Anekant Education Society's

Tuljaram Chaturchand College, Baramati

(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 (2023 Pattern)

(As Per NEP 2020)

To be implemented from Academic Year 2023-2024

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

(Autonomous)

Board of Studies (BOS) in Electronics

From 2022-23 to 2024-25

Sr. No.	Name	Designation
1.	**Dr. Deshpande J. D.**	**Chairman**
2.	**Dr. Mrs. Pawar A. M.**	**Member**
3.	**Dr. Patil S. N.**	**Member**
4.	**Mrs. Rupanawar P. D.**	**Member**
5.	**Dr. Kothawale A. S.**	**Member**
6.	**Mrs. Gawade S. A.**	**Member**
7.	**Mrs. Patil S. S.**	**Invitee**
8.	**Mrs. Shinde P. K.**	**Invitee**
9.	**Mrs. Adsul K. R.**	**Invitee**
10.	**Prof. Dr. S. R. Kumbhar**	**Expert from other University**
11.	**Dr. Sadistap Shashikant**	**Expert from other University**
12.	**Dr. Mudassar Shaikh**	**Expert from University**
13.	**Mr. Patil Sharad. V.**	**Industry Expert**
14.	**Miss. Salunkhe Yogita.**	**Meritorious Alumni**
15.	**Miss Ekatpure Arti**	**Student Representative**
16.	**Mr. Khaire Kiran**	**Student Representative**

Anekant Education Society's

Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati

(Autonomous)

Credit Distribution Structure for (M.Sc. Electronics) Part-I (2023 Pattern)

Year	Level	Sem.	Major		Research Methodology (RM)	OJT/ FP	RP	Cum. Cr.
			Mandatory	Electives				
I	6.0	Sem-I	ELE-501-MJM: Mathematical Methods in Electronics and Network Analysis (Credit 04)	ELE-511-MJE(A): Digital System Design using Verilog. **(Credit 04)** ELE-511-MJE(B): Advanced 'C' and JAVA Programming. **(Credit 04)**	ELE-521-RM Research Methodology (**Credit 04**)	--	--	**20**
			ELE-502-MJM: Integrated Circuit Analysis. (Credit 04)					
			ELE-503-MJM: Electronics Science Practical Course -I (Credit 02)					
			ELE-504-MJM: Electronics Science Practical Course -II (Credit 02)					
		Sem- II	ELE-551-MJM: Electromagnetics, Microwave and Antennas.(Credit 04)	ELE-561-MJE(A): Instrumentation and Measurement Techniques. **(Credit 04)** ELE-561-MJE(A): Foundation of Semiconductor Devices (**Credit 04**)	--	ELE-581-OJT/FP **Credit 04**	--	**20**
			ELE-552-MJM: Embedded System Design with PIC Microcontroller. (Credit 04)					
			ELE-553-MJM:: Electronics Science Practical Course -III (Credit 02)					
			ELE-554-MJM:: Electronics Science Practical Course - IV (Credit 02)					
Cum. Cr.			**24**	**8**	**4**	**4**	**--**	**40**

Anekant Education Society's

Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati (Autonomous)

Course Structure for (M.Sc. Electronics) Part-I (2023 Pattern)

Sem.	Course Type	Course Code	Course Title	Theory/ Practical	No. of credits
I	Major (Mandatory)	ELE-501-MJM	Mathematical Methods in Electronics and Network Analysis	Theory	04
	Major (Mandatory)	ELE-502-MJM	Integrated Circuit Analysis	Theory	04
	Major (Mandatory)	ELE-503-MJM	Electronics Science Practical Course -I	Practical	02
	Major (Mandatory)	ELE-504-MJM	Electronics Science Practical Course -II	Practical	02
	Major (Elective)	ELE-511-MJE(A)	Digital System Design using Verilog	Theory	04
		ELE-511-MJE(B)	Advanced 'C' & JAVA Programming.	Theory	
	Research Methodology (RM)	ELE-521-RM	Research Methodology	Theory	04
	Total credits Semester I				**20**
II	Major (Mandatory)	ELE-551-MJM:	Electromagnetics, Microwave and Antennas.	Theory	04
	Major (Mandatory)	ELE-552-MJM:	Embedded System Design with PIC Microcontroller.	Theory	04
	Major (Mandatory)	ELE-553-MJM:	Electronics Science Practical Course -III	Practical	02
	Major (Mandatory)	ELE-554-MJM:	Electronics Science Practical Course - IV	Practical	02
	Major (Elective)	ELE-561-MJE(A)	Instrumentation and Measurement Techniques.	Theory	04
	Major (Elective)	ELE-561-MJE(B)	Foundation of Semiconductor Devices	Theory	
	On Job Training (OJT)/Field Project (FP)	ELE-581-OJT/FP	On Job Training Filed Project	Training/Project	04
	Total credits Semester II				**20**
	Cumulative Credits Semester I and II				**40**

CBCS Syllabus as per NEP 2020 for M.Sc. I (2023 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-MJM

