

Pimpri Chinchwad Education Trust's

PIMPRI CHINCHWAD COLLEGE OF ENGINEERING

SECTOR NO. 26, PRADHIKARAN, NIGDI, PUNE 411044

(An Autonomous Institute Approved by AICTE and Affiliated to SPPU, Pune)



Curriculum Structure and Syllabus

of

Multi-Disciplinary Minors (MDM) in Internet of Things (Regulations 2023)



Effective from Academic Year 2024-25

Institute Vision

To be one of the top 100 Engineering Institutes of India in coming five years by offering exemplarily Ethical, Sustainable and Value Added Quality Education through a matching ecosystem for building successful careers.

Institute Mission

1. Serving the needs of the society at large through establishment of a state-of-art Engineering Institute.
2. Imparting right Attitude, Skills, Knowledge for self-sustenance through Quality Education.
3. Creating globally competent and Sensible engineers, researchers and entrepreneurs with an ability to think and act independently in demanding situations.

EOMS Policy

“We at PCCOE are committed to offer exemplarily Ethical, Sustainable and Value Added Quality Education to satisfy the applicable requirements, needs and expectations of the Students and Stakeholders.

We shall strive for technical development of students by creating globally competent and sensible engineers, researchers and entrepreneurs through Quality Education.

We are committed for Institute’s social responsibilities and managing Intellectual property.

We shall achieve this by establishing and strengthening state-of-the-art Engineering Institute through continual improvement in effective implementation of Educational Organizations Management Systems (EOMS).”

Course Approval Summary

Board of Studies - **Department of Electronics and Telecommunication Engineering**

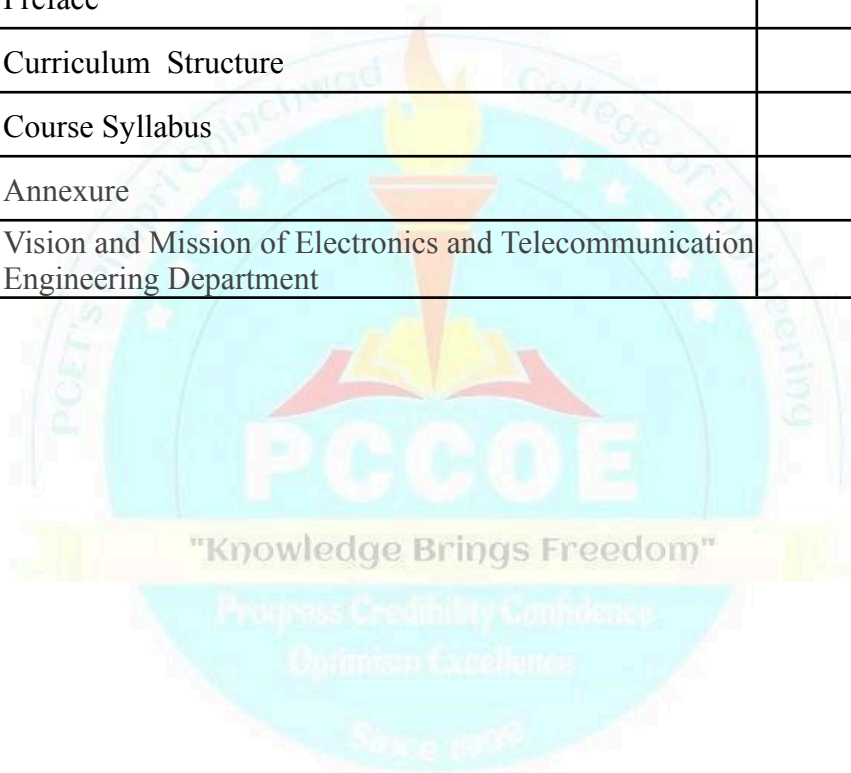
Sr. No.	Name of the Course	Course Code	Page number	Signature and stamp of BoS chairman
1.	Principles of Internet of Things	BET23MD11	7	
2.	Technologies Enabling IoT	BET24MD11	10	
3.	IoT System Design	BET25MD11	13	
4.	IoT System Design Lab	BET25MD12	16	
5.	Industrial IoT	BET26MD11	18	
6.	Capstone Project	BET27MD11/ BET28MD11	21	

