Anekant Education Society's

Tuljaram Chaturchand College, Baramati

(Autonomous)

Four Year B. Sc. Degree Program in Electronics

(Faculty of Science & Technology)

CBCS Syllabus

T.Y.B. Sc. (Electronics) Semester -VI

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 2025-2026

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Course & Credit Structure for T. Y. B. Sc. Electronics
(2023 Pattern as per NEP-2020)

Sem	Course Type	Course Code	Course Title	Theory/ Practical	Credits
V	Major Mandatory	ELE-301-MJM	Digital Logic Design with Verilog HDL	Theory	02
	Major Mandatory	ELE-302-MJM	8051 Microcontroller	Theory	02
	Major Mandatory	ELE-303-MJM	Analog Circuit Design and Applications	Theory	02
	Major Mandatory	ELE-304-MJM	Foundation of Semiconductor Devices	Theory	02
	Major Mandatory	ELE-305-MJM	Hardware Practicals	Practical	02
	Major Elective (MJE)	ELE-306MJE(A)	JAVA Progamming	Theory (Any two)	04
	Major Elective (MJE)	ELE-306-MJE(B)	Optical Fiber Communication		
	Major Elective (MJE)	ELE-306-MJE(C)	Single Board Computers		
	Minor	ELE-311-MN	Progamming in C	Theory	02
	Minor	ELE-312-MN	C Program Practicals	Practical	02
	Vocational Skill Course (VSC)	ELE-321-VSC	Software Practicals	Practical	02
	Field Project(FP)	ELE-335-FP	Field Project(FP)	Practical	02
	Total Credits Semester-V				**22**
VI	Major Mandatory	ELE-351-MJM	Advanced Communication Techniques	Theory	02
	Major Mandatory	ELE-352-MJM	Embedded System Design	Theory	02
	Major Mandatory	ELE-353-MJM	Power Electronics	Theory	02
	Major Mandatory	ELE-354-MJM	Nano Electronics	Theory	02
	Major Mandatory	ELE-355-MJM	Ele. Practical 4	Practical	02
	Major Elective(MJE)	ELE-356MJE(A)	MATLAB and Simulink for Electronics	Theory (Any two)	04
	Major Elective(MJE)	ELE-356-MJE(B)	Electronic Instrumentation		
	Major Elective(MJE)	ELE-356-MJE(C)	Electric Vehicals		
	Minor	ELE-361-MN	Advanced C Programming	Theory	02
	Minor	ELE-362-MN	Advanced C Lab	Practical	02
	On Job Training(OJT)	ELE-385-OJT	On Job Training(OJT)	Practical	04
	Total Credits Semester-VI				**22**
			Total Credits Semester-V+ VI		**44**

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CBCS Syllabus as per NEP 2020 for T. Y. B. Sc. Electronics (SEM V) (2023Pattern)

Name of the Programme: B.Sc. Electronics

Programme Code : USEL

Class: T. Y. B.Sc.

Semester: VI

Course Type: Major Mandatory (Theory)

Course Code :ELE-351-MJM

Course Title : Advanced Communication Techniques

No. of Credits: 02

No. of Teaching Hours: 30

Course Objectives:

1. To learn types of antenna
2. Study the wave propagation methods.
3. To learn modulation and demodulation system.
4. To study transmitter and receiver section in communication systems
5. To understand the advanced communication system.
6. To study basic digital communication system.
7. To learn concept of MODEM.

Course Outcomes:

CO1. To understand the fundamentals of antennas and wave propagation.
CO2. To study the principles and techniques of signal modulation and demodulation.
CO3. To know the working principle modulation and demodulation
CO4. Student will be able to learn transmitter and receiver.
CO5. Student will be able to learn advanced communication technologies.
CO6. They will be able to understand various aspects of mobile communication
CO7. Student will be able to learn digital communication technologies

Topics

Unit 1: Antenna [08]

Antenna**:** Basic consideration Parameters of Antenna, EM waves, Resonant Antenna- Radiation patterns & length considerations, Non-Resonant antenna, UHF & Microwave antenna, Wide-band & special purpose Antennas, Monopole for MF and HF Applications. Parabolic Dish Antennas, Patch Antenna. Propagation of Waves: Ground (Surface waves), sky wave and space wave propagation.

Unit 2: Transmitter & Receiver [12]

Concept of modulation and need for modulation, Comparison of AM, FM and PM. Balanced Modulator- Using diodes & FETs, SSBSC- Filter Method, Phase shift method (third method), Synchronous Demodulation, Product Demodulator, Phase modulation & demodulation using PLL, AM transmitters and FM Transmitters: Block diagram, AM Receiver: Tuned Radio Frequency Receiver, Superheterodyne Receiver, FM Receiver.

Unit 3: Digital Communication **[10]**

Block diagram- Digital Communication System, Pulse modulation, Pulse code modulation, Differential Pulse Code Modulation, Delta modulation, Adaptive delta modulation, Mobile receiver block diagram, Amplitude Shift Keying, Frequency Shift Keying, Binary Phase Shift Keying, Block diagram of MODEM.

Recommended Books:

1. Electronic Communication By Dennis Roddy & John Coolean, Pearson Education
2. Principles of Communication Systems By Taub Schilling, McGraw Hill.
3. Antenna Theory: Design & Analysis By Balanis, Wiley Eastern
4. Electronic Communication systems By Kennedy & Davis, Tata McGraw Hill
5. Antennas and Wave Propagation By: Harish, A.R.; Sachidananda, M.
6. Electronic Communication Systems Fundamentals through advanced, Wayne Tomasi, Pearson Education Press

Mapping of Program Outcomes with Course Outcomes

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

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	2	1	2	2	1	1	2	2	1	1	2	1
CO2	3	3	1	2	3	1	1	2	2	1	1	2	1
CO3	3	3	1	2	3	1	1	2	2	1	1	2	1
CO4	2	3	1	3	3	2	1	2	3	1	1	2	1
CO5	3	3	2	3	3	1	1	3	3	2	1	3	1
CO6	3	3	2	3	3	2	2	3	3	2	1	3	2
CO7	3	3	2	3	3	2	2	3	3	1	1	3	2

Mapping Justification:

PO1 – Comprehensive Knowledge and Understanding

This outcome is achieved through CO1 to CO7. Students gain a solid understanding of antenna fundamentals, modulation techniques, transmitters, receivers, and both analog and digital communication systems. They acquire comprehensive theoretical and conceptual knowledge necessary for building a foundation in communication engineering.

PO2 – Practical, Professional, and Procedural Knowledge

This outcome is supported mainly by CO2, CO3, CO4, and CO7. Through the study of various modulation and demodulation methods, and the working principles of transmitters and receivers, students develop hands-on and procedural knowledge applicable in professional communication system design and testing.

PO3 – Entrepreneurial Mindset and Knowledge

CO5, CO6, and CO7 contribute to this outcome by exposing students to advanced and emerging communication technologies such as digital and mobile communication systems. This knowledge encourages innovation, creativity, and an entrepreneurial mindset for developing new communication-based products and solutions.

PO4 – Specialized Skills and Competencies

This outcome is achieved through CO4, CO5, and CO7. Students learn specialized technical skills related to transmitter and receiver design, advanced antenna technologies, and digital communication systems. These competencies enable them to handle complex communication engineering tasks and system-level design challenges.

PO5 – Capacity for Application, Problem-Solving, and Analytical Reasoning
CO2 to CO7 strongly support this outcome. Students apply analytical reasoning to understand and compare various modulation techniques, solve practical communication problems, and evaluate the performance of analog and digital systems using theoretical and experimental methods.

PO6 – Communication Skills and Collaboration
Through CO4, CO6, and CO7, students improve their ability to communicate technical concepts effectively. Laboratory experiments, report writing, and group activities promote teamwork, collaboration, and technical documentation skills necessary for engineering practice.

PO7 – Research-related Skills
This outcome is linked with CO5, CO6, and CO7. Students are encouraged to explore recent trends and research areas in communication systems, such as mobile and digital technologies, which develops their investigative and research-oriented thinking.

PO8 – Learning How to Learn Skills
All CO1 to CO7 contribute to this outcome. Communication technology evolves rapidly, requiring students to continuously learn and adapt to new concepts, tools, and systems. The syllabus helps develop a habit of self-learning and continuous professional development.

PO9 – Digital and Technological Skills
Primarily achieved through CO4, CO5, CO6, and CO7, this outcome involves using simulation tools (such as MATLAB or Multisim), digital testing instruments, and communication software, enabling students to apply modern digital techniques to design and analyze communication systems.