Course Title : Mathematical Methods in Electronics and Network Analysis

No. of Credits : 04

No. of Teaching Hours : 60

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
3. To get familiar with role of differential equations in applied electronics
4. To know about mathematical tools and techniques for 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. Solve higher order linear differential equation using appropriate techniques for modeling and analyzing electrical circuits.
CO3. Students will demonstrate basic knowledge of Laplace Transform.
CO4. Analyze the circuit using Kirchhoff's law and Network simplification theorems
CO5. System analyze using MATLB
CO6. To solve problem based on network theorems

Topics and Learning Points

Unit-1: Mathematical Modeling, Electronic Signals & System (15L)

Concept of modeling, types, mathematical modeling using differential equations, Differential Equation, Ordinary Differential Equations (ODE), DE and their occurrences in real life problems, linear differential equation with constant coefficients, partial DE

Signals: periodic, aperiodic, Continuous Time (CT) and Discrete Time (DT), Basic

Operations on Signals, signal types, amplitude and phase spectrum, special electronic signals (impulse, unit step, sinusoidal, ramp, square wave, staircase), Classification of Systems, Representations of Systems.

Unit-2: Mathematical Tools for Circuit Analysis (20L)

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, solution of DE using LT, 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.
Concept of transfer function of CT and DT systems, time and frequency domain response of systems using transfer function, poles and zeros of transfer function and their significance, applications to simple passive filters such as Low Pass (LP), High Pass (HP), Butterworth filters, synthesis of transfer function using poles and zeros, stability criterion, Routh-Hurwitz criterion.

Unit-3: Network Analysis (15L)

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.

Unit 4: Signal and System Analysis using MATLAB (10L)

MATLAB environment: Basic Structure of Matlab, File types, Matlab commands and operators, tool boxes, Arithmetic and Logical operations. Creating simple plots, MATLAB scripts and functions (m-files), Control structures (if, if-else, else-if, switch, for, while etc).

Reference Books:

1. Advanced Engineering Mathematics, E. Kreyzig, John Wiley andSons.
2. Signals and system by P Ramesh Babu and Anandanatarajan, Scitech
3. Network Analysis, G. K. Mittal, KhannaPublication.
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. Microwave Devices and Circuits, Samuel Y. Liao, 3rd Edition, PHI,2002.
9. Basics of MATLAB and Beyond by Andrew Knight, CRC

Mapping of Program Outcomes with Course Outcomes

Course Outcome	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	1	2	1	2	-	-	-	-	-
CO2	2	3	1	3	3	-	-	-	2
CO3	1	2	-	2	1	-	-	-	1
CO4	1	2	-	1	2	1	-	-	2
CO5	2	2	1	1	2	2	-	1	2
CO6	1	2	-	2	2	3	-	-	2
CO7	2	1	-	2	3	2	-	-	3

Justification for the mapping

PO1: Disciplinary Knowledge

The course outcomes (COs) contribute to the development of students' disciplinary knowledge in electronics using mathematical tools. For example, CO1, CO2, CO3, and CO4 require students to master higher order linear differential equation and various transformation method for simplifying system response. CO5 require students to apply these concepts to complex problems in electronic network simplification. CO6 and CO7 require students to develop a deep understanding MATLAB Programming.

PO2: Critical Thinking and Problem Solving

All of the COs contributes to the development of students' critical thinking and problem-solving skills. For example, CO1, CO2, CO3 and CO4 require students to think critically about how to apply different transformation method to solve problems. CO5 require students to use their knowledge for Network simplification in complex electronic engineering problems. CO6 and CO7 require students to think critically about MATLAB programing for simplifying the problem of critical design.

PO3: Social competence

CO1, CO2 and CO5: Students will able to use various transformation methods to crate solution or modeling of various applications for Social competence. Such as industrial, medical, automobile application etc.

PO4: Research-related skills and Scientific temper

The entire COs contributes to the development of students' research-related skills and scientific temper. CO1, CO2, CO3, CO4 and CO5 require students to learn how to use mathematical modeling, transformation method use for simplification and verify the result for complex circuit. CO6 and CO7 requires student to develop their ability to create MATLAB program for simplification of complex network and analysis of system performance.

PO5: Trans-disciplinary knowledge

All the COs contribute to the development of students' trans-disciplinary knowledge. CO2, CO3, CO4 and CO5 require students to learn how to apply mathematical models to problems in electronics and physics using mathematical modeling and transformation method. CO6 and CO7 require developing algorithm for problem solving in in physics and engineering technology.

PO6: Personal and professional competence

CO4, CO5, CO6, CO7, and CO8 all contribute to the development of students' personal and professional competence. For example, all of the COs require students to develop their ability to work independently and as part of a team.

PO8: Environment and Sustainability

CO5: Student will think to develop simplified mathematical model for diver's application.

PO9: Self-directed and Life-long learning

CO2, CO3, CO4, CO5, CO6, and CO7 all contribute to the development of students' ability to engage in self-directed and life-long learning. For example, the entire COs requires students to develop their ability to learn new concepts and apply them to new problems. They also require students to develop their ability to think critically about their own learning and to identify areas where they need to improve.

