Vidya Pratishthan's Kamalnayan Bajaj Institute of Engineering and Technology, Baramati

Department of Electronics and Telecommunication Engineering
Multidisciplinary Minor Course E& TC Engineering

2026-27

Multidisciplinary Minor Course of
Electronics and Telecommunication Engineering
w.e.f. AY 2026-27 (2025 PAT.)
Semester: III, IV, V, VI, VII

Course Code	Course Name	Teaching Scheme			Examination Scheme and Marks							Credits			
		TH	PR	TUT	Activity	ISE	ESE	TW	PR	OR	Total Marks	TH Credits	PR Credits	TUT Credits	Total Credits
ET25051	Embedded Systems	3	2	–	10	30	60	30	–	–	130	3	1	–	4
ET25052	Drone Technology	3	2	–	10	30	60	30	–	–	130	3	1	–	4
ET25053	Internet of Things	2	2	–	10	–	60	30	–	–	100	2	1	–	3
ET25054	Microcontroller Architecture	3	2	–	10	30	60	30	–	–	130	3	1	–	4
ET25055	Fundamentals of Drone Technology	2	2	–	10	–	60	30	–	–	100	2	1	–	3
ET25056	Internet of Things: Concepts and Applications	3	2	-	10	30	60	30	-	-	130	3	1	-	4
Total		**16**	**12**	**0**	**60**	**120**	**360**	**180**	**0**	**0**	**720**	**16**	**6**	**0**	**22**

.

Dr. JS Rangole
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Multidisciplinary Minor Course-1 ET25051:- Embedded Systems		
Teaching Scheme: Theory: 03 Hours/Week Practical: 02 Hours/Week	Credits 04	Examination Scheme: CAA: 10 Marks In Sem: 30 Marks End Sem: 60 Marks Term work: 30 Marks

Prerequisite Courses, if any:

1. Digital Logic Design

Course Objectives:

- To study and understand various microcontrollers and embedded systems
- To understand the design parameters of embedded systems applications.
- To study and impart different tools for embedded system and IoT application design.

Course Outcomes:

After the completion of the course, students will be able to-

CO1: Compare and interpret the architectures of Microprocessor and Microcontroller for generation of codes

CO2: Examine design metrics, design tradeoffs and software aspects of embedded systems.

CO3: Develop programming for real time applications.

CO4: To learn embedded networking and testing processes.

Course Contents

UNIT I: Microprocessor and Microcontrollers (06 Hrs.)

Microprocessor Technology: 8086- architectural overview & Programming model.

Microcontrollers: Introduction to microcontrollers, 8051 architecture, Memory Classification, Description of RAM, Description of CPU Registers, Functions of SFR.

UNIT II: Assembly Language Programming (08 Hrs.)

Introduction to Embedded C, Difference between C & Embedded C, Programming style, Basic structure of C program, Keywords & Identifiers, Data type & its memory representation Arrays and strings

UNIT III: Programming and Interfacing (08 Hrs.)

Types of Operators, Bitwise Operators explained, CONTROL STRUCTURES & LOOPS, Decision making with if statement, If....else statement, Switch statement, and GOTO, statement, The While and Do – While statements, For statement

Introduction to Software's: Keil, Compiler and Proteus.

Interfacing with 8051: ADC and DAC interfaces for microcontrollers, Real time interfacing with LED, Keypad, LCD display, Sensors interfacing.

UNIT IV: Embedded Networking (08 Hrs.)

I2C Bus Standard, Bluetooth, Zigbee, USB, UART, Linux Fundamentals, Linux Commands, VI Editors, Introduction to Device Driver, Role of Device Driver, Kernel Module Vs Application, Types of Device Driver, Character Driver, Block Driver & Network Drive.