PO10 – Multicultural Competence, Inclusive Spirit, and Empathy
This outcome is moderately supported by CO5 and CO6. By studying global communication systems like mobile and satellite communication, students gain awareness of international standards, cross-cultural technological needs, and inclusive communication solutions.

PO11 – Value Inculcation and Environmental Awareness
CO5 and CO6 address this outcome by creating awareness about responsible use of communication devices, power efficiency, and environmental impacts of electronic waste, promoting ethical and sustainable engineering practices.

PO12 – Autonomy, Responsibility, and Accountability
Through CO4 to CO7, students learn to work independently in laboratory and project environments. They become responsible for experimental accuracy, report preparation, and performance evaluation, fostering accountability and self-reliance.

PO13 – Community Engagement and Service
CO5, CO6, and CO7 relate to this outcome as students understand how communication systems contribute to societal development — such as improving rural connectivity, mobile communication access, and digital literacy — thereby fostering community engagement through technology.

CBCS Syllabus as per NEP 2020 for T. Y. B. Sc. Electronics (SEM VI) (2023 Pattern)

Name of the Programme: B.Sc. Electronics

Programme Code: USEL

Class: T. Y. B. Sc.

Semester: VI

Course Type: Minor (Theory)

Course Code: **ELE-352-MJM**

Course Title: **Embedded System Design**

No. of Credits: 02

No. of Teaching Hours: 30

Course Objectives:

1. To introduce basic blocks of embedded systems.
2. Use "C" language for programming the microcontrollers
3. Learn to use Timers, Interrupts and Serial Communication in Microcontroller.
4. Apply skills to conduct interfacing microcontroller boards to various peripherals.
5. Apply the knowledge in real world applications using embedded C.
6. Understand programming basics of python programming language.
7. Write code/program using open-source programming language (Arduino) for basic identified applications.

Course Outcomes:

CO1. Acquire a basic knowledge about fundamentals of microcontrollers

CO2. Acquire a basic knowledge about programming and system control to perform a specific task.

CO3. Acquire knowledge about devices and buses used in embedded networking

CO4. Develop programming skills in embedded systems for various applications.

CO5. Knowledge of various SBCs in the market and their comparison.

CO6. Familiar to Arduino microcontroller board.

CO7. Learn Arduino IDE and python programming.

Unit 1: Embedded systems **(10)**

Introduction to the concept of Embedded Systems, Introduction to PIC and AVR Microcontrollers, Embedded C programming of LED interfacing, 7-segment interfacing, LCD interfacing using 8051 microcontroller, ADC and DAC interfacing using 8051C, Temperature monitoring system using 8051C.

Unit II: Single Board Computers (SBC) in Embedded System (10)

SBC block diagram, Comparison of SBC models, Arduino Microcontroller Board: Introduction to Arduino, Microcontroller used in Arduino, Pin configuration and architecture, concept of digital and analog ports, Arduino programming: Introduction to Arduino IDE, variables and data types, Comparison operators (arithmetic, logical, relational, modulo, assignment), Statements: if-else statements, switch statement control structures: while and for loop, Writing Arduino Programs: LED blinking, push button, serial port communication, Function blocks: analogRead(), digitalRead() functions, Intensity control of LED with Pulse Width Modulation (PWM) using analogWrite().

Unit III: Introduction to Python (10)

Basic Python programming (script programming) : variable and data types, flow control structures, conditional statements (if__ then___ else), Functions: I/O functions (GPIO, digital), Time functions, Library functions, basic arithmetic programs: Addition, Subtraction, Multiplication, Division.

Table of Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3							3					
CO2	3			3					3				
CO3		3		3	3		3		3		2		
CO4		3			3	3				2	2	3	2
CO5			3				2				2		
CO6								2		2			2
CO7					3	3			3	2		3	2

Justification of Mapping

PO1: Comprehensive Knowledge and Understanding:

CO1: Understanding microcontroller fundamentals is essential to comprehensive knowledge in embedded systems.

CO2: Programming and system control directly demonstrate application of core microcontroller concepts.

PO2: Practical, Professional, and Procedural Knowledge:

CO2: Programming and system control are key professional and procedural skills.

CO3: Knowledge of devices and buses is directly applicable in practical embedded networking tasks.

PO3: Entrepreneurial Mindset and Knowledge:

CO5: Knowledge of SBCs in the market and comparison encourages product awareness, a key entrepreneurial skill.

PO4: Specialized Skills and Competencies:

CO2: Programming and system control directly build specialized competencies.

CO3: Knowledge of devices and buses is critical for embedded system specialization.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning:

CO3: Knowledge of devices and buses enables analytical reasoning in embedded networking tasks.

CO4: Developing programming skills directly enhances problem-solving and application capability.

CO7: Learning Arduino IDE and Python involves applying skills to solve programming and system control problems.

PO6: Communication Skills and Collaboration:

CO4: Developing programming skills often requires teamwork, code sharing, and collaboration.

CO7: Learning Arduino IDE and Python often involves collaborative coding, sharing, and communication.

PO7: Research-related Skills:

CO3: Knowledge of devices and buses is essential for research in embedded networking systems.

CO5: Comparing SBCs informs research decisions and experimental setups.

PO8: Learning How to Learn Skills:

CO1: Learning the fundamentals of microcontrollers builds self-directed learning skills in the embedded domain.

CO6: Familiarity with Arduino allows experiential learning, though limited in scope.

PO9: Digital and Technological Skills:

CO2: Programming and system control are core digital and technological skills.

CO3: Knowledge of devices and buses directly enhances embedded networking skills.

CO7: Learning Arduino IDE and Python is a direct enhancement of digital and technological capabilities.

PO10: Multicultural Competence, Inclusive Spirit, and Empathy:

CO4: Collaborative programming in projects could indirectly foster teamwork and inclusivity.

CO6: Working with Arduino in group settings can slightly enhance collaborative skills.

CO7: Learning Python/IDE in a team-based or open-source environment can help develop inclusive collaboration skills.

PO11: Value Inculcation and Environmental Awareness:

CO3: Knowledge of devices and buses can support environmentally conscious design choices in networking.

CO4: Developing programming skills can be applied in projects promoting ethical or sustainable solutions.

CO5: Comparing SBCs can lead to informed, energy-efficient, or eco-friendly hardware selection.

PO12: Autonomy, Responsibility, and Accountability:

CO4: Developing programming skills in embedded systems requires independent work and responsibility.

CO7: Learning Arduino IDE and Python independently reflect autonomy and accountability in self-directed learning.

PO13: Community Engagement and Service:

CO4: Programming skills can support community projects or outreach initiatives.

CO6: Familiarity with Arduino can enable hands-on workshops or educational outreach.

CO7: Learning Arduino IDE and Python can help in teaching or community tech projects.

CBCS Syllabus as per NEP 2020 for T. Y. B.Sc. Electronics (SEM VI) (2023 Pattern)

Name of the Program : B.Sc. Electronics
Program Code :USEL
Class : T. Y. B.Sc.
Semester : VI
Course Type : Major Mandatory (Theory)
Course Code : ELE-353- MJM
Course Title : Power Electronics
No. of Credits : 02
No. of Teaching Hours : 30

Course Objectives

1. To introduce the fundamental concepts and importance of power electronics in modern applications.
2. To understand the classification and operation of various power semiconductor devices.
3. To study the ideal and practical characteristics of power devices used as electronic switches.
4. To analyze the construction, working, and switching characteristics of power diodes, BJTs, MOSFETs, and thyristors.
5. To develop the ability to design and analyze basic power electronic circuits such as rectifiers, filters, and converters.
6. To gain knowledge about AC voltage controllers, choppers, inverters, and their performance parameters.
7. To understand the working principle and applications of Uninterrupted Power Supply (UPS) systems.

Course Outcomes

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

CO1: Define power electronics and explain its scope and applications in various fields.
CO2: Classify different power semiconductor devices and compare their characteristics.
CO3: Interpret the switching behavior and power losses in practical power devices.
CO4: Explain the construction and operation of power diodes, BJTs, MOSFETs, and thyristors with their protection methods.
CO5: Analyze and design rectifier and filter circuits for converting AC to DC with desired performance.
CO6: Describe the principles of controlled rectifiers, AC voltage controllers, choppers, and inverters used in power conversion systems.
CO7: Demonstrate understanding of UPS operation and evaluate its role in providing continuous power supply.

Topics and Learning Points

Unit 1: Introduction [6 L]
Definition of power electronics, Applications of power electronics, classification of power semiconductor devices, ideal and practical characteristics of power devices as a switch, switching power losses, types of Power circuits, Concept of single phase and three phase using phasors.