CBCS Syllabus as per NEP 2020 for M.Sc. I (2023 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-MJM

Course Title : Integrated Circuit Analysis

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

CO8. Apply basic concepts of P-N junction in developing simple application circuits

Topics and Learning Points

Unit-1: Basic 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.
BJT- construction and biasing, Operation, CC, CB and CB configurations JFET- construction, types and its operation, parameters, characteristics, JFET amplifiers.
MOSFET- types, biasing of MOSFET, applications, comparison between BJT, JFET, MOSFET.

Unit-2: Analysis of Amplifiers (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.

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, MillmanTaub, 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	PO9
CO1	2	3	2	3	2	3	-	1	3
CO2	3	1	1	3	3	-	-	-	-
CO3	2	3	-	2	-	1	-	-	2
CO4	3	2	-	2	-	-	-	1	2
CO5	1	1	-	3	-	-	-	-	-
CO6	2	-	2	1	2	-	-	-	2
CO7	2	1	-	3	-	-	-	-	1

Justification for the mapping

PO1: Disciplinary Knowledge

The course outcomes (COs) contribute to the development of students' disciplinary knowledge in electronics using various devices. For example, CO1, CO2, CO4, CO5 and CO6 require students to know the semiconductor behaviour of different components, it characteristics and operations. CO3 and CO7 require students to apply these concepts to electronic circuit design for amplifiers, filters and oscillators.

PO2: Critical Thinking and Problem Solving

All of the COs contributes to the development of students' critical thinking and problem-solving skills. For example, CO1, CO2, CO4 and CO5 require students to think critically about semiconductor behaviour of different components, effect of temperature, data converter and use of operational amplifiers. CO3 and CO7 require students to use their knowledge for filter and oscillator design.

PO3: Social competence

CO1, CO2 and CO6: Students will able to design electronic circuits using various ICc for Social competence. Such as industrial, medical, automobile application etc.

.**PO4: Research-related skills and Scientific temper**

The entire COs contributes to the development of students' research-related skills and scientific temper. CO1, CO2, CO4 CO5 and CO6 require students to learn how to use basic semiconductor devices, its operations characteristics for improvement of system performance, reducing error, stable for research related applications. CO3 and CO7 for Oscillator and filter response analysis for scientific temper.

PO5: Trans-disciplinary knowledge

CO1, CO2 and CO6 contribute to the development of students' trans-disciplinary knowledge. CO1, CO2 require students to learn how to use semiconducting material for electronics and physics for sensing application, device for circuit design. CO6 require developing op-amp based circuit for problem solving in in physics and engineering and agriculture applications..

PO6: Personal and professional competence

CO1 and CO3 contribute to the development of students' personal and professional competence. For example, all of the COs require students to develop their ability to work independently and as part of a team for system design using semiconducting devices.

PO8: Environment and Sustainability

CO1 and CO4: Student will think to develop simplified system for diver's application for monitoring and controlling the parameters.

PO9: Self-directed and Life-long learning

CO1, CO3, CO4, CO6 and CO7all contribute to the development of students' ability to engage in self-directed and life-long learning. For example, the entire COs requires students to develop their ability to learn new concepts and apply them to electronic system design for new problems. They also require students to develop their ability to think critically about their own learning and to identify areas where they need to improve.

CBCS Syllabus as per NEP 2020 for M.Sc. I (2023 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-503-MJM

Course Title : Electronic Science Practical Course -I

No. of Credits : 02

No. of Teaching Hours : 60

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.
CO8. Develop hobby projects.

Topics and Learning Points (Perform any 8 experiments)

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. Comparator and Schmitt trigger with single supply operation
5. Second order Butterworth filters(BP and BR)
6. V to F and F to V using commercially available IC
7. Instrumentation amplifier for a given gain
8. Low current negative power supplyusingIC555/dual power supply using single battery
9. Design RC phase shift oscillator using op-amp for frequency ________
10. Design Wien-bridge oscillators using op-amp for frequency ________
11. To design and set up an integrator and differentiator circuit using op-amp

12. Analog to Digital Convertor.
13. Two digit combinational lock
14. Keyboard encoder with latches
15. Traffic light controller
16. Multiplexed display(Bank token / two digit counter)
17. Bidirectional stepper motor control (Sequence Generator)
18. OnedigitBCDadderand8-bitadder/subtractor
19. Object counter (use of MMV, counter)
20. Binary-Gray and Gray-Binary code converter
21. Design a mod-- synchronous counter using JK flip flop.
22. 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.

- Industrial Visit / Study Tour / Field visit

Mapping of Program Outcomes with Course Outcomes

Course Outcome	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	2	2	-	-	-	-	-	-
CO2	3	2	2	3	2	2	-	2	2
CO3	-	2	-	2	-	-	-	-	-
CO4	2	2	2	2	-	2	3	2	2
CO5	1	2	-	2	-	-	-	-	-
CO6	1	2	-	2	-	-	-	-	1
CO7	3	2	-	3	-	2	-	-	-

Justification for the mapping

PO1: Disciplinary Knowledge

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.

PO2: Critical Thinking and Problem Solving

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.

PO3: Social competence

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.

PO4: Research-related skills and Scientific temper

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 standardisation.

