Anekant Education Society's

Tuljaram Chaturchand College, Baramati

(Empowered Autonomous)

Two Year Degree Program in Electronics

(Faculty of Science & Technology)

CBCS Syllabus

M.Sc. (Electronics) Part-I Semester -I

For Department of Electronics

Tuljaram Chaturchand College, Baramati

Choice Based Credit System Syllabus (2026 Pattern)

(As Per NEP 2020)

To be implemented from Academic Year 2026-2027

Title of the Programme: M.Sc. (Electronics)

Preamble

AES's Tuljaram Chaturchand College has made the decision to change the syllabus of across various faculties from June, 2023 by incorporating the guidelines and provisions outlined in the National Education Policy (NEP), 2020. The NEP envisions making education more holistic and effective and to lay emphasis on the integration of general (academic) education, vocational education and experiential learning. The NEP introduces holistic and multidisciplinary education that would help to develop intellectual, scientific, social, physical, emotional, ethical and moral capacities of the students. The NEP 2020 envisages flexible curricular structures and learning based outcome approach for the development of the students. By establishing a nationally accepted and internationally comparable credit structure and courses framework, the NEP 2020 aims to promote educational excellence, facilitate seamless academic mobility, and enhance the global competitiveness of Indian students. It fosters a system where educational achievements can be recognized and valued not only within the country but also in the international arena, expanding opportunities and opening doors for students to pursue their aspirations on a global scale.

In response to the rapid advancements in science and technology and the evolving approaches in various domains of Electronics and related subjects, the Board of Studies in Electronics at Tuljaram Chaturchand College, Baramati - Pune, has developed the curriculum for the first semester of M.Sc. Part-I Electronics, which goes beyond traditional academic boundaries. The syllabus is aligned with the NEP 2020 guidelines to ensure that students receive an education that prepares them for the challenges and opportunities of the 21st century. This syllabus has been designed under the framework of the Choice Based Credit System (CBCS), taking into consideration the guidelines set forth by the National Education Policy (NEP) 2020, LOCF (UGC), NCrF, NHEQF, Prof. R.D. Kulkarni's Report, Government of Maharashtra's General Resolution dated 20th April and 16th May 2023, and the Circular issued by SPPU, Pune on 31st May 2023.

A Electronics degree equips students with the knowledge and skills necessary for a diverse range of fulfilling career paths. Post Graduates in Electronics find opportunities in various fields, including Embedded System developer, IoT, IT, AI developer, WSN, MatLab

Developer, PCB Designer, Communication Sector, Defence, Sensor and System developer, PLC and SCADA developer, Lab View and many other domains.

The curriculum also delves into the intricate relationship between Industry and atomization. The objectives of updating syllabi is to prepare pupils to face the current challenges in Industry and Academia, to develop strong footprint in the fundamental, specialization and recent technology. The proposed syllabus and scheme of study equip students with both basic and advance topics in the field of Electronics. In addition, the syllabus incorporate more practical and working principles, design guidelines and experimental skills associated with different semiconductor devices and circuits, underlying mathematical and analysis techniques, electromagnetic and instrumentation principles, design methodologies for digital and embedded systems, communication electronics and control systems and various applications of electronic devices, circuits and systems are among such important aspects.

Overall, revising the Electronics syllabus in accordance with the NEP 2020 ensures that students receive an education that is relevant, comprehensive, and prepares them to navigate the dynamic and interconnected world of today. It equips them with the knowledge, skills, and competencies needed to contribute meaningfully to society and pursue their academic and professional goals in a rapidly changing global landscape.

Programme Specific Outcomes (PSOs)

PSO1: Acquire the knowledge in Electronic Devices and Circuits, Analog & Digital communication, Embedded systems, AI, WSN , MEMS and other core areas of Electronics.

PSO2: Understand the principles and working of both hardware and software aspects of Electronic systems

PSO3: Gain theoretical and practical knowledge in developing areas of Electronics.

PSO4: To analyze, design and implement analog and digital electronic systems, information and communication systems.

PSO5: Assess the impact of new technologies and solve complex problems.

PSO6: Develop research oriented skills and to inculcate laboratory skills in students so that they can take up independent projects.

Anekant Education Society's

Tuljaram Chaturchand College, Baramati

(Empowered Autonomous)

Board of Studies (BOS) in Electronics

From 2025-26 to 2027-28

Sr. No.	Name	Designation
1.	**Dr. Kothawale A. S.**	**Chairman**
2.	**Dr. Mrs. Pawar A. M.**	**Member**
3.	**Dr. Patil S. N.**	**Member**
4.	**Mrs. Gawade S. A.**	**Member**
5.	**Mrs. Patil S. S.**	**Member**
6.	**Mrs. Shinde P. K.**	**Member**
7.	**Mrs. Walekar S. S.**	**Invitee**
8.	**Miss. Pawar S. S.**	**Invitee**
9.	**Mr. Mahamuni M. G.**	**Invitee**
10.	**Prof. Dr. Tilekar S. K.**	**Expert from other University**
11.	**Dr. Lande Pankaj**	**Expert from other University**
12.	**Dr. Arun Patil**	**Expert from University**
13.	**Mr. Patil Sharad. V.**	**Industry Expert**
14.	**Mr. Sutar Ganesh**	**Meritorious Alumni**
15.	**Mr. Gaikwad Shubham**	**Student Representative**
16.	**Miss. Chavan Gauri**	**Student Representative**

Anekant Education Society's

Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati

(Empowered Autonomous)

Credit Distribution Structure for (M.Sc. Electronics) Part-I (2026 Pattern)

Year	Level	Sem.	Major: Mandatory	Major: Electives	Research Methodology (RM)	OJT/ FP	RP	Cum. Cr.
I	6.0	Sem-I	ELE-501-MRM : Digital System Design (Credit 04)	ELE-506-MJE(A): Introduction to Raspberry Pi (Credit 02)	ELE-508-RM Research Methodology (**Credit 04**)	--	--	**22**
			ELE-502-MRM: Integrated Circuit Design. (Credit 04)	ELE-506-MJE(B): MATLAB Programming (Credit 02)				
			ELE-503-MRM: Mathematical Methods in Electronics and Network Analysis (Credit 02)	ELE-507-MJE(A): : Practical based on Raspberry Pi (Credit 02)				
			ELE-504-MRM: Electronics Practical Lab -I (Credit 02)	ELE-507-MJE(B): Practical based on MATLAB (Credit 02)				
			ELE-505-MRM: Electronics Practical Lab –II (Credit 02)					
		Sem- II	ELE-551-MRM: Electromagnetics, Microwave and Antennas. (Credit 04)	ELE-556-MJE(A): Fundamentals of AI & ML (Credit 02)	--	ELE-558-OJT **:** On Job Training **Credit 04**	--	**22**
			ELE-552-MRM: Embedded System Design with PIC Microcontroller. (Credit 04)	ELE-556-MJE(B): Robotics and its Applications (Credit 02)				
			ELE-553-MRM: Instrumentation and Measurement Techniques (Credit 02)	ELE-557-MJE(A): Practical based on AI & ML (Credit 02)				
			ELE-554-MJM: Electronics Practical Lab – III (Credit 02)	ELE-557-MJE(B): Practical based on Robotics and Sensors (Credit 02)				

			ELE-554-MJM: Electronics Practical Lab IV (Credit 02)					
Cum. Cr.			**24**	**8**	**4**	**4**	**--**	**44**

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Course Structure for (M.Sc. Electronics) Part-I (2026 Pattern)

Sem.	Course Type	Course Code	Course Title	Theory/ Practical	No. of credits
I	Major (Mandatory)	ELE-501-MRM	Digital System Design	Theory	04
	Major (Mandatory)	ELE-502-MRM	Integrated Circuit Design	Theory	04
	Major (Mandatory)	ELE-503-MRM	Mathematical Methods in Electronics and Network Analysis	Theory	02
	Major (Mandatory)	ELE-504-MRM	Electronics Practical Lab -I	Practical	02
	Major (Mandatory)	ELE-505-MRM	Electronics Practical Lab - II	Practical	02
	Major (Elective)	ELE-506-MJE(A)	Introduction to Raspberry Pi	Theory (Any One)	02
		ELE-506-MJE(B)	MATLAB Programming		
	Major (Elective)	ELE-507-MJE(A)	Practical based on Raspberry Pi	Practical (Any One)	02
		ELE-507-MJE(B)	Practical based on MATLAB		
	Research Methodology (RM)	ELE-508-RM	Research Methodology	Theory	04
				Total credits Semester I	**22**
II	Major (Mandatory)	ELE-551-MRM	Electromagnetics, Microwave and Antennas	Theory	04
	Major (Mandatory)	ELE-552-MRM	Embedded System Design with PIC Microcontroller.	Theory	04
	Major (Mandatory)	ELE-553-MRM	Instrumentation and Measurement Techniques	Theory	02
	Major (Mandatory)	ELE-554-MRM	Electronics Practical Lab - III	Practical	02
	Major (Mandatory)	ELE-555-MRM	Electronics Practical Lab - IV	Practical	02
	Major (Elective)	ELE-556-MJE(A)	Fundamentals of AI & ML	Theory (Any One)	02
	Major (Elective)	ELE-556-MJE(B)	Robotics and its Applications		
	Major (Elective)	ELE-557-MJE(A)	Practical based on AI & ML	Practical (Any One)	02