Unit 2: Power Devices [10 L]

Power Diode (P-i-N): construction, Reverse recovery characteristics,
Power BJT, power MOSFET: Steady state and Switching Characteristics.
Thyristors: Types of Thyristors, SCR characteristics, Two transistor static and transient model, turn-on methods, turn-off characteristics, dv/dt and di/dt protection.

Unit 3: Power Circuits [14 L]

Rectifiers: Performance parameters, Half wave, Full wave centre tapped and bridge rectifier,
DC Filters: concept of C, L and LC filters.
Controlled rectifiers: Principle, Semi, Full and Dual Converters.
AC voltage controllers: on-off control, Phase angle control, Bi-directional control with Resistive load,transformer tap changer, Cycloconverter.
Choppers: Step-up, Step-down, concepts of choppers operating in various quadrants
Inverters: Performance parameters, principle, Half Bridge and full Bridge inverter.
Uninterrupted power supply (UPS).

Reference Books :

1. M.H. Rashid Power electronics: Circuits, Devices and Applications, third Edition (2004) Pearson Education.
2. Ned Mohan, undeland, Robbins Power Electronics, Third Edition (2006) John Wiley & Sons.
3. O.P. Arora Power electronics Laboratory: theory , Practice & Organization Narosa Publishing house (2007).
4. P.C. Sen Power Electronics Tata McGraw Hill, (1998).

Mapping Table:

Course Outcomes	Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	2	2	2	2	1	1	2	3	-	2	1	-
CO2	3	3	1	3	2	1	1	3	2	-	1	2	-
CO3	3	3	1	3	3	1	3	2	2	-	1	2	-
CO4	3	3	1	3	3	1	2	2	3	-	1	3	-
CO5	3	3	1	3	3	2	2	2	3	-	2	3	-
CO6	3	3	2	3	3	1	2	3	3	-	2	2	-
CO7	3	2	2	2	3	2	1	2	3	3	2	3	2

Justification For The Mapping:-

PO1: Comprehensive Knowledge and Understanding

CO1–CO7: Students gain thorough knowledge of power electronics principles, device operation, rectifiers, inverters, and UPS systems. They understand theoretical concepts of semiconductor devices and their applications in energy conversion. This foundational understanding supports both analytical and practical learning in subsequent topics.

PO2: Practical, Professional and Procedural Knowledge

CO2, CO4, CO5, CO6: Learners develop hands-on skills in designing and testing circuits, implementing device protection, and handling controlled converters. They follow professional procedures in analyzing semiconductor devices and designing rectifier and inverter circuits. This ensures competence in real-world laboratory and industrial scenarios.

PO3: Entrepreneurial Mindset and Knowledge

CO1, CO6, CO7: Students learn real-world applications such as UPS, renewable energy, and power controllers, encouraging innovative thinking. They develop entrepreneurial insight into creating solutions and products in power electronics and energy management.

PO4: Specialized Skills and Competencies

CO3, CO4, CO5, CO6: Students acquire specialized skills in analyzing switching behavior, implementing protection strategies, and designing complex power circuits. This develops competency in both theoretical and applied aspects of modern power electronics systems.

PO5: Capacity for Application, Problem-Solving and Analytical Reasoning

CO3, CO4, CO5, CO6: Students evaluate power losses, optimize circuit designs, and troubleshoot devices, enhancing problem-solving abilities. They integrate theoretical concepts with practical applications to find efficient solutions to real-world power electronics problems.

PO6: Communication Skills and Collaboration

CO5, CO7: Students communicate technical ideas clearly and document their designs effectively. Team-based projects, such as UPS design or rectifier circuits, foster collaboration and presentation skills.

PO7: Research-related Skills

CO3, CO4, CO6: Students investigate device switching behavior, power losses, and system performance analytically. They develop skills to evaluate and optimize circuits systematically, fostering research-oriented learning.

PO8: Learning How to Learn Skills

CO2, CO6, CO7: Students develop independent learning skills through exploring new devices, controllers, and UPS systems. They learn to adapt to emerging technologies and acquire knowledge beyond the syllabus.

PO9: Digital and Technological Skills

CO1, CO2, CO4, CO5, CO6, CO7: Students develop competence in using simulation tools, digital controls, and data acquisition systems for power electronics. They gain technological fluency in designing, analyzing, and optimizing circuits and converters.

PO10: Community Engagement and Service

CO7: Students understand the role of UPS systems and continuous power supply in critical community applications. This awareness connects technical knowledge to societal and infrastructure needs.

PO11: Value Inculcation and Environmental Awareness

CO1, CO5, CO6: Students learn energy-efficient designs and ethical practices in power electronics. They appreciate environmental impacts of power conversion and focus on sustainable engineering practices.

PO12: Autonomy, Responsibility and Accountability

CO4, CO5, CO7: Students take responsibility for device handling, circuit design, and UPS evaluation. Independent project work fosters accountability and self-reliance in professional tasks.

PO13: Multicultural Competence, Inclusive Spirit and Empathy

CO7: Students collaborate on projects in diverse teams, respecting inclusive perspectives. They develop empathy and an inclusive approach to solving practical engineering problems.

CBCS Syllabus as per NEP 2020 for T. Y. B.Sc. Electronics (SEM VI) (2023 Pattern)

Name of the Programme : B.Sc. Electronics

Programme Code : USEL

Class : T. Y. B.Sc.

Semester : VI

Course Type : Major Mandatory (Theory)

Course Code : ELE-354-MJM

Course Title : Nano Electronics

No. of Credits : 02

No. of Teaching Hours : 30

Course Objectives:

1. To understand the fundamental principles of electromagnetics, including the motion of charged particles in electromagnetic fields and the Hall effect.

2. To explore Maxwell's equations and their applications in deriving the wave equation for electric and magnetic fields.

3. To introduce the key concepts of quantum mechanics, including wave-particle duality, the Schrödinger wave equation, and quantum behavior in confined systems like potential wells.

4. To understand various statistical models, including Fermi-Dirac, Bose-Einstein, and Maxwell-Boltzmann distributions, and their relevance to the behavior of electrons in solids and nanostructures.

5. To study the importance of nanoelectronics and the methods used in nanofabrication, such as top-down and bottom-up approaches, and lithography techniques.

6. To gain insights into advanced nanostructure devices like resonant-tunneling diodes, quantum wells, quantum wires, and their applications in nanoelectronics.

7. To connect the theoretical aspects of electromagnetics, quantum mechanics, and statistical mechanics with the practical applications in nanoelectronic devices and technologies.

Course Outcomes:

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

CO1. Students will be able to understand the motion of charged particles in electromagnetic fields, calculate cyclotron frequency, and explain the Hall effect.

CO2. Students will be able to apply Maxwell's equations to derive wave equations for electric and magnetic fields, and use the Poynting vector theorem to analyze energy flow in electromagnetic systems.

CO3. Students will be able to comprehend quantum mechanical concepts like wave-particle duality, the Schrödinger equation, and the behavior of particles in confined quantum systems such as potential wells.

CO4. Students will be able to describe different statistical distributions (Fermi-Dirac, Bose-Einstein, Maxwell-Boltzmann) and their applications in modeling electron behavior in solids and nanostructures.

CO5. Students will be able to explain the significance of nanoelectronics and differentiate between the top-down and bottom-up approaches used in the fabrication of nanoscale devices.

CO6. Students will be able to analyze and describe the operation of advanced nanostructure devices, including resonant-tunneling diodes, quantum wells, quantum wires, and quantum dots.

CO7. Students will be able to relate theoretical principles from electromagnetics, quantum mechanics, and statistical mechanics to the design and analysis of nanoelectronic devices and applications

Unit 1: Essential Electromagnetics

Lorentz force-Motion of charged particle in E-M fields, cyclotron frequency, Hall effect, Maxwell's equations, Equation of continuity, Poynting vector theorem, Wave equation for E and H, Skin depth, Polarization of Electromagnetic (or light) Wave.

Unit 2: Quantum mechanics

Particles and Waves: Classical particles, Light as wave and particle, de-Broglie wavelength,Wave particle duality and Uncertainty principle, Wave mechanics: The Schrödinger wave equation, wave mechanics of particles, Infinite potential well.

Unit 3:Statistical Mechanics

Classical statistics, Gaussian distribution, Poisson distribution, Fermi-Dirac, Bose Einstein, Maxwell Boltzmann statistics, Statistical Mechanics and Applications,Time and length scales of the electrons in solids, statistics of electrons in solids and nanostructures, Density of states of electrons, electron transport.