CO6,7: Students apply their knowledge for antenna design.

PO5: Trans-disciplinary knowledge

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

PO6: Personal and professional competence

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.

PO7: Effective Citizenship and Ethics

CO4: Student will demonstrate the use of technology for smart work and aware the need of technology.

PO8: Environment and Sustainability

CO4,6: Student will think to develop system for environmental parameter monitoring system which help various applications, energy conservation.

PO9: Self-directed and Life-long 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.

CBCS Syllabus as per NEP 2020 for M.Sc. I (2023 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-MJM

Course Title : Electronic Science Practical Course -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 analog circuits and simulation.
6. To understand the use of MATLAB for filter and transfer function design.
7. To learn C program for differential equations.

Course Outcomes:

By the end of the course, students 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.

Topics and Learning Points (Perform any 8 experiments)

1. Combinational Logic
   a. Parity Generator and checker

b. Hamming Code Generator
c. Manchester code Generator
2. Sequential Logic
    a. Up-down bit binary counter (minimum 4-bit)
    b. Universal shift register
3. Four bit ALU design(structural modelling)
4. Keyboard Scanning
5. Designing of Traffic light Controller
6. Implementation of 8 bit multiplexer
7. LCD controller
8. Code Converter (BCD to seven Segments)
9. State machine(Stepper sequence generator/Vending Machine/Washing Machine)
10. Barrel shifter
11. Phase and frequency response of a CT system: Low Pass and High Pass
12. Phase and frequency response of a DT system: Low Pass and High Pass
13. Transient and steady state response of CT system: LCR series circuit
14. Simulation of transfer function using poles and zeros
15. Synthesis of periodic waveform from Fourier coefficients
16. Solution of differential equation with given boundary conditions
17. Analysis of a given dc electrical circuit
18. Effectoflocationsofpolesandzerosonthetransferfunctionandcorrespondin gfrequencyresponse
19. Laplace transform of given function ……

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.

Mapping of Program Outcomes with Course Outcomes

Course Outcome	Program Outcome								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	1	3	1	2	-	1	3
CO2	3	3	1	3	2	2	-	1	3
CO3	3	3	1	3	2	2	-	1	3
CO4	3	3	1	3	2	2	-	1	3
CO5	3	3	1	3	2	2	-	1	3
CO6	3	3	1	3	1	2	1	1	3
CO7	2	2	1	3	2	2	2	1	3

Justification for mapping

PO1: Disciplinary Knowledge

CO1, CO2: Ensures a strong foundation in disciplinary knowledge, aligning with the practical application of digital design principles.
CO3: Enhances disciplinary knowledge by providing hands-on experience in electrical circuit studies and analysis.
CO4: Creating, designing, and developing problem-solving abilities in the context of digital systems and circuit analysis contribute to a comprehensive understanding of the discipline, fostering a problem-solving mindset.
CO5, CO6, CO7: Understanding the state of the art in digital systems and electrical circuits, coupled with the development of soft skills, contributes to disciplinary knowledge by preparing individuals for the technological advancements and employability within the field.

PO2: Critical Thinking and Problem solving:

CO1,CO2: Fostering the ability to design and troubleshoot complex digital circuits.
CO3: Analyzing intricate circuits with various network theorems and utilizing software tools like MATLAB, C, and PSPICE enhances critical thinking and problem-solving abilities in electrical circuit studies.
CO4: Creating, designing, and developing solutions for complex problems in digital systems contribute to honing critical thinking and problem-solving skills, aligning with the ability to address challenges in the field.
CO5, CO6, CO7: Understanding the state of the art in technology and development requires critical evaluation, and the development of soft skills for effective communication and self-employability further emphasizes critical thinking in diverse contexts.

PO3: Social competence:

CO1,CO2: Collaborative work on Verilog programming and implementing digital systems fosters social competence by encouraging teamwork, communication, and shared problem-solving in a technological context.
CO3: Collaborative analysis of intricate circuits using tools like MATLAB, C, and PSPICE promotes social competence through teamwork, knowledge sharing, and mutual support in understanding electrical circuit studies.
CO4, CO5, CO6, CO7: Preparing individuals for effective interaction, communication, and collaboration in diverse professional settings.

PO4: Research-related skills and Scientific temper

CO1,CO2: Enhances research-related skills by enabling exploration and experimentation with advanced technologies in the field of CPLD/FPGA boards.
CO3: Fosters research-related skills by encouraging a systematic and scientific approach to electrical circuit studies.
CO4, CO5, CO6, CO7: Creating, designing, and problem-solving within the context of technology and development contribute to research-related skills, promoting a scientific temper and innovative thinking.

PO5: Trans-disciplinary knowledge

CO1,CO2: Involve trans-disciplinary knowledge by integrating hardware description languages and digital design principles from various fields.
CO3: Analyzing complex circuits with tools like MATLAB, C, and PSPICE requires a trans-disciplinary approach, combining electrical engineering principles with computational and software skills.
CO4, CO5, CO6, CO7: Problem-solving, understanding the state of the art, and developing soft skills in the context of electrical systems contribute to a trans-disciplinary perspective, considering both technical and non-technical aspects.

