: Digital Image Fundamentals (15 Hrs.)

Digital image fundamentals: representation - elements of visual perception - simple image formation model - Image sampling and quantization - basic relationships between pixels – imaging geometry. Review of matrix theory results: Row and column ordering. Review of Image transforms: 2D-DFT, FFT.

Unit II: Image Enhancement (15 Hrs.)

Image enhancement: Spatial domain methods: point processing - intensity transformations, histogram processing, image subtraction, image averaging; Spatial filtering- smoothing filters, sharpening filters. Frequency domain methods: low pass filtering, high pass filtering.

Unit III: Image Compression (15 Hrs.)

Image compression: fundamentals- redundancy: coding, inter pixel, psychovisual, fidelity criteria, Models, Elements of information theory, Error free compression- variable length, bit plane, lossless predictive, Lossy compression- lossy predictive, transform coding. Fundamentals of JPEG and MPEG. Image Compression using MATLAB.

Unit IV: Laboratory Work (1 Credit: 30 Hrs.)

Note: The student is required to attempt at least 10 experiments

1. Read and display an image.
2. Implement arithmetic, logical, and geometric operations on images.
3. Implement relationships between pixels.
4. Apply transformations to an image.
5. Image thresholding (binary conversion)
6. Morphological operations (dilation, erosion)
7. Perform contrast stretching on a low-contrast image.
8. Compute and display the histogram, and perform histogram equalization.
9. Display bit planes of an image.
10. Compute and display the DCT of an image.
11. Calculate the mean, standard deviation, and correlation coefficient of a given image.
12. Apply image smoothing filters (mean and median filtering).
13. Implement image sharpening filters and edge detection using gradient filters.
14. Implement image compression techniques.
15. Noise addition (Gaussian, salt & pepper)
16. Image denoising using filters

Books Recommended:

1. Gonzalez and Woods, "Digital Image Processing", 2 Ed, Pearson Education, 2002.
2. Anil K. Jain "Fundamentals of Digital Image Processing", Pearson Education, 2003.
3. Mark Nelson, Jean-Loup Gailly "The Data compression Book" 2 Ed, bpb Publications.
4. Pratt William K.,"Digital Image Processing", John Wiley & sons
5. M.Sonka,V. Hlavac, R. Boyle, "Image Processing, Analysis and Machine Vision", Vikas Publishing House

CLO-PLO matrix for the courseMELEDDI1425 (DIGITAL IMAGE PROCESSING)

Unit-Wise CLOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	Average CLO
MELEDDI425.1	3	2	2	1	2	1	2	1	2	2	1.8
MELEDDI425.2	3	3	3	1	3	1	2	2	2	3	2.3
MELEDDI425.3	3	3	3	1	3	1	2	2	2	3	2.3
MELEDDI425.4	2	3	3	2	3	1	2	2	2	3	2.3
Average PLO	2.8	2.8	2.8	1.3	2.8	1.0	2.0	1.8	2.0	2.8	2.21

SEMESTER - IV

MELEDMS425: Multimedia Signal coding and communication — **Course Type: DCE**

Hours			Total Credits	Maximum Marks				Time Allowed for Theory Examination
Lecture	Tutorial	Practical		Internal	End Term		Total	
					Theory	Lab		
3	0	2	4	28	54	18	100	1 ¾ Hours

Course Learning Outcomes (CLOs):

Unit-Wise CLOs	After the completion of this course the students will be able to:
MELEDMS425.1	Analyze different types of multimedia with emphasis on image data, file formats, and basic color models.
MELEDMS425.2	Evaluate image and video compression techniques by conducting experiments with simple lossless and lossy methods such as RLE, DCT, and JPEG.
MELEDMS425.3	Analyze multimedia communication concepts and conduct basic security applications using digital watermarking and steganography.
MELEDMS425.4	Conduct image, audio, and video processing experiments to analyze transformations, compression methods, and quality evaluation techniques.

Detailed Syllabus:

THEORY (3 Credits):

Unit I: Introduction to Multimedia and Images (15 Hrs.)

Introduction to multimedia: Audio, Images, Video and their real-world applications, Image data types and file formats: Binary, Grayscale, and Color images, Basics of color models: RGB, CMY, CMYK, Simple interconversion between color spaces.

Unit II: Image and Video Compression (15 Hrs.)