Text Books:

1. Muhammad Ali Mazidi, the 8051 Microcontroller & Embedded System using assembly & C, Pearson Education.
2. Muhammad Ali Mazidi, ARM Assembly language programming and Architecture,
3. Raj Kamal, Microcontrollers: Architecture, Programming, Interfacing and System Design, Pearson Education India, 2009, Second

References:

1. Shibu K. V. Introduction to Embedded System, The McGraw Hill.
2. Ajay V. Deshmukh, Microcontrollers - Theory and Applications, Tata McGraw Hill,
3. Kenneth J. Ayala, The 8051 Microcontroller – Architecture, Programming & Applications, Penram International & Thomson Asia.

MOOC / NPTEL Courses:

1. https://nptel.ac.in/courses/108/105/108105102/

List of Experiments

1) Configure timer control registers of 8051 and develop a program to generate a given time delay.
2) Port I / O: Use one of the four ports of 8051 for O / P interfaced to eight LED's. Simulate binary counter (8 bit) on LED's.
3) Serial I / O : Configure 8051 serial port for asynchronous serial communication with serial port of PC exchange text messages to PC and display on PC screen. Signify end of message by carriage return.
4) Interface 8051 with D/A converter and generate square waves of given frequency on an oscilloscope.
5) Interface 8051 with D/A converter and generate triangular waves of given frequency on an oscilloscope.
6) Using a D/A converter generates sine waves on an oscilloscope with the help of a lookup table stored in the data area of 8051.
7) Interface Stepper motor with 8051 and write a program to move the motor through a given angle in clockwise or counterclockwise direction.
8) Generate traffic signals.
9) Temperature controller.
10) Elevator control.

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Multidisciplinary Minor Course-2 ET25052: Drone Technology		
Teaching Scheme: **Theory: 03 Hours/Week** **Practical: 02 Hours/Week**	**Credits** **04**	**Examination Scheme:** **Activity: 10 Marks** **In Sem: 30 Marks** **End Sem: 60 Marks** **Term work: 30 Marks**

Course Objectives:

The course aims to:

1. Provide fundamental knowledge of drones, their types, configurations, and applications.
2. Develop an understanding of drone power systems, battery technologies, and management strategies.
3. Explain the principles of sensors, actuators, and control mechanisms used in drone systems.
4. Familiarize students with drone communication technologies, GPS, flight controllers, and navigation techniques.
5. Introduce drone regulations, safety measures, and emerging technologies such as AI, computer vision, and swarm intelligence.
6. Enable learners to apply drone concepts through case studies, laboratory experiments, and simulation for real-world problem-solving.

Course Outcomes (COs):

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

CO1: Explain drone classification, configurations, and applications.
CO2: Analyze battery technologies, specifications, and battery management systems for drones.
CO3: Demonstrate working principles of sensors, actuators, and PID control in drones.
CO4: Evaluate drone communication technologies, GPS modules, ESCs, and flight controllers.
CO5: Interpret drone regulations, safety guidelines, and ethical practices.
CO6: Apply drone technology knowledge in case studies related to agriculture, defence, healthcare, and industry.

Unit I: Introduction to Drones (06 Hrs.)

Definition, Classification of Drones, Classification of Multirotor, Concept of Payload, Different frame configurations, Basic Components of Drones, Types of Drones: based on aerial platform and body material, Current and Future applications of drones.

Unit II: Battery Electronics in Drones (06 Hrs.)

Different types of batteries used in Drones: NiMH, NiCd, Li-Po, Li-ion, Battery Specifications, Selection Criteria of Battery for best performance, charging technologies of drone batteries- Constant Current and Constant Voltage, TRICKLE Charging, Building blocks of Drone Battery Management System.

Unit III: Sensors and Actuators in Drones (06 Hrs.)

Sensor-Definition, Role of Sensors in Drones, Core Sensors used in Drones and their principle of operation- Accelerometer, Gyroscope, Magnetometer and Barometer sensors, Selection Criteria for Sensors in Drones, Inertial Measurement Unit (IMU). Actuator-Definition, DC Motor and its principle, BLDC Motors-Construction and Operation, Speed Control Technique of BLDC Motor, Servomotor, PID Control.

Unit IV: Communication Technology and Advances in Drones (06 Hrs.)