Approved by Academic Council:

Chairman, Academic Council
Pimpri Chinchwad College of Engineering

INDEX

Sr. No.	Content	Page No.
1	Preface	4
2	Curriculum Structure	5
3	Course Syllabus	7
4	Annexure	24
5	Vision and Mission of Electronics and Telecommunication Engineering Department	25



Preface

The Internet of Things in Engineering consists of sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet together. IoT has a huge impact on the engineering fields such as Smart cities, Smart health, Smart agriculture, Cyber-security, Preventive Maintenance Programs, Real-Time Construction Management Solution, Workers' Safety, Machine Governance and Field testing etc. In view of the same, the Multidisciplinary Minor (MDM) in Internet of Things (IoT) is offered by Electronics and Telecommunication Engineering for students of branches from Computer, IT, AIML, Mechanical and Civil Programs.

Objectives:

1. To familiarize the students with the fundamentals of hardware and software required for designing an IoT system.
2. To introduce the students with the technologies those contribute in building an IoT application.
3. To acquaint the students regarding building an IoT system.
4. To familiarize the students with the use cases of IoT in Industry.

Outcomes:

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

1. Develop embedded applications using IoT development boards, sensors and actuators.
2. Choose the appropriate protocol, cloud service and data handling methods for an IoT application.
3. Develop skills in identifying areas where IoT can be deployed for smart applications.
4. Implement real field problem by gained knowledge of Industrial applications with IoT capability.

Curriculum Structure

MDM in

Internet of Things (IoT)

CURRICULUM STRUCTURE
MDM in Internet of Things (IoT) (Regulations 2023)
(With effect from Academic Year 2024-25)

Course Code	Course Name	Credit Scheme				Teaching Scheme (Hours/Week)			Evaluation Scheme and Marks						
		L	P	T	Cr	L	P	T	FA		SA	TW	PR	OR	Total
									FA 1	FA 2					
Semester III															
BET23MD 11	Principles of Internet of Things	2	-	-	2	2	-	-	10	10	30	-	-	-	50
Semester IV															
BET24MD 11	Technologies Enabling IoT	2	-	-	2	2	-	-	10	10	30	-	-	-	50
Semester V															
BET25MD 11	IoT System Design	3	-	-	3	3	-	-	20	20	60	-	-	-	100
BET25MD 12	IoT System Design Lab	-	1	-	1	-	2	-	-	-	-	50	-	-	50
Semester VI															
BET26MD 11	Industrial IoT (IIoT)	2	-	-	2	2	-	-	10	10	30	-	-	-	50
Semester VII/VIII															
BET27MD 11 /BET28MD 11	Capstone Project	-	4	-	4	-	8	-	-	-	-	100	-	50	150
Total		9	5	-	14	9	10	-	50	50	150	150	-	50	450

L-Lecture, P-Practical, T-Tutorial, FA-Formative Assessment, SA-Summative Assessment , TW-Term Work, OR-Oral, PR-Practical

