Anekant Education Society's

Tuljaram Chaturchand College of Arts, Science & Commerce,

Baramati

(Empowered Autonomous)

Four Year B.Sc. Degree Program in Electronics

Program in Electronics

(Faculty of Science & Technology)

CBCS Syllabus

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

For Department of Electronics

Choice Based Credit System Syllabus (2024 Pattern)

(As Per NEP 2020)

To be implemented from Academic Year 2026-2027

Programme Specific Outcomes (PSOs)

PSO1. Proficiency in digital system design:
Students should develop the ability to analyze and design digital electronic systems, including combinational and sequential circuits. They should be able to apply principles of digital logic design to solve practical problems.

PSO2. Competence in microcontrollers and embedded systems:
Students should gain practical skills in developing embedded system applications using microcontrollers such as 8051 and platforms like Arduino. They should be able to interface sensors and actuators effectively.

PSO3. Understanding of analog circuit design:
Students should be able to design, analyze, and troubleshoot analog electronic circuits such as amplifiers, oscillators, and filters. They should understand circuit behavior and performance in real-world applications.

PSO4. Proficiency in programming and software development:
Students should develop programming skills using C language for solving engineering problems. They should be able to write efficient programs for hardware interfacing and embedded applications.

PSO5. Ability in hardware-software integration:
Students should demonstrate the capability to integrate hardware and software components through laboratory experiments and projects. They should be able to develop real-time embedded systems.

PSO6. Knowledge of communication systems and optical fiber technology:
Students should understand the principles of communication systems, including optical fiber communication. They should be able to analyze signal transmission and its applications in modern communication systems.

PSO7. Development of practical skills and career readiness:
Students should gain hands-on experience with laboratory instruments, simulation tools, and industrial training (OJT). They should also develop problem-solving, communication, and technical skills required for employment, entrepreneurship, and higher education.

Anekant Education Society's

Tuljaram Chaturchand College, Baramati

(Empowered Autonomous)

Board of Studies (BOS) in Electronics

From 2025-26 to 2027-28

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

Anekant Education Society's

Tuljaram Chaturchand College

of Arts, Science & Commerce, Baramati.

Tuljaram Chaturchand College of Arts, Science & Commerce, Baramati is an empowered autonomous & dynamic institute and has successfully implemented the National Education Policy 2.0 2024 pattern since the academic year 2024-25. We are updating our academic policies as per local needs keeping in view the global perspectives. Accordingly, we have updated our program outcomes as per the graduate attributes defined in New Education Policy. In general, program outcomes are categorized into two categories as disciplinary & interdisciplinary outcomes and generic outcomes.

Program Outcomes for B.Sc.

PO.1. Comprehensive Knowledge and Understanding:

Graduates will possess a profound understanding of their field of study, including foundational theories, principles, methodologies, and key concepts, within a broader multidisciplinary context.

PO.2. Practical, Professional, and Procedural Knowledge:

Graduates will acquire practical skills and expertise essential for professional tasks within their field. This includes knowledge of industry standards, best practices, regulations, and ethical considerations, with the ability to apply this knowledge effectively in real-world scenarios.

PO.3. Entrepreneurial Mindset and Knowledge:

Graduates will cultivate an entrepreneurial mindset, identifying opportunities, fostering innovation, and understanding business principles, market dynamics, and risk management strategies.

PO.4. Specialized Skills and Competencies:

Graduates will demonstrate proficiency in technical skills, analytical abilities, problem-solving, effective communication, and leadership, relevant to their field of study. They will also adapt and innovate in response to changing circumstances.

PO.5. Capacity for Application, Problem-Solving, and Analytical Reasoning:

Graduates will possess the capacity to apply learned concepts in practical settings, Department of Electronics T.Y. B.Sc. (Electronics) Semester – V 5 AES', T.C. College Arts, Science and Commerce (Empowered Autonomous), Baramati. CBCS Syllabus (2024 Pattern) As per NEP 2.0 They should be able to analyze electronic systems, interpret experimental data. This requires critical thinking, creativity, adaptability, and a readiness to learn and take calculated risks.

PO.6. Communication Skills and Collaboration:

Graduates will effectively communicate complex information, both orally and in writing, using appropriate media and language. They will also collaborate effectively in diverse teams, demonstrating leadership qualities and facilitating cooperative efforts toward common goals.

PO.7. Research-related Skills:

Graduates will demonstrate observational and inquiry skills, formulate research questions, and utilize appropriate methodologies for data collection and analysis. They will also adhere to research ethics and effectively report research findings.

PO.8. Learning How to Learn Skills:

Graduates will acquire new knowledge and skills through self-directed learning, adapt to changing demands, and set and achieve goals independently.

PO.9. Digital and Technological Skills:

Graduates will demonstrate proficiency in using ICT, accessing information sources, and analyzing data using appropriate software.

PO.10. Multicultural Competence, Inclusive Spirit, and Empathy:

Graduates will engage effectively in multicultural settings, respecting diverse perspectives, leading diverse teams, and demonstrating empathy and understanding of others' perspectives and emotions.

PO.11. Value Inculcation and Environmental Awareness:

Graduates will embrace ethical and moral values, practice responsible citizenship, recognize and address ethical issues, and take appropriate actions to promote sustainability and environmental conservation.

PO.12. Autonomy, Responsibility, and Accountability:

Graduates will apply knowledge and skills independently, manage projects effectively, and demonstrate responsibility and accountability in work and learning contexts.

PO.13. Community Engagement and Service:

Graduates will actively participate in community-engaged services and activities, promoting societal well-being.

Course and Credit Distribution Structure for B.Sc. (Electronics) 2024-2025

Level/ Difficulty	Sem	Subject DSC-1				Subject DSC-2	Subject DSC-3	GE/OE	SEC	IKS	AEC	VEC	CC	Total
4.5/100	I	2(T)+2(P)				2(T)+2(P)	2(T)+ 2(P)	2(T)	2 (T/P)	2(T) (Generic)	2(T)	2(T)	--	**22**
	II	2(T)+2(P)				2(T)+2(P)	2(T)+2(P)	2(P)	2 (T/P)	--	2(T)	2(T)	2(T	**22**
Exit option: Award of UG Certificate in Major with 44 credits and an additional 4 credits core NSQF course/Internship OR Continue with Major and Minor **Continue option**: Student will select one subject among the (subject 1, subject 2 and subject 3) as major and other as minor and third subject will be dropped.														
Level/ Difficulty	**Sem**	**Credits Related to Major**				**Minor**	**--**	**GE/OE**	**SEC**	**IKS**	**AEC**	**VEC**	**CC**	**Total**
		Major Core	**Major Elective**	**VSC**	**FP/OJT/CEP/RP**									
5.0/200	III	4(T)+2(P)	--	2 (T/P)	2(FP)	2(T)+2(P)	--	2(T)	--	2(T)	2(T)	--	2(T)	**22**
	IV	4(T)+2(P)	--	2 (T/P)	2(CEP)	2(T)+2(P)	--	2(P)	2 (T/P)	--	2(T)	--	2(T)	**22**
Exit option: Award of UG Diploma in Major and Minor with 88 credits and an additional 4credits core NSQF course/Internship OR Continue with Major and Minor														
5.5/300	V	8(T)+4(P)	2(T)+2(P)	2 (T/P)	2(FP/CEP)	2(T)	--	--	--	--	--	--	--	**22**
	VI	8(T)+4(P)	2(T)+2(P)	2 (T/P)	4 (OJT)	--	--	--	--	--	--	--	--	**22**
Total 3Years		**44**	**8**	**8**	**10**	**18**	**8**	**8**	**6**	**4**	**8**	**4**	**6**	**132**
Exit option: Award of **UG Degree in Major** with 132 credits OR Continue with Major and Minor														
6.0/400	VII	6(T)+4(P)	2(T)+2 (T/P)	--	4(RP)	4(RM)(T)	--	--	--	--	--	--	--	**22**
	VIII	6(T)+4(P)	2(T)+2 (T/P)	--	6(RP)	--	--	--	--	--	--	--	--	**22**
Total 4Years		**64**	**16**	**8**	**22**	**22**	**8**	8	**6**	**4**	**8**	**4**	**6**	**176**
Four Year **UG Honours with Research Degree** in Major and Minor with 176 credits														
6.0/400	VII	10(T)+4(P)	2(T)+2 (T/P)	--	--	4(RM) (T)	--	--	--	--	--	--	--	**22**
	VIII	10(T)+4(P)	2(T)+2 (T/P)	--	4 (OJT)	--	--	--	--	--	--	--	--	**22**
Total 4Years		**72**	**16**	**8**	**14**	**22**	**8**	8	**6**	**4**	**8**	**4**	**6**	**176**
Four Year **UG Honours Degree** in Major and Minor with 176 credits														

T = Theory **P** = Practical **DSC** = Discipline Specific Course **OE** = Open Elective **SEC** = Skill Enhancement Course

IKS = Indian Knowledge System **AEC =** Ability Enhancement Course **VEC =** Value Education Course **CC =** Co-curricular Course **VSC**= Vocational Skill Course

OJT= On Job Training **CEP**= Community Engagement Project **FP**= Field Project **RP**= Research Project

Course Structure for T. Y. B. Sc. Electronics (2024 Pattern)

Sem	Course Type	Course Code	Course Title	Theory / Practical	Credits
V	Major Mandatory	ELE-301-MRM	Digital logic design using Verilog	T	02
		ELE-302-MRM	Architecture of 8051 Microcontroller	T	02
		ELE-303-MRM	Analog Circuit Design	T	02
		ELE-304-MRM	Advanced C Language	T	02
	Major Mandatory	ELE-305-MRM	Hardware Practical	P	02
		ELE-306-MRM	Software Practical	P	02
	Major Elective (MJE)	ELE -307-MJE(A)	Principle of OFC	T (Any one)	02
		ELE -307-MJE(B)	Arduino & it's Programing		
	Major Elective (MJE)	ELE -308-MJE(A)	OFC LAB	P (Any one)	02
		ELE -308-MJE(B)	Arduino LAB		
	On Job Training (OJT)	ELE -309-OJT	On Job Training	P	04
	Minor	ELE -310-MN	Introduction to AI	T	02
			Total Credits Semester-V		**22 (T=12,P=10)**
VI	Major Mandatory	ELE -351-MRM	Communication System	T	02
		ELE -352-MRM	Embedded System Design	T	02
		ELE -353-MRM	Power Electronics	T	02
		ELE -354-MRM	Introduction to Nano Electronics	T	02
	Major Mandatory	ELE -355-MJM	Hardware LAB	P	02
		ELE -356-MJM	Software LAB	P	02
	Major Elective (MJE)	ELE -357-MJE(A)	Introduction to Java	T (Any one)	02
		ELE -357-MJE(B)	Internet of things		
	Major Elective (MJE)	ELE -358-MJE(A)	Java Practical	P (Any one)	02
		ELE -358-MJE(B)	IOT Practical		
	Vocational Skill Course (VSC)	ELE -359-VSC	PCB Design	T	02
	Vocational Skill Course (VSC)	ELE -360-VSC	Simulation Design LAB	P	02
	Field Project	ELE -361-FP	Field Project	P	02
			Total Credits Semester-VI		**22**
	Cumulative Credits Semester V + Semester VI				**44 (T=12,P=10)**

CBCS Syllabus as per NEP 2020forT.Y. B. Sc. Electronics (SEMV) (2024Pattern)

Name of the Programme :B.Sc. Electronics

Programme Code **:USEL**

Class **:**T.Y. B.Sc.