PO6: Personal and professional competence:

CO1,CO2: Fostering technical proficiency and hands-on skills in the field of CPLD/FPGA-based digital design.
CO3: Honing analytical and software skills crucial for electrical circuit studies.
CO4, CO5, CO6, CO7: Creating, designing, and problem-solving in electrical systems, coupled with understanding technology trends and developing soft skills, contribute to personal and professional competence, fostering self-employability.

PO7: Effective Citizenship and Ethics
CO6,CO7: Developing soft skills and self-employability knowledge aligns with effective citizenship and ethics, as it prepares individuals to contribute responsibly to society, either through meaningful employment or entrepreneurial endeavors.

PO8: Environment and Sustainability
CO1,CO2: Promoting efficient design practices, reducing resource consumption, and aligning with green technologies in CPLD/FPGA-based systems.
CO3: Aligns with environmentally sustainable practices in electrical circuit studies, fostering awareness and responsible use of resources.
CO4, CO5, CO6, CO7: Reflects an understanding of environmental sustainability, ensuring that developments align with eco-friendly practices.

PO9: Self-directed and Life-long learning
CO1,CO2: Fosters self-directed and life-long learning by equipping individuals with skills to adapt and grow in a dynamic technological landscape.
CO3: Promotes self-directed learning, empowering individuals to engage in continuous learning throughout their careers.
CO4, CO5, CO6, CO7: Developing problem-solving ability, understanding the state of the art, and acquiring self-employability skills all contribute to a mindset of self-directed and life-long learning, ensuring adaptability in a changing professional landscape.

CBCS Syllabus as per NEP 2020 for M.Sc. I (2023 Pattern)

Name of the Programme	: M.Sc. Electronics
Programme Code	**: PSEL**
Class	: M.Sc. I
Semester	: I
Course Type	: Elective (Theory)
Course Code	: ELE-511(A)-MJE
Course Title	: Digital System Design using Verilog
No. of Credits	: 04
No. of Teaching Hours	: 60

Course Objectives:

1. To understand sequential and combinational logic design techniques
2. To introduce VERILOG
3. To learn various digital circuits using VERILOG
4. To learn Programable Devices and their applications
5. To learn various digital circuits using VERILOG
6. To learn FSM.
7. To understand memory Concept

Course Outcomes:

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

CO1. To know the basic language features of Verilog HDL and the role of HDL in digital logic design
CO2. To know the various modeling of combinational and simple sequential circuits.
CO3. To know the architectural features of programmable logic devices
CO4. Construct the combinational circuits, using discrete gates and programmable logic devices.
CO5. Describe Verilog model for sequential circuits and test pattern generation.
CO6. Design a semiconductor memory for specific chip design.
CO7. Design embedded systems using small microcontrollers, larger CPUs/DSPs, or hard or soft processor cores.
CO8. Synthesize different types of processor and I/O controllers that are used in embedded system.

Topics and Learning Points

Unit-1:HDL for Digital System Design 10L

VERILOG: 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, comparison between VERILOG and VHDL language.

Unit-2: Combinational Logic 15L

Introductiontocombinationalcircuits,realizationofbasiccombinationalfunctions-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,ComplexProgrammableLogicDevice(CPLD)andFieldProgrammableLogicDevices(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.

References:

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. DigitalSystemDesignwithVERILOGDesign,StephenBrown,ZvonkoVranesic

,TMH,2ndEd
4. Digital design; Principles Practices, Wakerly,PHI.
5. Modern Digital Electronics, R.PJain,McGrawHill.
6. Digital systems; Principles and Applications ,Tocci, Pearson Education.
7. Digital Logic and Computer Design ,Morris Mano, PHI.

Mapping of Program Outcomes with Course Outcomes

Course Outcome	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	2	3	2	3	2	1	3
CO2	1	1	1	3	3	-	1	-	-
CO3	-	3	-	2	-	1	-	-	-
CO4	3	2	-	2	-	-	2	1	2
CO5	1	1	-	3	-	-	-	-	-
CO6	-	-	-	1	2	-	-	-	-
CO7	2	1	-	-	-	-	1	-	1

Justification for the mapping

PO1: Disciplinary Knowledge

C01: Understanding the basic language features of Verilog HDL contributes to disciplinary knowledge in the field of digital design.

CO2: Knowing various modeling techniques for combinational and sequential circuits contributes to disciplinary knowledge by providing insights into different ways to represent and design these fundamental components of digital systems.

CO4: Constructing combinational circuits using discrete gates and programmable logic devices is a practical application of knowledge in digital design.

CO5: Describing Verilog models for sequential circuits and test pattern generation involves applying knowledge of Verilog HDL to design and simulate sequential circuits

CO7:Designing Finite State Machine (FSM) code for various applications involves applying knowledge of sequential circuit design.

PO2: Critical Thinking and Problem solving

CO1 to CO7 (Expect CO6):All include Critical Thinking and Problem solving.

PO3: Social competence

C01: Understanding the basic language features of Verilog HDL contributes to Social competence in the field of digital design.