Unit 4: Nanotechnology

Importance of nanoelectronics, Top down approach, Bottom up approach, Lithography, Nanostructure devices like resonant- tunneling diode, electrons in quantum wells, electrons in quantum wire, Quantum dot applications.

Recommended Books:

1. George W. Hanson "Fundamentals of nanoelectronics", LPE, Pearson Education

V. Mitin ,Viatcheslav A. Kochelap , Michael A. Stroscio Vladimir

2. "Introduction to Nano electronics Science ,nanotechnology , Engineering and

Applications"Cambridge University Press 2008

3. Ben G. Streetman ,Sanjaykumar Banerjee "Solid State Electronic Devices ", 6th Edition

4. Kraus and Fleisch "Electromagnetics with applications" McGraw Hill, 5th edition

5. Electromagnetics by B.B. Laud, Wiley Edition

6. Donald A.Neaman, “Semiconductor Physics and devices” 3rd edition TMH

Mapping of Program Outcomes with Course Outcomes

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	**3**	**2**	-	**2**	**2**	-	-	-	-	-	-	-	-
CO2	**3**	**3**	-	-	**2**	-	**2**	-	-	-	-	-	-
CO3	**3**	**2**	-	**2**	**3**	-	**1**	-	-	-	-	3	-
CO4	**3**	-	-	**3**	**3**	-	-	-	-	-	-	-	-
CO5	**3**	**3**	-	-	**3**	-	-	-	**1**	-	3	-	-
CO6	**3**	**3**	-	**3**	**3**	-	-	-	**1**	-	2	2	-
CO7	**3**	**3**	-	**3**	**3**	-	**1**	-	**1**	-	-	7	-

PO1: Comprehensive Knowledge and Understanding
CO1: Builds a strong conceptual understanding of electromagnetic theory and charged particle motion.
CO2: Strengthens theoretical understanding of Maxwell’s equations and their applications.
CO3: Provides foundational knowledge of quantum mechanics and wave-particle duality.
CO4: Enhances understanding of statistical distributions applied to nanostructures.
CO5: Offers comprehensive knowledge of nanoelectronics and fabrication techniques.
CO6: Provides conceptual understanding of nanostructure devices and their operations.
CO7: Integrates theoretical principles across electromagnetics, quantum, and statistical mechanics.

PO2: Practical, Professional, and Procedural Knowledge
CO1: Applies electromagnetic concepts to real-world and laboratory problems.
CO2: Strengthens procedural understanding of electromagnetic wave applications.
CO3: Applies quantum mechanical concepts to nanostructure behavior.
CO5: Provides knowledge of fabrication techniques used in modern nanotechnology.
CO6: Enables students to analyze nanodevice functioning using practical approaches.
CO7: Builds a professional understanding of the relationship between theory and device behavior.

PO4: Specialized Skills and Competencies
CO1: Develops specialized skills in analyzing electromagnetic systems.
CO3: Enhances technical skills in applying quantum principles to nanoscale materials.
CO4: Builds competencies in understanding electron behavior using statistical mechanics.
CO6: Develops analytical skills for studying advanced nanostructure devices.
CO7: Integrates specialized knowledge for nanoelectronic design and applications.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning
CO1: Encourages analytical reasoning in studying electromagnetic particle motion.
CO2: Promotes problem-solving in applying Maxwell's equations to field analysis.
CO3: Enhances reasoning and analytical ability in solving Schrödinger-based problems.
CO4: Builds analytical understanding of statistical models for electron behavior.
CO5: Strengthens application skills in fabrication and nanoengineering techniques.
CO6: Promotes analytical reasoning in understanding operation of nanostructure devices.
CO7: Develops problem-solving capability linking theory with nanoelectronics applications.

PO7: Research-Related Skills
CO2: Encourages exploration of theoretical electromagnetic models for further study.
CO3: Builds research aptitude in quantum mechanics and nanostructure theory.
CO7: Promotes scientific thinking and research orientation in nanoelectronics.

PO9: Digital and Technological Skills
CO5: Builds awareness of advanced fabrication technologies and tools.
CO6: Develops digital skills for simulation and modeling of nanostructure devices.
CO7: Encourages use of technological tools for analysis of nanoelectronic systems.

PO11: Value Inculcation and Environmental Awareness
CO5: Promotes understanding of sustainable and eco-friendly nanofabrication processes.
CO6: Encourages awareness of ethical use of nanotechnology in industry and research.

PO12: Autonomy, Responsibility, and Accountability
CO3: Builds responsibility through precision in theoretical and practical calculations.
CO6: Promotes accountability in accurate analysis of nanodevices.
CO7: Encourages independent thinking and responsible application of nanoelectronics knowledge.

CBCS Syllabus as per NEP 2020 for T. Y. B.Sc. Electronics (SEM VI) (2023 Pattern)

Name of the Programme : B.Sc. Electronics

Programme Code : USEL

Class : T. Y. B.Sc.

Semester : VI

Course Type : Major Mandatory (Practical)

Course Code : ELE-355-MJM

Course Title : Electronics Practical –4

No. of Credits : 02

No. of Teaching Hours : 60

Course Objectives:

1. To study and understand the characteristics of transducers and controllers used in industrial automation systems, such as LVDT and capacitive transducers.

2. To provide hands-on experience in designing and implementing basic circuits such as Wheatstone's bridge for resistive transducers and ON-OFF controllers using microcontrollers or operational amplifiers.

3. To explore advanced communication techniques through practical applications of FM and FSK modulation and demodulation, as well as time-division multiplexing and single-sideband (SSB) generation.

4. To familiarize students with power electronics components like SCR, MOSFET, and IGBT, and their applications in circuits such3 as light dimmers, fan regulators, and PWM-based motor control.

5. To provide practical exposure to the fundamentals of fiber optics, including bending losses, numerical aperture measurements, and fiber optics as sensors.

6. To gain real-world insights into fiber optic communication systems through visits to telecom facilities and learning key processes like splicing, alignment, fusing, and OTDR operations.

7. To engage in activities like industrial visits, hands-on workshops, or open-ended DIY projects to enhance practical knowledge and problem-solving skills in electronics and communication.

Course Outcomes:

CO1. Students will be able to measure and analyze the characteristics of LVDT and capacitive transducers and design ON-OFF controllers for industrial automation systems.

CO2. Students will be able to design and test circuits like Wheatstone's bridge for resistive transducers and implement ON-OFF controllers using microcontrollers or operational amplifiers.

CO3. Students will be able to implement advanced communication systems by designing FM and FSK modulators and demodulators, and SSB generation and demodulation circuits.

CO4. Students will be able to analyze the static characteristics of power electronics devices like SCR, MOSFET, and IGBT, and design circuits such as light dimmers, fan regulators, and PWM motor control systems.

CO5. Students will be able to measure bending loss, calculate numerical aperture, and understand the use of optical fibers in sensor applications through hands-on experiments.

CO6. Students will be able to apply knowledge gained from telecom facility visits, observing and understanding key processes like splicing, fusing, OTDR operations, and fiber optic connectorization.

CO7. Students will be able to enhance their practical skills and industrial exposure through participation in activities like industrial visits, workshops, or by developing and presenting their own open-ended projects.

LABORATORY EXPERIMENTS

(Total 8 Experiments)

Group A: Industrial Automation Systems. (Any two)

1. LVDT Characteristics- Sensitivity measurement.
2. Level measurement using capacitive transducers.
3. Design of Wheatstone's bridge for resistive transducer.
4. ON-OFF controller using microcontroller/op amp.

Group B: Advanced Communication Techniques. (Any two)

1. FM modulator using VCO.
2. FSK modulator and demodulator using XR 2206 and XR2211.
3. Time division multiplexer (IC CD 4051).
4. SSB generation using IC 1496/1596 or equivalent and demodulation.

Group C: Power Electronics (Any two)

1. SCR/MOSFET/IGBT static characteristics.
2. Light Dimmer / fan regulator circuit.
3. PWM based PMDC motor control.
4. Study of SMPS.

Group D: Fiber Optics and fiber optic Communication (Any two)

1. Study of bending loss in fibers.
2. Fiber in sensor application.
3. Measurement of Numerical Aperture.
4. Visit to telecom facility for observing splicing, alignment, fusing, OTDR operation,types of connectors, couplers and cables.

Group E: ACTIVITY (Any one activity will be considered as equivalent to 2 experiments.)

