DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Curriculum and Syllabus for Minor Degree Programme

Name of the Minor Degree	**Internet of Things (IoT)**
Minor Degree Offering Department	**ECE**
Eligible Departments	**All branches except ECE**

Sl. No.	Course Code	Course Title	L	T	P	Total Contact Periods	Credits
1	U23MDEC101	Introduction to Internet of Things	3	0	0	3	3
2	U23MDEC102	Introduction to Sensor Technology	3	0	0	3	3
3	U23MDEC103	IoT: Communication Technologies	3	0	0	3	3
4	U23MDEC104	Industry 4.0 and IIoT	3	0	0	3	3
5	U23MDEC105	IoT System Design	3	0	2	5	4
6	U23MDEC106	Mini Project	0	0	3	3	2
TOTAL CREDITS							**18**

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U23MDEC101	INTRODUCTION TO INTERNET OF THINGS	L	T	P	C
Prerequisites: Nil		3	0	0	3

COURSE OBJECTIVES:

- To acquire knowledge in fundamentals of Internet of Things (IoT) and protocols like SCADA and RFID.
- To gain conceptual understanding in various IoT architectures like architecture of WoT
- To apply the concept of Internet of Things in the real-world scenario.

UNIT I **IOT – AN OVERVIEW** **9**

Introduction to IoT – Elements of an IoT ecosystem, Technology drivers, Business drivers, Trends and implications, Overview of Governance, Privacy and Security Issues.

UNIT II **IOT PROTOCOLS** **9**

Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – Issues with IoT Standardization – Unified Data Standards – Protocols – IEEE802.15.4 – BACNet Protocol – SCADA and RFID Protocols - Modbus – KNX – Zigbee– Network layer – APS layer – Security.

UNIT III **IOT ARCHITECTURE** **9**

M2M high –level ETSI architecture – IETF architecture for IoT - OGC architecture - IoT reference model – Domain model - information model – functional model – communication model.

UNIT IV **WEB OF THINGS** **9**

Web of Things versus Internet of Things – Two Pillars of the Web – Architecture Standardization for WoT– Platform Middleware for WoT – Unified Multi-tier WoT Architecture – WoT Portals and Business Intelligence.

UNIT V **IOT APPLICATIONS** **9**

Applications of IoT in Agriculture, Logistics, Smart home, Health and Energy - IoT applications for industry: Future Factory Concepts, Brownfield IoT.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Ovidiu Vermesan, Peter Friess, "Internet of Things Applications - From Research and Innovation to Market Deployment", River Publishers, 2024.
2. Pramod R Gunjal, Satish R Jondhale, Jaime Lloret Mauri, Karishma Agrawal, "Internet of Things: Theory to Practice", 1st Edition, CRC Press, 2024.

REFERENCES:

1. Vijay Madisetti, Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)",1st Edition, VPT, 2014
2. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013

3 Cuno Pfister, Getting Started with the Internet of Things, O"Reilly Media, 2011, ISBN: 978-1-4493-9357-1

ONLINE RESOURCES

1 https://www.coursera.org/specializations/iot

2 https://www.mygreatlearning.com/iot/free-courses

3 https://onlinecourses.nptel.ac.in/noc22_cs53/preview

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the fundamentals of IoT.

CO2 Apply suitable protocol for IoT applications.

CO3 Analyze various architectures of IoT.

CO4 Apply the architecture of WoT for various applications.

CO5 Design an IoT application and connect to the cloud.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	-	-	-	-	-	1	2	2
CO2	3	2	1	2	-	-	-	-	-	-	-	1	2	2
CO3	3	3	2	2	-	-	-	-	-	-	-	1	2	2
CO4	3	2	1	2	1	-	-	-	-	-	-	1	2	2
CO5	3	3	3	3	1	-	-	-	-	-	-	1	2	2

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U23MDEC102	INTRODUCTION TO SENSOR TECHNOLOGY	L	T	P	C
Prerequisites: Nil		3	0	0	3

COURSE OBJECTIVES:

- To understand the transduction principles, sensors and measurement systems.
- To gain conceptual understanding of velocity and acceleration measurement methods and various measurement methods of physical and electrical Parameters.
- To apply calibration methods for sensors attached with real time systems.