CO2: Knowing various modeling techniques for combinational and sequential circuits contributes to Social competence by providing insights into different ways to represent and design these fundamental components of digital systems.

PO4: Research-related Skills and Scientific Temper

CO1 to CO6: All include Research-related Skills and Scientific Temper

PO5: Trans-disciplinary knowledge

CO1: Understanding the basic language features of Verilog HDL contributes to Trans-disciplinary knowledge in the field of digital design.

CO2: Knowing various modeling techniques for combinational and sequential circuits contributes to Trans-disciplinary knowledge.by providing insights into different ways to represent and design these fundamental components of digital systems.

CO6: Design semiconductor memory include Trans-disciplinary knowledge.

PO6: Personal and professional competence

CO1: Understanding the basic language features of Verilog HDL contributes to Personal and professional competence in the field of digital design.

CO3: Knowledge of logic include Personal and professional competence

PO7: Effective Citizenship and Ethics

CO1: Understanding the basic language features of Verilog HDL contributes to Effective Citizenship and Ethics in the field of digital design.

CO2: Knowing various modeling techniques for combinational and sequential circuits contributes to Effective Citizenship and Ethics by providing insights into different ways to represent and design these fundamental components of digital systems.

CO4: Constructing combinational circuits using discrete gates and programmable logic devices is a practical application of Effective Citizenship and Ethics in digital design.

CO7: Designing Finite State Machine (FSM) code for various applications involves Effective Citizenship and Ethics of sequential circuit design.

PO8: Environment and Sustainability

CO1: Understanding Verilog HDL and its role in digital logic design contributes to environmental sustainability by promoting efficient hardware design

CO4: Constructing combinational circuits with a focus on discrete gates and programmable logic devices allows for the creation of energy-efficient hardware, aligning with principles of environmental sustainability.

PO9: Self-directed and Life-long learning

CO1: Understanding the basic language features of Verilog HDL and its role in digital logic design is foundational knowledge

CO4: The ability to construct combinational circuits using discrete gates and programmable logic devices reflects hands-on skills.

CO7: Designing Finite State Machine (FSM) code for various applications involves applying knowledge in diverse contexts

CBCS Syllabus as per NEP 2020 for M.Sc. I (2023 Pattern)

Name of the Programme : M.Sc.Electronics

Programme Code : **PSEL**

Class : M.Sc. I

Semester : I

Course Type : Elective (Theory)

Course Code : ELE-511(B)-MJE

Course Title : Advanced 'C' & JAVA Programming

No. of Credits : 04

No. of Teaching Hours : 60

Course Objectives:

1. To understand basic concepts of C programming language.
2. To know the concepts of control statements, storage classes.
3. To understand structure and union in C.
4. To develop the C Program for structure, file user defined function and union.
5. To learn various advanced features of C programming.
6. To get the knowledge of C graphics and interfacing.
7. To learn concepts of object oriented programming in JAVA.

Course Outcomes:

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

CO1. Basic concept of C
CO2: Develop a C program
CO3: Basic and program of Graphics
CO4: Concept of Jawa and its programming.
CO5: Read, understand and trace the execution of programs written in C language.
CO6: Write the C code for a given algorithm.
CO7: Implement Programs with pointers and arrays, perform pointer arithmetic, and use the pre-processor.
CO8: Write programs that perform operations using derived data types.

Topics and Learning Points

Unit-1: Introduction to C **15L**

C fundamentals: Introduction of high-level programming language, operators and it's precedence, various data types in C, storage classes in C. Control statements: Decision–

making and forming loop in programs. Arrays& pointers: handling character, arrays in C, pointers in C, advanced pointers, structure and union. Functions: user defined function, pointer to functions.

Unit-2: Advanced Features and Interfacing 15L

Miscellaneous and advanced features: command line argument, dynamic memory. Allocation, Data files in C, file handling in C, C Programming examples.
Interfacing: interfacing to external hardware, via serial/parallel port using C, parallel port functions, interfacing with LED and seven segment display, applying C to electronic circuit problems.

Unit-3: Graphics in C 15L
Graphics in C: graphics-video modes, video adapters, C Graphics functions, arc bar circle, bar3D, rectangle, ellipse, drawpoly, fillellipse, fillpoly, Getbkcolor etc. drawing various objects and electronic components on Screen.

Unit-4 Introduction to JAVA 15L

Introduction to object oriented programming, objects, Classes, inheritance, polymorphism, overloading. Operators, Input in JAVA, mathematical library methods, Conditional and Iterative constructs, Programming examples

References/Books:

1. Computer programming in C, V. Rajaraman, Pearson Education, 2nd edition,2003.
2. The C programming language, Dennis Ritchie, Pearson Education, 2nd edition,2003.
3. Graphics programming in C, Roger T. Stevens, BPB Publications.
4. Java: A Beginner's Guide, Eighth Edition ,HerbertSchildt, McGraw-Hill Education.
5. Java - The Complete Reference**,** Herbert Schildt 11th Edition, McGraw Hill Education
6. Programming in C, Stephen G. Kochan. CBS.