Semester **:** V

Course Type **:** Major Mandatory (Theory)

Course Code **:** ELE-301-MRM

Course Title **:** Digital Logic Design using Verilog

No. of Credits **:** 02

No. of Teaching Hours **:** 30

Course Objectives:

1.To introduce VERILOG

2.To know the architectural features of programmable logic devices

3.To know the behavioral modeling of combinational and simple sequential circuits

4.To understand sequential and combinational logic design techniques

5.Tolearn various digital circuits using VERILOG

6.To know the behavioral modeling of algorithmic state machines

7.TolearnVLSIdevices

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. Understand the language constructs and programming fundamentals of Verilog HDL.

CO7. Analyze and verify the functionality of digital circuits/systems using test benches

Unit 1: Digital System Design **[10]**

Design flow for logic circuits, Mealy & Moore sequential machine models, state machine notation, state equivalence, state reduction, Equivalence classes, Implication charts, state reduction of incompletely specified state tables, Merger graphs, ASM symbols

Unit 2: Introduction to Verilog Language **[08]**

ImportanceofHDL's,featuresofVerilogHDL,OverviewofDigitalDesignwith VerilogHDL,Hierarchicalmodelingconcepts,BasicconceptsofVerilog-Operators, comments,Numberspecifications,strings,Identifiers&keywords,Datatypes,system tasks &Compiler Directives, Modules &ports.

Unit 3: Modeling of Digital systems **[12]**

Gate level Modeling-Introduction, Gate types, Gate delays
Data flow modeling-Introduction, Delays expression, operators & operands
BehavioralModeling-StructuredProcedures,Assignments,TimingControls, Conditional statements, Loops

Verilog-Based Design Examples:

- Combinational Circuits: Multiplexer, Demultiplexer, Encoder, Decoder, Adder, Subtractor
- Sequential Circuits: Flip-Flops, Counters, Shift Registers
- Practical Design Implementations: Traffic light controller, Stepper motor sequence generator

Recommended Books:

1.Digital logic: Applications &design by John M. Yarbrough, cengage Learning India(Thompson)

2.Verilog HDLA guide to digital design &synthesis By Samir Palnitkar, Pearson Second Edition

3.A VHDL Synthesis Primer J. Bhaskar BS Publications Hyderabad

4.Fundamental of digital logic with Verilog By Stephen Brown, Zvonko Vranesic, Tata Mc Graw Hill

5.Digital fundamentals By Floyd, Thoms, Jain R. P. Pearson

Mapping

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

PO1: Comprehensive Knowledge and Understanding

The course builds strong foundational and advanced knowledge in digital logic design and Verilog HDL.

- CO1 & CO6 provide fundamental understanding of HDL language features and programming constructs.
- CO2 & CO5 strengthen conceptual knowledge of combinational and sequential circuits.
- CO3 introduces architectural concepts of programmable logic devices.
- CO4 & CO7 ensure application and verification knowledge.

Thus, the course strongly contributes to comprehensive domain knowledge.

PO2: Practical, Professional, and Procedural Knowledge

Students apply procedural design methodologies using Verilog and simulation tools.

- CO2, CO4, and CO5 involve practical circuit modeling and implementation.
- CO7 emphasizes verification procedures through test benches.
  The course bridges theoretical concepts with professional digital design practices.

PO3: Entrepreneurial Mindset and Knowledge

Knowledge of PLDs (CO3) and practical circuit construction (CO4) enables students to design hardware-based solutions and embedded products, encouraging innovation and entrepreneurship in digital system design.

PO4: Specialized Skills and Competencies

The course develops specialized technical competency in:

- HDL coding (CO1, CO6)
- Circuit modeling (CO2, CO5)
- Hardware implementation (CO4)
- System verification (CO7)

Students gain industry-relevant digital design skills.

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

All COs require logical analysis and problem-solving:

- Translating logic specifications into Verilog code
- Designing optimized combinational and sequential circuits
- Debugging and waveform analysis in test benches (CO7)

The course strongly enhances analytical reasoning ability.

PO6: Communication Skills and Collaboration

Students prepare lab reports, explain simulation results, and participate in discussions related to verification and testing. CO7 particularly enhances technical communication during validation and debugging processes.

PO7: Research-related Skills

Students explore:

- Different modeling techniques (CO2)
- PLD architectures (CO3)
- Verification strategies and test pattern generation (CO5, CO7)

This develops investigative and analytical research-oriented thinking.

PO8: Learning How to Learn Skills

The course encourages self-learning through:

- Debugging and independent coding practice
- Learning new HDL constructs
- Exploring simulation tools

Students develop adaptability and continuous learning ability.

PO9: Digital and Technological Skills

The entire course revolves around:

- HDL programming

- Simulation tools
- Programmable logic devices
- Digital hardware design

Thus, it strongly contributes to technological proficiency.

PO10: Multicultural Competence, Inclusive Spirit, and Empathy

The course has minimal direct linkage. However, collaborative lab activities may promote teamwork and inclusivity.

PO11: Value Inculcation and Environmental Awareness

Although not directly addressed, digital system optimization learned in CO4 and CO5 may indirectly support energy-efficient hardware design.

PO12: Autonomy, Responsibility, and Accountability
Students independently:

- Design circuits
- Write and debug Verilog code
- Validate system functionality

Verification and testing processes promote accountability and professional responsibility.

PO13: Community Engagement and Service
The course is technical in nature with limited direct societal engagement; however, digital system knowledge can be applied in community-oriented technology solutions.

CBCS Syllabus as per NEP 2020 for T. Y. B.Sc. Electronics (SEM V) (2024 Pattern)

Name of the Program	: B.Sc. Electronics
Program Code	: USEL
Class	: T. Y. B.Sc.
Semester	: V
Course Type	: Major Mandatory (Theory)
Course Code	: ELE-302-MRM
Course Title	: Architecture of 8051Microcontroller
No. of Credits	: 02
No. of Teaching Hours	: 30

Course Objectives

1. To understand the basic concepts of microprocessors and microcontrollers and compare different architectures such as RISC, CISC, Harvard, and Von-Neumann.
2. To study the architecture and internal organization of the 8051 microcontroller including CPU, memory, I/O ports, timers, counters, and serial communication.
3. To understand the register structure, SFRs, flags, stack, and interrupt system of the 8051.
4. To learn the working of oscillator, clock circuits, and RESET operation in 8051.
5. To understand the 8051 instruction set, addressing modes, and different instruction groups.
6. To develop skills in assembly language programming using editor, assembler, and debugger tools.
7. To study basic interfacing techniques of 8051 with external devices such as switches, LEDs, LCD, seven-segment display, and DAC.

Course Outcomes

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

CO1: Explain the differences between microprocessor and microcontroller, RISC and CISC architectures, and Harvard and Von-Neumann architecture.
CO2: Describe the block diagram and internal architecture of 8051, including memory organization and peripheral components.
CO3: Illustrate the functioning of registers, SFRs, stack, timers, counters, serial communication, and interrupt system of 8051.
CO4: Interpret and apply various addressing modes and instruction groups in 8051.
CO5: Write and debug assembly language programs for arithmetic, logical, data transfer, and branching operations.
CO6: Develop simple programs using timers, serial communication, and interrupts.
CO7: Interface 8051 with external hardware components such as switches, LEDs, LCD, seven-segment display, and DAC for real-time applications.

Topics and Learning Points

Unit 1: 8051 Microcontroller [15 L]

Microprocessor and microcontroller, RISC and CISC processors, Harvard and Von-Neumann architecture. Different types of microcontrollers, selection criteria of controller. Block diagram of 8051, brief description of blocks, features of 8051, pin description, oscillator and clock ,CPU registers, I/O ports, RESET operation, internal RAM and ROM, SFRs, Flags and PSW, stack and stack pointer, timers and timer registers, counters, serial communication port registers, interrupts and interrupt registers.

Unit 2: Instruction Set and programming [15 L]
Different groups of instructions: data transfer instructions, arithmetic instructions, logical instructions, Boolean instructions, program branching instructions: jump and call instructions, Addressing modes, Arithmetic, logical, data transfer, code conversion, Role of editor, assembler, and debugger. Timer / Counter Programming.

Reference Books :

1. Advanced Microprocessors, Boris Bray, Tata McGraw Hill (2018)
2. 8051 Microcontroller Architecture, Programming and Applications: Kenneth Ayala, Thomson Delmar Learning (2005)
3. 8051 Microcontroller and Embedded System using Assembly and C: M. A. Mazidi, J.G. Mazidi

Mapping Table:

Course Outcomes	Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	1	-	1	3	-	1	1	3	-	-	-	-
CO2	3	3	-	2	3	1	1	1	3	-	-	-	-
CO3	3	3	-	3	3	1	3	1	3	-	-	-	-
CO4	3	3	-	3	3	1	3	3	3	-	-	-	-
CO5	2	3	1	3	3	3	2	1	3	-	-	3	-
CO6	2	3	2	3	3	3	3	3	3	-	-	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 thorough conceptual knowledge of microprocessor vs. microcontroller architectures and the complete 8051 system. They understand memory organization, peripherals, instruction sets, and interfacing concepts. This ensures strong theoretical and applied understanding of embedded systems.

