Anekant Education Society's
Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati
Autonomous

T. Y. B. Sc. (Computer Science)
Electronics (Sem. VI) (2023 Pattern)
(w.e.f. June, 2025)

Semester	Paper Code	Title of Paper	No. of Credits
VI	COS-361-MN (C)	Arduino and its Programming	2
	COS-362-MN (C)	Arduino Lab Experiments	2

Syllabus for T. Y. B.Sc. (Computer Science) Electronics (SEM-VI) (2023 Pattern)

Name of the Programme : B.Sc. (Computer Science) Electronics

Programme Code : USCS

Class : T. Y. B.Sc.

Semester :VI

Course Type : Minor (Theory)

Course Code : COS-361-MN(C):

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.
2. To develop an understanding of the architecture and working principles of Single Board Computers (SBCs) such as Arduino and their role in embedded system design
3. To enable students to design and implement simple embedded applications using Arduino by interfacing various input/output devices
4. To cultivate problem-solving and practical implementation skills through hands-on experiments
5. To Write and execute Arduino programs using variables, data types, operators, and control statements.
6. Demonstrate understanding of Arduino hardware architecture, pin configuration, and I/O Ports .
7. To familiarize students with Arduino hardware and software tools, including Microcontroller architecture, pin configuration, and programming using the Arduino IDE.

Course Outcomes:

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

CO1: Explain the fundamentals, history, and classification of embedded systems.

CO2: Identify and describe the purpose, features, and characteristics of various embedded systems used in real-life applications.

CO3: Explain the architecture, components, and operation of Single Board Computers (SBCs).

CO4: Demonstrate understanding of Arduino microcontroller architecture, pin configuration, and . input/output ports.

CO5: Write and execute Arduino programs using variables, data types, operators, and control statements.

CO6: Interface Arduino with peripheral devices such as LEDs, LCDs, 7-segment displays, and sensors for real-time data acquisition and control.

CO7: Design and develop simple embedded applications or mini-projects using Arduino and interfaced devices.

Topics and Learning Points

Unit 1: Introduction to Embedded Systems (08)
History of embedded systems, Classification of embedded systems based on generation and complexity, Purpose of embedded systems. Applications of embedded systems, and Characteristics of embedded systems.

Unit 3: Single Board Computers (SBC) in Embedded System (14)
SBC Block diagram, Types, Comparison of SBC models, Specifications, I/O devices (Storage, Display, Keyboard, Mouse), Network Access Devices. Arduino Microcontroller Board: Introduction to Arduino, Microcontrollers used in Arduino, Pin configuration and architecture, Concept of digital and analog ports. Arduino programming: Introduction to Arduino IDE, variables and data types, Comparison ,operators (arithmetic, logical and relational, modulo and assignment) Statements.

Unit 4: Interfacing Arduino (08)
Interfacing Arduino with-LED Blinking using Arduino, 7 segment display using Arduino, Data display on LCD using Arduino, Temperature monitoring system using Arduino.

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.

Mapping of Program Outcomes with Course Outcomes

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

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

Mapping justification:

PO1: Comprehensive Knowledge and Understanding:

CO1: Demonstrates fundamental understanding of embedded systems and their evolution.

CO3: Involves understanding of microcontroller hardware and analyzing system architecture.

CO5: Develops practical coding and problem-solving skills using modern embedded tools (Arduino IDE).

CO7: Integrates knowledge, design, and implementation skills to create real-time embedded applications.

PO2: Practical, Professional, and Procedural Knowledge:

CO1: Understanding embedded systems' fundamentals enables students to apply proper engineering procedures in system analysis and design tasks.

CO3: Knowledge of Arduino hardware allows students to practically configure and implement microcontroller-based systems following professional procedures.

CO6: Practical skills in interfacing hardware devices ensure students can execute embedded system applications using standardized engineering practices.

PO3: Entrepreneurial Mindset and Knowledge:

CO1: Understanding embedded systems fundamentals inspires students to identify potential opportunities for innovation and entrepreneurship.

CO2: Knowledge of SBCs and embedded applications enables students to explore and create new solutions or products in practical domains.

CO3: Hands-on understanding of microcontrollers and hardware architecture equips students to prototype and develop entrepreneurial solutions.

CO7: Applying design and development skills to real-world mini-projects encourages innovation, product development, and entrepreneurial thinking.

PO4: Specialized Skills and Competencies:

CO1: A strong foundational understanding helps develop specialized skills required for embedded system design and analysis.

CO2: Knowledge of SBCs and their specifications equips students with technical competencies for practical implementation.

CO5: Programming skills in Arduino enhance specialized competencies in developing embedded system solutions.

CO7: Designing real-world projects strengthens practical skills and technical expertise in embedded systems.