Mapping of Program Outcomes with Course Outcomes

Course Outcome	Program Outcome								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	1	2	1	2	-	-	3
CO2	3	3	1	2	1	2	-	-	3
CO3	3	3	1	2	1	2	-	-	3
CO4	3	3	1	2	1	2	-	-	3
CO5	3	3	1	2	1	2	-	-	3
CO6	3	3	1	2	1	2	-	-	3
CO7	3	3	1	2	2	2	-	-	3

Justification for mapping

PO1: Disciplinary Knowledge:
CO1,CO2, CO5: Establishing a foundational skill set in computer programming principles, essential for a comprehensive understanding of the discipline.
CO3: Integrating principles from computer science into the broader context of visual communication and multimedia, fostering a more comprehensive understanding of the field.
CO4: Providing a holistic view of different programming languages and their application in software development.
CO6: Emphasizing algorithmic problem-solving skills, a fundamental aspect of computer science, contributing to a deeper understanding of computational processes.
CO7: Enhances disciplinary knowledge by delving into advanced programming concepts and practices, enriching the understanding of low-level programming.

PO2: Critical Thinking and Problem Solving:
CO1,CO2.CO5: Requiring students to solve programming challenges, enhancing their problem-solving skills in a computational context.
CO3: Challenging students to solve problems related to visual communication, multimedia, and graphical representation in a programming environment.
CO4: Enhances critical thinking by requiring students to analyze and compare programming languages, fostering a deeper understanding of diverse programming paradigms.
CO6,CO7: Writing C code for algorithms and implementing programs with advanced features such as pointers and arrays requires critical thinking and problem-solving skills, challenging students to design efficient and effective solutions.

PO3: Social competence
CO1,CO2.CO5: Fostering effective communication and collaboration skills in a programming environment.
CO3: Encouraging collaborative work on visual communication projects, emphasizing teamwork and effective communication to achieve shared goals in multimedia programming.
CO4: Promoting collaborative learning experiences, where students can share insights and problem-solving approaches in a social setting.
CO6,CO7: Encouraging collaboration in problem-solving, code development, and the use of pre-processing techniques in a team environment.

PO4: Research-related skills and Scientific temper
CO1,CO2.CO5. Fostering a systematic and analytical approach to programming challenges, contributing to a scientific temper in problem-solving.
CO3: Promoting inquiry into visual communication methods, multimedia programming techniques, and scientific inquiry into effective graphical representation.
CO4: Cultivate research-related skills by encouraging systematic analysis and comparison of programming languages, fostering a scientific approach to software development.
CO6,CO7: Necessitating a structured and investigative approach to programming challenges, fostering a scientific temper in problem-solving.

PO5: Trans-disciplinary knowledge

CO1,CO2.CO5: Providing foundational programming skills that can be applied across various domains and disciplines.
CO3: Integrating principles from computer science into the broader context of visual communication, multimedia, and graphical representation, fostering a more comprehensive understanding that spans multiple disciplines.
CO4: Exposing students to different programming paradigms and languages, enhancing their adaptability and versatility in various technological contexts.
CO6,CO7: Providing skills that can be applied in diverse programming scenarios and technological contexts, fostering adaptability and versatility.

PO6: Personal and professional competence:
CO1,CO2.CO5: Acquiring a basic understanding of C and engaging in activities such as program development and execution analysis contribute to personal and professional competence by building foundational programming skills essential for a successful career in the field.
CO3: Providing skills in visual communication and multimedia programming, making individuals more versatile and competent in the professional landscape.
CO4: Providing a broad skill set, making individuals adaptable to different programming languages and environments.
CO6,CO7: Equipping individuals with versatile programming skills, enhancing their capability to address complex computational challenges.

PO9: Self-directed and Life-long learning

CO1,CO2.CO5: Encouraging students to explore programming independently, setting the foundation for lifelong learning in the rapidly evolving field of software development.
CO3: Understanding graphics programming promotes self-directed learning as students delve into multimedia programming, encouraging ongoing exploration of graphical representation techniques and applications throughout their professional journey.
CO4: Cultivates self-directed learning by fostering adaptability and a lifelong commitment to acquiring new programming languages and paradigms.
CO6,CO7: Writing C code for algorithms and implementing programs with advanced features involves self-directed learning as students explore complex programming concepts, encouraging ongoing skill development and a commitment to lifelong learning in programming.

CBCS Syllabus as per NEP 2020 for M.Sc. I (2023 Pattern)

Name of the Programme : M.Sc. Electronics

Programme Code : **PSEL**

Class : M.Sc. I

Semester : I

Course Type **Research Methodology (RM)** (Theory)

Course Code : ELE-521-RM

Course Title : Research Methodology

No. of Credits : 04

No. of Teaching Hours : 60

Course Objectives:

1. To understand basic concepts of Research.
2. To learn different identification and formulation.
3. To understand concept of research design.
4. To study qualitative and quantitative research concept.
5. To learn data collection technique.
6. To understand Report writing concept.
7. To understand IPR and Patent law.