PO2: Practical, Professional, and Procedural Knowledge
CO2–CO7: The course emphasizes hands-on assembly programming and hardware interfacing using 8051. Students follow systematic procedures for program development, debugging, and testing. This prepares them for professional embedded system development work.

PO3: Entrepreneurial Mindset and Knowledge
CO6, CO7: By developing real-time embedded applications, students explore automation and product-oriented thinking. Interfacing projects encourage innovation in device-level solutions.
This nurtures an entrepreneurial outlook in embedded system design.

PO4: Specialized Skills and Competencies
CO3, CO4, CO5, CO6, CO7: Students gain specialized skills in assembly programming, addressing modes, timers, interrupts, and serial communication. They learn hardware interfacing with LEDs, LCDs, DACs, and displays. These competencies are essential for embedded and microcontroller-based systems.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning
CO1–CO7: Learners analyze instruction execution, timing, and hardware behavior to solve embedded problems. Programming and interfacing tasks strengthen logical thinking and debugging ability. Students become capable of designing efficient real-time solutions.

PO6: Communication Skills and Collaboration
CO5, CO6, CO7: Students document assembly programs, timing diagrams, and interfacing results. Lab work and mini-projects promote teamwork and technical discussion. This improves their ability to communicate embedded system solutions clearly.

PO7: Research-related Skills
CO3, CO4, CO6, CO7: Students investigate different addressing modes, interrupt strategies, and serial communication methods. They evaluate program efficiency and hardware response through experimentation. This develops inquiry-based learning and research aptitude.

PO8: Learning How to Learn Skills
CO4, CO6, CO7:Students learn to explore datasheets, instruction sets, and new interfacing techniques independently. They adapt to debugging challenges in embedded programming.
This builds self-learning capability in evolving embedded technologies.

PO9: Digital and Technological Skills
CO1–CO7: The course builds strong embedded programming and hardware interfacing skills.
Students gain experience with real-time control using microcontrollers.These are essential digital competencies for electronics and embedded domains.

PO10: Community Engagement and Service
CO7: Interfacing-based applications demonstrate how microcontrollers solve real-world automation problems. Students can design small embedded solutions useful for societal needs.
This connects technical learning with community-oriented applications.

PO11: Value Inculcation and Environmental Awareness
CO7: Students learn responsible and efficient use of electronic hardware resources. They follow safe laboratory and hardware handling practices. This promotes ethical and environmentally conscious engineering behavior.

PO12: Autonomy, Responsibility and Accountability
CO5, CO6, CO7: Students independently write, test, and debug assembly programs and interfacing circuits. They take responsibility for correctness and performance of embedded applications. This builds professional accountability in system development.

PO13: Multicultural Competence, Inclusive Spirit, and Empathy
CO7: Team-based interfacing projects encourage collaboration among diverse learners. Students learn to respect different approaches to problem-solving. This nurtures inclusive teamwork skills in technical environments.

CBCS Syllabus as per NEP 2020 for T. Y. B. Sc. Electronics (SEM V) (2024Pattern)

Name of the Programme	: B.Sc. Electronics
Programme Code	: **USEL**
Class	: T. Y. B.Sc.: V
Semester	: Major Mandatory (Theory)
Course Type Course	: ELE-303-MJM
Code Course Title No.	: Analog Circuit Design
of Credits	: 02
No. of Teaching Hours	: 30

Course Objectives:

1. To study the practical design aspects while using Op- amps
2. To study the basic application circuits of Op -amps
3. To Learn the specifications and selection criterion for linear ICs
4. To obtain information about different special purpose ICs and their applications
5. To refer and understand applications of timer IC.
6. To study the voltage regulators for power supply.

Course Outcomes:

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

CO1: Learn about the basic concepts for the circuit configuration for the design of linear integrated circuits and develops skill to solve engineering problems

CO2 : Develop skills to design simple circuits using OP-AMP.

CO3 : Gain knowledge of Single power supply Op-amp.

CO4 : Gain knowledge voltage regulators.

CO5: Learn about various techniques to develop multivibrator.

CO6 : Develop skills to develop simple filter circuits and various amplifiers and can solve problems related to it.

CO7 : Develop skills to design power supply

Unit 1: Basic Application Circuits using Op-amp [12]

Selecting Op-amps for dc, low frequency and high frequency applications, offset compensation /balancing techniques, Active filters: 2nd and higher order, Design of LP, HP and BP filters Log and antilog amplifiers, Precision half wave rectifier, precise full wave rectifiers, peak detectors, sample and hold circuits.

Unit 2: Application Circuits using Linear ICs **[10]**

Voltage comparators using op-amp as well as comparator IC (LM311), Comparator applications, Single power supply Op-amp. Astable and mono stable multivibrators using op-amp. Timer IC555: Astable and mono stable multivibrators applications. Function generators: LM 566, ICL8038,V to F and F to V converter.

Unit 3: Voltage Regulators **[8]**

Design of Power Supply, Voltage Regulator, Fixed three terminal regulators ICs-78XX, 79XX; Adjustable Three terminal regulators ICs LM317, LM337, Dual Power supply, PWM controller IC3524, Short circuit protection.

Recommended Books:

1. George Clayton and Steve Winder, "Operational Amplifiers," 5th Edition Newnes An Imprint of Elsevier.
2. Sergio Franco, "Design With operational Amplifiers and analog integrated circuits,"TMH
3. Ramakant A. Gayakwad, "Op-Amps and Linear Integrated Circuits," 4th EditionPHI
4. R.F. Coughlin, F.F. Driscoll, "Operational Amplifiers and Linear Integrated Circuits," PrenticeHall.
5. J . S . K a t a r e Linear Integrated Circuits,, Tech-Max Publication.

Mapping of Program Outcomes with Course Outcomes

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

Cour se Outc ome	Program Outcomes												
	PO 1	PO 2	PO 3	P O4	PO 5	PO 6	PO 7	PO 8	P O9	PO 10	PO1 1	PO1 2	PO1 3
CO1	3	2	--	2	3	-	1	2	2	-	-	-	-
CO2	2	3	1	3	3	1	1	2	3	-	-	1	-
CO3	3	2	-	2	2	-	1	2	2	-	-	-	-
CO4	2	3	1	3	3	1	2	2	3	-	1	1	-
CO5	3	3	2	3	3	1	2	2	3	-	-	1	-
CO6	2	3	2	3	3	1	2	2	3	-	-	1	-
CO7	3	3	2	3	3	1	2	2	3	-	1	2	-

Justification For The Mapping

PO1: Comprehensive Knowledge and Understanding

All the COs relate this PO. The course provides fundamental and advanced knowledge of linear integrated circuits including OP-AMP configurations, voltage regulators, multivibrators, filters, amplifiers and power supplies. This helps students develop a comprehensive understanding of analog electronic circuits.

PO2: Practical, Professional, and Procedural Knowledge

Students learn the procedures for designing and analyzing OP-AMP circuits, filters and regulated power supplies. These activities enhance their

practical and professional skills in electronic circuit design.Therefor all CO relate this PO.

PO3: Entrepreneurial Mindset and Knowledge

CO2, CO4 to CO7 relates this PO. Students can design electronic circuits

used in real-world products like amplifiers and power supplies.These

skills help students to develop electronics-based startup ideas and products.

PO4: Specialized Skills and Competencies

CO1, CO2, CO3, CO4, CO5, CO6, CO7-The course develops specialized skills in designing analog electronic circuits. Hence Students gain core

competency in linear IC design.

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

All the COs relats to enhances analytical and problem-solving ability.

PO6: Communication Skills and Collaboration

Students explain circuit operation, perform experiments, and present results.CO2, CO4, CO5, CO6, CO7 helps to improves technical communication skills

PO7: Research-related Skills

CO1, CO2, CO3, CO4, CO5, CO6, CO7 develops research and investigation ability of Students to study different IC configurations and circuit techniques.

PO8: Learning How to Learn Skills

CO1, CO2, CO3, CO4, CO5, CO6, CO7 Promotes self-learning ability and learn circuit design concepts and apply them independently.

PO9: Digital and Technological Skills

CO1, CO2, CO3, CO4, CO5, CO6, CO7 Enhances technological skills. Students use simulation tools and modern electronics technology for design.

PO11: Value Inculcation and Environmental Awareness

CO4, CO7 Promotes energy efficiency awareness by learning efficient power supply and voltage regulation.

PO12: Autonomy, Responsibility, and Accountability

CO2, CO4, CO5, CO6, CO7 Develops responsibility and accountability of independently design circuits and complete assignments.

PO13: Multicultural Competence, Inclusive Spirit, and Empathy

CO7: Team-based interfacing projects encourage collaboration among diverse learners. Students learn to respect different approaches to problem-solving. This nurtures inclusive teamwork skills in technical environments.

CBCS Syllabus as per NEP 2020 for T. Y. B.Sc. Electronics (SEM V) (2024 Pattern)

Name of the Program : B.Sc. Electronics
Program Code : USEL
Class : T. Y. B.Sc.
Semester : V
Course Type : Major Mandatory (Theory)
Course Code : ELE-304-MRM
Course Title : Advanced C Language
No. of Credits : 02
No. of Teaching Hours : 30

Course Objectives

1. To understand the concept of pointers and their declaration, initialization, and usage in C programming.
2. To develop the ability to manipulate arrays and functions using pointers effectively.
3. To learn string handling techniques including length, copy, concatenation, and comparison operations.
4. To understand dynamic memory allocation and its practical applications in C.
5. To gain knowledge of file handling operations including reading, writing, and appending data files.
6. To understand the concept and implementation of structures for organizing complex data.
7. To introduce basic computer graphics concepts and implement graphical functions in C.

Course Outcomes

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

CO1: Use pointers efficiently for array handling and function parameter passing in C programs.
CO2: Perform various string operations using standard and user-defined functions.
CO3: Apply dynamic memory allocation techniques in problem-solving programs.
CO4: Create, read, write, and append files using appropriate file handling functions.
CO5: Design and implement programs using structures to manage grouped data.
CO6: Develop simple graphical applications using basic graphics functions and commands.
CO7: Integrate pointers, strings, files, structures, and graphics concepts to build complete C programs.