UNIT I INTRODUCTION TO MEASUREMENT SYSTEMS 9

General concepts and terminology, measurement systems, sensor classifications: Analog Input and Output, Digital Input and Output, general input-output configuration, methods of correction. Passive Sensors Resistive Sensors: Potentiometers, Strain Gauges, RTDs, LDRs, Resistive Hygrometers, Capacitive Sensors, Inductive Sensors.

UNIT II SELF-GENERATING SENSORS 9

Thermoelectric Sensors: Thermocouples, Thermo electric effects, Common thermocouples, Practical thermocouple laws, cold junction compensation in thermocouple circuits. Piezoelectric Sensors: Piezoelectric effect, piezoelectric materials, applications.

UNIT III VELOCITY AND ACCELERATION MEASUREMENT 9

Relative velocity – Translational and Rotational velocity measurements – Revolution counters and Timers – Magnetic and Photoelectric pulse counting stroboscopic methods. Accelerometers-different types, Gyroscopes – applications.

UNIT IV DENSITY, VISCOSITY AND OTHER MEASUREMENTS 9

Units of Viscosity, specific gravity scales used in Petroleum Industries, Different Methods of measuring consistency and Viscosity – Two float viscorator – Industrial consistency meter. Sound-Level Meters, Microphones.

UNIT V CALIBRATION AND INTERFACING 9

Calibration using Master Sensors, Interfacing of Force, Pressure, Velocity, Acceleration, Flow, Density and Viscosity Sensors, Variable Frequency Drives.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Sinha G R, "Advances in Modern Sensors", Illustrated Edition, IOP Publishing Limited, 2020.
2. Ahmed Barhoum, Zeynep Altintas, "Fundamentals of Sensor Technology: Principles and Novel Designs", 1st Edition, Elsevier Science, 2023.

REFERENCES:

1. Jon S Wilson, "Sensor Technology Handbook – Volume 1", 1st Edition, Elsevier Science, 2005.
2. John Vetelino, Aravind Reghu, "Introduction to Sensors", 1st Edition, CRC Press, 2017.

3 Ahmed Barhoum, Zeynep Altintas, "Fundamentals of Sensor Technology", Elsevier Science, 2023.

ONLINE RESOURCES

1 https://onlinecourses.nptel.ac.in/noc23_ee95/preview

2 https://www.coursera.org/learn/sensors-circuit-interface

3 https://alison.com/course/introduction-to-electronic-sensors

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Analyze the working of sensors using various measurement methods.

CO2 Analyze the actuation of sensors using their fundamental principles.

CO3 Analyze the velocity and acceleration of accelerometers and gyroscopes.

CO4 Apply various measurement methods of physical and electrical parameters.

CO5 Apply the calibration methods for sensors attached with real time systems.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	-	-	-	-	-	-	1	2	2
CO2	3	3	2	2	-	-	-	-	-	-	-	1	2	2
CO3	3	3	2	2	-	-	-	-	-	-	-	1	2	2
CO4	3	2	1	2	-	-	-	-	-	-	-	1	2	2
CO5	3	2	1	2	1	-	-	-	-	-	-	1	2	2

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U23MDEC103	IOT: COMMUNICATION TECHNOLOGIES	L	T	P	C
		3	0	0	3

Prerequisites: Nil

COURSE OBJECTIVES:

- To understand the fundamentals of communication networks and various IoT models to build efficient IoT platform.
- To analyze different design methodologies and build IoT platform using python using Raspberry PI.
- To apply IoT platforms in real time environment.

UNIT I FUNDAMENTALS OF COMMUNICATION NETWORKS 9

Data Communication, Networks, Protocols and standards, Line configuration, Topology, Transmission mode, Signaling, RS232 Serial Communication and Manchester encoding, OSI reference model – layers and duties. TCP/IP reference model – layers and duties, Addressing.

UNIT II IOT AND M2M 9

IoT Architecture: State of the art introduction, state of the art; Architecture reference model: Introduction, reference model and architecture, IoT reference model.

UNIT III IOT PLATFORMS DESIGN METHODOLOGY 9

IoT Architecture, Architecture reference model: Introduction, reference model and architecture, Logical design using Python: Installing Python, Python data types and data structures, control flow, functions, modules, packages, file handling.

UNIT IV IOT PHYSICAL DEVICES AND ENDPOINTS 9

Introduction to Raspberry Pi interfaces (Serial, SPI, I2C), programming Raspberry PI with Python, other IoT devices.

