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ताळगांव पठार,
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International Year of Cooperatives 2025
Cooperatives Build a Better World

(Accredited by NAAC)

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GU/Acad –PG/BoS -NEP/2025/387 Date: 09.09.2025

**CIRCULAR**

The University has decided to implement the Curriculum and Credit Framework for the Undergraduate Programme (CCFUP) under the National Education Policy (NEP), 2020 based on All India Council for Technical Education (AICTE) and National Credit Framework (NCrF) Guidelines from the Academic Year 2024-2025 onwards.

The Syllabus of Semester III & IV Courses offered under Specialization **Internet of Things (IOT)** of **Bachelor of Engineering in Electronics and Computer Engineering/ Bachelor of Engineering in Electronics and Computer Science** Programme is attached.

The Dean, Faculty of Engineering and Principals of affiliated Engineering Colleges are requested to take note of the above and bring the contents of the Circular to the notice of all concerned.

ASHWIN VYAS LAWANDE
Digitally signed by ASHWIN VYAS LAWANDE
Date: 2025.09.09 11:16:57 +05'30'

(Ashwin V. Lawande)
Deputy Registrar – Academic

To,

1. The Dean, Faculty of Engineering, Goa University.
2. The Principals of affiliated Engineering Colleges.

Copy to,

1. The Director, Directorate of Technical Education, Govt. of Goa
2. The Chairperson, BoS in Electronics and Computer Engineering.
3. The Controller of Examinations, Goa University.
4. The Assistant Registrar, Prof. Examinations (Technical and Allied), Goa University.
5. Directorate of Internal Quality Assurance, Goa University for uploading the Syllabus on the University website.

**Electronics and Computer Engineering and Electronics and Computer Science**

**Specialization: Internet Of Things (IOT)**

| Sr. No. | Semester | Course Code | Title of the Course | L | T | P | TCr |
|---|---|---|---|---|---|---|---|
| 1 | III | ECS-281 | Fundamentals of IOT and Smart Systems | 3 | 0 | 0 | 3 |
| | | ECS-282 | Fundamentals of IOT and Smart Systems Lab | 0 | 0 | 1 | 1 |
| 2 | IV | ECS-283 | IOT Sensing, Communication and Security | 3 | 0 | 0 | 3 |
| | | ECS-284 | IOT Sensing, Communication and Security Lab | 0 | 0 | 1 | 1 |



**Approved by: Standing Committee of the Academic Council on 24th & 25th July 2025**

**SEMESTER III**

**Name of the Programme : Electronics and Computer Engineering/Electronics and Computer Science (Internet of Things)**

**Course Code : ECS-281**

**Title of the Course : Fundamentals of IoT and Smart Systems**

**Number of Credits : 3**

**Effective from AY : 2024-25**

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| **Pre-requisites for the Course:** | Nil | |
| **Course Objectives:** | This course will enable students to:<br>• To understand the basic components of an IoT system.<br>• To understand the technologies and current standards relating to each of the IOT layers.<br>• To understand the importance of interoperability in IoT, and the concepts of Cloud computing and Fog computing via examples.<br>• To appreciate and understand the appropriate use of various IoT technologies through real-life case studies and examples. | |
| **Content** | | **No of hours** |
| **Unit 1** | **Basics of Networking:** Introduction, Connection types, OSI Model.<br>**Emergence of IoT :** Introduction, Evolution of IoT, Enabling IoT and the Complex Interdependence of Technologies, IoT Networking Components.<br>**Sensors and Actuators:** Sensors, Sensor Characteristics, Sensing Types, Sensor Considerations, Actuators, Actuator Types, Actuator Characteristics.<br>**Introduction to Arduino Board:** Writing an Arduino Sketch, Hand's-on experiments with Arduino. | **11** |
| **Unit 2** | **IoT Processing Topologies and Types:** Data Format, Importance of Processing in IoT, Processing Topologies, Processing Offloading.<br>**IoT Connectivity Technologies:** Introduction to connectivity technologies and standards, IEEE 802.15.4, Zigbee, RFID, NFC, LORA, Wi-Fi, Bluetooth.<br>**IoT Communication Technologies:** Introduction to communication technologies, Infrastructure Protocols and Discovery Protocols, Introduction to Data Protocols - MQTT, CoAP, REST and Web Sockets. | **11** |
| **Unit 3** | **IoT Interoperability:** Introduction, Standards, Frameworks.<br>**Cloud Computing:** Introduction, Virtualization, Cloud Models (Service & Deployment Models), Cloud Implementation, Sensor cloud: Sensors-as-a-service | **11** |