Radio Frequency Spectrum, RF Transmitter and Receiver Circuit, Fundamentals of GPS, GPS Module for base station, Flight Controller Boards (FCB), Electronic Speed Controllers (ESC), Case Studies- LIDAR and Time of Flight (ToF) based UAV for Remote Sensing Applications.

Unit V: Drone Regulations, Safety & Emerging Technologies (06 Hrs)

DGCA & FAA drone regulations (categories: nano, micro, small, medium, large), Drone licensing and pilot certification requirements, No-fly zones and airspace restrictions, Safety measures in drone flight (redundancy, geo-fencing, failsafe systems), Advances in AI, computer vision, and machine learning in drones, Swarm drones and autonomous navigation, Industry 4.0 applications of drones.

Unit VI: Case Studies of Drones (06 Hrs)

- Case Study 1: Drones in Precision Agriculture (crop monitoring, spraying)
- Case Study 2: Drones in Disaster Management (flood, earthquake, rescue ops)
- Case Study 3: Drones in Defense and Surveillance
- Case Study 4: Medical & Healthcare Drone Delivery (COVID-19 supply chains)
- Case Study 5: Drone-based Remote Sensing & Environmental Monitoring
- Case Study 6: Startup and Industry Case Studies in India (e.g., Garuda Aerospace, ideaForge).

Text Books:

1. John Baichtal: "BUILDING YOUR OWN DRONES: A Beginner's Guide to Drones, UAVs, and ROVs", Que Publishing USA, 2016.
2. Ian Cinnamon, Romi Kadri, Fitz Tepper: "DIY Drones for the Evil Genius: Design, Build, and Customize Your Own Drones", McGraw Hill TAB, 2016.

Reference Books:

1. Neeraj Kumar Singh, Porselvan Muthukrishnan, Satyanarayana Sanpini, "Industrial System Engineering for Drones: A Guide with Best Practices for Designing", Apress.
2. Felipe Gonzalez Toro, Antonios Tsourdos, "UAV or Drones for Remote Sensing Applications".

Web resources:

1. https://enterprise-insights.dji.com/blog/lidar-equipped-uavs
2. https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SECA4003.pdf
3. https://www.bharatskills.gov.in/pdf/E_Books/CTS/443/English/TT/Drone%20Technician%20-%20TT%20(NSQF%202022).pdf

Laboratory Experiments

1. To study different types of drone frames and their configurations.
2. To study the working of DC and BLDC motors used in drones.
3. To study Accelerometer, Gyroscope, Magnetometer, and Barometer sensors.
4. To study different batteries and charging techniques used in drones.
5. To study the working principle of ESC in controlling drone motors.
6. To study the functions of flight controller boards.
7. To simulate basic drone flight movement in MATLAB.
8. To simulate PID control for drone stability in MATLAB.
9. To study the application of drones in agriculture.
10. To study DGCA rules, no-fly zones, and safety practices.

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Autonomy Coord.	HOD-E&TC	Dean Academics	Principal

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Multidisciplinary Minor Course-3
ET25053: – Internet of Things (IoT)

Teaching Scheme:	**Credits**	**Examination Scheme:**
Theory: 02 Hours/Week Practical: 02 Hours/Week	03	Activity: 10 Marks End Sem: 60 Marks Term work: 30 Marks

Prerequisite Courses, if any:

1. Digital Systems
2. Microcontrollers

Course Objectives:

- To introduce the fundamentals concepts of an IoT.
- To give Insights IoT Design Outlooks with sensors and actuators.
- To make aware of the usage of communication protocols in IoT.
- To develop design skills with IoT Physical devices and endpoints with programming.

Course Outcomes: On completion of the course, learner will be able to

- CO1: Comprehend and analyze concepts of IoT.
- CO2: Interpret IoT Design Outlooks with sensors and actuators.
- CO3: Comprehend the operation of communication protocols in IoT.
- CO4: Describe various IoT Physical devices and endpoints with programming and apply programming skills for application development.

Course Contents

Unit I: IoT Fundamentals (06 Hrs.)