	Major (Elective)	ELE-557-MJE(B)	Practical based on Robotics and Sensors		
	On Job Training (OJT)/Field Project (FP)	ELE-558-OJT	On Job Training	Practical	04
	Total credits Semester II				**22**
	Cumulative Credits Semester I and II				**44**

CBCS Syllabus as per NEP 2020 for M.Sc. I (2026 Pattern)

Name of the Programme : M.Sc. Electronics

Programme Code : **PSEL**

Class : M.Sc. I

Semester : I

Course Type : Major Mandatory (Theory)

Course Code : ELE-501-MRM

Course Title : Digital System Design

No. of Credits 04

No. of Teaching Hours 60

Course Objectives

1. To understand the fundamentals of Hardware Description Languages (HDL) with emphasis on VERILOG and its role in digital system design.
2. To compare VERILOG and VHDL in terms of syntax, modeling styles, design flow, and application domains using EDA tools.
3. To analyze and design basic combinational logic circuits such as multiplexers, decoders, encoders, comparators, and arithmetic circuits using VERILOG..
4. To understand the principles and operation of sequential logic circuits including flip-flops, counters, and shift registers with proper timing analysis.
5. To design and implement Finite State Machines (FSMs) using Mealy and Moore models for real-time control applications.
6. To understand the architecture, working, and applications of Programmable Logic Devices (PLDs), CPLDs, and FPGAs in digital system implementation.
7. To study memory devices including SRAM and DRAM, their architecture, timing characteristics, and role in PLD/FPGA-based systems

Course Outcomes

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

CO1: Explain the concepts of HDL, VERILOG language constructs, data types, modeling styles, and digital design flow using EDA tools.

CO2: Develop and simulate VERILOG models for basic and complex combinational logic circuits and verify their functionality using test benches.

CO3: Design and analyze arithmetic and data processing circuits such as adders, subtractors, multipliers, and carry look-ahead adders using VERILOG.

CO4: Implement and simulate sequential circuits including flip-flops, counters, and shift registers with correct timing behavior.

CO5: Design FSM-based controllers for real-life applications such as traffic light control,

stepper motor control, washing machine, and vending machines.
CO6: Identify and utilize appropriate PLDs, CPLDs, and FPGAs for implementing combinational and sequential digital systems with efficient resource estimation.
CO7: Analyze memory architectures (SRAM and DRAM), understand their timing parameters, and explain their integration and role in modern programmable logic systems.

Topics and Learning Points

Unit-1:HDL for Digital System Design 10L

VERILOG: Comparison between VERILOG and VHD Llanguage ,design flow, EDA tools, data types, modules and ports, operators, gate level modeling, data flow modeling , behavioral modeling, tasks and functions, timing and delays, test bench, types of test bench,.

Unit-2:Combinational Logic 15L

Introduction to combinational circuits, realization of basic combinational functions-magnitude comparator, code converters, multiplexers, demultiplexers, multiplexed display, encoder and decoders, priority encoders, parity generator/checker, arithmetic circuits (adder,Subtractor, binary multiplier), parallel adder, look ahead carry generator, VERILOG models and simulation of above combinational circuits.

Unit-3:Sequential Logic Design and Circuits 20L

Introduction to sequential circuits, Flip flops: types, state table, transition table, excitation tables, timing wave forms, clock generators.
Counters: synchronous, asynchronous, design of counters ,up/down counter.
Shift Registers: ring counter, Johnson counter.
Finite State Machine (FSM) Design: Mealy and Moore state machines.
VERILOG Models and Simulation Code of above Sequential Circuits and FSMs: stepper motor controller, traffic light control, washing machine control, parking controller, coffee vending machine, LCD controller

Unit-4:PLDs and Memories 15L

Need of PLD, architecture of simple PLD(SPLD)-PAL, PLA, Complex Programmable Logic Device(CPLD)and Field Programmable Logic Devices(FPGA),CPLD/FPGA based system design applications - typical combinational and sequential system implementation, estimation of uses of blocks, links ,LUTs, etc.
Memories: types, data storage principle, control inputs, and timings, applications, Random Access Memories (RAM), Static Ram (SRAM), standard architecture, transistor cell diagram ,sense amplifier, address decoders, timings, Dynamic RAM (DRAM), different DRAM cells ,refresh circuits, timings ,role of memories in PLD.

Text/Reference Books:

1. Verilog HDL; A Guideto Digital Design and Synthesis, Samir Palnitkar, Pearson Education,
2. Verilog HDL synthesis; A Practical Primer,J.Bhaskar,StarGalaxyPublishing,1998.
3. Digital System Design with VERILOG Design, Stephen Brown, Zvonko Vranesic ,TMH,2ndEd
4. Digital design; Principles Practices, Wakerly, PHI.
5. Modern Digital Electronics, R.P Jain, McGraw Hill.
6. Digital systems; Principles and Applications , Tocci, Pearson Education.
7. Digital Logic and Computer Design ,Morris Mano, PHI.

Mapping Table :

Course Outcomes	Program Outcomes							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2	1	2	1	-	1	-
CO2	2	3	2	3	2	-	1	1
CO3	2	3	3	3	1	-	1	1
CO4	2	2	2	3	1	-	1	-
CO5	2	3	3	3	2	1	1	2
CO6	3	2	2	3	1	1	1	3
CO7	3	3	2	2	1	1	1	-

Justification For The Mapping:-

PO1: Advanced Disciplinary Knowledge and Originality

CO1, CO2, CO3, CO4, CO5, CO6, CO7

This course strengthens advanced disciplinary knowledge in digital system design through HDL fundamentals, VERILOG modeling, combinational and sequential circuits, FSM design, programmable logic devices, and memory architectures. Students apply originality while implementing real-world digital systems using VERILOG and PLD/FPGA platforms.

PO2: Research, Analysis and Complexity

CO1, CO2, CO3, CO4, CO5, CO6, CO7

The course emphasizes analytical and research-oriented thinking by requiring students to analyze HDL constructs, simulate and verify logic circuits, study timing behavior, and evaluate complexity in FSMs, PLDs, and memory systems. These activities develop the ability to handle complex digital design problems.

PO3: Problem Solving in New Contexts

CO1, CO2, CO3, CO4, CO5, CO6, CO7

Students solve new and unfamiliar problems by designing arithmetic circuits, sequential systems, FSM-based controllers, and FPGA-based applications. Practical system-level implementations enable learners to apply theoretical concepts to novel and real-life problem contexts.

PO4: Technical Mastery and Scientific Reasoning

CO1, CO2, CO3, CO4, CO5, CO6, CO7

The course develops strong technical mastery in VERILOG programming, EDA tool usage, timing analysis, FSM design, and programmable logic architectures. Scientific reasoning is applied to understand circuit behavior, memory operation, and system performance evaluation.

PO5: Integrated Communication

Mapped COs: CO1, CO2, CO3, CO4, CO5, CO6, CO7

Students communicate technical ideas effectively through HDL code documentation, simulation results, timing waveforms, state diagrams, and design explanations. This enhances written, graphical, and technical communication skills.

PO6: Ethical, Social and Professional Judgement

Mapped COs: CO5, CO6, CO7

Ethical and professional responsibility is developed through the design of reliable and safe digital systems for societal applications such as traffic control, automation systems, and memory-based architectures. Students learn to consider efficiency, safety, and responsible technology use.

PO7: Autonomous and Lifelong Learning

CO1, CO2, CO3, CO4, CO5, CO6, CO7

The course promotes autonomous learning through independent HDL coding, experimentation with EDA tools, and exploration of evolving technologies such as CPLDs, FPGAs, and advanced memory systems, fostering lifelong learning habits.

PO8: Employability, Innovation and Entrepreneurship

CO2, CO3, CO5, CO6

Industry-relevant skills in VERILOG modeling, FSM design, FPGA-based system implementation, and resource optimization enhance employability. Application-driven designs and programmable logic solutions encourage innovation and entrepreneurial thinking.

CBCS Syllabus as per NEP 2020 for M.Sc. I (2026 Pattern)

Name of the Programme	: M.Sc. Electronics
Programme Code	: **PSEL**
Class	: M.Sc. I
Semester	: I
Course Type	: Major Mandatory (Theory)
Course Code	: ELE-502-MRM
Course Title	: Integrated Circuit Design
No. of Credits	04
No. of Teaching Hours	60

Course Objectives:

1. To deliver the knowledge about physics of basic semiconductor devices and circuits.
2. To learn the characteristics and working of electronic devices
3. To study the various device models
4. To study the wideband and narrowband amplifiers using BJT
5. To develop skills in analysis and design of analog circuits
6. To study the designs of opamp applications
7. To study the active and passive filter.