UNIT V IOT PHYSICAL SERVERS AND CLOUD OFFERINGS 9

Introduction to cloud storage models and communication APIs, WAMP – AutoBahn for IoT, Xively cloud for IoT, case studies illustrating IoT design – home automation, smart cities, smart environment.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Rolando Herrero, "Fundamentals of IoT Communication Technologies", Illustrated Edition, Springer International Publishing, 2022.
2. Veena S Chakravarthi, "Internet of Things and M2M Communication Technologies Architecture and Practical Design Approach to IoT in Industry 4.0", 1st Edition, Springer International Publishing, 2021.

REFERENCES:

1. Debosree Ghosh, "Basic IoT Blueprint: From Devices to Data", 1st Edition, Kitab Writing Publication, 2023.
2. John Vetelino, Aravind Reghu, "Introduction to Sensors", 1st Edition, CRC Press, 2017.
3. Arshdeep Bahga, Vijay Madisetti, "Cloud Computing A Hands-on Approach", VPT, 1st Edition, 2014.

ONLINE RESOURCES

1 https://onlinecourses.nptel.ac.in/noc22_cs53/preview

2 https://www.coursera.org/learn/internet-of-things-communication

3 https://www.edx.org/learn/iot-internet-of-things

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the fundamentals of communication networks.

CO2 Apply various IoT platform based on architecture analysis

CO3 Apply accurate design methodologies and build IoT platform

CO4 Write Program for Raspberry PI using Python

CO5 Design IoT platforms in a real time environment.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	-	-	-	-	-	1	2	2
CO2	3	2	1	2	-	-	-	-	-	-	-	1	2	2
CO3	3	2	1	2	-	-	-	-	-	-	-	1	2	2
CO4	3	3	3	3	-	-	-	-	-	-	-	1	2	2
CO5	3	3	3	3	1	-	-	-	-	-	-	1	2	2

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U23MDEC104	INDUSTRY 4.0 AND IIOT	L	T	P	C
Prerequisites: Nil		3	0	0	3

COURSE OBJECTIVES:

- To understand the basics of Industry 4.0 and IIoT.
- To analyze IIOT platform and SDN using big data analytics and implement safety protocols in Industrial IoT.
- To apply IIOT in various applications.

UNIT I INTRODUCTION 9

Introduction – Definition and characteristics of IoT – Physical and Logical Design of IoT - Communication models and APIs – Challenges in IoT - Evolution of IoT- Components of IoT - A Simplified IoT Architecture – Core IoT Functional Stack.

UNIT II BASICS OF INDUSTRIAL IOT 9

IIoT-Introduction, Industrial IoT: Business Model and Reference Architecture: IIoT-Business Models, Industrial IoT- Layers: IIoT Sensing, IIoT Processing, IIoT Communication, IIoT Networking.

UNIT III INDUSTRIAL IOT-BIG DATA ANALYTICS AND SOFTWARE DEFINED NETWORKS 9

Big Data Analytics and Software Defined Networks, Machine Learning and Data Science, Julia Programming, Data Management with Hadoop.

UNIT IV INDUSTRIAL IOT SECURITY 9

Fog Computing in IIoT, Security in IIoT, Industrial IoT – Application Domains; Industrial IoT – Application Domains: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security, Facility Management.

UNIT V INDUSTRIAL IOT – APPLICATION DOMAINS 9

Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Real case studies.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", Apress, 2017.

2 Giacomo Veneri, Antonio Capasso, "Hands-On Industrial Internet of Things: Create a Powerful Industrial IoT", Packt, 2018.

REFERENCES:

1 Sabina Jeschke, Christian Brecher, Houbing Song, Danda B Rawat, "Industrial Internet of Things: Cyber Manufacturing Systems", Springer International Publishing, 2017.

2 John Vetelino, Aravind Reghu, "Introduction to Sensors", 1st Edition, CRC Press, 2017.

3 Ismail Butun, "Industrial IoT Challenges, Design Principles, Applications, and Security", Springer International Publishing, 1st Edition, 2020.

ONLINE RESOURCES

1 https://www.coursera.org/courses?query=industry%204.0

2 https://onlinecourses.nptel.ac.in/noc20_cs69/preview

3 https://www.classcentral.com/tag/industry-4-0

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the basics of Industry 4.0.

CO2 Explain the basics of IIoT.

CO3 Analyze IIOT platform and SDN using big data analytics

CO4 Analyze the safety protocols in Industrial IoT.