Topics and Learning Points

Unit 1: Pointers and String [10 L]

Pointers: declarations, initialization, passing pointers to arrays, passing pointers to a function, programming examples.

String: Declaring and initializing string, Operations on string: string length, string size, string copy, string concatenation, string compare, programming examples.

Unit 2: File Handling and Structure [10 L]

Dynamic memory allocation functions. File: 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	3	1	1	1	3	-	-	-	-
CO2	3	3	1	1	3	1	3	2	3	-	-	-	-
CO3	3	3	1	3	3	-	3	3	3	-	-	-	-
CO4	2	3	-	1	3	1	3	1	3	-	-	3	-
CO5	3	3	-	3	3	2	1	1	3	-	-	3	-
CO6	2	3	2	3	3	2	1	3	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 gain strong conceptual knowledge of pointers, strings, dynamic memory, file handling, structures, and graphics. The course builds a complete understanding of C programming fundamentals and their integration. This enables learners to comprehend both theoretical and applied programming aspects.

PO2: Practical, Professional, and Procedural Knowledge

CO1–CO7: The course emphasizes hands-on coding using pointers, files, structures, and graphics. Students follow systematic programming procedures and good coding practices.
This prepares them for professional programming and laboratory work.

PO3: Entrepreneurial Mindset and Knowledge

CO6, CO7: Through graphical and integrated applications, students develop creativity and innovation. They learn how programming concepts can be used to build useful software tools.
This nurtures an entrepreneurial outlook toward software solution development.

PO4: Specialized Skills and Competencies

CO3, CO5, CO6, CO7: Students acquire specialized skills in dynamic memory allocation, structured data handling, and graphics programming. These competencies enable them to design efficient and structured C programs. The integration tasks further strengthen domain-specific expertise.

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

CO1–CO7: Learners analyze programming problems and implement optimized solutions using various C concepts. Activities like memory management, file operations, and graphics enhance analytical thinking. Students develop strong logical reasoning and debugging abilities.

PO6: Communication Skills and Collaboration

CO5, CO7: Students document programs, display structured outputs, and explain program logic.
Group work in integrated applications promotes teamwork and technical communication.
This improves clarity in presenting computational solutions.

PO7: Research-related Skills

CO2, CO3, CO4, CO7: Students explore different methods for string handling, memory allocation, and file processing. They evaluate efficiency and correctness of programs through experimentation. This cultivates investigation and research orientation in programming.

PO8: Learning How to Learn Skills

CO3, CO6, CO7: Students learn to independently explore new library functions and graphics commands. They adapt to new programming challenges and debugging situations. This builds lifelong learning ability in software development.

PO9: Digital and Technological Skills

CO1–CO7: The course develops strong digital programming skills using modern C tools and libraries.
Students gain confidence in handling memory, files, data structures, and graphics.
These are essential technological competencies for computing fields.

PO10: Community Engagement and Service
CO7: Integrated programming tasks demonstrate real-world applications of C programs.
Students can design small utility programs useful for academic or community needs.
This connects technical learning with societal applications.

PO11: Value Inculcation and Environmental Awareness
CO7: Students practice ethical coding, proper data handling, and efficient resource usage.
They become aware of responsible computing practices. This promotes value-based professional behavior.

PO12: Autonomy, Responsibility and Accountability
CO4, CO5, CO7: Students independently manage files, structured data, and integrated projects.
They are responsible for correctness, testing, and documentation of programs. This builds accountability in software development tasks.

PO13: Multicultural Competence, Inclusive Spirit, and Empathy
CO7: Collaborative programming work encourages interaction with diverse peers. Students learn inclusive problem-solving approaches during project development.
This nurtures teamwork in multicultural environments

CBCS Syllabus as per NEP 2020 for T. Y. B.Sc. (2024 Pattern)

Name of the Program : B. Sc.

Program Code : **USEL**

Class : T. Y. B.Sc.

Semester : V

Course Type : **Major Mandatory (Practical)**

Course Code : **ELE-305-MRM**

Course Title : Hardware Practical

No. of Credits : 02

No. of Teaching Hours : 60

Course Objectives:

1. To understand and apply fundamental concepts of analog circuit design using operational amplifiers and ICs.
2. To design, build, and test wave shaping and signal conditioning circuits such as integrators, differentiators, clippers, and clampers.
3. To analyze and implement functional analog circuits including power supplies, function generators, converters, and filters.
4. To design and verify digital system circuits including combinational logic, counters, and code converters.
5. To develop skills in hardware implementation, testing, and troubleshooting of analog and digital circuits.
6. To enhance practical understanding through simulation, experimentation, and performance analysis of electronic systems.
7. To encourage innovation, teamwork, and experiential learning through open-ended projects, industrial visits, or hands-on training activities.

Course Outcomes

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

CO1: Design and analyze analog wave shaping circuits, power supplies, and op-amp based applications.
CO2: Implement and test signal generation and conversion circuits such as function generators, V–F and F–V converters.
CO3: Design and evaluate active filters with desired frequency responses using standard ICs.
CO4: Design, implement, and verify digital combinational and sequential circuits including counters, encoders, and comparators.
CO5: Use appropriate measurement instruments and tools to test, debug, and validate circuit performance.
CO6: Integrate theoretical knowledge with practical hardware realization and documentation of experimental results.
CO7: Demonstrate professional skills, innovation, and problem-solving ability through industrial exposure, workshops, or open-ended projects.

There are 15 Experiments (11 practical +2Activity) in Paper ELE-305-MRM Hardware Practical

Group A: Analog Circuit Design

1. Wave shaping circuits (Integrator / differentiator circuit)
2. Op-amp based clipper and clampers
3. Log amplifier using opamp
4. Regulated power supply using IC 723 (Low and High Voltage,1A Current)
5. Function generator using 8038/2206 or any equivalent IC
6. Design of monostable multivibrator using IC 555
7. To design, build and test second order Butterworth active Low Pass/ High Pass/ Band Pass/ Band Reject Filter (any two)

8.V to F converter.

9.F to V converter.

Group B: Digital System Design

1.Combinational Lock

2.Keyboard Encoder

3.Design of 4 bit up counter.

4.Design of Mod counter.

5. Design of Magnitude Comparators.

6.Design Gray to binary and Binary to Gray.

Group C: ACTIVITY:

Any one of the following activities will be considered as equivalent to 2 experiments.

1. Any two additional experiments than specified from any Group.
2. Industrial /field Visit
3. Hands on training Workshop
4. Do it Yourself Open ended Project

Mapping Table:

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

PO1: Comprehensive Knowledge and Understanding

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

The course provides comprehensive knowledge in analog circuit design, digital system design, and practical experimentation. Students gain strong conceptual understanding of electronic components, circuits, and systems through design, implementation, and testing activities across all course outcomes.

PO2: Practical, Professional, and Procedural Knowledge

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

Students acquire procedural and professional skills through hands-on design, simulation, hardware implementation, and troubleshooting of analog and digital circuits. Laboratory practices and structured experimentation strongly contribute to this outcome.

PO3: Entrepreneurial Mindset and Knowledge
CO5, CO6, CO7
Open-ended projects, DIY activities, and system-level designs encourage innovation, creativity, and entrepreneurial thinking. Students learn to convert technical ideas into workable solutions with potential practical and commercial relevance.

PO4: Specialized Skills and Competencies
CO1, CO2, CO3, CO4, CO5, CO6, CO7
The course develops specialized competencies in op-amp applications, power supplies, signal generators, filters, counters, and code converters. Students demonstrate advanced technical skills through circuit design, analysis, and performance evaluation.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning
CO1, CO2, CO3, CO4, CO5, CO6, CO7
Students apply theoretical knowledge to solve real-world engineering problems by designing, testing, and analyzing analog and digital systems. Analytical reasoning is strengthened through debugging, optimization, and performance comparison of circuits.

PO6: Communication Skills and Collaboration
CO2, CO3, CO4, CO5, CO6, CO7
Students develop communication and teamwork skills by preparing laboratory records, presenting experimental observations, and working collaboratively during experiments, workshops, industrial visits, and group-based activities.

PO7: Research-related Skills
CO1, CO3, CO4, CO5, CO6, CO7
The course promotes research aptitude through experimentation, observation, analysis of results, and comparison with theoretical expectations. Open-ended experiments and projects enhance inquiry-based learning and research-oriented thinking.

PO8: Learning How to Learn Skills
CO1, CO2, CO3, CO4, CO5, CO6, CO7
Students are encouraged to independently explore datasheets, application notes, and new ICs, fostering self-learning and adaptability. Exposure to evolving technologies supports continuous and lifelong learning.

PO9: Digital and Technological Skills
Mapped COs: CO1, CO2, CO3, CO4, CO5, CO6, CO7
Strong digital and technological skills are developed through the use of simulation tools, digital ICs, counters, encoders, converters, and modern laboratory instruments, aligning with contemporary engineering practices.

PO10: Community Engagement and Service
CO7Industrial visits, workshops, and real-world projects expose students to societal and industrial needs, encouraging awareness of community engagement and service-oriented engineering applications.

PO11: Value Inculcation and Environmental Awareness
CO7 Students develop professional ethics, discipline, and responsible laboratory practices. Awareness regarding efficient design, resource utilization, and environmental considerations is fostered through practical exposure and project work.

PO12: Autonomy, Responsibility and Accountability
CO5, CO6, CO7Independent experimentation, project execution, and activity-based learning cultivate autonomy, responsibility, and accountability in completing assigned tasks and achieving learning objectives.

PO13: Multicultural Competence, Inclusive Spirit, and Empathy
CO7 Collaborative learning during group experiments, workshops, and projects encourages teamwork, inclusiveness, mutual respect, and empathy among students from diverse backgrounds.

CBCS Syllabus as per NEP 2020 for T. Y. B.Sc. Electronics (SEM V)
(2026 Pattern)

Name of the Programme : B.Sc. Electronics

Programme Code : **USEL**

Class : T. Y. B.Sc.