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| | **Fog Computing and its application:** Introduction, View of a fog computing architecture, Fog Computing in IoT, Selected applications of FOG Computing. | |
| **Unit 4** | **IoT Smart Systems (Case studies):**<br>**Agricultural IoT** – Components of an agricultural IoT, Advantages of IoT in agriculture, Case Studies - In-situ assessment of leaf area index using IoT-based agricultural system, Smart irrigation management system.<br>**Vehicular IoT** – Introduction, Components of vehicular IoT, Advantages of vehicular IoT, Crime assistance in a smart IoT transportation system.<br>**Healthcare IoT** – Introduction, Components of healthcare IoT, Advantages and risks of healthcare IoT. **Case Studies-** AmbuSens system.<br>Evolution of New IoT Paradigms, Emerging Pillars of IoT. | **12** |
| **Pedagogy:** | Interactive, reflective, and inquiry-based methods, with a strong emphasis on critical thinking and problem-solving skills | |
| **References/ Readings:** | **TEXTBOOKS:**<br>1. Sudip Misra, Anandarup Mukherjee, Arijit Roy, Introduction to IoT, Cambridge University Press, 2020.<br>2. Nitesh Dhanjani, Abusing the Internet of Things, Shroff Publisher/O'Reilly Publisher, 2015<br>**REFERENCES:**<br>1. RMD Sundaram, Shriram K. Vasudevan, Abhishek S. Nagarajan, Internet of Things, John Wiley and Sons, 2019<br>2. Cuno Pfister, Getting Started with the Internet of Things, Shroff Publisher, 2011<br>3. Francis daCosta, Rethinking the Internet of Things: A Scalable Approach to Connecting Everything, Apress Publications, 1st Edition, 2014.<br>4. Massimo Banzi, Michael Shiloh, Getting Started with the Arduino, Maker Media Publishers/ O'Reilly, 3rd edition, 2015. | |
| **Course Outcomes:** | **Upon completion of the course, students will be able to:**<br>CO 1. Explain the core concepts of networking, IoT architecture, sensor and actuator characteristics, and their roles in IoT systems.<br>CO 2. Analyze IoT processing topologies, communication protocols and connectivity technologies<br>CO 3. Evaluate the effectiveness of IoT systems in real-world domains such as agriculture, transportation, and healthcare through case studies<br>CO 4. Develop basic IoT applications using Arduino by interfacing sensors and actuators | |

**Name of the Programme** : **Electronics and Computer Engineering/Electronics and Computer Science (Internet of Things)**
**Course Code** : **ECS-282**
**Title of the Course** : **Fundamentals of IoT and Smart Systems Lab**
**Number of Credits** : **01**
**Effective from AY** : **2024-25**

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| **Prerequisites for the Course:** | Nil | |
| **Course Objectives:** | This course will enable students to:<br>• Understand the fundamentals of IoT hardware, including sensors, actuators, and microcontrollers like Arduino.<br>• Introduce interfacing techniques for common sensors (e.g., LDR, DHT, Ultrasonic) and actuators (e.g., LEDs, buzzers, servo motors).<br>• Enable students to implement wireless communication using Bluetooth, Wi-Fi, and GPS modules in IoT applications<br>• Develop practical skills in designing and testing real-time IoT systems for monitoring, control, and automation. | |
| **Content:** | **List of programs/ Experiments**<br>***(Following experiments should be conducted. A certified journal reporting the experiments conducted should be submitted at the end of the term)*** | **No of Hours** |
| | 1. Digital Control of LED and Buzzer<br>2. Ambient Light Monitoring Using an LDR-Based Analog Sensing Circuit<br>3. Environmental Sensing: Acquisition of Temperature and Humidity Using a DHT Sensor<br>4. Proximity and Distance Measurement Using an Ultrasonic Sensor<br>5. PIR-Based Motion Detection with Visual and Audio Alert System<br>6. Servo Motor Position Control via Push Button or Sensor Input<br>7. Bluetooth-Based Wireless Control of LED Using HC-05 Module<br>8. Sensor Data Transmission to Mobile Application via Bluetooth<br>9. Wi-Fi-Based IoT Application<br>10. GPS-Based Monitoring System | **30** |
| **Pedagogy:** | Integration of instructional learning, constructive thinking, inquiry-based, collaborative, experiential, and problem-solving approaches. | |