Need for multimedia compression and its importance in storage/communication, Lossless Compression: Run Length Coding, Variable Length Coding, Lossy Compression: DCT-based coding, basics of JPEG standard, Introduction to video compression: concept of motion compensation (basic idea only), Overview of video standards: Simple introduction to MPEG.

Unit III: Multimedia Communication and Security (15 Hrs.)

Multimedia information representation and networks (basic concepts only), Multimedia standards (overview only, e.g., MP3, JPEG, MPEG), Need for multimedia security in today's digital world, Introduction to multimedia security techniques: Digital watermarking; Principle and Applications, Steganography Principle and Applications, Fundamental Algorithms (LSB and DCT). Evaluation criteria: payload, imperceptibility, conflict triangle.

Unit IV: Laboratory Work (1 Credit: 30 Hrs.)

Note: The student is required to attempt at least 10 experiments

1. Convert an image from RGB to grayscale
2. Convert RGB image to different color spaces (e.g., HSV, CMYK)
3. Perform color balancing on an image
4. Detect and correct white point in images
5. Explore and manipulate image histograms
6. Convert image format (e.g., PNG to JPEG)
7. Compress an image using JPEG standard
8. Compress an image using JPEG2000 standard
9. Analyze image quality after compression (PSNR, SSIM)

10. Resize and scale an image
11. Perform edge detection using Canny and Sobel operators
12. Apply spatial filtering to smooth an image
13. Perform histogram equalization
14. Extract color channels from an RGB image
15. Read and play an audio file
16. Display waveform and spectrogram of an audio signal
17. Read and play video file.
18. Extract frames from a video file
19. Apply color transformations on video frames
20. Convert video from RGB to grayscale

Books Recommended:

1. Fundamentals of Multimedia – Ze- Nian Li, Mark S. Drew, PHI.
2. Multimedia Signals & Systems – Mrinal Kr. Mandal Springer International Edition 1st Edition, 2009
3. Multimedia Communications, Fred Halsall, Pearson education
4. K.R. Rao, Zorans. Bojkoric, DragoradA.Milovanovic, Multimedia Communication Systems – Techniques, Stds & Netwroks, Prentice Hall.
5. Ze- Nian Li, Mark S. Drew, Fundamentals of Multimedia, Pearson Education (LPE).
6. Multimedia Systems, John F. KoegelBufond Pearson Education (LPE).

CLO-PLO matrix for the courseMELEDMS425 (MULTIMEDIA SIGNAL CODING and COMMUNICATION)

Unit-Wise CLOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	Average CLO
MELEDMS425.1	3	2	3	1	3	1	2	1	2	2	2
MELEDMS425.2	3	3	3	2	3	1	2	2	3	3	2.5
MELEDMS425.3	3	3	3	2	3	2	1	3	3	3	2.6
MELEDMS425.4	3	3	3	1	3	1	3	3	3	3	2.6
Average PLO	3	2.75	3	1.5	3	1.25	2	2.25	2.75	2.75	2.43

SEMESTER - IV

MELEDCI425: Computational Intelligence and Wireless Communication — **Course Type: DCE**

Hours			Total Credits	Maximum Marks				Time Allowed for Theory Examination
					End Term			
Lecture	Tutorial	Practical		Internal	Theory	Lab	Total	
3	0	2	4	28	54	18	100	1 ¾ Hours

Course Learning Outcomes (CLOs):

Unit-Wise CLOs	After the completion of this course the students will be able to:
MELEDCI425.1	Analyze computational intelligence models such as neural networks and fuzzy systems.
MELEDCI425.2	Apply evolutionary and swarm-based optimization algorithms to problem solving.
MELEDCI425.3	Evaluate the fundamentals of wireless communication systems and standards and examine advanced wireless techniques including MIMO, OFDM, and 5G concepts

MELEDCI425.4	Conduct simulation and experimental studies of wireless systems using computational intelligence techniques and assess real-world applications of computational intelligence in wireless communication

Detailed Syllabus:

THEORY (3 Credits):

Unit I: Computational Intelligence for Wireless Communications (15 Hrs.)

Basics of Computational Intelligence, searching algorithms, Probability basics — Bayes Rule and its Applications — Bayesian Networks— Hidden Markov Models — Forms of Learning — Supervised Learning — Learning Decision Trees — Regression and Classification with Linear Models — Artificial Neural Networks — Nonparametric Models — Support Vector Machines — Statistical Learning — Learning with Complete Data — Learning with Hidden Variables- The EM Algorithm — Reinforcement Learning. .

