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

Course Structure & Credit Distribution for
S. Y. B. Sc. (Comp. Sci.) (Sem. IV) (2022 Pattern)
(w.e.f. June, 2023)

Semester	Paper Code	Title of Paper	No. of Credits
IV	UCSEL241	Advance Embedded System	3
	UCSEL242	Advance Communication and IoT	3
	UCSEL243	Practical Course	3

ANEKANT EDUCATION SOCIETY'S
Tuljaram Chaturchand College of Arts, Science and Commerce,
Baramati (Autonomous)
S.Y.B.Sc. (Comp.Sci.)
(2022 Pattern)
Paper-I: Advance Embedded System
Paper Code – UCSEL241
Credits - 4

Course Objectives:

1. To introduce the Building Blocks of Embedded System.
2. To educate about the characteristics and need of advance embedded system.
3. To introduce various communication interfaces in embedded systems.
4. To impart knowledge about various wireless communication devices.
5. To introduce and learn Single Board Computers
6. To introduce Basics of Real time data and example tutorials to discuss real time applications.
7. To learn Arduino IDE.

Course Outcomes:

1. Acquire basic knowledge about the fundamentals of embedded systems.
2. Acquire knowledge about devices and buses used in embedded networking.
3. Develop programming skills in embedded systems for various applications.
4. Acquire knowledge about basic concepts of Arduino IDE.
5. Acquire knowledge about devices and buses used in embedded systems.
6. Acquire knowledge about the hardware and software in Embedded System using SBCs.
7. Acquire knowledge about the Internet of Things and an online application tool Blynk.

Unit 1: Introduction to Embedded Systems **(12)**

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 2: Communication Interface **(12)**

Onboard communication interfaces-I2C, SPI, CAN, parallel interface; External communication interfaces-RS232 and RS485, USB, infrared, Bluetooth, WI-FI, ZigBee.

Unit 3: Introduction to Embedded systems using single board computers (SBC) **(12)**

Single boards computer block diagram, types, Comparison of SBC models, Specifications, I/O devices (Storage, display, keyboard and mouse), Network access devices. Arduino Microcontroller board.

Unit 4: Case Studies **(12)**

LED Blinking using Arduino, 7 segment display using Arduino, Data display on LCD using Arduino, Temperature monitoring system using Arduino, Intruder Detector System Using Arduino, Blynk IoT.

Recommended books:

1. Embedded Systems - Raj Kamal, TMH.
2. Embedded System Design - Frank Vahid, Tony Givargis, John Wiley.
3. Embedded Systems – Lyla, Pearson, 2013.
4. An Embedded Software Primer - David E. Simon, Pearson Education.
5. Arduino: The complete guide to Arduino for beginners, including projects, tips, tricks, and programming – James Arthur, Ingram Publishing, 2020.

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

PO Justification:

PO1: Computer knowledge:

CO2: This adds to the understanding of computer hardware, especially networking components, which is essential for a comprehensive grasp of computer systems.

Develop programming skills in embedded systems for various applications:

CO3: Developing programming skills for embedded systems enhances the application of computer knowledge by implementing software on specific hardware, showcasing practical understanding.

CO4: Arduino IDE is a platform for programming embedded systems. Learning its basic concepts contributes to understanding integrated development environments, which is a key aspect of computer knowledge.

CO6: Single Board Computers (SBCs) represent an integration of hardware and software. Learning about them enhances understanding of computer architecture, system integration, and software development.

C07: IoT involves the connection of embedded systems to the internet. Learning about IoT and tools like Blynk contributes to understanding networked systems and online applications, extending computer knowledge to the realm of connectivity.

PO2: Design/development of a solution:

CO2: Students able to acquire knowledge about devices and buses used in embedded networking.

CO3: Students able to develop programming skills in embedded systems for diverse applications.

CO4: Understanding the basic concepts of Arduino IDE is part of the broader understanding of embedded systems.

CO6: Student acquire knowledge about the hardware and software in Embedded System using SBCs (Single Board Computers).

CO7: Students have knowledge about the Internet of Things and the application tool Blynk.

PO3: Modern tool usage:

CO3: Student will develop programming skills using contemporary tools in the context of embedded systems.