Course Outcomes:

By the end of the course, students will be able to:

CO1. Explain the concept of basic semiconductor devices.
CO2. Various characteristics of electronic devices and working of device model.
CO3. Elucidate and design the active filters and oscillators.
CO4. Understand and analyze the operational amplifier and its characteristics.
CO5. Understand the concept of Circuits & Theorems.
CO6. Understand the basic material and properties of semiconductors
CO7. Explore constructional features and I-V characteristics of basic semiconductor devices diode, Transistors

Topics and Learning Points

Unit-1: Semiconductor Devices (15L)

Diode and applications- Practical diode characteristics (static and dynamic resistance), temperature effects, switching characteristics, diode breakdown, diode applications in wave shaping circuits, Scho ttky diode physics.
BJT- construction and biasing, Operation, CC, CB and CB configurations JFET- construction, types and its operation, parameters, characteristics, JFET amplifiers, Thermal stability analysis.
MOSFET- types, biasing of MOSFET, applications, comparison between BJT, JFET, MOSFET.

Unit-2: Analog Amplifier Design and Analysis (15L)
BJT models and modeling parameters -equivalent circuits for CE, CB and CC configurations, single stage amplifier, class A and class B, class C, class AB amplifier, small signal analysis, distortion.
Design of single stage RC-coupled amplifier with frequency response (f1 and f2), bode plots, frequency response of multistage amplifiers, different coupling schemes, gain of multistage amplifiers, Feedback Amplifiers-Negative feedback topologies, Stability criterion.

Unit-3: Tuned Amplifier and Oscillators (10L)

Tuned amplifier -design, multistage tuned amplifiers: synchronous and stagger tuning cascade configuration, large signal tuned amplifier .
Oscillators- design and analysis of LC and RC oscillators, Hartley, Colpitt's, Miller oscillators, phase shift and Wien-bridge oscillators, crystal oscillators and applications
Data converters:- 1)ADC – types , characteristic **2)**DAC- types , characteristic.

Unit-4: Operational Amplifiers and their Applications (20L)
Opamp - Practical consideration in opamp based circuit design
Opamp parameters- dc and low frequency parameters and their significance in design of opamp, closed loop stability analysis and frequency compensation.
Opamp application- Inverting and non-inverting amplifiers with design aspects such as input and output impedance, common mode errors and limitations, bandwidth, etc. Bridge and instrumentation amplifier Practical design aspect of integrator and differentiators, such as offset error and stability, bandwidth considerations. Concept and applications of PLL.
Active Filters: transfer functions poles and zeros, Design of active filters - LPF, HPF, BPF and BRF (first and higher orders), Butterworth and Chebyshev filters.

References:

1. Electronic Devices and Circuits, S. Salivahanan, N. Suresh Kumar, 3rd Edn, McGraw Hill.
2. Electronic Devices and Circuit Theory, Robert Boylestead, Louis Nashelsky, PHI.
3. Electronic Devices & Circuits: Milliman and Halki
4. Design with Operational Amplifiers and Linear IC, Sergio Franco, 3rd Edn, TMH.
5. Electronic Principles, Malvino and Bates, McGraw Hill.
6. Operational amplifier, G.B.Clayton, Elsevier Sci. Tech.
7. Microelectronic Circuits: Analysis and Design, Mohammad H. Rashid, PWS Publishing
8. Digital Switching Circuits, Millman Taub, TMH.
9. Electronic devices, Allen Motershed, PHI.
10. Integrated electronics, Millman Halkies, McGraw Hill.

Mapping of Program Outcomes with Course Outcomes

Course Outcome	Program Outcomes							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	1	1	2	-	-	1	1
CO2	3	2	2	2	1	-	1	1
CO3	3	2	3	3	1	-	1	2
CO4	3	2	2	3	1	-	1	2
CO5	2	2	3	2	1	-	1	1
CO6	3	1	1	1	-	-	1	-
CO7	3	2	2	3	1	-	1	2

Justification for the mapping

PO1: Advanced Disciplinary Knowledge & Originality:

Demonstrating comprehensive and advanced knowledge in the chosen field of science, extending beyond the undergraduate level, providing a specialized foundation for developing and applying original ideas, particularly within a research context.

PO2: Research, Analysis, and Complexity:

Ability to formulate hypotheses and design experiments while demonstrating the capacity to integrate knowledge and handle complex information, even when it is incomplete or limited.

PO3: Problem Solving in New Contexts:

Apply theoretical knowledge and problem-solving abilities to unfamiliar, real-world, or multidisciplinary environments, moving beyond standard classroom scenarios to innovative applications.

PO4: Technical Mastery and Scientific Reasoning:

Utilize modern tools, specialized techniques, and instruments with high proficiency, underpinned by a deep rationale and scientific reasoning for the choice of methodology.

PO5: Integrated Communication:

Clearly and unambiguously communicate complex scientific conclusions, and the knowledge/rationale supporting them, to both specialist peers and non-specialist stakeholders.

PO6: Ethical, Social, and Professional Judgment:

Adhere to strict ethical standards in research while reflecting on the social and environmental responsibilities linked to the application of scientific knowledge and professional judgments.

PO7: Autonomous and Lifelong Learning:

Exhibit the learning skills necessary to pursue further study or professional development in a largely self-directed and autonomous manner.

PO8: Employability, Innovation, and Entrepreneurship:

Translate advanced technical skills and independent thinking into professional excellence within industry, academia, or entrepreneurial ventures.

CBCS Syllabus as per NEP 2020 for M.Sc. I (2026 Pattern)

Name of the Programme : M.Sc. Electronics

Programme Code : **PSEL**

Class : M.Sc. I

Semester : I

Course Type : Major Mandatory (Theory)

Course Code : ELE-503-MRM

Course Title : Mathematical Methods in Electronics and Network Analysis

No. of Credits : 02

No. of Teaching Hours : 30

Course Objectives:

1. To learn the methods of analysis for CT and DT signals and systems
2. To learn concept of mathematical modeling of simple electrical circuits using LT
3. To get familiar with role of Z-transform in circuit analysis.
4. To know about mathematical tools and techniques for network analysis
5. Familiar with basic theorems of network analysis

Course Outcomes:

By the end of the course, students will be able to:

CO1. From this course, the students are expected to learn some mathematical techniquesrequired to understand the Electronics phenomena at the postgraduate level.
CO2. Students will able to analysis the standard signal using various methods
CO3. Students will demonstrate basic knowledge of Laplace Transform.
CO4: Understand and apply Z-Transform methods for analysis and solution of discrete time systems and linear difference equations.

CO5. Analyze electrical networks using topology concepts such as nodes, branches, loops, meshes, and trees.

CO6: Apply mesh, nodal, and state variable methods for solving electrical circuits.

CO7: Understand two-port network parameters and analyze T and π network configurations.

Topics and Learning Points

Unit-1: Introduction to Signal and Mathematical Tools for Circuit Analysis (20L)

Signals: periodic, aperiodic, Continuous Time (CT) and Discrete Time (DT), special electronic signals (impulse, unit step, sinusoidal, ramp, square wave, staircase)

Laplace Transform (LT): definition, LT of standard electronic signals, inverse LT, methods of ILT (partial fraction method), properties of LT (shifting, linear, scaling), initial and final value theorem, LT of derivatives and Integrals, concept of Transient and steady state response, Laplace transformation of electrical circuits, Network Transfer function.

Z-Transform (ZT): definition, ZT of standard electronic signals, properties of Z transform, inverse ZT (partial fraction and residue method), linear difference equation and solutions using ZT.

Unit-2: Network Analysis (10L)

Two port network functions, Network Topology (nodes, tree, graph, branch, mesh, and loop), Mesh, loop and nodal analysis of circuits, T and π networks, state variable method with simple examples

Network Theorems and Applications to DC and AC Circuits: Thevenin's, Norton's, superposition, maximum power transfer – theorems.

Reference Books:

1. Advanced Engineering Mathematics, E. Kreyzig, John Wiley and Sons.
2. Signals and system by P Ramesh Babu and Anandanatarajan, Scitech
3. Network Analysis, G. K. Mittal, Khanna Publication.
4. Circuits and Networks Analysis and Synthesis, A. Sudhakar, Shyam Mohan and S. Pilli,TMH.
5. Digital Signal Processing, S. Salivahan, A. Vallavraj and C. Gnanpriya, McGraw Hill.
6. Network Analysis, M. E. Van Valkenberg, PHI.
7. Network and Systems, Roy Choudhary, Wiley Eastern.
8. Basics of MATLAB and Beyond by Andrew Knight, CRC

Mapping of Program Outcomes with Course Outcomes

Weightage: 1=Weak or low relation, 2=Moderate or partial relation, 3=Strong or direct relation

Cour se Outc ome	**Program Outcomes**							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2	--	3	1	-	2	-
CO2	3	3	1	3	1	-	2	-
CO3	3	3	2	3	1	-	2	-
CO4	3	3	3	3	1	-	2	1
CO5	3	3	3	3	1	-	2	1
CO6	3	3	3	3	1	-	2	1
CO7	3	2	2	3	1	-	2	2

Justification For The Mapping

P01 Advanced Disciplinary Knowledge & Originality:

All COs provide strong foundation in Signals, Laplace Transform, Z-Transform, Network analysis. This develops core electronics knowledge.