1. Industrial visit.
2. Hands on training Workshop.
3. Do it Yourself Open ended Project

Mapping of Program Outcomes with Course Outcomes

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	2	2	2	2	1	-	-	-	-	2	2	-
CO2	3	3	2	-	2	2	2	-	2	-	-	3	-
CO3	3	2	3	2	3	-	1	-	1	-	-	-	-
CO4	3	2	3	3	3	-	-	-	-	-	-	2	-
CO5	3	3	3	2	3	-	-	-	-	-	3	-	-
CO6	3	3	1	3	3	2	-	-	1	-	-	3	2
CO7	3	3	3	3	3	2	1	-	1	-	3	2	3

PO1: Comprehensive Knowledge and Understanding

CO1: Builds conceptual understanding of industrial automation systems and transducer characteristics.

CO2: Strengthens theoretical and practical knowledge of transducer interfacing and control circuits.

CO3: Enhances conceptual clarity in advanced communication techniques such as FM, FSK, and SSB.

CO4: Reinforces understanding of power electronic device characteristics and their applications.

CO5: Broadens knowledge of fiber optics principles and measurement techniques.

CO6: Provides comprehensive insight into real-world fiber optic communication systems.

CO7: Integrates multidisciplinary concepts through industrial visits, workshops, and projects.

PO2: Practical, Professional, and Procedural Knowledge

CO1: Applies practical methods to analyze and measure sensor and controller behavior.

CO2: Demonstrates professional circuit design and testing skills using microcontrollers and op-amps.

CO3: Acquires procedural knowledge of communication circuit implementation.

CO4: Gains hands-on experience with power electronics circuits such as dimmers and PWM controllers.

CO5: Develops technical expertise in optical fiber measurement and sensor applications.

CO6: Applies procedural knowledge in telecom system operations during field visits.

CO7: Strengthens professional competence through real-life technical and industrial exposure.

PO3: Problem Identification and Analysis

CO1: Identifies measurement errors and calibration needs in transducer systems.

CO2: Analyzes and improves performance of automation and control circuits.

CO3: Recognizes and corrects signal-related issues in modulation and demodulation setups.

CO4: Evaluates and resolves challenges in power electronics circuit performance.

CO5: Identifies optical losses and performance variations in fiber systems.

CO6: Examines real-world issues during telecom operations and suggests improvements.

CO7: Applies analytical reasoning to practical problems in projects and workshops.

PO4: Specialized Skills and Competencies

CO1: Develops skills in interfacing sensors and automation control systems.

CO3: Builds specialized competency in modulation and multiplexing techniques.

CO4: Gains technical mastery in power electronics components and control systems.

CO5: Develops specialized laboratory skills in fiber optics measurements.

CO6: Strengthens understanding of telecom equipment and optical communication analysis.

CO7: Integrates diverse technical skills for industrial and academic applications.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning

CO1: Encourages practical application of theory in automation system design.

CO2: Enhances analytical reasoning through testing and calibration activities.

CO3: Promotes logical thinking in designing communication systems.

CO4: Strengthens analytical skills through study of power electronics systems.

CO5: Encourages application of analytical tools in optical fiber experiments.

CO6: Promotes real-world application of theoretical knowledge in telecom technology.

CO7: Enhances analytical and design-oriented skills through project-based learning.

PO6: Communication Skills and Collaboration

CO1: Builds ability to communicate experimental observations effectively.
CO2: Enhances collaborative work in team-based lab and project setups.
CO6: Improves communication and reporting skills through field interaction.
CO7: Promotes teamwork and technical presentation abilities in open-ended projects.

PO7: Research-Related Skills
CO2: Encourages curiosity and research attitude toward automation and control systems.
CO3: Builds research orientation through practical communication circuit experiments.
CO7: Promotes independent and creative thinking for experimental or innovative projects.

PO9: Digital and Technological Skills
CO2: Develops skills in using digital measuring instruments and software tools.
CO3: Strengthens technological abilities in designing and testing communication modules.
CO6: Promotes understanding of modern fiber optic and telecom technologies.
CO7: Enhances technological proficiency through project design and evaluation.

PO11: Value Inculcation and Environmental Awareness
CO1: Promotes safe and ethical use of sensors and automation tools.
CO5: Encourages responsible handling of optical devices and components.
CO7: Reinforces discipline and ethics during project and industrial work.

PO12: Autonomy, Responsibility, and Accountability
CO1: Develops accountability and precision in executing experiments.
CO2: Promotes responsibility in accurate circuit implementation and observation.
CO4: Fosters safety and discipline while dealing with high-power circuits.
CO6: Encourages independent learning during telecom facility visits.
CO7: Builds responsibility, confidence, and self-directed learning through projects.

PO13: Lifelong Learning and Employability Skills
CO6: Promotes continuous learning through exposure to industrial environments.
CO7: Enhances employability through hands-on experience, workshops, and open-ended innovation.

CBCS Syllabus as per NEP 2020 for T. Y. B.Sc. Electronics (SEM V) (2023 Pattern)

Name of the Program : B.Sc. Electronics
Program Code :USEL
Class : T. Y. B.Sc.
Semester : VI
Course Type : Major Elective (Theory)
Course Code : ELE-356- MJE(A)
Course Title : MATLAB and Simulink for Electronics
No. of Credits : 02
No. of Teaching Hours : 30

Course Objectives

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

CO1: Understand the main features and importance of the MATLAB mathematical programming environment.
CO2: Apply working knowledge of MATLAB package to simulate and solve Electrical, Electronics circuits and Applications.
CO3: Solve, Simulate and Analyse various DC circuits.
CO4: Solve, Simulate and Analyse various AC circuits.
CO5: Solve, Simulate and Analyse various Analog and Digital Electronics circuits.
CO6: Solve, Simulate and Analyse simple Transformer and DC Generator circuits.
CO7: Analyze the generation Various Signals and Sequences in MATLAB, including the operations on Signals and Sequences

Unit-1: Basics of MATLAB **[12]**

MATLAB windows, working in command window, display formats, Built in function, mathematical operations with array, Array-1D, 2D & Script files, 2D & 3D plots. Function and function files, file handling.

MATLAB Programming: -Conditional statement, Switch-case statement, loops, nested loops, break & continue statement.

Unit-2: Laplace Transform and its applications **[10]**

Definition, Laplace transform of simple functions, properties of L.T. (Linearity, shifting, change of scale), Inverse L.T., Partial fraction technique to find inverse L.T.function

Applications: Series RC circuit, RL circuit, RLC circuit for dc input.

MATLAB Exercises**:** 1.To find Laplace Transform and Inverse LT of any given function.
2. Transient analysis of RC / RL/RLC (series) circuit

Unit-3. Mathematical Applications **[08]**

Curve fitting(Straight line, Exponential) and its application to Diode characteristics, Ohm's Law, RC Filter.

Recommended Books:

1. Amos Gilat MATLAB : An introduction with applications Wiley India
2. G K Mittal Network Analysis Khanna Publishers , New Delhi
3. Van Valkenberg Network Analysis, 3rd Edition Dorling Kindersley (India) Pvt Ltd
4. Umesh Sinha Network Analysis and Synthesis Satya Prakashan, Delhi.
5. RudraPratap Getting Started with MATLAB , 7th Edition Oxford University Press, N Delhi
6. Stephen J. Chapman MATLAB Programming For Engineers. Thomas Learning

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

PO1: Disciplinary Knowledge:

CO1: This CO aligns with disciplinary knowledge as it focuses on understanding the main features of MATLAB, which is an essential tool in various engineering disciplines.

PO2: Critical thinking and problem-solving:

CO3: Solving and analyzing DC circuits require critical thinking and problem-solving skills, aligning with the corresponding program outcome.

CO4: Similar to CO3, this CO also aligns with critical thinking and problem-solving skills, specifically in the context of AC circuits.

CO5: The ability to solve, simulate, and analyze analog and digital electronics circuits requires critical thinking and problem-solving skills, aligning with PO2.

CO6: This CO aligns with critical thinking and problem-solving skills, particularly in the context of transformer and DC generator circuits.

PO4: Research-related skills and scientific temper:

CO2: The use of MATLAB for simulation and problem-solving enhances research-related skills and scientific temper by encouraging students to apply a systematic approach in solving electrical and electronics circuit problems.

CO7: Analyzing signal generation and sequences in MATLAB involves research-related skills and encourages self-directed learning, aligning with PO4.

PO9: Self-directed and life-long learning:

CO7: Analyzing signal generation and sequences in MATLAB involves research-related skills and encourages self-directed learning, aligning with PO9.