Semester : V

Course Type : Major Mandatory (Practical)

Course Code : ELE-306-MRM

Course Title : Software Practical's

No. of Credits : 02

No. of Teaching Hours : 60

Course Objectives:

1. To learn the basic embedded C-Programming.
2. To learn Verilog HDL to design basic combinational and sequential circuits
3. To get familiar with structural, data flow and behavioral modeling
4. To learn assembly level language of 8051 microcontroller
5. To Understand assembly language for programming
6. To develop 8051 microcontroller based systems.
7. To learn hobby project

Course Outcomes:

After completing the course, the students will be able to

CO1: Develop and simulate design digital systems using Verilog.
CO2: Design and develop AVR microcontroller based systems.
CO3: Understand c language programming.
CO4: Increase problem-solving skills, creativity, algorithmic etc.
CO5: sequential and computational thinking skills.
CO6: Understand assembly language for programming
CO7: inculcate basic skills required for design and development of embedded Systems.

List

Digital System Design using Verilog

1. Design logic gates using gate level/data flow/Structural/Behavioral style of modeling
2. Design 4 to 1 line MUX/ 1 to 4 DEMUX
   Use a) gate level b) data flow c) Structural d) Behavioral style of modeling
3. Arithmetic circuits: Half adder, Full adder (using gate level , Data flow modeling) and Parallel adder using structural modeling

4. Four bit ALU design.
5. Design of flip-flops : R-S, J-K, D and T using behavioral modeling
6. Code converters
7. Binary Adder
8. Counters. (Up counter/down counter, ring counter)
9. Shift Registers (SIPO/SISO/PISO/PIPO)

8051 Microcontroller

1. Program to find Largest/smallest from a series.
2. Arithmetic, logical problems using embedded C programming
3. Code conversion problems using embedded C programming
4. Factorial Calculation
5. Sum of First N Natural Numbers
6. Swapping Two Numbers
7. Fibonacci Sequence (First 10 Numbers)
8. Checking Prime Number
9. Timer/Counter Programming.

Activity

1. PCB Making using simulator
2. Internet browsing
3. Industrial /field Visit
4. Hands on training workshop
5. Hobby Project

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

Mapping

PO1: Comprehensive Knowledge and Understanding

- Supported by **CO1, CO2, CO3, CO6, CO7**
- The course develops strong foundational knowledge in **digital systems (Verilog), C programming, assembly language, AVR microcontrollers, and embedded systems**, ensuring conceptual clarity and domain understanding.

PO2: Practical, Professional, and Procedural Knowledge

- Supported by **CO1, CO2, CO6, CO7**
- Students gain hands-on exposure to **hardware description language, microcontroller interfacing, low-level programming, and embedded system development**, enhancing professional competency.

PO3: Entrepreneurial Mindset and Knowledge

- Supported by **CO2, CO4, CO7**
- Designing microcontroller-based and embedded systems encourages **innovation, product-oriented thinking, and real-world application development**, fostering entrepreneurial abilities.

PO4: Specialized Skills and Competencies

- Supported by **CO1, CO2, CO6, CO7**
- The course imparts specialized technical skills in **digital design, microcontroller programming, assembly coding, and embedded system development**.

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

- Supported by **CO3, CO4, CO5**
- C programming, algorithm development, and computational thinking enhance **logical reasoning, debugging skills, and analytical problem-solving capabilities**.

PO6: Communication Skills and Collaboration

- Supported by **CO4, CO7**
- Implementation of projects and lab activities requires **documentation, teamwork, discussion of design approaches, and presentation of solutions**.

PO7: Research-related Skills

- Supported by **CO1, CO2, CO6, CO7**

- Students explore **simulation tools, microcontroller datasheets, debugging techniques, and embedded system optimization**, encouraging investigative and research-oriented learning.

PO8: Learning How to Learn Skills

- Supported by **CO4, CO5**
- Algorithmic thinking and computational logic promote **self-learning ability, adaptability, and continuous skill enhancement**.

PO9: Digital and Technological Skills

- Supported by **CO1, CO2, CO3, CO6, CO7**
- Use of **simulation software, programming environments, and hardware tools** strengthens digital proficiency.

PO10: Multicultural Competence, Inclusive Spirit, and Empathy

- Minimally addressed through **CO4**
- Collaborative learning activities promote inclusive participation and peer learning.

PO11: Value Inculcation and Environmental Awareness

- Supported by **CO2, CO7**
- Embedded system design encourages **efficient hardware utilization and low-power system development**, contributing to sustainability awareness.

PO12: Autonomy, Responsibility, and Accountability

- Supported by **CO7**
- Independent project design and implementation cultivate **ownership, responsibility, and accountability in system development**.

PO13: Community Engagement and Service

- Supported by **CO2, CO7**
- Embedded and microcontroller-based systems can be applied to **real-life community problems such as automation, monitoring, and assistive devices**.

CBCS Syllabus as per NEP 2020 for T. Y. B.Sc. (2024 Pattern)

Name of the Program : B. Sc.

Program Code : **USEL**

Class : T. Y. B.Sc.

Semester : V

Course Type : **Major Elective (Theory)**

Course Code : **ELE-307-MJE(A)**

Course Title : Principle of OFC

No. of Credits : 02

No. of Teaching Hours : 30

Course Objectives:

1. To understand the fundamentals, history, and basic structure of optical fiber communication systems.
2. To study optical fiber materials, fabrication techniques, cables, joints, connectors, and splicing methods.
3. To explain the principles of light propagation in optical fibers, including numerical aperture and acceptance angle.

4. To analyze different types of optical fibers, their specifications, advantages, and applications.
5. To understand transmission characteristics such as attenuation, dispersion, and pulse broadening in optical fibers.
6. To study optical sources and detectors, including their operating principles, characteristics, and performance parameters.
7. To analyze modulation and noise effects in optical sources and detectors used in communication systems.

Course Outcomes

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

CO1: Explain the working principle and block diagram of optical fiber communication systems.
CO2. Identify and compare different optical fiber materials, fabrication methods, and types of fibers.
CO3: Analyze light propagation characteristics and calculate parameters such as numerical aperture and acceptance angle.
CO4: Evaluate transmission losses and dispersion effects in optical fibers and their impact on system performance.
CO5: Measure and interpret optical parameters such as attenuation and dispersion in fiber links
CO6: Describe the working principles, characteristics, and modulation techniques of LEDs and laser diodes.
CO7: Analyze the operation, noise characteristics, and performance of optical detectors such as PIN and APD

UNIT 1: Overview of Optics and Optical Fiber Communication 10L

History of fiber optic systems, block diagram, Fiber material, fiber cables and fiber fabrication, fiber joints, fiber connectors, splicer, Propagation of light in optical fiber, acceptance angle, numerical aperture, Types and specification of optical fiber, Advantages of optical fiber communication, applications

UNIT 2: Transmission Characteristics of Optical Fiber 10L

Attenuation, absorption, linear and nonlinear scattering losses, bending losses, modal dispersion, waveguide dispersion and pulse broadening, Dispersion shifted and dispersion flattened fibers, Measurement of optical parameters, attenuation and dispersion

UNIT 3: Optical Sources and Detectors Sources 10L

Coherent and non-coherent sources, quantum efficiency, modulation capability of optical sources, Working principle and characteristics of - LEDs, Laser diodes, Modulation in laser diodes, Detectors: PIN and APD, Noise analysis in optical detectors.

RECOMMENDED BOOKS:

1. Optical fiber communication – Principles and practice, J.M. Senior, PHI

2. Fiber optics and Optoelectronics, R.P. Khare, Oxford University Press

3. Optical fiber communication, G. Kaiser McGraw Hill

Mapping Table:

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

PO1: Comprehensive Knowledge and Understanding
Mapped COs: CO1, CO2, CO3, CO4, CO5, CO6, CO7
The course builds comprehensive knowledge of optics and optical fiber communication systems, including fiber structure, propagation, transmission characteristics, sources, detectors, and applications. All course outcomes contribute to strengthening conceptual and theoretical understanding of the subject.

PO2: Practical, Professional, and Procedural Knowledge
Mapped COs: CO1, CO2, CO3, CO4, CO5, CO6, CO7
Students gain procedural and professional knowledge through the study of optical measurements,

attenuation and dispersion analysis, source and detector characteristics, and system-level understanding. Emphasis on performance parameters and measurement techniques enhances professional competence.

PO3: Entrepreneurial Mindset and Knowledge
Mapped COs: CO5, CO6, CO7
Knowledge of optical communication technologies, modern fiber systems, and optoelectronic devices encourages innovative thinking. Understanding real-world applications of fiber optics supports entrepreneurial awareness in communication and networking domains.

PO4: Specialized Skills and Competencies
Mapped COs: CO1, CO2, CO3, CO4, CO5, CO6, CO7
The course develops specialized skills in analyzing light propagation, fiber losses, dispersion mechanisms, modulation of optical sources, and detector noise characteristics. These competencies are essential for careers in optical communication and photonics.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning
Mapped COs: CO1, CO2, CO3, CO4, CO5, CO6, CO7
Students apply theoretical concepts to analyze fiber transmission losses, dispersion effects, and system performance. Problem-solving skills are strengthened through evaluation of optical parameters and selection of suitable fibers, sources, and detectors.

PO6: Communication Skills and Collaboration
Mapped COs: CO2, CO3, CO4, CO5, CO6, CO7
The course enhances technical communication through interpretation of optical characteristics, explanation of system behavior, and presentation of analytical results. Collaborative learning is supported through discussions and problem-solving activities.

PO7: Research-related Skills
Mapped COs: CO1, CO3, CO4, CO5, CO6, CO7
Students develop research aptitude by analyzing transmission impairments, evaluating advanced fiber types such as dispersion-shifted fibers, and studying noise and modulation effects, fostering inquiry-based and analytical thinking.

PO8: Learning How to Learn Skills
Mapped COs: CO1, CO2, CO3, CO4, CO5, CO6, CO7
The course encourages self-directed learning through the study of evolving optical technologies, standards, and device characteristics, promoting adaptability and lifelong learning.

PO9: Digital and Technological Skills
Mapped COs: CO1, CO2, CO3, CO4, CO5, CO6, CO7
Strong technological skills are developed through understanding modern optical communication systems, measurement techniques, optoelectronic devices, and system performance evaluation aligned with current industry practices.