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

CO1: Understanding the basics enables analytical evaluation of embedded systems and their applications in solving real-world problems.

CO5: Programming and logic implementation strengthen problem-solving and analytical reasoning skills.

CO7: Designing and implementing projects develops the capacity to apply knowledge and solve practical engineering problems effectively.

PO6: Communication Skills and Collaboration:

CO1: Understanding and explaining concepts of embedded systems enhances students' ability to communicate technical knowledge effectively.

CO2: Learning and presenting SBC specifications and features improves teamwork and collaborative learning in laboratory or project activities.

PO7: Research-related Skills:

CO1: Understanding the evolution and types of embedded systems promotes analytical thinking and research exploration.

CO2: Comparative study of SBCs and their specifications encourages research and evaluation skills.

CO3: Studying microcontroller architectures enhances investigative skills for system design and analysis.

CO5: Implementing programs and debugging fosters experimental research and problem-solving methodology.

CO7: Designing projects promotes applied research, experimentation, and innovation in embedded systems.

PO8: Learning How to Learn Skills:

CO1: Understanding foundational concepts encourages self-directed learning and exploration of advanced topics in embedded systems.

CO3: Hands-on study of microcontroller architecture helps students independently learn new hardware platforms.

CO4: Writing and experimenting with Arduino code promotes iterative learning and skill development in programming and problem-solving.

PO9: Digital and Technological Skills:

CO2: Understanding SBCs and their specifications builds competency in modern embedded hardware technologies.

CO3: Hands-on work with Arduino microcontrollers enhances technical and digital skills in

hardware interfacing.
CO5: Programming using Arduino IDE develops software skills and practical knowledge of digital systems.
CO6: Interfacing sensors and output devices fosters applied technological skills in real-time embedded systems.

PO10: Multicultural Competence, Inclusive Spirit, and Empathy:
CO2: Collaborative learning of SBCs and embedded systems encourages understanding of diverse approaches and perspectives in technology.
CO3: Working on microcontroller-based projects in teams promotes inclusiveness and sharing of knowledge.
CO5: Collaborative programming and debugging sessions foster teamwork, patience, and empathy among students.

PO11: Value Inculcation and Environmental Awareness:

CO1: Understanding the evolution and purpose of embedded systems helps students appreciate responsible and ethical technology use.
CO2: Knowledge of SBCs and hardware specifications encourages environmentally responsible selection and use of resources.
CO4: Writing efficient code promotes optimal use of computational resources, supporting sustainability and environmental awareness.
CO7: Developing real-time applications with consideration for resource efficiency fosters ethical engineering and environmental consciousness.

PO12: Autonomy, Responsibility, and Accountability:
CO1: Understanding the foundational concepts enables students to take responsibility for independent learning and comprehension of embedded systems.
CO2: Knowledge of SBCs and their specifications empowers students to responsibly select and apply appropriate hardware solutions.
CO6: Performing practical interfacing tasks independently encourages accountability and professional responsibility in implementing embedded applications.

PO13: Community Engagement and Service:
CO1: Understanding the applications of embedded systems enables students to conceptualize solutions that can serve societal needs.
CO3: Knowledge of microcontrollers allows students to implement practical solutions that can address community challenges.
CO6: Interfacing sensors and devices enables the development of prototypes or systems with real-world community applications.
CO7: Designing projects encourages students to create solutions that have societal or community impact.

Syllabus for T. Y. B.Sc. (Computer Science) Electronics (SEM-VI) (2023 Pattern)

Name of the Programme : B.Sc. (Computer Science) Electronics

Programme Code : USCS

Class : T. Y. B.Sc.

Semester : VI

Course Type : Minor (Practical)

Course Code : COS-362-MN(C)

Course Title : Electronics Practical-VI

No. of Credits 02

No. of Teaching Hours 60

Course Objectives:

1. To Understand the working of RAM using memory IC.
2. To Install Operating System (OS) and configure dual boot.
3. To Understanding the applications of embedded systems enables students to conceptualize solutions that can serve societal needs.
4. To Interfacing sensors and devices enables the development of prototypes or systems with real-world community applications
5. To Designing projects encourages students to create solutions that have societal or community impact.
6. To Interface single or multiple LEDs to Arduino

Course Outcomes:

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

CO1: Understanding embedded systems fundamentals.

CO2: Knowledge of SBCs, hardware, and system assembly.

CO3: Arduino hardware, pin configuration, and interfacing.

CO4: Arduino programming skills .

CO5: Designing and implementation filed project.

CO6: Practical implementation and interfacing.

CO7: Designing simple embedded applications / mini-projects .

List of Practicals

❖ The practical course consists of **15** experiments.

❖ Any two of the following activities with proper documentation will be considered as equivalent of 4 experiments weightage in term work.