Unit II: Principles of Wireless Communications (15 Hrs.)

The wireless communication environment, Free Space Propagation Model, Ground-Reflection Scenario, Okumura Model, Hatta Model, Log-Normal Shadowing Receiver Noise Computation, Link-Budget Analysis, Modelling of wireless systems, system model for narrowband signals, Rayleigh Fading Wireless channels, baseband model of a wireless systems, BER performance of wireless systems, Diversity in Wireless communications, BER in multi-antenna systems. Channel estimation in wireless systems.

Unit III: Introduction to MIMO networks and AI Driven Future Networks (15 Hrs.)

Introduction to MIMO Wireless Communications, MIMO System model, MIMO Zero-forcing (ZF) Receiver, MIMO MMSE Receiver, Singular value Decomposition (SVD) of the MIMO Channel, SVD and MIMO Capacity, OSTBC. Spectrum sharing and resource allocation: Resource allocation, Spectrum sharing, Power allocation using reinforcement learning (RL) and deep RL.

Unit IV: Laboratory Work (1 Credit: 30 Hrs.)

Note: The student is required to attempt at least 10 experiments

1. Explore the methods of implementing algorithms using artificial intelligence techniques with special applications in wireless communications.
2. Write a program to implement A* Algorithm.
3. Write a program to implement DFS.
4. Write a program to implement BFS.
5. Study of channel estimation in wireless systems.
6. Study of BER in Multi-antenna systems.
7. To develop MIMO model.
8. To study various MIMO receivers like Zero forcing, MMSE
9. To study OSTBC Receivers.
10. To study Machine learning models for Channel estimation.
11. To study Machine learning models for MIMO Receivers

Books Recommended:

1. Samarendra Nath Sur, Agbotiname Lucky Imoize, Artificial Intelligence for Wireless Communication Systems: Technology and Applications, CRC Press.
2. Singal, Anuj, Wireless Communication with Artificial Intelligence, Taylor and Francis Ltd
3. Jaganthan, MIMO and Wireless communications, Wiley.

CLO-PLO matrix for the courseMELEDCI425 (COMPUTATIONAL INTELLIGENCE and WIRELESS COMMUNICATION)											
Unit-Wise CLOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	Average CLO
MELEDCI425.1	3	3	3	2	2	1	2	2	2	2	2.2
MELEDCI425.2	3	3	3	2	2	1	2	2	2	2	2.2
MELEDCI425.3	3	3	3	2	2	1	2	2	2	2	2.2
MELEDCI425.4	3	3	3	2	2	1	2	2	2	2	2.2
Average PLO	3	3	3	2	2	1	2	2	2	2	2.2

SEMESTER - IV

MELEDWE425: Wearable Electronics and Antennas — **Course Type: DCE**

Hours			Total Credits	Maximum Marks				Time Allowed for Theory Examination
				Internal	End Term		Total	
Lecture	Tutorial	Practical			Theory	Lab		
3	0	2	4	28	54	18	100	1 ¾ Hours

Course Learning Outcomes (CLOs):

Unit-Wise CLOs	After the completion of this course the students will be able to:
MELEDWE425.1	Analyze the principles and challenges of wearable electronic systems.
MELEDWE425.2	Evaluate the integration of sensors and actuators for wearable applications.
MELEDWE425.3	Examine wireless power transfer and communication techniques in wearable devices and apply antenna design principles to meet wearable system requirements.
MELEDWE425.4	Conduct experiments on wearable sensors, circuits, and antennas to demonstrate practical system functionality and assess emerging applications and trends in wearable electronics and antennas.

Detailed Syllabus:

THEORY (3 Credits):

Unit I: Radiation and Basic Antennas (15 Hrs.)

Source of radiation, Potential functions and the electromagnetic field, the Hertzian dipole, power radiated by the Hertzian dipole, Basic antenna parameters, pattens, beam area, beam efficiency, directivity, gain, antenna efficiency, resolution, Friss transmission formula, Reciprocity theorem, antenna effective length, , antenna arrays

Unit II: Planer Antennas (15 Hrs.)

Printed Antennas, slot antennas, Quasi-Yagi antennas, bow-tie antennas, reflector antennas, horn antennas, dielectric antennas, lens antennas, multiple antennas, advanced antenna materials

Unit III: Wearable and Bio inspired Antennas (15 Hrs.)