PO10: Community Engagement and Service

Mapped COs: CO7

Awareness of the role of optical fiber communication in societal infrastructure such as telecommunications, internet connectivity, and data networks encourages appreciation of community-oriented technological applications.

PO11: Value Inculcation and Environmental Awareness

Mapped COs: CO7

Students gain awareness of professional ethics, responsible use of technology, and the importance of energy-efficient and sustainable communication systems through discussions on modern optical networks.

PO12: Autonomy, Responsibility and Accountability

Mapped COs: CO5, CO6, CO7

Independent analysis of optical systems, performance parameters, and device characteristics fosters responsibility and accountability in technical decision-making and learning.

PO13: Multicultural Competence, Inclusive Spirit, and Empathy

Mapped COs: CO7

Understanding global communication technologies and collaborative learning environments promotes inclusiveness, teamwork, and appreciation of diverse perspectives in engineering practice.

CBCS Syllabus as per NEP 2020 for F. Y. B.Sc. (2024 Pattern)

Name of the Program : B. Sc.

Program Code : **USEL**

Class : T. Y. B.Sc.

Semester : V

Course Type : **Major Elective (Practical)**

Course Code : **ELE-308-MJE(A)**

Course Title : OFC LAB

No. of Credits : 02

No. of Teaching Hours : 60

Course Objectives:

1. To understand practical aspects of optical fiber propagation, losses, and transmission characteristics through laboratory measurements.
2. To study and analyze numerical aperture, bending loss, and propagation loss in optical fibers using standard experimental methods.
3. To gain hands-on experience in fiber optic link establishment, including voice communication systems.
4. To understand fiber termination, polishing, connectors, couplers, and cables used in optical communication networks.

5. To design, build, and test fiber optic transmitter and receiver circuits.
6. To study the characteristics of optical sources and detectors, including LEDs, laser diodes, and photodetectors.
7. To enhance professional, experimental, and problem-solving skills through industrial visits, workshops, or open-ended projects.

Course Outcomes:-

CO1: Measure and analyze propagation loss and bending loss in optical fibers.

CO2: Determine the numerical aperture and evaluate light acceptance characteristics of optical fibers.

CO3: Set up and test fiber optic communication links for voice transmission.

CO4:Perform fiber termination, polishing, splicing, and connectorization using standard practices.

CO5:Design, implement, and test fiber optic transmitter and receiver systems.

CO6: Analyze I–V characteristics and performance parameters of fiber optic LEDs, laser diodes, and photodetectors.

CO7: Demonstrate professional competence, teamwork, and practical problem-solving ability through industrial exposure, hands-on training, or open-ended projects.

Practical List:

1. To measure propagation loss in optical fibers
2. To measure bending loss in optical fibers
3. To set up fiber optic voice link
4. To measure Numerical Aperture of given optical fiber.
5. To study different methods of optical fiber terminations and polishing
6. To study fiber optic sensors and their applications
7. To design, build and test fiber optic Transmitter
8. To design, build and test of fiber optic Receiver
9. Visit to telecom facility for observing splicing, alignment, fusing, OTDR operation.
10. Study of Characteristics of LASER diode.
11.To study different types of connectors, couplers and cables.
12. Study of I-V Characteristics of Fiber optic LED and Photodetector.

ACTIVITY:

Any one of the following activities will be considered as equivalent to 2 experiments.

1. Industrial /field Visit
2. Hands on training Workshop
3. Do it Yourself Open ended Project

Mapping Table:

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

PO1: Comprehensive Knowledge and Understanding
Mapped COs: CO1, CO2, CO3, CO4, CO5, CO6, CO7
The course provides comprehensive theoretical and practical knowledge in optical fiber communication systems. Students gain a strong understanding of fiber properties, transmission characteristics, optoelectronic devices, measurements, and real-world applications across all course outcomes.
PO2: Practical, Professional, and Procedural Knowledge
Mapped COs: CO1–CO7
Hands-on experiments such as loss measurement, numerical aperture determination, transmitter-receiver design, and industrial exposure develop procedural competence and professional laboratory practices

essential for engineering applications.

PO3: Entrepreneurial Mindset and Knowledge

Mapped COs: CO5, CO6, CO7

Design-oriented experiments, system implementation, and open-ended activities encourage innovation and application-driven thinking, supporting entrepreneurial awareness in optical communication and networking technologies.

PO4: Specialized Skills and Competencies

Mapped COs: CO1–CO7

The course develops specialized skills in fiber handling, splicing concepts, attenuation and dispersion analysis, optoelectronic device characterization, and system-level implementation, aligning with industry-specific competencies.

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

Mapped COs: CO1–CO7

Students apply theoretical concepts to practical problems such as loss evaluation, link setup, and system performance analysis. Analytical reasoning is strengthened through interpretation of experimental results and troubleshooting.

PO6: Communication Skills and Collaboration

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

Preparation of laboratory records, interpretation of results, group experiments, and industrial visits enhance technical communication skills and teamwork abilities.

PO7: Research-related Skills

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

Experimental analysis, observation, data interpretation, and comparison with theoretical expectations promote inquiry-based learning and foundational research skills.

PO8: Learning How to Learn Skills

Mapped COs: CO1–CO7

Exposure to evolving fiber technologies, measurement techniques, and device characteristics encourages self-learning, adaptability, and lifelong learning habits.

PO9: Digital and Technological Skills

Mapped COs: CO1–CO7

The course strengthens technological proficiency through modern optical communication systems, optoelectronic devices, instrumentation, and telecom practices.

PO10: Community Engagement and Service

Mapped COs: CO7

Industrial visits and real-world exposure highlight the role of optical fiber communication in societal infrastructure, promoting awareness of community-oriented engineering applications.

PO11: Value Inculcation and Environmental Awareness

Mapped COs: CO7

Students develop professional ethics, discipline, and awareness of sustainable and responsible use of communication technologies.

PO12: Autonomy, Responsibility, and Accountability

Mapped COs: CO5, CO6, CO7

Independent experimentation, system design tasks, and project-based activities foster responsibility, accountability, and autonomous learning.

PO13: Multicultural Competence, Inclusive Spirit, and Empathy

Mapped COs: CO7

Collaborative laboratory work, group activities, and exposure to global communication technologies promote inclusiveness, teamwork, and empathy.

CBCS Syllabus as per NEP 2020 for T. Y. B.Sc. (2024 Pattern)

Name of the Program **:** B. Sc.

Program Code **: USEL**

Class **:** T. Y. B.Sc.

Semester **:** V

Course Type **: Major Elective (Theory)**

Course Code **: ELE-307-MJE(B)**

Course Title **:** Arduino and its programming.

No. of Credits **:** 02

No. of Teaching Hours : 30

Course Objectives:

1. To introduce the fundamentals of embedded systems and Arduino platform.
2. To understand Arduino hardware architecture.
3. To study interfacing of sensors and peripherals using Arduino.
4. To develop basic Arduino-based electronic applications.
5. To understand **Embedded C programming concepts**.
6. To understand **serial communication, ADC, and PWM concepts** for practical implementation.

7. To identify and explain the **pin configuration of Arduino Uno,** including digital I/O pins, analog pins, clock system, reset circuitry, and onboard voltage regulation.

Course Outcomes:

CO1: Explain the fundamentals, block diagram, and applications of embedded systems.
CO2: Describe the architecture, features, and pin configuration of the Arduino Uno and ATmega328 microcontroller.
CO3: Understand the structure of Arduino programs and apply Embedded C concepts for microcontroller programming.
CO4: Develop and upload Arduino sketches using built-in functions and control structures in the Arduino IDE.
CO5: Interface basic input and output devices such as LEDs, switches, and push buttons with Arduino.
CO6: Implement sensor interfacing, ADC, PWM, and serial communication for real-time data acquisition and control.
CO7: Design simple embedded system applications using Arduino with proper debugging techniques.

Unit I: Introduction to Arduino and Embedded Systems 10

Embedded systems: definition, block diagram, and applications, History and evolution of Arduino, Advantages of Arduino, Arduino Uno board architecture, Block diagram of Arduino Uno, ATmega328 microcontroller: features, Pin configuration of Arduino Uno, Digital I/O pins, Analog input pins, Power pins, Clock system, reset circuitry, and onboard voltage regulation.

Unit II: Arduino Programming 10

Introduction to Arduino IDE, Structure of Arduino program (sketch), setup() function, loop() function, Basics of Embedded C programming, Data types, variables, and constants, Operators and expressions, Decision-making statements, Looping statements, Arduino built-in functions, pinMode(), digitalWrite(), digitalRead(), delay(), Program compilation and uploading process, Common programming errors and debugging basics.

Unit III: Interfacing and Applications 10

Interfacing LEDs with Arduino, Interfacing switches and push buttons, Interfacing sensors: Temperature sensor, Light Dependent Resistor (LDR), Analog to Digital Converter (ADC) in Arduino, Serial communication: UART basics, Serial Monitor, Pulse Width Modulation (PWM): concept and applications, Interfacing buzzer and relay.

Reference Books:

1. Embedded Systems: Architecture and Programming Author: Raj Kamal Publisher: McGraw Hill Education
2. Exploring Arduino: Tools and Techniques for Engineering Wizardry Author: Jeremy Blum Publisher: Wiley
3. G.K. Kanagachidambaresan, Role of Single Board Computers (SBCs) in Rapid IoT Prototyping, First edition (2021), Springer publication.
4. Dr. Charles Russell Severance, Python for everybody, First edition (2016).
5. Allen B. Downey, Think Python: How to Think Like a Computer Scientist, second edition (2015), O'Reilly publication

CO-PO Mapping:

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

CO-PO Mapping Justification:

PO1: Comprehensive Knowledge and Understanding:
CO1: Explaining the fundamentals, block diagram and applications of embedded systems demonstrates comprehensive engineering knowledge of embedded system concepts and real-world applications.
CO2: Describing the architecture, features, and pin configuration of Arduino Uno and ATmega328 reflects strong understanding of microcontroller hardware and system design principles.
CO5: Interfacing LEDs, switches, and push buttons with Arduino illustrates foundational knowledge of digital input/output operations and hardware integration concepts.
CO7: Designing simple embedded applications with Arduino and applying debugging techniques demonstrates integrated knowledge of hardware, software, and systematic problem-solving skills.