Internet of Things – Evolution and History, Basic Definitions, Characteristics and Features; Physical & Logical Design of IoT; Enabling Technologies in IoT (Wireless Sensor Networks, Cloud Computing, Embedded Systems, AI/ML); Things and Identifiers in IoT; IoT Architecture/Frameworks; IoT and M2M; Networking Basics – Types, Devices, and Topology.

Unit II: IoT Design Outlooks and Sensors & Actuators (06 Hrs.)

M2M and IoT; IoT Devices and Gateways; Introduction to Sensors and Actuators – Types and Principle of Working; Basics of Wireless Sensor Networks; Fundamentals of Edge Computing, Edge AI and Cloud Computing; Introduction to TinyML; Cloud Service Models: SaaS, IaaS, PaaS & XaaS.

Unit III: Communication Protocols (06 Hrs.)

Short-Range Communication Protocols: Zigbee, Z-Wave, Bluetooth/BLE, Wi-Fi, and an overview of Thread & Matter

Long-Range Communication Protocols: LoRaWAN, with an overview of NB-IoT

Application Layer Protocols: MQTT (Message Queuing Telemetry Transport), CoAP (Constrained Application Protocol), HTTP/HTTPS

Unit IV: IoT Physical devices and endpoints (06 Hrs.)

IoT development and deployment hardware (Arduino, Raspberry Pi, ESP32, etc.); Interfacing sensors and actuators to the development boards; Basics of IoT Security; Introduction to Digital Twins; Applications of IoT: Home Automation, Smart Cities, Energy, Agriculture, Health and Lifestyle, etc. What is the IoE? Difference between IoT and IoE. Introduction to IIoT.

Textbooks:

1. Hakima Chaouchi, – The Internet of Things Connecting Objects to the Web, ISBN: 978-1-84821-140-7, Wiley Publications
2. Olivier Hersent, David Boswarthick, and Omar Elloumi, –The Internet of Things: Key Applications and Protocols, Wiley Publications
3. Vijay Madisetti and Arshdeep Bahga, –Internet of Things (A Hands-On Approach), 1st Edition, VPT, 2014.

References:

1. Daniel Minoli, –Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications, ISBN: 978-1-118-47347-4, Willy Publications
2. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press
3. http://www.cse.wustl.edu/~jain/cse570-15/ftp/iot_prot/index.html
4. https://onlinecourses.nptel.ac.in/noc17_cs22/course

List of Experiments

1. Study & Survey of various IoT platforms.
2. Study & Survey of various development boards for IoT. Understanding the process of OS installation on Raspberry Pi.
3. Program digital read/write using LED and Switch using Arduino.
4. Measure the distance of an object using an ultrasonic sensor.
5. Interfacing sensors (Temperature, PIR, LDR) and actuators (Motors) using Arduino.
6. Introduction to PictoBlox software: build a simple block-based program to control an LED/Motor connected to Arduino.
7. PictoBlox with Arduino: build a simple obstacle-detection program using an ultrasonic sensor with block-based coding.
8. Building a Motion-Activated Alarm System using Arduino/Raspberry Pi.
9. IoT based Home Automation mini-project: control home appliances (e.g., lights/fan) using Arduino/Raspberry Pi, which can also be built on any IoT simulation platform like TinkerCAD.

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Multidisciplinary Minor Course-4

ET25054: Microcontroller Architecture

Teaching Scheme: Theory: 02Hours/Week Practical: 02 Hours/Week	Credits 03	Examination Scheme: CAA: 10 Marks End Sem: 60 Marks Term work: 30 Marks

Course Objectives:

1. To study architectural details of PIC 18 microcontroller.
2. Explore the knowledge and skills required to interface PIC microcontrollers with external peripherals and to develop embedded applications
3. To study applications of PIC through various interfacing devices

Course Outcomes: On completion of the course, the learner will be able to–

CO1: Apprehend the fundamentals of PIC Microcontroller

CO2: Students will be able to analyze the difference between microprocessor and microcontroller-based systems.