PO2 Research, Analysis, and Complexity:

All COs provide strong foundation for Students learn to Analyze signals, Analyze circuits, Apply transforms to builds analytical ability.

PO3 Problem Solving in New Contexts:

CO2 to CO7 support Circuit problems, Difference equations, Network analysis problems.

PO4 Technical Mastery and Scientific Reasoning:

All the COs support for Mathematical reasoning, Scientific analysis, Engineering problem solving

P05 Integrated Communication:
All the COs provide indirect contributions to write mathematical solutions and Present circuit analysis

PO7 Autonomous and Lifelong Learning:
All COs provide strong foundation in Mathematical foundation supports in higher education and lifelong learning.
PO8 Employability, Innovation, and Entrepreneurship:

CO4 to CO7 provide Knowledge useful in Electronics industry, Communication field, Signal

processing, electrical and electronics jobs.

CBCS Syllabus as per NEP 2020 for M.Sc. I
(2026 Pattern)

Name of the Programme : M.Sc. Electronics

Programme Code : **PSEL**

Class : M.Sc. I

Semester : I

Course Type : Major Mandatory (Practical)

Course Code : ELE-504-MRM

Course Title : Electronics Practical Lab -I
No. of Credits : 02
No. of Teaching Hours : 60

Course Objectives:

1. Design and implement analog circuits using op-amps and linear ICs.
2. To learn signal conversion and signal conditioning circuits.
3. To understand designing of combinational digital circuits using logic gates and MSI devices.
4. To learn design and implementation of sequential digital circuits using flip-flops and counters.
5. To learn higer order filter.
6. To learn V-F and F-V techniques.
7. To Study Activity.

Course Outcomes:

By the end of the course, students will be able to:

CO1. Learn the advanced analysis facilities available in DSO, function generators.
CO2. Experiment analog electronic circuits using discrete components and ICs.
CO3. Evaluate different electronic circuits and review the analog and digital circuits.
CO4. Develop ability to design, build and test analog/digital application circuits.
CO5. To know operation of different instruments used in the laboratory.
CO6. To connect circuit and do required performance analysis
CO7. Capability to develop experimental skills, analyzing the results and interpret data.

Topics and Learning Points

1. Boot strap ramp generator for delay triggering
2. Tuned amplifier small signal/large signal or IF
3. Voltage controlled current source/sink and current mirror and doubler

4. Second order Butterworth filters(BP and BR)
5. V to F and F to V using commercially available IC
6. Instrumentation amplifier for a given gain
7. Design RC phase shift/ Wien-bridge oscillator using op-amp for frequency ________
8. Two digit combinational lock
9. Keyboard encoder with latches
10. Traffic light controller
11. Multiplexed display(Bank token / two digit counter)
12. Bidirectional stepper motor control (Sequence Generator)
13. One digit BCD adder and 8-bitadder/subtractor
14. Object counter (use of MMV, counter)
15. Binary-Gray and Gray-Binary code converter
16. Design a mod-- synchronous counter using JK flip flop.
17. Design full adder using MUX

Activity: (Any one Activity equivalent to two experiments)

Students must perform at least one additional activity out of two activities in addition to eight experiments mentioned above. Total Laboratory work with

additional activities
should be equivalent to ten experiments.

Course Outcome	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5-	PO6	PO7	PO8	
CO1	2	-	2	-	-	2	-		
CO2	3	3	2	2	2	2	2		
CO3	-	2	2	-	-	-	-		
CO4	2	2	2	2	-	2	2		
CO5	1	2	2	-	-	-	-		
CO6	1	2	2	-	-	-	1		
CO7	3	3	2	2	-	-	-		

- Industrial Visit / Study Tour / Field visit

Mapping

Justification for the mapping

PO1: Advanced Disciplinary Knowledge & Originality:

CO1: Students will able to demonstrate working and use of transducer, which helpful for development of application.
CO2: Students will able to develop analog design for sensor and transducer for dedicated application. This is a strong relation.
CO4: Students will master in analog and digital design for hardware.
CO5: Students will develop knowledge to demonstrate the various instruments performance, use and antenna working.
CO6: Students will demonstrate the use of test bench and microwave application.
CO7: Students will be able to develop capability develop hardware and discussion result.

PO 2: Research, Analysis, and Complexity:

CO2,3,4: Student develop their ability to think need of sensor and transducers and design necessary circuit.
CO5: Students will able to use scientific instruments for result analysis and stand ardisation.
CO6,7: Students apply their knowledge for system design.

PO3: Problem Solving in New Contexts:

CO1: Students will apply their knowledge for selecting transducer for specific application.
CO2: Students will think to develop specific analog design using sensor and transducer for dedicated application.
CO3: Student will think to develop system for observing the problem.
CO4: Students will use their knowledge for solving complex analog and digital hardware design.
CO5: Students will apply their knowledge for use of instruments for diverse application with reduced error.
CO6: Students will use their understanding to use of microwave frequency, microwave test bench for various applications.
CO7: Students will increase thinking ability to develop experimental skill to design electronics system for diverse field problem solving.

PO4 Technical Mastery and Scientific Reasoning:

CO2,4,7: Students to develop their ability to work independently or as a team to solve real-world problems. Students develop their skills for starting own start-up in electronics design. Students use their knowledge to develop suitable solution for interdisciplinary field such as physics, chemistry, agriculture, industrial, botany etc.

PO5: Integrated Communication:

CO2: Student will use their knowledge for designing electronic system for solving practical problems interdisciplinary field.

PO6: Ethical, Social, and Professional Judgment:

CO1: Students will able to write idea or communicate the use of sensors and transducers for industrial, agriculture, medical, automobile or any other relevant application.
CO2: Student will apply the idea to exhibit the hardware design for required field.
CO4: Student will use their knowledge for design analog, digital or combination circuit for dedicated application to solve real-world problems.

PO7: Autonomous and Lifelong Learning:

CO2,4,6: Student will think the technical solution for real-world problems and start-up in electronics design for various application. It is lifelong learning due to technology up gradation.

PO8 : Employability, Innovation, and Entrepreneurship:
CO2-7: Student will think to develop system for various parameter monitoring and control system which help various applications, energy conservation. This cos help for self-development of systems.

CBCS Syllabus as per NEP 2020 for M.Sc. Electronics (SEM I) (2026 Pattern)

Name of the Program	**:** M.Sc. Electronics
Program Code	**:** PSEL
Class	**:** M.Sc.
Semester	**:** I
Course Type	**:** Major Mandatory (Practical)
Course Code	**:** ELE-505-MRM
Course Title	**:** Electronics Practical Lab -II
No. of Credits	**:** 02
No. of Teaching Hours	**:** 60

Course Objectives

1. To understand the basics of verilog programming.
2. To learn CPLD/FPGA boards.
3. To understand the digital system design.
4. To learn digital circuit design in verilog.
5. To study MATLAB command for communication and simulation.
6. To understand the use of MATLAB for filter, modulation, antenna and transfer function design.
7. To learn C program for differential equation.

Course Outcomes

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

CO1: Verilog programming for CPLD/FPGA boards.
CO2: Implement digital systems on CPLD/FPGA boards.
CO3: Analyze complicated circuits using different network theorems and acquire skills

of using MATLAB/ C software for electrical circuit studies.
CO4: Create, design and develop problem solving ability.
CO5: Understand state of the art, technology and development.
CO6: Develop soft skills needed.
CO7: Get knowledge of self-employability.

List of Practical's

[A] Practical Based on VERILOG Programming and Implementation on FPGA (Any 5)

1. 4 bit logic gates
2. Parity Generator and checker
3. Hamming Code Generator
4. Manchester code Generator
5. Up-down bit binary counter (minimum4-bit)
6. Universal shift register
7. Four bit ALU design (structural modeling)
8. Designing of Traffic light Controller
9. Implementation of 8 bit multiplexer
10. LCD controller
11. Code Converter (BCD to seven Segment)
12. Practical based on state machine (Stepper sequence generator/Vending Machine/ Washing Machine)
13. Adder and subtractor

[B] Practical based on MATLAB (Any 3)

1. Phase and frequency response from transfer function of a CT system: Low Pass and High Pass
2. Phase and frequency response from transfer function of a DT system: Low Pass and High Pass
3. Simulation of transfer function using poles and zeros
4. Synthesis of periodic waveform from Fourier coefficients
5. Solution of differential equation with given boundary conditions
6. Analysis of a given dc electrical circuit
7. Effect of locations of poles and zeros on the transfer function and corresponding

frequency response
8. Laplace transform of given function ……

Activity: One activity equivalent to TWO Experiments.
1. Hobby project
2. Use of Simulator
3. Industry visit
4. Hands on training
5. Any other activity

Mapping Table :

Course Outcomes	Program Outcomes							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	1	1	3	-	-	1	1
CO2	3	3	3	3	1	-	1	3
CO3	3	3	3	3	1	-	1	1
CO4	1	3	3	2	3	1	3	3
CO5	3	1	1	2	1	3	3	1
CO6	1	1	1	1	3	3	3	2
CO7	1	1	2	1	1	1	2	3

Justification For The Mapping:-

PO1: Advanced Disciplinary Knowledge and Originality
CO1, CO2, CO3, CO5: Students gain advanced knowledge of Verilog programming, FPGA/CPLD implementation, and circuit analysis tools. They understand modern digital design methodologies and emerging technologies. This builds strong disciplinary depth and originality in hardware design.