CO4: The use of modern tools, such as Arduino IDE, is essential for gaining knowledge about the basic concepts of embedded systems.

CO6: Students have knowledge about the hardware and software in Embedded System using SBCs (Single Board Computers).

CO7: Student will know about application of modern tools for proficiency in hardware and software aspects.

PO4: Environmental Sustainability:

CO7: Students not only gain technical knowledge about IoT and Blynk but also develop a sense of responsibility for minimizing the environmental impact of their work.

PO5: Ethics:

CO3: Students have knowledge about development of innovative programming skills that contribute to both employability and entrepreneurial potential.

CO5: Student knows the importance of ethical awareness in the context of choosing and utilizing devices and buses for embedded systems. Students need to consider ethical implications, ensuring that their choices uphold moral standards to ethical principles in the development and deployment of embedded systems.

CO7: Encourages students to reflect on the ethical aspects of hardware and software decisions. They should be mindful of the environmental and social implications associated with the use of SBCs in embedded systems, aligning with ethical considerations related to sustainability and responsible technology use.

PO6: Individual and teamwork:

CO1: Student know importance of both individual learning and teamwork in acquiring basic knowledge.

CO6: Student know the need for a combination of individual and teamwork to gain proficiency in hardware and software aspects.

CO7: Students knows the importance of both individual learning and teamwork in understanding IoT concepts and tools like Blynk.

PO7: Innovation, Employability and Entrepreneurial skill:

CO1: Student having foundational understanding which contributes to their employability as they are equipped with skills that are in demand across various industries.

CO2: Student acquire knowledge that supports both innovation and entrepreneurial skills. Understanding devices and buses in embedded networking allows individuals to explore innovative applications and potentially pursue entrepreneurial ventures in the field.

CO3: Student enhancing development of programming skills that contribute to both employability and innovation. Individuals with the ability to program embedded systems for diverse applications are well-positioned for a variety of roles and can contribute to innovative projects.

CO5: Students have knowledge about devices and buses in embedded systems. Reiterating this aspect emphasizes its relevance to both innovative endeavors and entrepreneurial pursuits.

CO6: Student acquire knowledge that supports both innovation and entrepreneurial skills. Understanding the hardware and software aspects of embedded systems using SBCs equips individuals to explore innovative applications and potentially pursue entrepreneurial ventures in this domain.

CO7: Students have knowledge which contributes to innovation, employability, and entrepreneurial skills. Understanding IoT and utilizing tools like Blynk prepares individuals to work on cutting-edge projects, making them valuable contributors to innovative initiatives and potential entrepreneurs in the IoT domain.

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Paper- II: Advance Communication and IoT
Paper Code – UCSEL242
Credits - 4

Course Objectives:

1. To impart knowledge about the basic communication system in Electronics.
2. To educate about the modulation and demodulation techniques.
3. To know about different data collecting and accessing techniques for communication.
4. To expose students about the wireless communication system.
5. To study the recent trends adopted in cellular systems.
6. To introduce the students to recent wireless standards.
7. To get knowledge about wireless electronics applications.

Course Outcomes:

1. Discuss various types of communication system.
2. Solve the numerical problems related to data transmission.
3. Get the knowledge about technologies in telephones and MODEM.
4. Learn about the concept of wireless communication.
5. Discuss the cellular system design and technical challenges.
6. Summarize the principles and applications of wireless systems and standards like GSM, Wi-Fi, Bluetooth, IoT.
7. Design Real Time Applications regarding wireless communication.

UNIT-1: Introduction to Electronic Communication [12]

Block diagram of Electronic Communication System, types of communication (Base band and Broadband, Simplex and Duplex), Serial (Asynchronous and Synchronous) and Parallel communication, Definition of Signal bandwidth, channel bandwidth, data rate, baud rate.

Modulation and Demodulation **-** Introduction to concepts of modulation and demodulation, Need of modulation, Modulation techniques: Analog modulation: Amplitude, Phase and Frequency modulation, modulation index and frequency spectrum. Digital modulation: Pulse Amplitude Modulation (PAM), Pulse Code Modulation (PCM), MODEM.

UNIT-2: Multiplexing and Multiple Accessing [12]

Study of multiplexing: FDM, TDM, CDM, WDM. Concept of Spread Spreading, Study of Multiple Accessing: FDMA, TDMA, CDMA.