1.write action of RAM (using IC 2112/4 or equivalent).
2. Knowledge of hardware that goes in the making of a computer: Assembling of PC. Installation of OS, setting up of dual boot, installation of hardware and software.
3.Arduino Interfacing with LED .
4. Arduino with LCD.
5. Interfacing of Seven Segment Display to arduino.
6. Analog to Digital Conversion using arduino.
7. Pulse Width Modulation using arduino.
8. Wireless Connectivity to Arduino.
9. Serial communication using RS 232.
10.Display counter using Arduino.
11.IR Sensor interface.
12. Tempeture monitoring system.
13.Interfacing LDR.
14. Interfacing to Switch.
15.Interfacing Relay.

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

Justification of Mapping

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

Justification of Mapping

PO1: Comprehensive Knowledge and Understanding

CO1: To Identifying electronic devices and ICs demonstrates fundamental understanding of electronics components, which is essential for comprehensive knowledge in embedded systems.

CO2: Understanding the operation of lab instruments ensures students can correctly measure, test, and analyze circuits, reflecting applied comprehension of electronic principles.

CO4:Knowledge of key parameters (voltage, current, resistance, capacitance, etc.) reinforces theoretical understanding and prepares students for practical design and analysis tasks.

CO4: Applying foundational knowledge to hobby projects allows students to integrate theory and practice, demonstrating holistic understanding of embedded systems and electronics.

PO2: Practical, Professional, and Procedural Knowledge

CO2: Understanding how laboratory instruments operate demonstrates fundamental knowledge of measurement and testing techniques, reinforcing comprehensive understanding of electronics principles.

CO3: Connecting circuits and analyzing their performance reflects the application of theoretical knowledge to practical scenarios, showing deep understanding of electronic system behavior.

CO5: Developing experimental skills and analyzing results requires integrating knowledge of concepts, components, and measurements, demonstrating comprehensive grasp of electronics and embedded systems.

PO3: Entrepreneurial Mindset and Knowledge

CO1: Understanding various electronic devices and ICs equips students with knowledge to explore innovative product ideas and identify potential opportunities in electronics and embedded systems, fostering an entrepreneurial mindset.

CO7: Developing hobby projects encourages creativity, experimentation, and practical problem-solving, which are key skills for entrepreneurship and turning ideas into feasible solutions or products.

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

CO1: Recognizing and understanding various electronic components allows students to analyze problems and select appropriate devices for solving practical engineering challenges.

CO2: Understanding laboratory instruments helps in applying measurement techniques effectively and analyzing experimental data to troubleshoot and optimize circuits.

CO3: Connecting and testing circuits develops hands-on problem-solving and analytical skills as students evaluate performance and identify deviations from expected behavior.

CO7:Designing and implementing hobby projects promotes critical thinking and practical application of knowledge to solve real-world or creative engineering problems.

PO6: Communication Skills and Collaboration.

CO4:Understanding and explaining electronic parameters requires clear communication of technical concepts, fostering students' ability to convey information effectively in team discussions or reports.

CO5: Analyzing experimental results and interpreting data often involves collaboration and presentation of findings, enhancing teamwork and communication skills in a laboratory or project environment.

PO9: Digital and Technological Skills

CO3:Connecting and testing circuits requires practical use of digital tools, simulation software, and measurement instruments, enhancing students' technological skills.

CO5:Understanding electronic parameters and analyzing them using digital measurement tools fosters proficiency in modern technological methods for experimentation and system evaluation**.**

PO10: Multicultural Competence, Inclusive Spirit, and Empathy:

CO4: Through Arduino programming, students collaborate in diverse teams, sharing different perspectives and problem-solving approaches. This develops mutual respect, enhances cross-cultural communication, and encourages an inclusive learning environment while working on hardware–software integration tasks.

CO5: Field projects often address real-world social or community needs. By designing solutions that consider various user groups, environments, and accessibility, students cultivate empathy and inclusive thinking, ensuring that their designs benefit people from different cultural and social backgrounds.

CO6:Practical interfacing tasks require teamwork and collaboration among peers with diverse technical strengths and backgrounds. This fosters an inclusive spirit, appreciation of diverse skill sets, and empathetic collaboration to achieve successful system integration.

PO11: Value Inculcation and Environmental Awareness:

CO1: Understanding Embedded Systems Fundamentals

Understanding the fundamentals of embedded systems helps students realize the importance of designing energy-efficient, sustainable, and reliable systems. It promotes awareness of how technology can be used responsibly to reduce environmental impact and support eco-friendly innovations.

CO2: Knowledge of SBCs, Hardware, and System Assembly

Learning about Single Board Computers (SBCs) and hardware components encourages resource optimization and the use of low-power, cost-effective technologies. Students develop a sense of value-based engineering practice, emphasizing environmental consciousness and responsible utilization of electronic resources.