PO2: Research, Analysis and Complexity
CO2, CO3, CO4: Learners analyze complex digital and electrical circuits using network theorems and software tools. They evaluate design alternatives and interpret simulation results.
This strengthens research orientation and ability to handle complex engineering problems.

PO3: Problem Solving in New Contexts
CO2, CO3, CO4: Students design and implement digital systems to solve real engineering problems. MATLAB/C-based circuit studies enhance analytical problem-solving skills. They become capable of applying knowledge in unfamiliar technical situations.

PO4: Technical Mastery and Scientific Reasoning

CO1, CO2, CO3: Students achieve technical proficiency in Verilog coding, FPGA implementation, and circuit analysis. They apply scientific reasoning while verifying logic designs and simulations. Hands-on work ensures mastery of modern digital design tools.

PO5: Integrated Communication
CO4, CO6: Problem-solving activities and soft-skill development improve technical communication. Students present design results, reports, and simulation outcomes effectively.
Team interactions enhance collaborative communication abilities.

PO6: Ethical, Social and Professional Judgement
CO5, CO6: Students understand the responsible use of modern technology and professional conduct. Soft-skill training promotes ethical workplace behavior and teamwork. They develop awareness of the societal impact of electronic system design.

PO7: Autonomous and Lifelong Learning
CO4, CO5, CO6: Students explore new tools, technologies, and design methods independently.
They adapt to evolving FPGA and digital design environments. This cultivates continuous self-learning and professional growth.

PO8: Employability, Innovation and Entrepreneurship
CO2, CO4, CO7: Practical FPGA implementation and problem-solving enhance job readiness.
Students develop innovative digital solutions and entrepreneurial thinking. Knowledge of self-employability prepares them for startups and industry roles.

CBCS Syllabus as per NEP 2020 for M.Sc. Electronics (SEM I) (2026 Pattern)

Name of the Program : M.Sc. Electronics
Program Code : PSEL
Class : M.Sc.
Semester : I
Course Type : Major Elective (Theory)
Course Code : ELE-506-MJE (A)
Course Title : Introduction to Raspberry Pi
No. of Credits : 02
No. of Teaching Hours : 30

Course Objectives

1. To introduce the **Raspberry Pi platform**, its models, and System on Chip (SoC) architecture.
2. To understand the **hardware structure of Raspberry Pi**, including GPIO pins, on-board components, and operating system support.
3. To differentiate **Raspberry Pi from other development platforms** such as Arduino and Asus Tinker Board.
4. To develop foundational knowledge of **Python programming**, including syntax, data types, operators, and control structures.
5. To understand **functions, modules, libraries, and data visualization** techniques in Python.
6. To learn interfacing of **basic I/O devices** such as LEDs, buzzers, push buttons, and switches using Python.

7. To implement **sensor and communication interfacing** using Raspberry Pi such as DHT11, PIR sensor, ultrasonic sensor, DC motors, relays, GSM, and Wi-Fi.

Course Outcomes

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

CO1: Explain the architecture and features of **Raspberry Pi models and SoC structure**.

CO2: Describe the **GPIO pin configuration and on-board peripherals** of Raspberry Pi.

CO3: Compare Raspberry Pi with **other embedded platforms** based on architecture and applications.

CO4: Write basic to intermediate **Python programs using variables, operators, control structures, and functions.**

CO5: Develop Python programs using **modules, libraries, and simple data visualization techniques.**

CO6: Interface and control **LEDs, buzzers, switches, DC motors, relays, and ultrasonic Sensors** using Raspberry Pi.

CO7: Design and implement small embedded applications using **sensor interfacing and communication modules.**

Topics and Learning Points

Unit 1: Overview of Raspberry Pi [8 L]

Introduction to Raspberry Pi Comparison of various Rpi Models. Understanding SoC architecture and SoC used in Raspberry Pi. Pin Description of Raspberry Pi. On-board components of Rpi, Operating system. GPIO pins. differentiating Raspberry pi from other platform like arduino, asus thinker etc.

Unit 2: Python Programming [12 L]

Introduction, Python vs. Other Languages, Applications of Python. Understanding Python, Interpreted Languages. Variables, Keywords, Operators and Operands. Data Types in Python, Importing Libraries, Control structures, Functions, Strings, Python modules and data visualization.

Unit 3: Interfacing Programming [10 L]

Python programs for I/O devices: Interfacing LEDs and buzzers. Interfacing push buttons, switches, Working with Ultrasonic sensors, DC motors, and Relays.

Sensors Interfacing- Temperature and Humidity Sensor (DHT11), Motion Sensor(PIR), Obstacle detection using Ultrasonic sensor, etc. Communicating using RPi- GSM interfacing, Accessing on-board Wi-Fi.

Reference Books :

1. Python Programming : PHI Learning by Veena Ghuriani, Akansha Gautam, Vaishali Chawla
2. Programming the Raspberry Pi, Second Edition: Getting Started with Python 2nd Edition by Simon Monk McGraw Hill Professional, 04-Jun-2021 - Technology & Engineering
3. Exploring Raspberry Pi: Interfacing to the Real World with Embedded Linux 1st Edition by Derek Molloy, wiley publications 2016.
4. The Computer Programming Bible: A Step by Step Guide On How To Master From The Basics to Advanced of Python, C, C++, C#, HTML Coding Raspberry Pi3 by C.P.A Inc 2020.

5. Raspberry Pi IoT Projects: Prototyping Experiments for Makersby John C. Shovic, APress 2016

Mapping Table :

Course Outcomes	Program Outcomes							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	1	-	2	-	-	1	-
CO2	3	1	-	3	-	-	1	-
CO3	3	3	1	2	1	-	1	-
CO4	3	3	3	3	3	-	3	1
CO5	3	3	3	3	3	-	3	1
CO6	2	2	3	3	1	3	3	3
CO7	3	3	3	3	3	3	3	3

Justification For The Mapping:-

PO1: Advanced Disciplinary Knowledge and Originality
CO1–CO7: Students acquire advanced knowledge of Raspberry Pi architecture, SoC structure, GPIO, and Python programming. They understand embedded system concepts and hardware–software integration. This develops originality in designing Raspberry Pi–based applications.

PO2: Research, Analysis and Complexity
CO3, CO4, CO5, CO7:Learners analyze different embedded platforms and evaluate their applications. Python programming and data visualization tasks involve analytical thinking. Complex sensor-based projects enhance research and investigative skills.

PO3: Problem Solving in New Contexts
CO4, CO5, CO6, CO7: Students solve real-world problems using Python and Raspberry Pi interfacing. They develop solutions for automation and monitoring applications. This builds the ability to apply knowledge in unfamiliar and practical contexts.

PO4: Technical Mastery and Scientific Reasoning
CO2, CO4, CO5, CO6, CO7: Students gain technical expertise in GPIO configuration, programming logic, and sensor interfacing. They apply scientific reasoning while debugging and optimizing embedded programs. Hands-on work ensures mastery of Raspberry Pi–based system development.

PO5: Integrated Communication
CO4, CO5, CO7:Students present program outputs, graphs, and embedded project results effectively. They

document code and communicate technical findings clearly.Team-based mini projects enhance collaborative communication skills.

PO6: Ethical, Social and Professional Judgement
CO6, CO7: Students learn responsible use of electronic components and safe interfacing practices. They understand the societal impact of embedded automation systems. This promotes ethical and professional decision-making in technology use.

PO7: Autonomous and Lifelong Learning
CO4, CO5, CO6, CO7: Students independently explore Python libraries, GPIO functions, and sensor modules. They adapt to new hardware and software challenges through self-learning.This cultivates continuous learning habits in embedded and IoT domains.

PO8: Employability, Innovation and Entrepreneurship
CO6, CO7: Interfacing projects and embedded applications build job-ready practical skills. Students design innovative automation and monitoring solutions. This enhances employability and encourages entrepreneurial thinking in IoT systems.