PO2: Practical, Professional, and Procedural Knowledge:
CO1: Explaining embedded system fundamentals and block diagrams provides practical and procedural knowledge required to understand real-world embedded system design and applications.
CO3: Applying Embedded C concepts in Arduino programming builds procedural programming skills necessary for professional microcontroller-based system development.
CO5: Interfacing LEDs, switches, and push buttons with Arduino strengthens practical knowledge of hardware integration and real-time input/output handling.

CO6: Implementing sensor interfacing, ADC, PWM, and serial communication develops applied technical skills required for professional real-time data acquisition and control systems.

PO3: Entrepreneurial Mindset and Knowledge:
CO1: Understanding embedded system fundamentals and applications enables identification of innovative product opportunities and market-driven embedded solutions.
CO2: Knowledge of the architecture and features of Arduino Uno and ATmega328 supports cost-effective hardware selection and prototype development for entrepreneurial ventures.
CO4: Developing and uploading sketches using the Arduino IDE fosters rapid prototyping skills essential for startup product development and innovation.
CO6: Implementing sensor interfacing, ADC, PWM, and serial communication enhances the ability to develop smart, data-driven systems aligned with emerging industry demands.
CO7: Designing and debugging embedded applications cultivates problem-solving, innovation, and product development skills necessary for entrepreneurial success in embedded technology.

PO4: Specialized Skills and Competencies:
CO2: Describing the architecture and pin configuration of Arduino Uno and ATmega328 develops specialized hardware analysis and microcontroller configuration skills.
CO3: Applying Embedded C concepts in Arduino programming strengthens specialized coding and firmware development competencies for microcontroller-based systems.
CO4: Developing and uploading sketches using the Arduino IDE enhances technical proficiency in embedded software implementation and testing.
CO7: Designing and debugging embedded applications builds specialized problem-solving abilities and

system-level integration skills in embedded engineering.

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

CO1: Explaining embedded system fundamentals enhances analytical reasoning to understand system components and their functional relationships in practical applications.

CO3: Applying Embedded C concepts in Arduino programs develops logical thinking and structured problem-solving skills in microcontroller programming.

CO4: Developing and uploading sketches using the Arduino IDE builds practical competence in implementing solutions and analyzing program behavior.

CO5: Interfacing LEDs, switches, and push buttons improves the ability to apply theoretical knowledge to solve real-time input/output integration problems.

CO6: Implementing sensor interfacing, ADC, PWM, and serial communication enhances analytical skills for data interpretation and real-time control system design.

PO6: Communication Skills and Collaboration:

CO2: Describing the architecture and pin configuration of Arduino Uno and ATmega328 strengthens technical documentation and collaborative hardware discussion skills.

CO3: Understanding Arduino program structure and applying Embedded C concepts improves the ability to write clear, structured code that can be shared and maintained within a development team.

CO4: Developing and uploading sketches using the Arduino IDE promotes collaborative software development, testing, and presentation of working prototypes.

CO6: Implementing sensor interfacing, ADC, PWM, and serial communication enhances the ability to present data, interpret results, and collaborate on real-time system integration tasks.

PO7: Research-related Skills:

CO2: Analysing the architecture and features of Arduino Uno and ATmega328 enhances investigative skills in understanding microcontroller-based system design.

CO4: Developing and uploading sketches using the Arduino IDE promotes collaborative software development, testing, and presentation of working prototypes.

CO5: Interfacing basic input/output devices builds teamwork skills through coordinated hardware setup, testing, and troubleshooting activities.

CO7: Designing and debugging embedded applications fosters effective communication of problem-solving approaches and collaborative improvement of embedded system solutions.

PO8: Learning How to Learn Skills:

CO1: Understanding embedded system fundamentals fosters self-directed learning by enabling students to independently explore new embedded technologies and applications.

CO3: Applying Embedded C concepts in Arduino programming develops the ability to learn new programming frameworks and adapt to different embedded development environments.

CO5: Interfacing basic input/output devices promotes experiential learning through hands-on experimentation and iterative improvement.

CO6: Implementing sensor interfacing, ADC, PWM, and serial communication strengthens the capacity to acquire new technical skills for emerging real-time and IoT-based applications.
CO7: Designing and debugging embedded applications cultivates reflective learning, enabling continuous skill enhancement and adaptation to advanced embedded system challenges.

PO9: Digital and Technological Skills:
CO1: Explaining embedded system fundamentals enhances digital literacy by understanding core technological components and their integration in modern electronic systems.
CO2: Describing the architecture and pin configuration of Arduino Uno and ATmega328 strengthens technological competence in handling microcontroller-based hardware platforms.
CO4: Developing and uploading sketches using the Arduino IDE enhances proficiency in using digital development tools and integrated programming environments.
CO5: Interfacing LEDs, switches, and push buttons develops practical technological skills in digital input/output configuration and circuit implementation.

CO6: Implementing sensor interfacing, ADC, PWM, and serial communication advances digital system integration skills for real-time monitoring and control applications.

PO10: Multicultural Competence, Inclusive Spirit, and Empathy:
CO1: Understanding embedded system fundamentals promotes awareness of globally relevant technologies that address diverse societal needs across cultures.
CO4: Developing sketches using the Arduino IDE promotes shared learning experiences and respectful collaboration in multicultural project teams.
CO5: Interfacing input/output devices in group activities builds cooperation, peer support, and empathy during hands-on hardware integration tasks.
CO7: Designing and debugging embedded applications nurtures teamwork, mutual respect, and inclusive problem-solving approaches in embedded system development environments.

PO11: Value Inculcation and Environmental Awareness:
CO2: Studying Arduino Uno and ATmega328 architecture encourages conscious hardware selection for sustainable and efficient designs.
CO3: Applying Embedded C concepts fosters disciplined coding practices and mindful resource usage in microcontroller programming.
CO6: Implementing sensors, ADC, PWM, and communication systems promotes eco-friendly and energy-efficient real-time solutions.
CO7: Designing and debugging embedded applications nurtures responsible engineering choices and sustainable problem-solving.

PO12: Autonomy, Responsibility, and Accountability:

CO1: Understanding embedded systems builds independent learning and responsible application of core concepts.

CO3: Applying Embedded C concepts fosters self-directed programming and responsible coding practices.

CO5: Interfacing I/O devices promotes responsible handling of hardware and independent problem-solving.

CO6: Implementing sensors, ADC, PWM, and communication strengthens accountability in real-time system design.

PO13: Community Engagement and Service:

CO1: Understanding embedded systems enables development of technologies that benefit communities.

CO2: Studying Arduino Uno supports creating accessible and low-cost solutions for societal needs.

CO5: Interfacing I/O devices promotes hands-on projects that can be used in community service.

CO7: Designing and debugging embedded applications fosters practical, service-oriented technology solutions for societal benefit.

CBCS Syllabus as per NEP 2020 for T. Y. B.Sc. (2024 Pattern)

Name of the Program : B. Sc.
Program Code : **USEL**
Class : T. Y. B.Sc.
Semester : V
Course Type : **Major Elective (Practical)**
Course Code : **ELE-308-MJE(B)**
Course Title : Arduino Practicals.
No. of Credits : 02
No. of Teaching Hours : 30

Course Objectives:

1. To familiarize students with the Arduino architecture, components, and pin configuration.
2. To install and effectively use the Arduino IDE for writing, compiling, and uploading programs to the Arduino board.
3. To understand and implement digital output control through LED blinking and multiple LED interfacing.
4. To apply decision-making and looping statements in Arduino programs for control applications.
5. To understand and implement serial communication for data monitoring and debugging.
6. To study and perform analog-to-digital conversion (ADC) for sensor-based applications.
7. To interface LDR, Relay, Buzzer using Arduino. To generate and apply PWM signals for controlling output devices.

Course Outcomes:

Course Outcomes (COs)

CO1: Understand the architecture, pin configuration, and working principles of the Arduino Uno board.

CO2: Install, configure, and effectively use the Arduino IDE for writing, compiling, and uploading programs.

CO3: Develop and implement basic digital output applications such as LED blinking, multiple LED control, buzzer interfacing, and relay interfacing.

CO4: Interface and program digital input devices including switches and PIR sensors for real-time control applications.

CO5: Design and implement display systems using 7-segment displays and demonstrate serial communication for data monitoring.

CO6: Analyze and utilize Analog-to-Digital Conversion (ADC) for interfacing analog sensors such as LDR and temperature sensors.

CO7: Generate and control PWM signals for variable output applications and build integrated mini-projects using multiple sensors and actuators.

Practical List:

1. Study of Arduino Uno Board.
2. Installation and Familiarization of Arduino IDE.
3. LED Blinking using Arduino.
4. Multiple LED Control.
5. Digital Input – Switch Interfacing.
6. Interfacing 7 segment display.
7. PIR interfacing.
8. Serial Communication Basics.
9. ADC Operation in Arduino.
10. LDR Interfacing with Arduino.
11. Temperature Sensor Interfacing.
12. PWM Output using Arduino.
13. Buzzer Interfacing.
14. Relay Interfacing.

Activity: Any One Activity (Equivalent to two Practical)

1. Internet browsing
2. software simulator
3. Hands on training workshop
4. Do it Yourself Open ended Project

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13

CO1	3	2	-	-	2	-	-	2	3	-	-	2	-
CO2	2	3	-	2	-	-	-	2	3	-	-	2	-
CO3	-	3	-	3	2	-	-	1	3	-	-	2	-
CO4	-	2	2	-	-	-	-	2	3	-	-	2	-
CO5	2	-	-	3	3	2	2	2	-	-	-	2	-
CO6	3	3	2	-	3	1	2	2	-	-	2	2	1
CO7	3	-	3	3	-	2	2	2	-	1	2	3	2

CO-PO Mapping:

CO-PO Mapping Justification:

PO1: Comprehensive Knowledge and Understanding:
CO1: Provides fundamental knowledge of Arduino architecture, components, and pin configuration.
CO2: Enhances understanding of software tools and program development workflow in embedded systems.
CO5: Builds knowledge of serial communication concepts for monitoring and debugging systems.
CO6: Provides theoretical and practical understanding of ADC and sensor integration principles.
CO7: Expands comprehensive knowledge of device interfacing and PWM-based control mechanisms.