UNIT- 3: Wireless Communication systems ` [12]

Introduction to wireless communication system. Need of wireless communication systems. Mobile Communication, Cellular concept, working of GSM, Concept of Hand over. Bluetooth and Wi-Fi (Comparison based on range, data rate, frequency, Power).

Unit- 4: Internet of Things **[12]**

Introduction, Definitions and History of Internet of Things, Need of IoT, IoT Architecture, Applications – Home Automation, Smart Cities, IoT in Environmental Protection, Habitat Monitoring, Agricultural Automation.

Recommended Books:

1. Communication Electronics: Principles and Applications. L. E. Frenzel 3rd Edition.
2. Modern Electronic Communication. G.M. Miller 7th Edition
3. Mobile Communication Jochen Schiller 2nd Edition.
4. Wireless Communications: Principles and Practice. Rappaport
5. Wireless Communications and Networks. William Stallings
6. Hakima Chaouchi, ― "The Internet of Things Connecting Objects to the Web" ISBN : 978-1- 84821-140-7, Wiley Publications
7. Olivier Hersent, David Boswarthick, and Omar Elloumi, ― "The Internet of Things: Key Applications and Protocols", Wiley Publications

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

PO Justification:

PO1: Computer Knowledge:

CO1: Students able to understand that communication systems is crucial for individuals to comprehend how computers communicate with each other and with external devices, contributing to their overall computer knowledge.

CO3: Students acquired knowledge about the technologies that form the basis of computer networking. Telephones and MODEMs are crucial components in the history of computer communication, and understanding their technologies enhances overall computer knowledge.

CO4: Students grasp the concepts related to wireless communication, which is an integral part of modern computer networks. Wireless communication technologies are widely used, and knowledge in this area enhances overall computer knowledge.

CO5: Students will be able to design technical aspects of cellular systems, which are critical components of mobile computing. Knowledge in this area contributes to a well-rounded understanding of computer systems and networks.

CO6: Students have deep understanding about applications of various wireless technologies which are important for modern communication systems.

CO7: Designing real-time applications involves considering latency, reliability, and data integrity. Examples include real-time video streaming, online gaming, and remote monitoring systems.

PO2: Design/development of a solution:

CO2: Students solving numerical problems related to data transmission involves practical application of concepts. This helps in designing efficient data transmission systems by optimizing bandwidth, data rate, and addressing issues like signal-to-noise ratio for robust communication.

CO4: Understanding wireless communication is vital for designing solutions that involve mobility and flexibility. Developing applications for wireless networks requires addressing issues like signal interference, security, and efficient use of the available spectrum.

CO7: Design Real-Time Applications Regarding Wireless Communication:

Developing real-time applications for wireless communication involves addressing latency issues, ensuring data integrity, and designing user interfaces that provide a seamless experience. Design choices impact the overall performance and user satisfaction of the application.

PO3: Modern tool usage:

CO7: Utilizing tools and technologies specific to wireless communication is essential for designing real-time applications. This may include software development environments, network simulation tools, and debugging tools.

PO4: Ethics:

CO2: The ability to solve numerical problems in data transmission directly impacts the design of efficient and effective communication systems, contributing to the development of optimal solutions.

CO4: Understanding the concept of wireless communication is crucial for ethical considerations in ensuring secure, interference-free, and accessible communication. Ethical considerations include privacy, security, and responsible spectrum usage.

CO5: Ethical considerations in cellular system design include ensuring equitable access to communication services, addressing digital divides, and prioritizing user privacy and security.

PO5: Environmental Sustainability:

CO3: Knowledge of telephone and modem technologies is crucial for assessing their environmental impact. This includes considerations related to manufacturing processes, energy consumption, and electronic waste.

PO6: Individual and teamwork:

CO1: Understanding different communication systems requires both individual learning and collaborative efforts to grasp the complexities and variations. It promotes individual knowledge acquisition and the ability to work collectively on diverse communication technologies.
CO3: Gaining knowledge about telephone and modem technologies requires individual research and learning. However, collaborative efforts may be necessary for understanding complex technical details, discussing applications, and sharing insights into emerging technologies.
CO6: Summarizing wireless systems and standards involves individual comprehension, but teamwork is valuable for discussing real-world applications, sharing experiences, and addressing challenges associated with these technologies.