CBCS Syllabus as per NEP 2020 for T. Y. B.Sc. Electronics (SEM V) (2023 Pattern)

Name of the Program : B.Sc. Electronics
Program Code :USEL
Class : T. Y. B.Sc.
Semester : VI
Course Type : Major Elective (Theory)
Course Code : ELE-356- MJE(B)
Course Title : Electronic Instrumentation
No. of Credits : 02
No. of Teaching Hours : 30

Course Objectives

1. To know about general configuration and different characteristics of instrumentation.
2. To learn working principle and specifications of different sensors.
3. To study different amplifiers.
4. To understand data Acquisition System.
5. To study some standard bridges.
6. To understand the concept of signal conditioning.
7. To learn the different data acquisition systems.

Course Outcomes

CO1: To understand the generalized configuration and performance characteristics of instrumentation systems.
CO2: To study the functional elements, modes of operation, and input-output configurations of instruments and measuring systems.
CO3: To acquire knowledge about various types of sensors and their working principles.
CO4: To understand the design and working of manipulating, computing, and compensating devices used in instrumentation.
CO5: To study and analyze the impact of noise in instrumentation systems and methods for shielding and grounding.
CO6: To learn the concept and design of signal conditioning circuits used for accurate data acquisition.
CO7: To understand the architecture and working of data acquisition systems.

Unit-1: Generalized configuration and performance characteristics of instrumentation system : [15]
Block diagram of an instrumentation system, Performance Characteristics, Functional Elements of an instrument, Analog and Digital Modes of Operation, Null and Deflection Methods, Input Output configuration of Instruments and measuring systems.

Study Of Sensors : Working principle and specification of

i) Thermal sensors: Thermistor, Thermocouple
ii) Optical sensors: Photo detector, Optical encoder
iii) Mechanical sensor: LVDT
iv) Magnetic sensor: Hall effect.

Unit 2 : Manipulating, Computing and Compensating devices [15]

Instrumentation Amplifiers with three op-amps, Transconductance and Transimpedance Amplifiers, Noise Problems, Shielding and Grounding. Study of some standard bridges.
Signal Conditioning and Data Acquisition Systems
Concept of signal conditioning, Generalized Data Acquisition system- Elements of a data acquisition system, Single channel Data Acquisition system, Multichannel Data Acquisition system

Recommended Books:

1. Electrical and Electronic Measurements and Instrumentation,
   A K Sawhney, Dhanpat Rai and Co.2023.
2. C S Rangan, G R Sarma, V S Mani: Instrumentation Devices & Systems, 2nd Edition TMH
3. Ernest O Doebelin, Dhanesh N Manik: Measurement Systems Application and Design ,5th Edition Tata McGraw Hill
4. Joseph J. Carr: Elements of Electronic Instrumentation and Measurement, 3rd Edition, Pearson Education
5. H S Kalsi: Electronic Instrumentation, Second edition, Tata McGraw Hill Pub.

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	2	1	2	3	1	1	2	2	1	1	2	1
CO2	3	3	1	2	3	1	1	2	2	1	1	2	1
CO3	3	3	1	2	3	1	1	2	3	1	1	2	2
CO4	3	3	1	3	3	2	1	2	3	1	1	2	1
CO5	3	3	1	3	3	1	2	3	3	1	2	3	2
CO6	3	3	2	3	3	1	2	3	3	1	1	3	1
CO7	3	3	2	3	3	2	2	3	3	1	1	3	1

PO1 – Comprehensive Knowledge and Understanding

Achieved through CO1 to CO7, as students gain a thorough understanding of instrumentation systems, sensor technologies, signal conditioning, and data acquisition. Theoretical knowledge of system configurations, performance characteristics, and sensor principles builds a solid conceptual foundation.

PO2 – Practical, Professional, and Procedural Knowledge

Supported by CO2, CO3, CO4, CO6, and CO7, where students learn to operate, design, and analyze instrumentation systems and sensors. Laboratory exercises, signal conditioning experiments, and data acquisition tasks enhance procedural and professional skills.

PO3 – Entrepreneurial Mindset and Knowledge

Addressed through CO5, CO6, and CO7. Exposure to modern signal conditioning and data acquisition systems encourages innovative thinking and potential for entrepreneurship in developing measurement or automation solutions.

PO4 – Specialized Skills and Competencies

Achieved through CO4, CO5, CO6, and CO7. Students develop expertise in instrumentation amplifiers, signal conditioning circuits, noise reduction techniques, and multichannel data acquisition systems, providing specialized technical competencies.

PO5 – Capacity for Application, Problem-Solving, and Analytical Reasoning

Supported by CO1 to CO7. Students apply theoretical knowledge to analyze sensor outputs, design amplifiers, mitigate noise, and develop data acquisition systems, enhancing problem-solving and analytical skills.

PO6 – Communication Skills and Collaboration

Developed through CO4, CO6, and CO7. Lab reports, group experiments, and project work improve students' ability to document results, present technical information, and work collaboratively in teams.

PO7 – Research-related Skills

Addressed via CO5, CO6, and CO7. Students explore noise analysis, signal conditioning optimization, and modern DAQ systems, fostering investigative and research-oriented thinking.

PO8 – Learning How to Learn Skills

Supported through CO1 to CO7. The course encourages students to explore new sensors, instrumentation devices, and DAQ technologies, promoting self-directed learning and adaptability to evolving instrumentation techniques.

PO9 – Digital and Technological Skills

Developed through CO3, CO4, CO6, and CO7. Students work with digital sensors, simulation tools, data acquisition software, and signal conditioning circuits, strengthening their digital and technological capabilities.

PO10 – Multicultural Competence, Inclusive Spirit, and Empathy

Moderately supported via CO5 and CO7. Understanding global standards in instrumentation and data acquisition systems exposes students to diverse technological environments, fostering awareness and inclusive thinking.

PO11 – Value Inculcation and Environmental Awareness

Addressed by CO5 and CO6. Students learn responsible use of electronic equipment, noise mitigation, and environmentally safe practices in sensor and instrumentation systems.

PO12 – Autonomy, Responsibility, and Accountability

Developed through CO4, CO6, and CO7. Lab exercises, individual assignments, and DAQ system implementations require students to work independently, take responsibility for results, and maintain accountability.

PO13 – Community Engagement and Service

Supported via CO5 and CO7. Knowledge of sensors, data acquisition, and instrumentation can be applied to community-benefiting projects such as environmental monitoring, automation solutions, and public safety systems.

CBCS Syllabus as per NEP 2020 for T. Y. B.Sc. Electronics (SEM V) (2023 Pattern)

Name of the Program : B.Sc. Electronics
Program Code :USEL
Class : T. Y. B.Sc.
Semester : VI
Course Type : Major Elective (Theory)
Course Code : ELE-356- MJE(C)
Course Title : Electric Vehicals
No. of Credits : 02
No. of Teaching Hours : 30

Course Objectives

1. To impart foundational and applied knowledge of electric vehicle systems to electronics students
2. To develop competence in power electronics, motor drives, battery systems, control, and embedded aspects in EVs
3. To enable students to design/simulate small EV subsystems and carry out practical projects
4. To prepare students for industry roles or higher studies in EV / e-mobility
5. To understand the fundamentals, history, and evolution of electric and hybrid vehicles.
6. To understand standards, regulations, and environmental aspects of EVs.
7. To explore advancements in electric vehicle technologies including IoT integration and intelligent transport systems.

Course Outcomes

After completing this EV course, students should be able to:
1. Explain the architecture and core subsystems in EVs (battery, motor, power electronics, control)
2. Analyze battery behavior, motor performance and efficiency trade-offs in EV systems
3. Design or simulate converter circuits, motor drives, BMS algorithms
4. Integrate subsystems and evaluate system-level performance of an EV
5. Understand latest trends (wireless charging, V2G, solid-state batteries)
6. Execute a project / prototype applying EV principles
7. Discover and correlate the advancement in e-vehicles

Topics

Unit 1: Introduction & EV Fundamentals **[4]**
EV Technology, History & evolution of EVs / hybrid vehicles, Significance of e-Vehicle. Types of electric vehicles and it components, market trends, EV architectures: BEV, HEV, PHEV, Fuel-cell EV

Unit 2: Energy Storage & Battery Systems **[6]**
Battery basics: cell, module, pack, Battery chemistries: Li-ion, NiMH, etc., Battery parameters (SOC, SOH, C-rate), Battery modeling, Pack design, interconnection Thermal management, safety

Unit 3: Power Electronics, Converters & Drives in EVs **[10]**

Power semiconductor devices (IGBT, MOSFET, SiC, GaN), DC–DC converters (buck, boost, bidirectional), Inverters (voltage source, current source), Switching modulation (PWM, SVPWM) Regenerative braking converter Types of motors: DC, induction, synchronous, BLDC, SRM

Unit 4:Advancement in e-vehicles **[10]**

Integration of IoT in e-vehicle, Wireless sensor networks need for IoT, Intelligent Transport Systems, Degradation and disposal of batteries, modes of fast and efficient charging, and availability of charging stations as per Indian road conditions. Types of standards. Safety rules and regulations.