CBCS Syllabus as per NEP 2020 for M.Sc. –I Electronics (2026 Pattern)

Name of the Programme : M.Sc.-I Theory

Programme Code : PSEL

Class : M. Sc. I

Semester : I

Course Type : Major (Elective Theory)

Course Code : ELE-506-MJE (B)

Course Title : MATLAB Programming

No. of Credits : 02

No. of Teaching Hours : 30

Course Objectives:

Topics and Learning Points:-

1. To learn features of MATLAB as a programming tool.
2. To promote new teaching model that will help to develop programming skills and technique

to solve mathematical problems.
3. To understand Laplace Transform and Fourier series and its applications.
4. To use MATLAB as a simulation tool.
5. To impart practical working knowledge of Electrical and Electronics Simulation and Analysis using Mathematical computing languages such as MATLAB and/or SCILAB.
6. To Solve, Simulate and Analyse basic Electrical and Electronics Circuits and Applications.
7. To develop hands on working experience with reference to Solve, Simulate and Analyse Electrical & Electronics Circuits using MATLAB environments

Course Outcomes:

By the end of the course, students will be able to:

1. CO1: Understand the basic features of the MATLAB **environment**, including Command Window, Workspace, Command History, and Current Folder.

2. **CO2:** Apply **MATLAB data types, variables, arrays, and matrix operations** to perform basic numerical computations.

3. **CO3:** Develop **MATLAB programs using scripts and functions** with control structures such as loops, conditional statements, and file input/output operations.

4. **CO4:** Create and customize **2D and 3D graphical visualizations** using MATLAB plotting functions such as plot, subplot, plot3, mesh, and surf.

5. **CO5:** Implement **numerical methods** in MATLAB to solve linear systems, nonlinear equations, numerical integration, and differential equations.

6. **CO6:** Analyze **electronic circuits and signals** using MATLAB tools such as mesh/nodal analysis, Fourier Transform (FFT), and basic filter design techniques.

7. **CO7:** Design and simulate **electronic system models using** Simulink for applications like RC and RLC circuit analysis.

Topics and Learning Points

Unit 1: Introduction to MATLAB Environment (10)
MATLAB Layout: Command Window, Command History, Workspace, Current Folder. Data Types, Variables, and Assignment Statements. Scalar and Array Operations. Matrix Manipulation

Programming Structure & Data Handling:

Script Files (.m files), Functions Control Flow, Loops, File Input/ Output.

Unit 2: Visualization & Plotting Numerical Methods for Electronics (10)

2D Plotting: plot, subplot, title, xlabel, ylabel, legend. 3D Plotting: plot3, mesh, surf.

Customizing Graphs and Saving Figures.

Solving Linear Systems: Gauss Elimination, Matrix Inverse. Solving Non-linear Equations: Newton-Raphson Method. Numerical Integration: Trapezoidal and Simpson's Methods. Differential Equations: Solving ODEs using ode45.

Unit 3: Electronics Applications & Simulink **(10)**
Circuit Analysis: Solving Mesh/Nodal Equations. Signal Processing: Fourier Transforms (fft), Filter Design. Simulink Basics: Model-Based Design, Simulation of RC/RLC Circuits.

Recommended Books:

- MATLAB: An Introduction with Applications by Amos Gilat.
- Essentials of MATLAB Programming by Stephen J. Chapman.
- A Guide to MATLAB for Beginners and Experienced Users by Brian R. Hunt.
- G K Mittal Network Analysis Khanna Publishers , New Delhi
- Van Valkenberg Network Analysis, 3rd Edition Dorling Kindersley (India) Pvt Ltd
- Umesh Sinha Network Analysis and Synthesis Satya Prakashan, Delhi.
- Rudra Pratap Getting Started with MATLAB , 7th Edition Oxford University Press, N Delhi
- Stephen J. Chapman MATLAB Programming For Engineers. Thomas Learning

Table of Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	-	-		-	-	-	-
CO2	3	2	2		-	-	-	-
CO3	3	-	3	3	2	2	3	3
CO4	-	-	-	-	3	-	-	-
CO5	3	-	3	3	-	-	3	-
CO6	3	-	-	3	2	3	-	-
CO7	3	-	3	3	2	3	-	3

Justification of Mapping

PO1: Advanced Disciplinary Knowledge and Originality:

CO1: Understanding the MATLAB environment builds strong foundational disciplinary knowledge required for computational analysis..
CO2: Applying MATLAB data types, arrays, and matrices develops core analytical skills essential for engineering computations

CO3: Developing MATLAB programs using scripts and control structures demonstrates deep technical understanding and problem-solving ability.
CO5: Implementing numerical methods in MATLAB reflects advanced knowledge of mathematical modelling and computational techniques.
CO6: Analyzing electronic circuits and signals using MATLAB tools demonstrates strong disciplinary expertise in electronics.
CO7: Designing and simulating electronic systems in Simulink shows advanced application of domain knowledge in modeling and simulation.

PO2: Research, Analysis and Complexity:
CO2: Using MATLAB variables, arrays, and matrices supports numerical analysis and

PO3: Problem Solving in New Contexts:

CO2: Applying MATLAB variables and matrix operations helps solve numerical problems in different computational contexts.
CO3: Developing MATLAB programs with control structures enables solving new computational and engineering problems effectively.
CO4: Creating 2D and 3D visualizations helps interpret and analyze results while solving problems in new contexts.
CO5: Implementing numerical methods in MATLAB directly supports solving complex mathematical and engineering problems.
CO7: Analyzing circuits and signals using MATLAB tools applies problem-solving skills to real electronic systems.

PO4: Technical Mastery and Scientific Reasoning:

CO3: Developing MATLAB programs using scripts, functions, and control structures demonstrates strong technical programming skills.

CO5: Implementing numerical methods in MATLAB reflects strong technical mastery in solving scientific and engineering problems.
CO6: Analyzing electronic circuits and signals using MATLAB tools applies scientific reasoning to real engineering applications.
CO7: Designing and simulating electronic systems using Simulink demonstrates advanced technical competence and system-level understanding.

PO5: Integrated Communication:

CO3: Writing MATLAB programs with structured scripts and functions improves logical documentation and communication of algorithms.
CO4: MATLAB graphical visualization effectively communicates complex data and results through clear 2D and 3D plots.
CO6: Implementing numerical methods allows interpretation and presentation of analytical results in a communicable format.
CO7: Simulink models visually communicate system behavior and design concepts effectively.

PO6: Ethical, Social and Professional Judgment:

CO3: Developing structured MATLAB programs promotes disciplined and professional coding practices.
CO6: Implementing numerical methods requires careful analysis and responsible interpretation of computational results.
CO7: Designing and simulating systems in Simulink helps evaluate engineering solutions responsibly before real-world implementation.

PO7: Autonomous and Lifelong Learning:

CO3: Developing MATLAB programs using scripts and functions promotes independent problem solving and programming proficiency.
CO5: Implementing numerical methods requires continuous learning and application of mathematical concepts in MATLAB.

PO8: Employability, Innovation and Entrepreneurship:

CO3: Developing MATLAB programs enhances programming ability that is essential for innovative software and engineering solutions.
CO7: Analyzing circuits and signals using MATLAB tools helps develop industry-relevant analytical skills used in electronics and signal processing.

CBCS Syllabus as per NEP 2020 for M.Sc. Electronics (SEM I)
(2026 Pattern)

Name of the Program	**:** M.Sc. Electronics
Program Code	**:** PSEL
Class	**:** M.Sc.
Semester	**:** I
Course Type	**:** Major Elective (Practical)
Course Code	**:** ELE-507-MJE(A)
Course Title	**:** Practical based on Raspberry Pi
No. of Credits	**:** 02
No. of Teaching Hours	**:** 60

Course Objectives

1. To understand GPIO interfacing techniques of Raspberry Pi with LEDs and switches.
2. To develop skills for interfacing analog and digital sensors such as LM35, photocell, and DHT11.
3. To learn motion detection and PWM control using Raspberry Pi programming.
4. To strengthen programming fundamentals through sorting and mathematical function-based programs.
5. To develop modular programming skills using user-defined functions in C/Python.
6. To understand simulation of electronic circuits such as rectifiers and RC networks.
7. To enable students to integrate hardware interfacing with software analysis and visualization.

Course Outcomes

After completion of the course, students will be able to

CO1: Interface and control LEDs and switches using Raspberry Pi GPIO pins.

CO2: Acquire and process data from sensors like LM35, photocell, and DHT11.

CO3: Implement motion detection and PWM-based LED brightness control using Raspberry Pi.

CO4: Write structured programs using sorting algorithms and mathematical functions.

CO5: Apply user-defined functions to solve computational problems efficiently.

CO6: Simulate full-wave rectifier and analyze RC charging/discharging and filter responses.

CO7: Design integrated mini-projects combining embedded interfacing and programming concepts.

List of Practical's

Students should perform Eight Practical's.