Course Syllabus

Sem III

MDM :	Internet of Things (offered by E&Tc Engg.) (Applicable to: Comp, IT, AIML, Mech, Civil)			Semester : III			
Course :	Principles of Internet of Things			Code :	BET23MD11		
Credits	Teaching Scheme (Hrs./Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	FA		SA	Total
				FA1	FA2		
2	2	-	-	10	10	30	50
Prior knowledge of Basic Electronics Engineering Is essential							
Course Objectives: This course aims at enabling students, <ol style="list-style-type: none"> To study fundamental concepts of IoT To study roles of sensors, actuators and development boards in IoT To correlate the connection of smart objects and IoT access technologies. 							
Course Outcomes: After learning the course, the students should be able to: <ol style="list-style-type: none"> Analyze the role of IoT in societal benefits. Characterize the key attributes of sensors and actuators along with their significance in diverse IoT context. Compare and contrast Arduino, Raspberry Pi, and ESP8266 development boards based on their specifications and GPIO pin structures. Assess the impact of data acquisition and integration strategies on IoT system performance and scalability. 							
Detailed Syllabus:							
Unit	Description						Duration
1	Introduction to IoT Introduction to Internet of Things (IoT), Functional Characteristics, Architecture, Recent Trends in the Adoption of IoT, Role of cloud in IoT, Main design principles and needed capabilities, standards considerations. M2M and IoT Technology .Societal Benefits of IoT:- Health Care, Machine to Machine (M2M), Smart Transportation, Smart Living, Smart Cities, Smart Grid						08
2	Sensing and Actuation Role of Sensors and Actuators in IoT Sensors- Definition, characteristics, types and their working- Soil moisture sensor, DHT11, Ultrasonic sensor, PIR sensor, sound sensor, colour sensor, LDR, accelerometer, Gyroscope, magnetometer etc. Actuator- Definition, characteristics, types and their working- LED, Relay, DC motor, LCD etc.						06
3	Development boards for IoT Introduction to Arduino, Raspberry Pi, NodeMCU, - Their versions, models, physical design, specifications, GPIO pin structure, OS requirement, capabilities, reading datasheet						08
4	IoT Application Development Frame work for IoT Applications-Implementation of Device integration, Data acquisition and Integration, Device data storage on cloud/local server, Authentication, authorization of Devices						08
	Total Hrs.						30

Text Books:

1. Raj Kamal , “ Internet of Things: Architecture and Design”, McGraw Hill.2nd edition June 2022.
2. Misra, Sudip., Mukherjee, Anandarup., Roy, Arijit. “Introduction to IoT”. India: Cambridge University Press, 2021.

Reference Books:

1. Pethuru Raj, Anupama C. Raman ,” The Internet of Things Enabling Technologies, Platforms, and Use Cases”, Taylor and Francis group. February 2017
2. Peter Waher, “Mastering Internet of Things: Design and create your own IoT applications using Raspberry Pi 3”, First Edition, Packt Publishing, 2018.

Online courses Links:

1. <https://nptel.ac.in/courses/117/102/117102060/>

Course Syllabus

Sem IV

MDM :	Internet of Things (offered by E&Tc Engg.) (Applicable to: Comp, IT, AIML, Mech, Civil)			Semester : IV			
Course :	Technologies Enabling IoT			Code :	BET24MD11		
Credits	Teaching Scheme (Hrs./Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	FA		SA	Total
				FA1	FA2		
2	2	-	-	10	10	30	50
Prior knowledge of Fundamentals of IoT is essential.							
Course Objectives:							
This course aims at enabling students,							
<ol style="list-style-type: none"> 1. To get an exposure to the different IoT enabling technologies. 2. To understand handling huge amount of data for its analysis. 3. To learn the contemporary aspects like cloud computing. 							
Course Outcomes:							
After learning the course, the students should be able to:							
<ol style="list-style-type: none"> 1. Choose the hardware required for building an IoT system 2. Comprehend the concepts of WSN and choose the required communication protocol 3. Identify the required cloud service based on the requirement 4. Analyze the big data. 							
Detailed Syllabus:							
Unit	Description						Duration
1	Embedded Systems Introduction to IoT Boards, IoT deployment for Raspberry Pi /Arduino/Beaglebone/Jetson Nano Equivalent platform – Interfacing of Sensors and actuators, Communication: Connecting microcontroller with mobile devices – communication through Bluetooth and wi-fi						07
2	Wireless Sensor Network What is communication? Wired and wireless communication, types of wired and wireless communication, What is WSN? WSN node, Anatomy of the network node, Architecture of WSN, Types of WSN WSN standards: IEEE 802.15.4, Low rate WPAN, Zigbee, BLE, LoRA. Protocol stack of WSNs						08
3	Cloud Computing Introduction to Cloud Computing (concept, architecture, working) Introduction to Cloud service models, Cloud Platforms: Google App Engine, Amazon Web Services, Microsoft Azure Cloud services, Windows Azure Platform Appliance. Distributed Computing: Need, Distributed computing vs. Cloud computing						07
4	Big Data Analytics Introduction to Big data, Types of data, Characteristics of Big data, Data handling technologies, Flow of data, Data acquisition, Data storage, Introduction to Hadoop, Introduction to Data Analytics, Types of data analytics-Local Analytics, Cloud analytics and applications						08
	Total Hrs.						30