Reference Books:

1. Advances in Battery Technologies for Electric Vehicles, by Bruno Scrosati, Jürgen Garche and Werner Tillmetz, Woodhead Publishing Series in Energy: Number 80.
2. R. Krishnan, Electric Motor Drives: Modeling, Analysis and Control
3. Behaviour of Lithium-Ion Batteries in Electric Vehicles Battery Health, Performance,Safety, and Cost by Gianfranco Pistoia Boryann Liaw.
4. Fundamentals And Applications of Lithium-Ion Batteries in Electric Drive Vehicles Jiuchun Jiang and Caiping Zhang Beijing Jiaotong University, Wiley publications.
5. Electric Motor drives – Modelling, Analysis & Control, R. Krishnan, PHI India, Ltd.

Mapping of Program Outcomes with Course Outcomes

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

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	2	1	2	3	1	1	2	2	1	1	2	1
CO2	3	3	1	2	3	1	2	2	3	1	1	2	1
CO3	3	3	2	3	3	1	2	3	3	1	1	3	1
CO4	3	3	2	3	3	2	2	3	3	1	1	3	2
CO5	3	2	3	2	3	1	2	3	3	1	2	2	1
CO6	3	3	3	3	3	3	3	3	3	1	2	3	2
CO7	3	2	3	2	3	1	3	3	3	1	2	2	1

Mapping Justification:

PO1 – Comprehensive Knowledge and Understanding

CO1–CO7: Students gain deep theoretical understanding of EV architectures, batteries, motor drives, power electronics, IoT integration, and EV standards, building a solid knowledge foundation.

PO2 – Practical, Professional, and Procedural Knowledge

CO2, CO3, CO4, CO6: Hands-on skills in analyzing batteries, designing converters, simulating motor drives, and building prototypes develop professional and procedural competencies.

PO3 – Entrepreneurial Mindset and Knowledge

CO5, CO6, CO7: Exposure to emerging trends such as wireless charging, V2G, and solid-state batteries encourages innovative thinking and entrepreneurship in EV technology development.

PO4 – Specialized Skills and Competencies
CO3, CO4, CO6: Designing and simulating converter circuits, motor drives, and battery management systems enhances specialized technical skills essential for EV engineering.

PO5 – Capacity for Application, Problem-Solving, and Analytical Reasoning
CO1–CO7: Students analyze battery behavior, motor efficiency, system trade-offs, and integrate subsystems, applying knowledge to solve complex EV-related problems.

PO6 – Communication Skills and Collaboration
CO4, CO6: Group projects, prototype development, and reporting require effective teamwork, collaboration, and communication of technical information.

PO7 – Research-related Skills
CO2, CO3, CO5, CO7: Students research new motor types, battery chemistries, IoT applications, and EV system optimizations, fostering research and investigative skills.

PO8 – Learning How to Learn Skills
CO1–CO7: Students explore new EV technologies, simulate designs, and work on projects, promoting self-directed learning and adaptability to technological advances.

PO9 – Digital and Technological Skills
CO3, CO4, CO5, CO6, CO7: Use of simulation tools, BMS algorithms, and digital EV systems strengthens students' technological and digital skills.

PO10 – Multicultural Competence, Inclusive Spirit, and Empathy
CO5, CO7: Understanding global EV standards and emerging trends exposes students to diverse technological environments, promoting inclusivity and awareness.

PO11 – Value Inculcation and Environmental Awareness
CO5, CO7: Students learn about battery disposal, EV environmental impact, and sustainable technologies, fostering environmental consciousness.

PO12 – Autonomy, Responsibility, and Accountability
CO3, CO4, CO6: Students take ownership of simulations, prototypes, and projects, learning to work independently and responsibly.

PO13 – Community Engagement and Service
CO4, CO7: Knowledge of EV systems can be applied to community-benefiting initiatives like smart charging stations, environmental monitoring, or public EV awareness programs.

CBCS Syllabus as per NEP 2020 for T. Y. B.Sc. Electronics (SEM VI) (2023 Pattern)

Name of the Program : B.Sc. Electronics
Program Code : USEL
Class : T. Y. B.Sc.
Semester : VI
Course Type : Minor (Theory)
Course Code : ELE-361- MN
Course Title : Advanced C Programming
No. of Credits : 02
No. of Teaching Hours : 30

Course Objectives

8. To understand the concept of pointers, their declaration, and how to use them in functions.
9. To develop the ability to define and use user-defined functions, including recursive functions, in C programming.
10. To learn the concept of strings, their initialization, and various string handling operations.
11. To study file handling techniques for reading, writing, appending, and processing data files in C.
12. To understand the use of structures for organizing related data efficiently.
13. To introduce the fundamentals of computer graphics and commonly used graphic functions in C.
14. To develop programming skills for implementing file handling and graphics-based applications using C language.

Course Outcomes

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

CO1: Declare and manipulate pointers and apply them in function calls effectively.
CO2: Design and implement user-defined and recursive functions to solve programming problems.
CO3: Perform string operations such as copy, concatenation, comparison, and find string length using C library functions.
CO4: Apply file handling techniques to read, write, and append data using standard input/output functions.
CO5: Define and use structures for storing and managing multiple data items of different types.
CO6: Utilize C graphics library functions such as line, circle, ellipse, and polygon for basic graphical applications.
CO7: Develop and execute programs integrating file handling and graphics to demonstrate real-world problem-solving.

Topics and Learning Points

Unit 1: Pointers and Functions [8 L]
Pointer's declarations, passing pointers to a function, programming examples.
Defining a user defining function, accessing a function, function prototype, recursion and programs.

Unit 2: String and File Handling [12 L]

Declaring and initializing string, Operations on string, string length, string size, string copy, string concatenation, string compare, programming examples. Defining file in C, Operations on file, Opening and closing of data file, read and write data file, input and output functions on files - getc and putc ,fscanf and fprintf , processing data file and append data file, programming examples. Structure- Declaration, initialization, programming examples.

Unit 3: Introduction to Graphics [10 L]

Concept of graphics, Graphics initialization, graphics commands, getpixel, putpixel, line, Polyline, lineto, circle,arc, ellipse, rectangle, polygon, bar, getmax x, getmax y, setcolor,fillpattern etc. And programming examples.

Reference Books :

1. E Balaguruswamy Programming in ANSI C The McGraw Hill publications.
2. Stephens Cochan Programming in C Prentice hall of India Ltd.
3. V. Rajaraman Computer Programming in C Prentice hall of India Ltd.
4. Madhusudan Mothe C for Beginners.

Mapping Table:

Course Outcomes	Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	3	1	1	3	1	1	1	3	-	-	-	-
CO2	3	3	1	3	3	1	1	3	2	-	-	-	-
CO3	3	3	-	1	3	-	3	1	3	-	-	-	-
CO4	2	3	-	1	3	1	3	1	3	-	-	3	-
CO5	3	3	-	3	3	2	1	2	3	-	-	3	-
CO6	2	3	1	3	3	2	1	3	3	-	-	-	-
CO7	3	3	2	3	3	3	3	3	3	3	3	3	3

Justification For The Mapping:-

PO1: Comprehensive Knowledge and Understanding

CO1–CO7: Students develop a thorough understanding of pointers, functions, strings, file handling, structures, and graphics in C. This conceptual foundation allows them to integrate multiple C programming concepts to solve real-world problems.

PO2: Practical, Professional, and Procedural Knowledge

CO1- CO7: Learners gain hands-on skills in pointer manipulation, file I/O, structure handling, and graphics programming. Following procedural steps and coding standards enhances professional programming practices.

PO3: Entrepreneurial Mindset and Knowledge

CO6, CO7: Students develop creativity through graphical applications and integration of multiple concepts. They are exposed to innovative problem-solving approaches that can translate into real-world products or projects.

PO4: Specialized Skills and Competencies

CO2, CO5, CO6, CO7: Learners acquire specialized skills in recursion, user-defined functions, structures, and graphical programming. They gain the competence to implement advanced C programming solutions for practical applications.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning

CO1- CO7: Students analyze problems, design algorithms, and implement solutions efficiently using pointers, strings, files, structures, and graphics. They develop strong analytical and problem-solving skills through practical programming exercises.

PO6: Communication Skills and Collaboration

CO5, CO7: Students document, explain, and present program outputs effectively.