1. Interfacing LED array to Raspberry Pi.
2. Interfacing switch connected to the GPIO pins of Raspberry Pi.
3. Interfacing temperature sensor (LM35) to Raspberry Pi.
4. interfacing photocell sensor to Raspberry Pi.
5. Programming of Raspberry Pi for Motion detection.
6. Interfacing DHT11 Temperature & Humidity.
7. Programming of Raspberry Pi for PWM LED Brightness.
8. Program to sort list using bubble sort algorithm.
9. Program to Implement Simple Calculator Using Functions
10. Program to Find Factorial Using Function
11. To simulate full wave rectified signal.
12. Program to plot RC Charging and Discharging Curve
13. Program to plot response of RC Low Pass Filter.

Activity : Equivalent to TWO Experiments

1. Hobby project
2. Use of Simulator
3. Industry visit
4. Hands on training
5. Any other activity

Mapping Table :

Course Outcomes	Program Outcomes							
	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	1	1	3	-	3	1	1
CO2	3	3	1	3	-	3	1	1
CO3	3	3	3	3	1	1	3	3
CO4	2	3	3	2	3	-	1	1
CO5	2	2	3	2	3	-	3	1
CO6	3	3	1	3	1	-	3	1
CO7	3	3	3	3	3	3	3	3

Justification For The Mapping:-

PO1: Advanced Disciplinary Knowledge and Originality
CO1–CO7: Students gain advanced knowledge of Raspberry Pi GPIO interfacing, sensor acquisition, PWM control, and simulation concepts. They integrate programming with embedded hardware to build complete systems. This develops strong disciplinary depth and originality in embedded applications.

PO2: Research, Analysis and Complexity
CO2, CO3, CO4, CO6, CO7: Learners analyze sensor data, motion detection behavior, and rectifier/filter responses. Sorting algorithms and simulations require analytical thinking and evaluation. This strengthens the ability to handle complex technical problems systematically.

PO3: Problem Solving in New Contexts
CO3, CO4, CO5, CO7: Students apply programming and embedded techniques to solve real-world automation problems. User-defined functions and control algorithms enhance solution design skills. Mini-projects build confidence in addressing unfamiliar engineering challenges.

PO4: Technical Mastery and Scientific Reasoning
CO1, CO2, CO3, CO6, CO7: Students gain technical expertise in GPIO control, sensor interfacing, PWM, and circuit simulation. They apply scientific reasoning while analyzing RC responses and rectifier behavior. Hands-on activities ensure mastery of embedded and electronic system design.

PO5: Integrated Communication
CO4, CO5, CO7: Students document structured programs, algorithm outputs, and mini-project results. They present simulation graphs and embedded results clearly. Collaborative project work enhances technical communication skills.

PO6: Ethical, Social and Professional Judgement
CO1, CO2, CO7: Students practice safe hardware interfacing and responsible data handling.
They understand the societal relevance of sensor-based monitoring systems.
This promotes ethical and professional behavior in embedded system development.

PO7: Autonomous and Lifelong Learning
CO3, CO5, CO6, CO7: Students independently explore libraries, simulation tools, and programming methods. They adapt to new sensors and embedded challenges through self-learning. This fosters lifelong learning habits in emerging embedded technologies.

PO8: Employability, Innovation and Entrepreneurship
CO3, CO7: Embedded mini-projects and automation tasks build strong job-oriented skills.
Students design innovative solutions using Raspberry Pi and sensors. This enhances employability and encourages entrepreneurial thinking.

CBCS Syllabus as per NEP 2020 for M.Sc. –I Electronics (2026 Pattern)

Name of the Programme : **M.Sc**. – I Electronic Science

Programme Code : **PSEL**

Class : **M.Sc.-I**

Semester : **I**

Course Type : **Major Elective [Practical]**

Course Code : **ELE-507-MJE(B)**

Course Title : **Practical Based on MATLAB**

No. of Credits : **02**

No. of Teaching Hours : **60**

Course Objectives

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

1. To learn features of MATLAB as a programming tool.
2. To promote new teaching model that will help to develop programming skills and technique to solve mathematical problems.
3. To understand Laplace Transform and Fourier series and its applications.
4. To use MATLAB as a simulation tool.
5. To impart practical working knowledge of Electrical and Electronics Simulation and Analysis using Mathematical computing languages such as MATLAB and/or SCILAB.
6. To Solve, Simulate and Analyse basic Electrical and Electronics Circuits and Applications.
7. To develop hands on working experience with reference to Solve, Simulate and Analyze Electrical & Electronics Circuits using MATLAB environments.

Course Outcomes:

By the end of the course, students will be able to:

1. **CO1:** Demonstrate familiarity with the MATLAB **interface**, including the command window, workspace, and help tools for basic computations.
2. **CO2:** Perform **matrix manipulations, arithmetic operations, and mathematical functions** in MATLAB for solving engineering problems.
3. **CO3:** Generate and visualize **2D and 3D plots of signals and waveforms** such as sine, square, triangular, exponential, and step signals.

4. **CO4:** Apply **programming concepts in MATLAB** including loops, conditional statements, and scripts to analyze electronic device characteristics such as diode and MOSFET I–V behavior.
5. **CO5:** Analyze **signals and systems** using MATLAB by performing signal operations, convolution, and computing signal energy and power.
6. **CO6:** Solve **electrical circuit problems** using MATLAB techniques such as mesh analysis, nodal analysis, and circuit theorems.
7. **CO7:** Design and simulate **electronic circuits and control systems using** Simulink, including RLC circuits, rectifiers, DC motor control, and bridge measurement circuits.

List of Practical Experiments

1. MATLAB Environment Familiarization: Navigating command window, workspace, and help functions.
2. Matrix Manipulations: Matrix addition, multiplication, and array manipulations.
3. Basic Arithmetic & Functions: Simple calculations, calculating interest, and using trigonometric functions.
4. Plotting Commands: Creating 2D / 3D plots, labeling axes for signals.
5. Basic Operations: Matrix multiplication, solving linear equations, and using scalar/array operations.
6. Visualization: Plotting various waveforms (Sine/Square/Triangle/UnitStep/ Exponential).
7. Numerical Analysis: Root finding for quadratic equations and solving circuits using Matrix methods.
8. Control Structure: Write a program for evaluating I-V characteristics of a diode/MOSFET using for loops and if-else.
9. Data Analysis: Plotting frequency response (Bode plot) of a filter circuit.
10. Simulation (Simulink): Simulation of RLC circuits, Rectifiers, and DC Motor control.
11. Signal Generation: Generate unit impulse/ unit step/ ramp/ square/ saw tooth/triangular/ sinc signals.
12. Signal Operations: Addition, multiplication, scaling, shifting, and folding.
13. Signal Analysis: Computing signal energy, average power, and finding even/odd parts.
14. Convolution: Evaluating linear and circular convolution for two sequences.
15. Circuit Analysis: Mesh / Nodal analysis of DC circuits.
16. Circuit Theorems: Application of Thevenin's/ Norton's/ Superposition theorems.
17. Characteristics of diodes and MOSFETs.
18. Rectifier Simulation: Simulation of single-phase diode bridge rectifiers with filters (R and RL loads).
19. Transient Analysis: Simulation of RC /RLC circuits.

20. Measurement: Simulating bridge circuits (Maxwell/Anderson) to measure unknown R, L, C values.

Activity List: (Any one Activity equivalent to two experiments)

1. Industrial Visit.
2. Study Tour
3. Internet Survey on different Simulators in Electronics
4. Any one extra practical done by student from the above list but, excluding regular laboratory practical.

Recommended Books:

- MATLAB: An Introduction with Applications by Amos Gilat.
- Essentials of MATLAB Programming by Stephen J. Chapman.
- A Guide to MATLAB for Beginners and Experienced Users by Brian R. Hunt.
- G K Mittal Network Analysis Khanna Publishers , New Delhi
- Van Valkenberg Network Analysis, 3rd Edition Dorling Kindersley (India) Pvt Ltd
- Umesh Sinha Network Analysis and Synthesis Satya Prakashan, Delhi.
- RudraPratap Getting Started with MATLAB , 7th Edition Oxford University Press, N Delhi
- Stephen J. Chapman MATLAB Programming For Engineers. Thomas Learning

Table of Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	-	-	-	-	-	-	-
CO2	2	3	3	3	2	-	-	-
CO3	-	-	-	-	3	3	-	-
CO4	-	-	3	-	-	2	3	3
CO5	3	-	3	2	-	-	3	2
CO6	3	3	2	3	-	-	2	3
CO7	3	3	3	3	3	3	3	3

Justification of Mapping

PO1: Advanced Disciplinary Knowledge and Originality:

CO1: Performing matrix manipulations and mathematical operations in MATLAB directly applies advanced mathematical concepts to engineering problems.
CO5: Applying programming concepts in MATLAB to analyze diode and MOSFET characteristics strengthens disciplinary knowledge of electronic devices.
CO6: Signal analysis using convolution, energy, and power calculations demonstrates advanced understanding of signals and systems.
CO7: Solving circuit problems using mesh and nodal analysis in MATLAB applies core electrical engineering theory to computational solutions.

PO2: Research, Analysis and Complexity:

CO2: Matrix manipulation and mathematical computations in MATLAB support analytical problem solving of complex engineering calculations.