CO5 Apply IIOT in various applications

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	-	-	-	-	-	1	2	2
CO2	2	2	1	1	-	-	-	-	-	-	-	1	2	2
CO3	3	3	2	2	-	-	-	-	-	-	-	1	2	2
CO4	3	3	2	2	-	-	-	-	-	-	-	1	2	2
CO5	3	2	1	2	1	-	-	-	-	-	-	1	2	2

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U23MDEC105	IOT SYSTEM DESIGN	L T P C
Prerequisites: Nil		3 0 2 4

COURSE OBJECTIVES:

- To understand various design techniques for configuration of distributed embedded systems
- To learn programming of Edge devices with Raspberry Pi and to explore machine learning with python
- To demonstrate workability of IoT platform using data analytics tools.

UNIT I **INTRODUCTION TO DESIGN TECHNIQUES** **9**

Design methodologies- Design flows - Requirement analysis – Specifications-System analysis and architecture design – Quality assurance techniques- Distributed embedded systems.

UNIT II **EDGE DEVICES** **9**

Raspberry Pi, Programming edge node, Introduction to Gateways, Gateways types and configurations, HTTP access method using API, Introduction and installing the Raspbian Stretch OS, Computer and Rpi configuration to connect Rpi remotely without Ethernet cable via SSH, IP address, Raspberry pi3 interfacing with Sensor DHT11, Raspberry pi python library install and reading sensor feed, MySQL server on Raspberry pi.

UNIT III **MACHINE LEARNING USING PYTHON** **9**

Python basics and its libraries for machine learning, NumPy, Pandas, SciPy, MatPlot Lib and SciKit Learn.

UNIT IV **IOT AND DATA ANALYTICS** **9**

IoT and Data Management, Data cleaning and processing, Deep Web, Semantic sensor web, Semantic Web Data Management, Searching in IoT, Real-time and Big Data Analytics for Internet of Things, Heterogeneous Data Processing, Data Processing, Parallel and Distributed Data Processing.

UNIT V **CLOUD OF THINGS** **9**

IoT Physical Servers, Cloud Offerings, and IoT Case Studies, Introduction to Cloud Storage Models, Communication API, Eclipse IoT, AWS IoT, Google Cloud IoT, ThingWorx.

45 PERIODS

LIST OF EXPERIMENTS:

1. Design and analysis of the following experiments using Arduino/Raspberry Pi:
2. Blinking of LED with different delays
3. Digital I/O Interface [IR Sensor, PIR Sensor]
4. Analog Interface [ADC, Temperature Sensor]
5. Motor speed and direction control
6. Wireless Interface –Bluetooth & Wi-Fi Technologies

30 PERIODS
TOTAL:75 PERIODS

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TEXT BOOKS:

1. Shrirang Ambaji Kulkarni, "Introduction to IOT with Machine learning and Image Processing using Raspberry Pi", CRC Press, 2020.
2. Rahul Dubey, "An Introduction to Internet of Things: Connecting Devices, Edge Gateway, and Cloud with Applications", 1st Edition, Cengage India Publication, 2019.

REFERENCES:

1. Richardson M, Wallace S, "Getting started with raspberry PI", "O"Reilly Publisher Media, Inc., 2012.
2. SudipMisra, Chandana Roy, Anandarup Mukherjee, "Introduction to Industrial Internet of Things and Industry 4.0", 1st Edition, CRC Press, 2020.
3. Rao, M, "Internet of Things with Raspberry Pi 3: Leverage the power of Raspberry Pi 3 and JavaScript to build exciting IoT projects", Packt Publishing Ltd., 2018.

ONLINE RESOURCES

1. https://www.classcentral.com/report/iot-free-online-courses/
2. https://onlinecourses.nptel.ac.in/noc23_cs65/preview
3. https://www.coursera.org/learn/iot-devices-il

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain various design techniques for configuration of distributed embedded systems

CO2 Comprehend programming of Edge devices with Raspberry Pi.

CO3 Apply the concept of Internet of Things in the real world scenario

CO4 Apply data analytics tools in IoT

CO5 Analyze IoT platform using various cloud storage models.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	2	2	2	1	1	1	-	1	2	2
CO2	2	2	1	1	2	2	2	1	1	1	-	1	2	2
CO3	3	2	1	2	2	2	2	1	1	1	-	1	2	2
CO4	3	2	1	2	2	2	2	1	1	1	-	1	2	2
CO5	3	3	2	2	2	2	2	1	1	1	-	1	2	2

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