Collaborative projects enhance teamwork and communication skills in lab and project work.

PO7: Research-related Skills

CO3, CO4, CO7: Students experiment with string manipulation, file handling, and integrated projects.They investigate program efficiency, performance, and optimization, fostering research-oriented skills.

PO8: Learning How to Learn Skills

CO2, CO6, CO7: Students develop the ability to learn new functions, graphics libraries, and integration techniques independently. They gain adaptability for learning emerging technologies and programming concepts.

PO9: Digital and Technological Skills

CO1, CO3, CO4, CO5, CO6, CO7: Students gain proficiency in pointers, strings, files, structures, and graphics using C programming tools. They develop competence in applying digital technology to solve programming and computational problems.

PO10: Community Engagement and Service

CO7: Students understand real-world relevance of their programming projects. Applications developed can benefit education, small communities, or problem-based learning initiatives.

PO11: Value Inculcation and Environmental Awareness

CO7: Students learn ethical programming practices and resource-efficient coding. They develop awareness of responsible computational practices in project development.

PO12: Autonomy, Responsibility and Accountability

CO4, CO5, CO7: Students independently manage files, structures, and integrated project work. They take responsibility for correctness, efficiency, and functionality of their programs.

PO13: Multicultural Competence, Inclusive Spirit, and Empathy

CO7: Collaborative programming projects foster teamwork with diverse peers. Students learn inclusive problem-solving and consider multiple perspectives in project implementation.

CBCS Syllabus as per NEP 2020 for T. Y. B.Sc. Electronics (SEM VI) (2023 Pattern)

Name of the Program : B.Sc. Electronics
Program Code :USEL
Class : T. Y. B.Sc.
Semester : VI
Course Type : Minor (Practical)
Course Code : ELE-362- MN
Course Title : Advanced C Lab
No. of Credits : 02
No. of Teaching Hours : 60

Course Objectives

15. To understand the concepts of pointers and their applications in memory management and function calls.
16. To develop the ability to write modular programs using user-defined and recursive functions.
17. To explore string handling techniques and perform various string operations using built-in and manual methods.
18. To study file handling operations for creating, reading, writing, and appending data files in C.
19. To learn the use of structures for storing and managing complex data efficiently.
20. To understand the fundamentals of computer graphics and implement simple 2D graphical programs using C.
21. To enhance logical thinking and problem-solving skills through real-time programming applications integrating files, structures, and graphics.

Course Outcomes

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

CO1: Demonstrate the use of pointers to access memory locations and pass data between functions.

CO2: Design and implement user-defined and recursive functions to solve computational problems efficiently.

CO3: Perform various string operations such as copy, concatenate, compare, and calculate length using both manual and library functions.

CO4: Apply file handling techniques to create, read, write, append, and copy data files effectively.

CO5: Use structures to store, process, and display data for multiple records (e.g., student information).

CO6: Implement graphical functions such as line, circle, rectangle, polygon, and simple animations in C programs.

CO7: Integrate multiple C programming concepts (pointers, functions, files, graphics) to develop practical problem-based applications.

List of Practicals

Practical Course consists of 15 practicals.

1. Write a C program to declare and initialize pointers and display the value and address of a variable using a pointer.
2. Write a C program to swap two numbers using call by value and call by reference (using pointers).
3. Write a C program to find the sum and average of an array of numbers using pointers.
4. Write a C program to demonstrate the use of user-defined functions with function prototype and return value.
5. Write a C program to calculate the factorial of a number using recursion.
6. Write a C program to find the length of a string without using built-in string functions.
7. Write a C program to perform string operations — copy, concatenate, and compare using string functions (`strcpy`, `strcat`, `strcmp`).
8. Write a C program to count the number of vowels, consonants, digits, and spaces in a given string.
9. Write a C program to create a text file and write data into it using `fprintf()` or `fputs()`.
10. Write a C program to read and display the contents of a file using `fscanf()` or `fgets()`.
11. Write a C program to append new data to an existing file.
12. Write a C program to define a structure for student details (roll no, name, marks) and display the data of multiple students using an array of structures.
13. Write a C program to initialize graphics mode and draw basic shapes such as line, rectangle, and circle.
14. Write a C program to draw an arc, ellipse, and polygon using appropriate graphics library functions.
15. Write a C program to demonstrate simple animation (e.g., moving ball or car) using `putpixel()`, `line()`, and `delay()` functions.
16. Write a C program to copy contents from one file to another.
17. Write a C program to find the largest element in an array using a function and pointer.
18. Write a C program to simulate a mini calculator using switch and functions.
19. Write a C graphics program to draw a smiley face or house using basic shapes.

Activities: (One activity is equivalent to two experiments.)

1. Internet Browsing
2. Simulation software.
3. Study Tour / Industry visit
4. Workshop
5. Do it yourself open ended project

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CO4	2	3	-	1	3	1	3	1	3	-	-	3	-
CO5	3	3	-	1	3	3	1	1	3	-	-	-	-
CO6	2	3	3	3	3	1	1	1	3	-	-	-	-
CO7	3	3	3	3	3	3	3	3	3	3	3	3	3

Justification For The Mapping:-

PO1: Comprehensive Knowledge and Understanding

CO1- CO7: Students develop a strong understanding of programming fundamentals including pointers, functions, strings, and structures. They gain conceptual clarity on how data and logic interact in a C program. By integrating these concepts in CO7, learners achieve comprehensive knowledge for designing complete applications.

PO2: Practical, Professional, and Procedural Knowledge

CO1- CO7: Students acquire procedural coding skills through practical exercises in all programming areas—functions, files, and graphics. They learn structured and professional coding standards required for real-world applications. This PO ensures students can apply theoretical principles effectively in professional programming environments.

PO3: Entrepreneurial Mindset and Knowledge

CO6, CO7: Through graphical programming and integrated project work, students cultivate creativity and innovation. They learn to convert ideas into executable programs, promoting an entrepreneurial and solution-oriented mindset. CO7 encourages independent project design, aligning with innovation and product development thinking.

PO4: Specialized Skills and Competencies

CO2, CO6, CO7: Students gain specialized competencies in algorithm design, recursive programming, and computer graphics. They learn how to implement visual and logical aspects of programming creatively and efficiently. These skills prepare them for advanced technical applications and domain-specific programming expertise.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning

CO1- CO7: Students analyze problems, design solutions, and implement logic using diverse programming techniques. They enhance reasoning by debugging, optimizing, and integrating code modules effectively. Each CO contributes to developing the ability to solve real-world problems using analytical and computational thinking.

PO6: Communication Skills and Collaboration

CO5, CO7: Students communicate program logic and results clearly through structured data display and documentation. They collaborate on projects involving multiple components, fostering teamwork and technical discussion. This PO ensures effective exchange of ideas during project design and debugging activities.

PO7: Research-related Skills

CO4, CO7: Students practice systematic data handling and exploration using file operations. They learn to test and analyze programs to improve accuracy and efficiency—key aspects of research-based learning.By integrating programming components in CO7, they develop curiosity and analytical evaluation habits.

PO8: Learning How to Learn Skills

CO2, CO7: Students learn recursive and modular function design, which encourages independent logical thinking. Through CO7, they adapt to integrating new programming concepts and technologies. This PO promotes lifelong learning skills essential for adapting to evolving programming environments.

PO9: Digital and Technological Skills

CO1, CO3, CO4, CO5, CO6, CO7: Students use C language tools and libraries for data, string, and graphics operations, building digital fluency. They handle technology-based problem-solving through coding, file management, and visualization. This PO ensures learners develop strong technological proficiency applicable to modern computing practices.

PO10: Community Engagement and Service

CO7: Students develop problem-based programs that can serve community or educational needs. They understand how programming can address social, educational, or environmental issues through practical applications. This PO nurtures awareness of using coding skills for societal benefit.

PO11: Value Inculcation and Environmental Awareness

CO7: Students apply ethical coding practices and understand the importance of responsible software use. They realize how optimized programming conserves system resources, aligning with environmental responsibility. This PO encourages developing value-based, sustainable, and ethical programming habits.

PO12: Autonomy, Responsibility, and Accountability

CO4, CO7: Students independently perform file handling and integrated program development, taking ownership of their work. They are accountable for producing efficient, error-free, and logically sound outputs. This PO helps them develop professional responsibility and self-management skills in coding projects.

PO13: Multicultural Competence, Inclusive Spirit, and Empathy

CO7: Students work in diverse teams while developing integrated coding projects. They learn to respect others' ideas, collaborate inclusively, and value diverse problem-solving approaches. This PO builds empathy, teamwork, and inclusivity in technical environments.