CO6: Applying mesh and nodal analysis in MATLAB strengthens the ability to analyze complex electrical circuits computationally

CO7: Designing and simulating systems using **Simulink** supports research-oriented analysis and modeling of complex electronic systems.

PO3: Problem Solving in New Contexts:

CO2: Matrix operations and mathematical functions in MATLAB enable solving various engineering problems in unfamiliar contexts.
CO4: Applying programming constructs to study diode and MOSFET characteristics develops problem-solving skills for electronic device analysis.
CO5: Signal operations such as convolution and energy calculation help analyze signals and systems in complex scenarios.
CO6: Using MATLAB for mesh and nodal analysis helps solve circuit problems under different engineering conditions.
CO7: Designing and simulating systems in Simulink allows testing solutions for new electronic and control system problems.

PO4: Technical Mastery and Scientific Reasoning:

CO2: Matrix manipulation and mathematical operations develop strong analytical and computational skills for engineering problem solving.
CO5: Signal analysis using convolution, energy, and power calculations demonstrates scientific reasoning in signal processing.

CO6: Solving circuit problems using mesh and nodal analysis reflects strong technical understanding of electrical network theory.
CO7: Designing and simulating systems in Simulink demonstrates advanced technical skills and engineering analysis capability.

PO5: Integrated Communication:

CO2: Performing matrix and arithmetic operations allows students to present numerical solutions clearly in engineering analysis.
CO3: Visualization of signals using plots in MATLAB enables clear graphical communication of waveform behavior and signal characteristics.
CO7: Designing and simulating systems in Simulink provides visual models that clearly communicate circuit and control system operations.

PO6: Ethical, Social and Professional Judgment:

CO3: Visualization of signals using plots in MATLAB enables clear graphical communication of waveform behavior and signal characteristics.
CO4: Writing MATLAB scripts to analyze electronic devices helps explain device behavior logically through code and results.
CO7: Signal analysis and convolution results support effective presentation and explanation of system behavior.

PO7: Autonomous and Lifelong Learning:

CO4: Applying programming concepts such as loops and conditions encourages independent problem solving and continuous skill development in electronics analysis.

CO5: Signal analysis using computational tools promotes deeper exploration and continuous learning in signals and systems concepts.

CO6:Solving circuit problems using computational methods encourages students to independently apply and expand their engineering knowledge
CO7: Designing and simulating systems in Simulink promotes self-driven experimentation and lifelong learning in circuit and control system design.

PO8: Employability, Innovation and Entrepreneurship:

CO4: Using MATLAB for matrix and mathematical computations develops strong analytical skills required in engineering employment and innovation.

CO5: Applying programming concepts for analyzing electronic device characteristics enhances technical problem-solving abilities important for employability and technological innovation.
CO6: Solving circuit problems using MATLAB techniques builds practical engineering skills useful for industrial projects and technical entrepreneurship.
CO7: Designing and simulating systems using Simulink promotes innovation, product design capability, and industry-ready simulation skills.

CBCS Syllabus as per NEP 2020 for M.Sc. I (2026 Pattern)

Name of the Programme : M.Sc. Electronics

Programme Code : **PSEL**

Class : M.Sc. I

Semester I

Course Type : Research Methodology

Course Code : ELE-508-RM

Course Title : Research Methodology

No. of Credits 04

No. of Teaching Hours 60

Course Objective

1.To understand the meaning, objectives, motivation, and utility of research in scientific and academic domains.

2.To explain the concepts of theory, empiricism, deductive and inductive reasoning, and the scientific research process.

3. To identify, define, and formulate appropriate research problems based on literature review and research gaps.

4.To understand research questions, hypotheses, and hypothesis testing including null and alternative hypotheses.

5.To analyze and select suitable research designs such as exploratory, descriptive, and experimental designs.

6.To differentiate between qualitative and quantitative research approaches and understand their integration.

7.To understand methods of data collection, data analysis, interpretation, and generalization of research findings.

Course Outcomes

CO1: Explain fundamental research concepts, terminology, and the importance of research in problem solving.

CO2: Apply deductive and inductive reasoning to develop theoretical and empirical research frameworks.

CO3: Identify research gaps and formulate clear research problems, questions, and objectives.

CO4: Develop testable hypotheses and apply appropriate hypothesis testing techniques.

CO5: Design appropriate research methodologies by selecting suitable research designs and variables.

CO6: Distinguish between qualitative and quantitative research methods and justify their application in research studies.

CO7: Collect, analyze, interpret research data, and present valid conclusions through generalization and replication.

Topics and Learning Points

Unit-1 Foundation of Research (15L)

Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory. Characteristics of scientific method - understanding the language of research - Concept, Construct, definition, Variable Research Process.

Unit-2 Problem Identification & Formulation (15L)

definition and formulating the research problem, Necessity of defining the problem, Importance of literature review in defining a problem, Research Question - Investigation Question - Measurement Issues - Hypothesis - Qualities of a good hypothesis - Null hypothesis & Alternative Hypothesis. Hypothesis Testing - Logic & importance

Unit-3 Research Design (15L)

Concept and Importance in Research - Features of a good research design - Exploratory Research Design - Concept, Types and uses, Descriptive Research Design - concept, types and uses. Experimental Design - Concept of Independent & Dependent variables.

Unit-4 Qualitative and Quantitative Research (15L)

Qualitative and Quantitative Research: Qualitative - Quantitative Research - Concept of measurement, causality, generalization, replication. Merging the two approaches.

Data Collection and analysis: Execution of the research - Observation and Collection of data - Methods of data collection, hypothesis-testing - Generalization and Interpretation.

Text Books:

1) Research Methodology - C. R. Kothari
2) Research Methodology : An Introduction - Stuart Melville and Wayne
3) Practical Research Methods - Catherine Dawson

Reference Books:

1) Garg, B. L., Karadia, R., Agarwal, F. and Agarwal, U. K., 2002. An introduction to Research Methodology, RBSA Publishers.
2) Kothati , C.R., 1990. Research Methodology: Methods and Techniques. New Age International. 418p.
3) Sinha, S. C. and Dhiman, A. K., 2002. Research Methodology, EssEss Publications. 2 columes.

4) Trochim, W. M. K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270p
5) Wadehra, B. L. 2000. Law relating to patents, trade marks, copyright designs and geographical indications. Universal Law Publishing.

Mapping Table :

Course Outcomes	Program Outcomes							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2	1	2	1	-	1	-
CO2	2	3	2	3	2	-	1	1
CO3	2	3	3	3	1	-	1	1
CO4	2	2	2	3	1	-	1	-
CO5	2	3	3	3	2	1	1	2
CO6	3	2	2	3	1	1	1	3
CO7	3	3	2	2	1	1	1	-

Justification for Mapping:-

PO1: Advanced Disciplinary Knowledge and Originality
CO1, CO2, CO3, CO4, CO5, CO6, CO7
This course develops strong disciplinary knowledge in research methodology through understanding research foundations, problem formulation, research design, qualitative and quantitative approaches, and data analysis. Students demonstrate originality by formulating research problems, hypotheses, and selecting appropriate methodologies.

PO2: Research, Analysis and Complexity
CO1, CO2, CO3, CO4, CO5, CO6, CO7
The course emphasizes analytical thinking through literature review, hypothesis formulation, research design selection, and data interpretation. Students handle research complexity by integrating theory, empirical evidence, qualitative and quantitative analysis methods.

PO3: Problem Solving in New Contexts
CO2, CO3, CO4, CO5, CO6, CO7
Students apply research concepts to identify and solve new research problems by framing research questions, testing hypotheses, and selecting suitable data collection and analysis techniques in unfamiliar and real-world contexts.

PO4: Technical Mastery and Scientific Reasoning
CO1, CO2, CO4, CO5, CO6, CO7
Scientific reasoning is strengthened through deductive and inductive logic, hypothesis testing, experimental design, measurement concepts, and causal analysis. Students gain technical mastery in executing structured research processes.

PO5: Integrated Communication

CO2, CO3, CO5, CO6, CO7
The course enhances communication skills by requiring students to clearly present research problems, hypotheses, methodologies, data interpretation, and conclusions through structured reports and academic writing.

PO6: Ethical, Social and Professional Judgement
Mapped COs: CO3, CO5, CO7
Students develop ethical and professional responsibility by understanding responsible research practices, unbiased data collection, proper interpretation of results, and adherence to ethical standards in research execution.

PO7: Autonomous and Lifelong Learning
Mapped COs: CO1, CO2, CO3, CO4, CO5, CO6, CO7
The course promotes independent learning through self-driven literature review, critical thinking, research design selection, and continuous skill development in research methodology, fostering lifelong learning.

PO8: Employability, Innovation and Entrepreneurship
CO3, CO4, CO5, CO6, CO7
Research skills such as problem identification, data analysis, hypothesis testing, and interpretation enhance employability. These competencies also support innovation, project development, and entrepreneurial research initiatives.