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| **References/ Readings:** | **TEXTBOOKS:**<br>1. Sudip Misra, Anandarup Mukherjee, Arijit Roy, Introduction to IoT, Cambridge University Press, 2020.<br>2. Nitesh Dhanjani, Abusing the Internet of Things, Shroff Publisher/O'Reilly Publisher, 2015<br>**REFERENCES:**<br>1. RMD Sundaram, Shriram K. Vasudevan, Abhishek S. Nagarajan, Internet of Things, John Wiley and Sons, 2019<br>2. Cuno Pfister, Getting Started with the Internet of Things, Shroff Publisher, 2011<br>3. Francis daCosta, Rethinking the Internet of Things: A Scalable Approach to Connecting Everything, Apress Publications, 1st Edition, 2014.<br>4. Massimo Banzi, Michael Shiloh, Getting Started with the Arduino, Maker Media Publishers/ O'Reilly, 3rd edition, 2015 |
| **Course Outcomes:** | **Upon completion of the course, students will be able to:**<br>CO 1. Explain the role and functionality of various sensors, actuators, and communication modules used in IoT projects.<br>CO 2. Interface and control devices such as LEDs, buzzers, motors, and sensors using Arduino-based systems.<br>CO 3. Implement wireless communication for data exchange using Bluetooth, Wi-Fi, and GPS modules.<br>CO 4. Design and demonstrate simple IoT systems that respond to user input, environmental conditions, or remote commands. |

**SEMESTER IV**

**Name of the Programme : Electronics and Computer Engineering/Electronics and Computer Science (Internet of Things)**
**Course Code : ECS-283**
**Title of the Course : IOT Sensing, Communication and Security**
**Number of Credits : 3**
**Effective from AY : 2024-25**

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| **Pre-requisites for the Course:** | Fundamentals of IoT and Smart Systems | |
| **Course Objectives:** | The course aims to provide the student with<br>• An understanding of IoT Sensing System and its applications<br>• An ability to select a particular sensor for the desired application.<br>• An understanding of various Ubiquitous Communication networks.<br>• An understanding of security related issues in Communication networks. | |
| **Content** | | **No of Hours** |
| **Unit 1** | **Introduction:** Overview, Sensing System, Conditioning System, Analog-to-digital Signal Conversion, Processor, **Example** : A Wireless Electrocardiogram.<br>**Applications:** Civil Infrastructure Monitoring-Water Pipelines, Medical Diagnosis and Monitoring - Sleep Apnea and Medical Journalling, Water-quality Monitoring.<br>**Conditioning Circuits:** Voltage and Current Sources, Transfer Function, Impedance Matching, Filters, Amplification, Closed-loop Amplifiers, Difference Amplifier.<br>**Concepts of Sensing (Introduction only):** Electrical, Ultrasonic, Optical, Magnetic & Medical. | **11** |
| **Unit 2** | **Energy Harvesting:** Factors Affecting the Choice of an Energy Source, Architecture of an energy-harvesting system, Prototype - Microsolar Panel.<br>**Sensor Selection and Integration:** Sensor Selection Parameters, Example: Temperature Sensor Selection, Sensor Integration Issues.<br>**Estimation:** Sensor Error as a Random Variable, Zero-offset Error, Conversion Error, Accumulation of Error. | **11** |
| **Unit 3** | **Ubiquitous Communication:** Introduction, Audio Networks, Data Networks, Wireless Data Networks, Universal and Transparent Audio, Video and Alphanumeric Data Network Access, Ubiquitous Networks, Further Network Design Issues. | **11** |