Basic Approaches for Printing and Weaving Wearables; Wearable Electronics with Flexible, Transferable, and Remateable Components; Wearable Antennas; Wearable Sensors; Wearable RF Harvesting; Radiofrequency Finger

Augmentation Devices for Tactile Internet, Wearable Imaging Technologies; Wearable Wireless Power Transfer Systems. Bio-inspired antenna design, Gielis formula, Procedure to design antenna via Gielis formula, Electrical characterization of wearable substrate, Bio-inspired wearable antennas.

Unit IV: Laboratory Work (1 Credit: 30 Hrs.)

1. Study of the structure and operation of wired, aperture, planar and array antennas.
2. Proof of Inverse square law
3. Proof of Reciprocity theorem
4. Measurement of radiation pattern of all wired and aperture antennas
5. Measurement of radiation pattern of planar antennas
6. Measurement of radiation pattern of reflector antennas
7. Measurement of radiation pattern of array antennas
8. Design and simulation of microstrip antenna using HFSS or CST
9. Design and simulation of wearable Antennas
10. Study of optimization tools for wearable antennas
11. Study and design of Bio- Medical antennas.

Books Recommended:

1. Kao-Cheng, Huang, David J. Edwards Millimeter wave antennas for Gigabit Wireless Communications: A practical approach guide to design and analysis in a system context, Wiley.
2. Asimina Kiourti, John L. Volakis, Wearable Antennas and Electronics, Artech House.
3. Albert Sabban, Wearable Systems and Antennas Technologies for 5G, IOT and Medical Systems, CRC Press.

CLO-PLO matrix for the courseMELEDWE425 (WEARABLE ELECTRONICS AND ANTENNAS)

Unit-Wise CLOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	Average CLO
MELEDWE425.1	3	3	3	2	2	2	3	3	3	3	2.7
MELEDWE425.2	3	3	3	2	2	2	3	3	3	3	2.7
MELEDWE425.3	3	3	3	2	2	2	3	3	3	3	2.7
MELEDWE425.4	3	3	3	2	2	2	3	3	3	3	2.7
Average PLO	**3**	**3**	**3**	**2**	**2**	**2**	**3**	**3**	**3**	**3**	2.7

CLOs-PLOs Mapping Matrix for all the courses

Unit-Wise CLOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	Average CLO
MELECEI125	3	3	3	2	3	2	2	2.25	2.25	3	2.55
MELECDS125	3	3	2.75	1.5	2.75	1.25	2	2.25	2.25	2.75	2.35
MELECES125	3	3	2.62	1.05	3	1	1	2.5	2	3	2.1
MELECCE125	3.0	3.0	3.0	2.0	2.0	1.0	2.0	3.0	2.0	3.0	2.4
MELEDFE125	2.8	3.0	3.0	1.3	3.0	1.3	1.5	1.5	2.0	3.0	2.3
MELEDEF125	2.75	2.75	2.75	1.25	2.75	1.25	2	1.75	2.25	3	2.25
MELEDEM125	2.75	2.75	2.75	2	2	1	2	2.75	3	3	2.4
MELEDOE125	3	2.5	2.25	1.25	2.75	1.25	2.75	2.5	2.5	3	2.375
MELECPE225	2.8	3.0	2.8	1.3	2.8	1.5	1.8	1.8	2.0	2.8	2.26
MELECCS225	3.00	2.83	2.88	2.18	2.45	1.63	1.95	2.13	2.20	2.88	2.41
MELECDA225	3.0	2.8	2.8	1.8	2.8	1.0	2.5	2.3	2.8	2.8	2.6
MELECEW225	3.0	3.0	3.0	2.0	2.0	1.0	2.0	3.0	2.0	3.0	3.0
MELEDFE225	3	3	3	2	2	1	2	3	2	3	2.4
MELEDAM225	3.0	2.62	2.80	1.65	2.37	1.17	1.40	1.95	1.87	2.87	2.20
MELEDDS225	2.5	3	3	1.75	3	1	2.75	2.75	3	3	2.57
MELEDAI225	3	2.75	3	1.5	3	1.75	1.75	2.25	2.5	2.5	2.43
MELECPS325	2.75	2.75	2.75	1.75	3	1.5	1.75	2	2.5	3	2.4
MELECMS325	3.00	2.65	2.75	1.67	2.37	1.20	2.00	2.12	2.62	2.37	2.28
MELECPE225	3.0	2.8	2.8	1.8	2.8	1.0	2.0	1.8	2.3	2.8	2.3
MELECME325	3	3	3	2	2	1	2	3	2	3	2.4
MELEDAM325	3	3	2.62	10.5	3	1.12	1.15	2.55	2.05	2.5	2.2
MELEDMS425	3	2.75	3	1.5	3	1.75	1.75	2.25	3	2.75	2.5
MELEDNN325	3	3	2.62	1.05	3	1.15	1.07	2.57	1.77	3	2.22
MELEDPA325	3	3	2.5	1.2	3	1.6	1.3	2.3	2.1	3	2.3
MELEPPI425.6	2.7	2.3	2.7	2.0	2.7	2.3	3.0	2.5	2.0	2.7	2.49
MELEPPI425.4	2.5	2.5	2.5	1.5	2.5	2.3	2.8	1.8	2.8	2.8	2.4
MELEPIT425.2	3.0	2.0	2.5	2.5	2.0	2.0	1.5	2.0	2.5	2.0	2.1
MELEPIT425.12	2.5	2.5	2.6	2.4	2.6	2.0	2.2	2.8	2.7	2.7	2.5
MELEDES425	3	3	2.63	1.07	3	1.15	1.12	2.57	1.77	2.75	2.2
MELEDLC425	3	3	2.57	10.7	2.85	1.07	1.02	2.57	1.77	2.3	2.15
MELEDNE425	2.8	2.8	2.5	1.5	2.8	1.3	2.8	2.5	2.8	2.5	2.5
MELEDNC425	3.0	2.8	2.8	1.8	2.8	1.3	2.3	2.5	2.3	2.8	2.5
MELEDDI425	2.8	2.8	2.8	1.3	2.8	1.0	2.0	1.8	2.0	2.8	2.21
MELEDMS425	3	2.75	3	1.5	3	1.25	2	2.25	2.75	2.75	2.43
MELEDCI425	3	3	3	2	2	1	2	2	2	2	2.2
MELEDWE425	3	3	3	2	2	2	3	3	3	3	2.7
Average PLO	2.91	2.82	2.78	2.17	2.64	1.36	1.95	2.35	2.32	2.78	2.38