CO3: Apply embedded C programming to configure and control I/O ports, and implement timer-based applications using polling and interrupt techniques on PIC18 microcontrollers.

CO4: Interface and program external devices with a PIC microcontroller to design functional embedded system solutions.

Course Contents

Module I: Fundamentals of PIC Microcontroller (07 Hrs.)

Introduction of Microcontroller, Microprocessor Vs Microcontroller, What is PIC Microcontroller, Architecture, Core Components of Microcontroller, Types of PIC Microcontrollers, Development Tools, Programming Languages for PIC Microcontroller, Typical Applications of PIC Microcontroller.

Module II: PIC Microcontroller Architecture (06 Hrs.)

Introduction to microcontroller, Criteria for selection of microcontroller, Features and architecture, Comparison of PIC 18 series microcontrollers; Details of Pins, Pin Diagram PIC 18 internal Architecture: ALU, EEPROM, RAM, IO Ports, Timer, ADC, Serial port PIC18 microcontroller programming model, Bus architecture Registers of PIC18F, Interrupts of PIC18F Program memory and data memory organization.

Module III: PIC I/O Ports Timer, Counter (06 Hrs.)

I/O Port Programming in PIC18 Microcontroller (Structure and configuration of I/O Ports (PORTx, TRISx, LATx), Bit-level I/O Control and Manipulation (Bitwise operations), Programming examples using Embedded C), Timers and Counters in PIC18 Microcontroller (Timer/Counter modules (Timer0, Timer1, etc.) and associated Registers, Delay Generation using Timers, Timer Programming in Embedded C).

Module IV: PIC Interfacing (08 Hrs.)

Interrupt: Interrupt Structure of PIC18F with SFR, PORTB change Interrupts, use of timers with interrupts CCP modes: Capture, Compare and PWM generation, DC Motor speed control with CCP, Block diagram of in-built ADC with Control registers, Sensor interfacing using

ADC: All programs in embedded C.

Interfacing of LED, interfacing 16X2 LCD and keyboard, 7-segment display interfacing, Interfacing Relay & Buzzer.

Basics of Serial communication protocols: Study of RS232, I2C, SPI, UART, Serial communication programming using Embedded C.

Text Books:

1.Muhammad Ali Mazidi, Danny Causey, RolinMcKinlay, "PIC Microcontroller and Embedded Systems: Using Assembly and C for PIC18", 4th Edition by, Pearson international Edition.

Reference Books:

1. 1.Peatman, John B, "Design with PIC Microcontroller", Pearson Education PTE
2. 2. Ramesh Gaonkar, "Fundamentals of Microcontrollers and Applications in Embedded Systems (with the PIC18 Microcontroller Family)" Thomson/Delmar Learning; 1 edition (January 8, 2007), ISBN:978-14018791433.
3. Microchip's PIC18FXXX Data Sheet

e-sources:

Course Title: Microprocessors and Microcontrollers by Prof. Santanu Chattopadhyay, Dept. of Electrical engineering, IIT Kharagpur Course

Details : https://onlinecourses.nptel.ac.in/noc22_ee12/preview Lectures available on https://archive.nptel.ac.in/courses/108/105/108105102/

List of Experiments (Any Eight)

1. Write a program for interfacing LED
2. Write a program for interfacing Seven Segment Display
3. Write a program for interfacing relay
4. Write a program for interfacing buzzer
5. Interfacing of LCD to PIC 8FXXXX
6. Interfacing of 4X4 keypad and displaying key pressed on LCD
7. Interfacing serial port with PC both side communication.
8. Generation of PWM signal for DC Motor control.
9. Write a program for interfacing Stepper Motor

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ET25055: Fundamentals of Drone Technology

Teaching Scheme:	Credits: 3	Examination Scheme
TH: 02 Hrs./week		End - Semester: 60 Marks
PR: 02 Hrs/week		TW: 30 marks
		CAA: 10 marks

Course Objectives: The course aims to

1. Provide fundamental knowledge of drones, their types, configurations, and applications.
2. Develop an understanding of drone power systems, battery technologies, and management strategies.
3. Explain the principles of sensors, actuators, and control mechanisms used in drone systems.
4. Familiarize students with drone communication technologies, GPS, flight controllers, and navigation techniques.