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| **Unit 4** | **Security:** Introduction, Security Protocols, Encryption, Security in Bluetooth, Authentication systems, Weaknesses and attack methods, Security on wireless channels. | **12** |
| **Pedagogy:** | Interactive, reflective, and inquiry-based methods, with a strong emphasis on critical thinking and problem-solving skills | |
| **References/ Readings:** | **TEXTBOOKS:**<br>1. Waltenegus Dargie, "Principles and Applications of Ubiquitous Sensing", A John Wiley and Sons, Ltd, Publication, 1st Edition, 2017.<br>2. Stefan Poslad, "Ubiquitous Computing: Smart Devices, Environments and Interactions", A John Wiley and Sons, Ltd Publication, 1st Edition, 2009.<br>3. Genco and S. Sorce, "Pervasive Systems and Ubiquitous Computing", WIT Press, 1st Edition, 2010.<br>**REFERENCES:**<br>1. Athanasios Vasilakos, Witold Pedrycz, "Ambient Intelligence, Wireless Networking, and Ubiquitous Computing", Artech House, 1st Edition, 2006.<br>2. John Krumm, "Ubiquitous Computing Fundamentals", CRC Press, Taylor and Francis Group, LLC, 1st Edition, 2010. | |
| **Course Outcomes:** | **Upon completion of the course, students will be able to**<br>CO 1. Explain the components and working principles of sensing and conditioning systems including filters, amplifiers, and ADCs.<br>CO 2. Analyze the selection criteria and integration issues of sensors based on application-specific parameters<br>CO 3. Evaluate error sources in sensor data and describe methods to estimate and manage those errors in real-time systems.<br>CO 4. Demonstrate an understanding of communication networks and security protocols used in sensor-based and ubiquitous systems | |

**Name of the Programme** : **Electronics and Computer Engineering/Electronics and Computer Science (Internet of Things)**
**Course Code** : **ECS-284**
**Title of the Course** : **IOT sensing, Communication and Security Lab**
**Number of Credits** : **1**
**Effective from AY** : **2024-25**

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| **Prerequisites for the Course:** | Nil | |
| **Course Objectives:** | This course will enable students :<br>• To introduce students to the design and operation of basic analog signal conditioning circuits used in sensor systems.<br>• To provide hands-on experience in interfacing and evaluating various sensors for real-world measurement applications.<br>• To expose students to energy harvesting concepts and the implementation of wireless data transmission systems.<br>• To familiarize students with basic encryption methods and the principles of securing wireless sensor communications. | |
| **Content:** | **List of programs/ Experiments** | **No of Hours** |
| | 1. Analog-to-Digital Converter (ADC)<br>2. Basic Voltage Divider Circuit<br>3. Low-Pass and High-Pass Filter Design<br>4. Design and Analysis of a Difference Amplifier<br>5. Testing a Small Solar Panel's Output<br>6. Set up a wireless sensor network<br>7. Basic Wireless Data Transmission using Bluetooth<br>8. Basic Encryption Using Simple XOR Method<br>Basic Signal Amplification using an Op-Amp<br>9. Basic Light Sensor (LDR) Experiment<br>10. Capacitor Charging Experiment in Energy Harvesting<br>11. Audio Signal Transmission Over a Wireless Network<br>12. Simple Temperature Measurement using LM35 Sensor<br>13. Implementation of Basic Data Encryption for Secure Communication<br>14. Demonstration of Sensor Offset Error<br>15. Analysis of Security Vulnerabilities in Bluetooth Communication | **30** |
| **Pedagogy:** | Learner centric teaching Integration of instructional learning, constructive thinking, inquiry-based, collaborative, experiential, and problem-solving approaches. | |

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| **References/ Readings:** | **TEXTBOOKS:**<br>1. Waltenegus Dargie, "Principles and Applications of Ubiquitous Sensing", A John Wiley and Sons, Ltd, Publication, 1st Edition, 2017.<br>2. Stefan Poslad, "Ubiquitous Computing: Smart Devices, Environments and Interactions", A John Wiley and Sons, Ltd Publication, 1st Edition, 2009.<br>3. Genco and S. Sorce, "Pervasive Systems and Ubiquitous Computing", WIT Press, 1st Edition, 2010.<br>**REFERENCES:**<br>1. Athanasios Vasilakos, Witold Pedrycz, "Ambient Intelligence, Wireless Networking, and Ubiquitous Computing", Artech House, 1st Edition, 2006.<br>2. John Krumm, "Ubiquitous Computing Fundamentals", CRC Press, Taylor and Francis Group, LLC, 1st Edition, 2010. |
| **Course Outcomes:** | Upon completion of the course, students will be able to:<br>CO 1. Demonstrate the ability to design and analyze basic analog circuits including voltage dividers, filters, and amplifiers.<br>CO 2. Implement sensor-based systems for measuring parameters such as temperature and light, and evaluate sensor performance and errors.<br>CO 3. Construct functional energy harvesting setups and wireless sensor networks for real-time data transmission.<br>CO 4. Develop secure communication mechanisms using basic encryption techniques and assess vulnerabilities in wireless communication. |