PO7: Innovation, Employability and Entrepreneurial skill:

CO3: Knowledge of telephone and modem technologies contributes to employability by providing a foundational understanding of communication systems. This knowledge is essential for individuals aspiring to work in areas related to networking, telecommunications, or related industries.
CO5: Discussing cellular system design and technical challenges demonstrates problem-solving skills and an understanding of complex systems. Such knowledge is valuable for innovation, employability, and entrepreneurial ventures in the telecommunications industry.
CO6: Summarizing wireless systems and standards reflects a comprehensive understanding of industry practices. This knowledge is valuable for innovation by staying current with technological advancements, enhancing employability, and potentially inspiring entrepreneurial ventures.

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Paper- III: Practical Course [UCSEL243]

Course Objectives:

1. Understand and study of SBC (Arduino UNO) and learn Arduino IDE.
2. Learning numerous applications using Arduino UNO.
3. Study of various hardware devices like 7segment display and LCD.
4. Designing of various modulator and demodulator circuits.
5. Design and generate error detector and error corrector circuit for 4 bit data.
6. Analyze different wireless communication techniques.
7. Learn serial communication in Arduino IDE.

Course Objectives:

1. Learn Arduino IDE.
2. Get knowledge about the programming in Arduino IDE for different applications.
3. Discuss various hardware interfacing devices and their applications in real time.
4. Design and implement hardware circuit to test performance and application in communication electronics.
5. Understand concept of Embedded Systems.
6. Design and implement hardware circuit and software to test performance and application in Embedded Systems.
7. Know the IoT technology Android Application.

Section I: Advance Embedded System

1. Understanding Arduino UNO Board.
2. Installing and work with Arduino IDE
3. LED Blinking with Arduino
4. Seven Segment Display interfacing with Arduino.
5. LCD interfacing with Arduino
6. Serial Communication with Arduino
7. LED control with ESP8266
8. Interfacing Arduino with Cloud (Thingspeak API)

Section II : Advanced Communication Systems

1. Build and test Amplitude Modulator and Demodulator.
2. Build and test Time Division Multiplexing circuit.
3. Build and test Frequency Shift Keying.
4. Build and test Delta Modulation circuit using IC.
5. Build and test Pulse Amplitude Modulation.
7. Build and test Hamming Code generator and detector circuit.
8. LED blinking using IoT. (Blynk).

Activities :

1. Internet Survey of Recent Trends in Electronics.
2. Seminar
3. Group Discussion
4. Hobby Project

***8 experiments and one Activity are compulsory.**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	1	-	-	-	1	1
CO2	1	1	1	-	-	-	-
CO3	1	-	-	-	-	2	2
CO4	1	2	-	-	1	2	2
CO5	2	2	2	2	-	-	2
CO6	1	1	2	-	-	-	-
CO7	2	2	2	2	2	2	2

PO justification:

PO1: Computer knowledge:

CO1: Enhances computer knowledge by introducing students to an integrated development environment specifically designed for embedded systems. It involves understanding software tools crucial for programming microcontrollers and embedded devices.

CO2: Students acquiring programming skills in Arduino IDE is a practical application of computer knowledge. It involves understanding programming structures, syntax, and the specific features of the Arduino platform, contributing to a deeper understanding of software development for embedded systems.

CO3: Discussing hardware interfacing devices involves understanding the interface between software and hardware. This contributes to computer knowledge by exploring how software interacts with various peripherals and sensors in real-time applications.

CO4: Students design and implement hardware circuits for communication electronics involves applying computer knowledge to create functional systems. It requires an understanding of digital and analog electronics, signal processing, and data communication principles.

CO5: Understanding embedded systems contributes to computer knowledge by delving into the principles and practices of designing systems with dedicated functions. It involves exploring how software and hardware collaborate in a specialized environment.

CO6: Designing and implementing hardware circuits and software for embedded systems is a practical application of computer knowledge. It requires integrating knowledge of programming, electronics, and system design to create functional embedded systems.

CO7: Knowing IoT technology and Android application development involves understanding the integration of software and hardware for Internet of Things applications. This knowledge expands computer knowledge by covering topics related to connectivity, data transfer, and mobile application development.