PO2: Practical, Professional, and Procedural Knowledge:
CO1: Develops practical understanding of Arduino hardware structure and proper pin configuration procedures.
CO2: Trains students in professional use of the Arduino IDE for coding, compiling, and program uploading.
CO3: Enhances hands-on skills in implementing digital output circuits and LED interfacing techniques.
CO4: Enhances hands-on skills in implementing digital output circuits and LED interfacing techniques.
CO6: Provides procedural knowledge of performing ADC and integrating sensors in embedded systems.

PO3: Entrepreneurial Mindset and Knowledge:
CO4: Develops logical programming skills required for designing smart control-based products.
CO6: Promotes innovation in sensor-based systems applicable to smart and IoT-based ventures.
CO7: Enables design of real-time automation systems (LDR, relay, PWM control) suitable for entrepreneurial projects.

PO4: Specialized Skills and Competencies:
CO2: Builds technical proficiency in using the Arduino IDE for embedded program development.
CO3: Enhances specialized skills in digital output control and multiple device interfacing.

CO5: Develops expertise in serial communication for system monitoring and debugging.
CO7: Enhances integrated system design skills through peripheral interfacing and PWM-based control applications.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning:
CO1: Enables analytical understanding of Arduino hardware structure for effective system application.
CO3: Enhances application skills through implementation and debugging of digital output circuits.
CO5: Builds problem-solving ability through real-time data monitoring and serial debugging techniques.
CO6: Promotes analytical thinking in interpreting ADC values and sensor data for practical applications.

PO6: Communication Skills and Collaboration:
CO5: Strengthens technical communication through presentation and interpretation of serial monitoring data.
CO6: Facilitates collaborative analysis of sensor readings and ADC results in practical sessions.
CO7: Enhances teamwork and coordinated implementation of integrated hardware projects using multiple peripherals.

PO7: Research-related Skills:
CO5: Enhances research capability through systematic monitoring and interpretation of serial data.
CO6: Develops data collection and analytical skills using ADC and sensor-based experimentation.
CO7: Supports prototype development and experimental validation of integrated hardware control systems.

PO8: Learning How to Learn Skills:
CO1: Encourages self-exploration of Arduino hardware features and independent understanding of board architecture.
CO2: Develops self-learning ability through independent installation, coding practice, and troubleshooting in the IDE.
CO3: Promotes experiential learning by experimenting with digital outputs and circuit variations.
CO4: Enhances adaptive learning by practicing different programming logic structures for control tasks.
CO5: Encourages reflective learning through debugging and analyzing serial communication outputs.
CO6: Develops continuous learning skills by interpreting sensor data and refining ADC-based applications.
CO7: Fosters independent project-based learning through integration of peripherals and PWM control techniques.

PO9: Digital and Technological Skills:
CO1: Understanding Arduino architecture, components, and pin configuration develops foundational digital hardware and embedded system knowledge.
CO2: Installing and using the Arduino IDE enhances practical software tool proficiency for coding, compiling, and hardware interfacing.
CO3: Implementing LED control strengthens hands-on skills in digital output programming and circuit interfacing.
CO4: Applying decision-making and looping statements builds logical thinking and programming competence for real-time control systems.

PO10: Multicultural Competence, Inclusive Spirit, and Empathy:
CO7: Developing automation projects with LDR, relay, buzzer, and PWM fosters teamwork and socially responsible innovation for community-oriented applications.

PO11: Value Inculcation and Environmental Awareness:
CO6: Performing ADC for sensor applications enables environmental monitoring solutions such as temperature, light, and pollution sensing.
CO7: Interfacing LDR, relay, buzzer, and PWM supports the development of eco-friendly automation systems for energy saving and environmental protection.

PO12: Autonomy, Responsibility, and Accountability:
CO1: Understanding Arduino architecture enables students to independently identify components and take responsibility for proper hardware usage.
CO2: Installing and using the Arduino IDE fosters self-learning and accountability in writing and uploading correct programs.
CO3: Implementing LED interfacing tasks develops independent problem-solving and responsibility for circuit accuracy.
CO4: Applying control structures strengthens autonomous decision-making and logical accountability in program execution.
CO5: Practicing serial communication builds responsibility in debugging, testing, and ensuring reliable system performance.
CO6: Performing ADC experiments enhances independent experimentation and accountability in interpreting sensor data.
CO7: Interfacing LDR, relay, buzzer, and PWM applications promotes self-directed project development and responsible implementation of automation systems.

PO13: Community Engagement and Service:
CO6: Performing ADC for sensor applications supports development of community services like environmental and safety monitoring systems.
CO7: Interfacing LDR, relay, buzzer, and PWM enables creation of socially beneficial automation projects such as smart lighting and public alert systems.

CBCS Syllabus as per NEP 2020 for T. Y. B.Sc. Electronics (SEM V) (2024 Pattern)

Name of the Program : B.Sc. Electronics
Program Code :**USEL**
Class : T. Y. B.Sc.
Semester : V
Course Type : Minor(Theory)
Course Code : ELE-310-MN
Course Title : Introduction to AI.
No. of Credits : 02
No. of Teaching Hours : 30

Course Objectives

1. Understand fundamentals of Artificial Intelligence
2. Learn intelligent agents and types
3. Apply search techniques for problem solving
4. Understand knowledge representation methods
5. Apply logical reasoning in AI
6. Analyze AI applications in real world

Course Outcomes

CO1: Define and explain the basic concepts, terminology, history, and applications of Artificial

Intelligence.

CO2: Classify and compare different types of AI systems and intelligent agents, and explain the concept of the Turing Test proposed by Alan Turing.

CO3: Describe and analyze problem-solving agents and properties of search algorithms used in AI.

CO4: Implement and differentiate uninformed and informed search strategies such as BFS, DFS, and heuristic search methods.

CO5: Explain and apply local search techniques and problem reduction methods for solving AI problems.

CO6: Demonstrate understanding of knowledge representation techniques including propositional logic and first-order logic.

CO7: Apply reasoning methods such as forward chaining and backward chaining to solve logical inference problems in AI.

Topics and Learning Points

UNIT 1: Introduction to AI (8L)

Basic Definitions and terminology, Foundation and History of AI, Applications of AI, Classification/Types of AI. Intelligent Agent: Types of AI Agent (only two). Turing Test in AI.

UNIT 2:- Solving Problems by Searching (10)

Problem Solving Agents, properties of search Algorithms, Uninformed Search, Informed Search Strategies, Problem reduction- BFS,DFS, Local Search and Search Algorithms.

UNIT3 :- Knowledge and Reasoning (12)

Need of first order logic, Approaches to designing a knowledge-based agent, knowledge representation: Techniques of knowledge representation, Propositional logic, Rules of Inference, First-Order Logic, Forward Chaining and backward chaining in AI, Reasoning in Artificial intelligence.

References:

1. Introduction to Artificial Intelligence & Expert Systems, Dan W Patterson, PHI., 2010
2. S Kaushik, Artificial Intelligence, Cengage Learning, 1st ed.2011. 2. Ric, E., Knight, K and Shankar, B. 2009. Artificial Intelligence, 3rd edition, Tata McGraw Hill.
3. Luger, G.F. 2008. Artificial Intelligence -Structures and Strategies for Complex Problem Solving, 6th edition, Pearson.
4. Alpaydin, E. 2010. Introduction to Machine Learning. 2nd edition, MIT.
5. CharuC.Aggarwal,"DataClassificationAlgorithmsandApplications",CRCPress,2014.

Mapping of Program Outcomes with Course Outcomes

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

Justification for the mapping

PO1: Comprehensive Knowledge and Understanding:

Graduates will possess a profound understanding of their field of study, including foundational theories, principles, methodologies, and key concepts, within a broader multidisciplinary context.

PO2: Practical, Professional, and Procedural Knowledge:

Graduates will acquire practical skills and expertise essential for professional tasks within their field. This includes knowledge of industry standards, best practices, regulations, and ethical considerations, with the ability to apply this knowledge effectively in real-world scenarios.

PO3: Entrepreneurial Mindset and Knowledge:

Graduates will cultivate an entrepreneurial mindset, identifying opportunities, fostering innovation, and understanding business principles, market dynamics, and risk management strategies.

PO4: Specialized Skills and Competencies:

Graduates will demonstrate proficiency in technical skills, analytical abilities, problem-solving, effective communication, and leadership, relevant to their field of study. They will also adapt and innovate in response to changing circumstances.

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

Graduates will possess the capacity to apply learned concepts in practical settings, solve complex problems, and analyze data effectively. This requires critical thinking, creativity, adaptability, and a readiness to learn and take calculated risks.

PO6: Communication Skills and Collaboration:

Graduates will effectively communicate complex information, both orally and in writing, using appropriate media and language. They will also collaborate effectively in diverse teams, demonstrating leadership qualities and facilitating cooperative efforts toward common goals.

PO7: Research-related Skills:

Graduates will demonstrate observational and inquiry skills, formulate research questions, and utilize appropriate methodologies for data collection and analysis. They will also adhere to research ethics and effectively report research findings.

PO8: Learning How to Learn Skills:

Graduates will acquire new knowledge and skills through self-directed learning, adapt to changing demands, and set and achieve goals independently.

PO9: Digital and Technological Skills:

Graduates will demonstrate proficiency in using ICT, accessing information sources, and analyzing data using appropriate software.

PO10: Multicultural Competence, Inclusive Spirit, and Empathy:

Graduates will engage effectively in multicultural settings, respecting diverse perspectives, leading diverse teams, and demonstrating empathy and understanding of others' perspectives and emotions.

PO11: Value Inculcation and Environmental Awareness:

Graduates will embrace ethical and moral values, practice responsible citizenship, recognize and address ethical issues, and take appropriate actions to promote sustainability and environmental conservation.

PO12: Autonomy, Responsibility, and Accountability:

Graduates will apply knowledge and skills independently, manage projects effectively, and demonstrate responsibility and accountability in work and learning contexts.

PO13: Community Engagement and Service:

Graduates will actively participate in community-engaged services and activities, promoting societal well-being.