Course Outcomes: On completion of the course, the learner will be able to–

CO1: Explain drone classification, configurations, and applications.

CO2: Analyze battery technologies, specifications, and battery management systems for drones.

CO3: Demonstrate working principles of sensors, actuators, and PID control in drones.

CO4: Evaluate drone communication technologies, GPS modules, ESCs, and flight controllers.

Course Contents

Unit I: Introduction to Drones (06 Hrs.)

Definition, Classification of Drones, Classification of Multirotor, Concept of Payload, Different frame configurations, Basic Components of Drones, Types of Drones: based on aerial platform and body material, Payload of UAVs: High Definition Cameras, Oblique Camera, Multispectral / Hyperspectral Imager, Stereovision camera, Thermal Camera, Current and Future applications of drones.

Unit II: Battery Electronics in Drones (06 Hrs.)

Different types of batteries used in Drones: NiMH, NiCd, Li-Po, Li-ion, Battery Specifications, Selection Criteria of Battery for best performance, charging technologies of drone batteries- Constant Current and Constant Voltage, TRICKLE Charging, Building blocks of Drone Battery Management System.

Unit III: Sensors and Actuators in Drones (06 Hrs.)

Sensor-Definition, Role of Sensors in Drones, Core Sensors used in Drones and their principle of operation- Accelerometer, Gyroscope, Magnetometer, and Barometer sensors, Inertial Measurement Unit (IMU). Actuator-Definition, DC Motor and its principle, BLDC Motors-Construction and Operation, Speed Control Technique of BLDC Motor, Servomotor, PID Control.

Unit IV: Communication Technology and Advances in Drones (06 Hrs.)

Radio Frequency Spectrum, RF Transmitter and Receiver Circuit, Fundamentals of GPS, GPS Module for base station, Flight Controller Boards (FCB), Electronic Speed Controllers (ESC), Case Studies- LIDAR and Time of Flight (ToF) based UAV for Remote Sensing Applications. SWARM of UAVs

Textbooks:

1. John Baichtal: "Building Your Own Drones: A Beginner's Guide to Drones, UAVs, and ROVs", Que Publishing USA, 2016.

2. Ian Cinnamon, Romi Kadri, Fitz Tepper: "DIY Drones for the Evil Genius: Design, Build, and Customize Your Own Drones", McGraw-Hill TAB, 2016.

Reference Books:
1. Neeraj Kumar Singh, Porselvan Muthukrishnan, Satyanarayana Sanpini, "Industrial System Engineering for Drones: A Guide with Best Practices for Designing". Apress.
2. Felipe González Toro, Antonios Tsourdos. "UAV or Drones for Remote Sensing Applications"

SWAYAM Course:

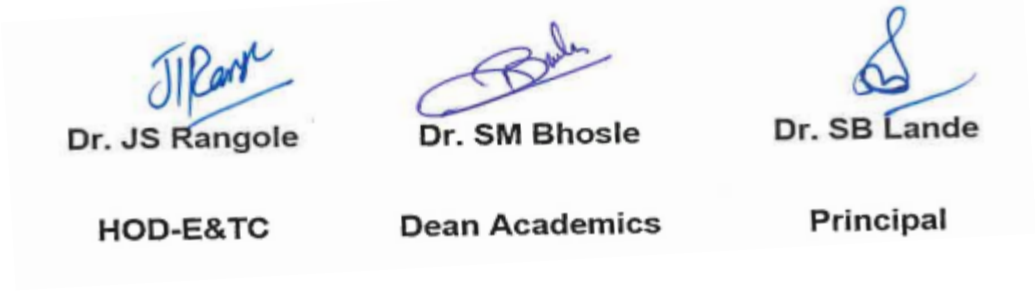
1. Drone Surveying

   https://onlinecourses.nptel.ac.in/noc26_ce12/preview

2. UAV in Engineering Applications https://onlinecourses.swayam2.ac.in/e-learning/preview/ntr26_ed33

Lab Assignments:

Expt. No.	Experiment Title	Type	Software / Platform
1	Assembling the Electrical Components of a Drone	Virtual Lab	Drone IITD Virtual Lab
2	Assembling the Software-Based Components of a Drone	Virtual Lab	Drone IITD Virtual Lab
3	Drone's Software Download, Installation, and Calibration	Virtual Lab	Drone IITD Virtual Lab
4	Drone's Take-off, Flight, and Landing Basics	Virtual Lab	Drone IITD Virtual Lab
5	Operation of Agricultural Drone	Virtual Lab	Drone IITD Virtual Lab
6	Study of Mission Planner Interface and Telemetry Monitoring	Simulation Practical	ArduPilot SITL + Mission Planner
7	Sensor Calibration Simulation in Mission Planner	Simulation Practical	ArduPilot SITL + Mission Planner
8	Autonomous Waypoint Mission Planning	Simulation Practical	ArduPilot SITL + Mission Planner
9	Telemetry Monitoring and Flight Log Analysis	Simulation Practical	ArduPilot SITL + Mission Planner
10	Study of DGCA Rules, No-Fly Zones, and Safety Practices	Study experiment	https://www.dgca.gov.in/digigov-portal/ +Digisky
Proposed Activities			
1	Visit to Drone Lab/ Expo/ Demonstrations	Field Visit	
2	MOOC or Certification courses	Online / Offline	



ET25056: Internet of Things: Concepts and Applications (Multidisciplinary Minor Course - 6)

Teaching Scheme:	**Credits**	**Examination Scheme:**
Theory: 03 Hours/Week Practical: 02 Hours/Week	**04**	CAA: 10 Marks In Sem: 30 Marks End Sem: 60 Marks Termwork: 30 Marks

Prerequisite Courses, if any:

1. Digital Systems
2. Basic Electronics / Microcontrollers

Course Objectives:

1. Understand IoT Fundamentals – Introduce the basic concepts, history, characteristics, and building blocks of IoT.
2. Analyze IoT Architecture – Study the architectural framework, design outlooks, M2M concepts, and XaaS (cloud service) models.
3. Understand Sensors, Actuators and WSN – Explore types and working of sensors, actuators, RFID and Wireless Sensor Networks.
4. Examine IoT Communication Protocols – Study short-range, long-range and application-layer protocols used for IoT connectivity.
5. Develop IoT Solutions – Provide hands-on experience with IoT boards, sensor/actuator interfacing and basic programming.
6. Explore IoT Applications and Cloud Integration – Understand real-world IoT applications, cloud-based IoT solutions and introduction to Industrial IoT.

Course Outcomes: On completion of the course, the learner will be able to

CO1: Comprehend the fundamental concepts, characteristics and building blocks of IoT.
CO2: Analyze IoT architecture, design outlooks and M2M/XaaS concepts.
CO3: Describe the working of sensors, actuators, RFID and Wireless Sensor Networks.
CO4: Compare wireless and IP-based communication protocols (Zigbee, BLE, LoRaWAN, MQTT, CoAP, etc.) used in IoT.
CO5: Implement IoT-based solutions using microcontrollers, sensors and communication modules.
CO6: Develop simple IoT applications using cloud-based storage and management tools, with an overview of Industrial IoT.

Course Contents

Unit I: Introduction to IoT (06 Hrs.)

Internet of Things – History, Basic Definitions, Characteristics, Features; Physical and Logical Design of IoT; Enabling Technologies in IoT; About Things in IoT; Identifiers in IoT; IoT Frameworks; Difference between IoT and M2M; Networking Basics – Types, Devices and Topology.

Unit II: IoT Architecture and Design Aspects (06 Hrs.)

IoT – An Architectural Overview, Building Architecture, Main Design Principles and Needed Capabilities; M2M and IoT Technology Fundamentals – Devices and Gateways, Local and Wide Area Networking, Business Processes in IoT; Everything as a Service (XaaS); What is the IoE? Difference between IoT and IoE.