PG Department of ELECTRONICS and INSTRUMENTATION TECHNOLOGY

University of Kashmir

Minutes of Board of Studies (BOS)

Notes:

A Board of Studies (BOS) meeting for finalizing the Course structure for the Two/One Year Post Graduate Program in Electronics, under NEP-2020, was held on 06-05-2025, at 11:00 AM in the office chamber of the Head of the Department. The following members attended the meeting.

1	Prof. M. Tariq Banday	HOD/Chairman
2	Dr. Farooq Ahmad Khanday	Member
3	Dr. Shabir Ahmad Parah	Member
4	Dr. Javaid Ahmad Sheikh	Member
5	Prof. Susheel Kumar Sharma	Member
6	Prof. Javaid Iqbal Shah	Member
7	Dr. Feroz Ahmad Mir	Member
8	Dr. Mohammad Rafi Beigh	Member
9	Ms. Farhat Roohi	Member
10	Ms. Mir Nazish	Sr. Scholar
11	Ms. Samrah Mehraj	Sr. Scholar

After thorough discussions and deliberations, the Board finalized the structure of both one-year and Two-Year PG programs in Electronics as per the guidelines of NEP-2020. The course structure of the Two-Year PG program is attached as Annexure-1, while that for the One-Year Program is attached as Annexure II.

The meeting ended with a vote of thanks to the chair.

Prof. M. Tariq Banday
(HOD/Chairman)

Prof. Susheel K. Sharma
Member

Prof. Javaid I. Shah
Member

Dr. Feroz A. Mir
Member

Dr. Farooq A. Khanday
Member

Dr. Shabir A. Parah
Member

Dr. Javaid A. Sheikh
Member

Ms. Farhat Roohi
Member

Dr. M. Rafi Beigh
Member

Ms. Samrah Mehraj
Sr. Scholar

Nazish.
Ms. Mir Nazish
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PG Department of ELECTRONICS and INSTRUMENTATION TECHNOLOGY

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Prof. M. Tariq Banday
(HOD/Chairman)

Signed Online
Prof. Susheel K. Sharma
Member

Prof. Javaid I. Shah
Member

Dr. Feroz A. Mir
Member

Dr. Farooq A. Khanday
Member

Dr. Shabir A. Parah
Member

Dr. Javaid A. Sheikh
Member

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