PO2: Design/development of a solution:

CO1: Learning Arduino IDE is the first step toward gaining proficiency in developing solutions using embedded systems. It introduces students to the environment where they can design and develop solutions for various applications.

CO2: Students acquiring programming skills in Arduino IDE enables students to develop solutions for diverse applications. Students have ability to design and implement software solutions in a specific embedded environment.

CO4: Designing and implementing hardware circuits for communication electronics is a direct application of solution design. It requires students to create functional hardware solutions, by focusing on the design and development process.

CO5: Understanding embedded systems is foundational for solution design in the embedded domain. It provides the necessary knowledge to design solutions that seamlessly integrate hardware and software in a cohesive manner.

CO6: PO Mapping Justification: Designing and implementing hardware circuits and software for embedded systems is a direct application of solution development. It involves the holistic design of a complete system, addressing both hardware and software aspects to meet specific performance and application requirements.
CO7: Knowing IoT technology and Android application development expands the scope of solution development to the realm of Internet of Things. It requires students to design solutions that involve both embedded systems and mobile application development.

PO3: Modern tool usage:
CO2: Students acquiring programming skills in Arduino IDE is a practical application of modern tool usage. It involves utilizing a modern programming environment for designing solutions for diverse applications in embedded systems.
CO5: Understanding embedded systems involves using modern tools for system design and analysis. Students explore the tools used in the design, simulation, and analysis of embedded systems.
CO6: Students designing and implementing both hardware circuits and software for embedded systems necessitates the use of modern tools for integrated development.
CO7: Knowing IoT technology and Android application development involves utilizing modern tools for mobile application development and IoT integration. Students incorporating the use of contemporary tools in the context of IoT and mobile application development.

PO4: Ethics:
CO5: Understanding embedded systems involves ethical considerations related to responsible system design. Ethical design includes considerations such as data privacy, security, and the impact on individuals or society. Awareness of these ethical aspects is crucial when developing systems that interact with the environment and users.
CO7: Knowing IoT technology and Android application development introduces ethical considerations related to the collection and use of data in interconnected systems. Students should be aware of privacy issues, data security, and the responsible use of IoT technology to prevent potential ethical dilemmas.

PO5: Environmental Sustainability:
CO5: Designing hardware circuits with an awareness of environmental sustainability involves choosing components with low power consumption, promoting energy efficiency, and minimizing electronic waste.
CO7: Knowing IoT technology and Android application development with a focus on environmental sustainability involves creating applications that use resources efficiently, reducing the overall environmental impact.

PO6: Individual and teamwork:
CO1: Students learning Arduino IDE involves both individual learning and potentially collaborative learning in a classroom setting. While individuals acquire knowledge, teamwork may come into play during discussions, problem-solving sessions, or group projects.
CO3: Students know hardware interfacing devices can involve both individual understanding and teamwork. Collaborative discussions allow the sharing of insights, experiences, and diverse perspectives, contributing to a more comprehensive understanding.
CO4: Designing and implementing hardware circuits can be both an individual and a teamwork activity. Individuals may work on specific components, and collaboration may occur when integrating various aspects or troubleshooting issues.
CO7: Students have knowledge of IoT technology and Android application development may involve individual learning, but collaboration becomes crucial when implementing complex IoT systems or applications. Teamwork allows the pooling of diverse skills for comprehensive solutions.

PO7: Innovation, Employability and Entrepreneurial skill:
CO1: Learning Arduino IDE introduces students to innovative tools for embedded systems. Acquiring this skill enhances employability by providing knowledge of a widely used platform in the industry.
CO3: Discussing hardware interfacing devices in real-time applications fosters innovation by exploring practical uses of diverse hardware. Understanding these devices enhances employability in roles requiring knowledge of real-world applications.
CO4: Designing and implementing hardware circuits for communication electronics requires innovation and problem-solving skills. This experience enhances employability in roles related to communication systems.
CO5: Understanding embedded systems contributes to innovation by providing a foundation for creating intelligent and efficient systems. This knowledge enhances employability in fields involving embedded technologies.
CO7: Knowing IoT technology and Android application development aligns with innovation in the rapidly evolving field of IoT. This knowledge enhances employability in roles related to IoT and mobile application development.