Unit III: Sensors, Actuators and Wireless Sensor Networks (06 Hrs.)

Types of Sensors and Actuators – Examples and Working; RFID – Principles and Components; Basics of Wireless Sensor Networks; Fundamentals of Edge and Cloud Computing; Cloud Services – SaaS, IaaS, PaaS.

Unit IV: Communication Protocols for IoT (06 Hrs.)

Short-Range Communication Protocols – Zigbee, Z-Wave, Bluetooth Low Energy, Wi-Fi; Long-Range Communication Protocol – LoRaWAN; IoT Network Layer Protocols – IPv4, IPv6, 6LoWPAN; Application Layer Protocols – MQTT, CoAP, HTTP/HTTPS; Comparison of Bluetooth & BLE, CoAP and MQTT.

Unit V: IoT Interfacing and Programming (07 Hrs.)

Introduction to IoT Boards – Arduino/Raspberry Pi/Equivalent Platform; Interfacing Sensors and Actuators with IoT Boards; Reading Data from Sensors; Communication – Connecting Microcontroller with Mobile Devices through Bluetooth, Wi-Fi and USB; Basic Programming for Sensor Data Acquisition and Actuator Control.

Unit VI: IoT Applications and Cloud Integration (06 Hrs.)

Applications of IoT – Home Automation, Smart Cities, Agriculture, Health and Lifestyle; Connecting IoT to Cloud; Cloud Storage for IoT; Data Analytics for IoT; Software and Management Tools for IoT; Introduction to Industrial IoT (IIoT).

Text Books:

1. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-On Approach)", 1st Edition, VPT, 2014.

2. Ovidiu Vermesan, Peter Friess, "Internet of Things: From Research and Innovation to Market Deployment", River Publishers Series in Communication, USA.

3. Olivier Hersent, David Boswarthick, and Omar Elloumi, "The Internet of Things: Key Applications and Protocols", 2nd Edition, Wiley Publications.

Reference Books:

1. Hakima Chaouchi, "The Internet of Things: Connecting Objects to the Web", ISBN: 978-1-84821-140-7, Wiley Publications.

2. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Wiley Publications.

3. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press.

4. Dr. Ovidiu Vermesan, Dr. Peter Friess, "Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems", River Publishers Series in Communication.

Useful Links for IoT Applications and Use Cases:

- http://www.cse.wustl.edu/~jain/cse570-15/ftp/iot_prot/index.html
- https://onlinecourses.nptel.ac.in/noc17_cs22/course
- https://pressbooks.bccampus.ca/iotbook/chapter/iot-use-cases/
- https://research.aimultiple.com/iot-applications/

List of Experiments

1. Study of Raspberry Pi/Arduino/Beagle board and different operating systems. Understanding the process of OS installation on Raspberry Pi/Beagle board/Arduino.

2. Open-source prototype platform – Raspberry Pi/Beagle board/Arduino – Simple program for digital read/write using LED and Switch – Analog read/write using sensor and actuator.

3. Interfacing sensors (Temperature, PIR, LDR) and actuators (Motor, Buzzer) with Arduino/Raspberry Pi.

4. Measure the distance of an object using an ultrasonic sensor / IoT-based DC Motor control with Arduino/Raspberry Pi.

5. Introduction to MQTT/CoAP and sending sensor data to the cloud using Raspberry Pi/Arduino.

6. Building a Motion-Activated Alarm System using Arduino/Raspberry Pi.

7. Blink an LED and control a Buzzer interfaced with Arduino using PictoBlox block-based programming software.

8. Read data from a sensor (Ultrasonic/IR) interfaced with Arduino and control an actuator based on the sensor value, using PictoBlox software.

9. Interfacing a Relay Module with Arduino/Raspberry Pi to control a Home Appliance (Bulb/Fan) – Home Automation basics.

10. Sending Temperature and Humidity sensor (DHT11) data to a cloud dashboard (ThingSpeak/Blynk) using Wi-Fi (ESP8266/ESP32).

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