Course Outcomes:

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

CO1. Students who complete this course will be able to understand and comprehend the basics in research methodology and applying them in research/ project work.
CO2. This course will help them to select an appropriate research design.
CO3. The Students will develop skills in qualitative and quantitative data analysis and presentation.
CO4. The course will also enable them to collect the data, edit it properly and analyse it accordingly. Thus, it will facilitate students' prosperity in higher education.
CO5. Students will be able to demonstrate the ability to choose methods appropriate to research objectives.
CO6. Plan a research proposal and design the research.
CO7. Understand research problem and design before initiating stage.
CO8. Comprehend and perform quantitative and qualitative data analysis.
CO9. Write research report by bearing in mind right Ethics.

Topics and Learning Points

Unit-1 **15L**

Foundation of Research: Meaning, Objectives, Motivation, Utility. Types of research: exploratory, descriptive and experimental; Significance and characteristics of research; Criteria of good research, 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 **15L**

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

Unit-3 **10L**

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

Unit-4 **(10L)**

Data collection: data, types of data, methods, sample and population, sampling techniques, characteristics of a good sample; Tools of data collection: observation method, interview, questionnaire, various rating scales, characteristics of good research tools.
Data analysis: Univariate analysis: frequency tables, bar charts, pie charts, percentages; Bivariate analysis: cross tabulations and Chi-square test.

Unit-5 **(15L)**

Research writing: Report: definition, importance, types; Research paper writing: methods & style; Seminar & conference paper writing; Synopsis writing: methods; Thesis/Project writing: structure & importance; 7 Cs of effective research writing: concreteness, completeness, clarity, conciseness, courtesy, correctness, consideration.
Research evaluation methods; Index: h-index, I-index; Plagiarism: significance and effects, citation and acknowledgement; Intellectual property right: copyright, royalty, patent law; Research ethics.

Reference Books:

1. Kothari, C. R., 2004. Research Methodology: Methods and Techniques. New Age International.
2. Research Methodology: An Introduction - Stuart Melville and Wayne, 2014. 2nd ed edition, Juta Academic.
3. Practical Research Methods - Catherine Dawson, 2002.
4. Sinha, S. C. and Dhiman, A. K., 2002. Research Methodology, Ess Publications.
5. Garg, B. L., Karadia, R., Agarwal, F. and Agarwal, U. K., 2002. An introduction to Research Methodology, RBSA Publishers.
6. Trochim, W. M. K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing.
7. Wadehra, B. L. 2000. Law relating to patents, trademarks, copyright designs and geographical indications. Universal Law Publishing.
8. Select references from the Internet

Mapping of Program Outcomes with Course Outcomes

Justification for mapping

Course Outcome	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	3	3	2	1	2	1	1
CO2	2	1	1	1	3	-	1	-	-
CO3	-	3	-	2	-	1	-	-	-
CO4	-	-	-	2	-	-	2	-	-
CO5	1	1	-	3	-	-	-	-	-
CO6	-	-	-	1	2	-	-	-	-
CO7	2	1	-	-	-	-	-	-	-

PO1: Disciplinary Knowledge:

CO1: Understanding and applying basics in research methodology and selecting appropriate research design.

C02: are fundamental components of disciplinary knowledge.

CO5 and C07: also contribute to this outcome by emphasizing the choice of methods and understanding research problems in the discipline.

PO2: Critical Thinking and Problem Solving

CO1: Understanding and applying basics in research methodology and analysis appropriate research design.

C02: The ability to select an appropriate research design and choose methods appropriate to research objectives.

CO3:Developing skills in qualitative and quantitative data analysis.

Co5: reflects problem analysis skills. Understanding research problems and designing methodologies

CO7: directly align with the design and development aspect of the Problem analysis.

PO3: Social competence

CO1: Understanding and applying basics in research methodology and design and development of appropriate Social competence

C02: The ability to select an appropriate research design and choose methods appropriate to Social competence

PO4: Research-related skills and Scientific temper :

CO1: Understanding basics in research methodology and research related skills.

C02: The ability to select an appropriate research design and choose methods appropriate Research-related skills**.**

CO3:Developing skills in qualitative and quantitative data analysis.

CO4:The ability to collect, edit, and analyze research related skill data.

Co5: reflects problem analysis skills.

CO6: planning and designing a research proposal.

P05: Trans-disciplinary knowledge

CO1: Understanding basics in research methodology and there Trans-disciplinary knowledge.

C02: The ability to select an appropriate research design and different tools for Trans-disciplinary knowledge.

CO6: planning and designing a research proposal and use of tools for Trans-disciplinary knowledge.

P06: Personal and Professional Competence

CO1: applying basics in research methodology and use for Professional Competence

CO3:Developing skills in qualitative and quantitative data analysis for Professional Competence

P07: Effective Citizenship and Ethics

CO1: Understanding basics in research methodology and Ethics

CO2: The ability to select an appropriate research design and choose methods appropriate to Effective Citizenship and Ethics

CO4:The ability to collect, edit, and analyze for Effective Citizenship and Ethics

PO8: Environment and Sustainability:

CO1: Understanding and applying basics in research methodology and design and development of appropriate research design for Environment and Sustainability

PO9: Self-directed and Life-long learning:

C01: collectively contribute to a holistic understanding of research methodology and a foundation for Self-directed and Life-long learning