Text Books:

1. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press, 2017
2. Olivier Hersent, David Boswarthick, and Omar Elloumi, —The Internet of Things: Key Applications and Protocols, Wiley Publications, 2012
3. Kazem Sohraby, Daniel Minoli and Taieb Znati, — Wireless Sensor Networks Technology, Protocols, and Applications—, John Wiley & Sons, 2010.

Reference Books:

4. Hakima Chaouchi, — The Internet of Things Connecting Objects to the Web, ISBN : 978-1-84821-140-7, Wiley Publications, 2013
5. Holger Karl and Andreas Willig, —Protocols and Architectures for Wireless Sensor Networks, John Wiley & Sons, Ltd, 2007.
6. 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, 2013

Online courses Links:

1. https://onlinecourses.nptel.ac.in/noc22_cs53/preview
2. <https://www.udemy.com/course/internet-of-things-iot-fundamental-course-iot-101-level/?couponCode=IND21PM>

Course Syllabus Sem V

MDM :		Internet of Things (offered by E&Tc Engg.) (Applicable to: Comp, IT, AIML, Mech, Civil)		Semester : V			
Course :		IoT System Design		Code :		BET25MD 11	
Credits	Teaching Scheme (Hrs./Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	FA		SA	Total
				FA1	FA2		
3	3	-	-	20	20	60	100
Prior knowledge of Fundamental knowledge of Sensors, Actuators and IoT boards. is essential.							
Course Objectives: This course aims at enabling students, <ol style="list-style-type: none"> To explain the key requirements for implementing IoT with Arduino Uno and Raspberry Pi development boards. To describe the Node-RED tool and python code for designing the IoT applications in Raspberry PI. To understand IoT security issues and concerns to create awareness 							
Course Outcomes: After learning the course, the students should be able to: <ol style="list-style-type: none"> Use Arduino Uno for designing the IoT applications. Illustrate use of Raspberry Pi for designing the IoT applications. Develop an IoT system with Node-RED tool using Raspberry Pi Develop the logic for Python Programming. Understand IoT security systems 							
Detailed Syllabus:							
Unit	Description						Duration
1	Implementing IoT with Arduino Introduction to Arduino Platforms, Arduino Uno architecture, IDE setup, importing Arduino boards in Arduino IDE tool, Installation of Arduino libraries, Basics of Embedded C Programming, Interfacing of Sensors and Actuators with Arduino Uno.						08
2	Implementing IoT with Raspberry Pi (RPi) Basic functionality of RPi board, RPi GPIO pins, Reading the datasheet of RPi setting up the board by installing OS, first boot and basic configuration of Rpi, Basic Linux Commands, Accessing RPi remotely using networking tools, Interfacing Interfacing of Sensors and Actuators with RPi						08
3	Node-RED tool on Rpi Prerequisite for Node-RED, Installing and upgrading Node-RED, Running Node-RED app locally and as a service on network, auto-start on boot, opening the editor, installation of various libraries for Node-RED, Creation and deployment of flows, Case studies on debug window, HTTP server, chart, gauge, slider, dashboard form etc.						09
4	Python Programming Introduction to Python programming language: Python Programming Environment, Python Expressions, Strings, Functions, Data types in python, flow control, conditional statement, Loops, importing libraries						10
5	Securing the Internet of Things & Security Architecture Introduction, Security Requirements in IoT Architecture, Security in Enabling Technologies, Security Concerns in IoT Applications, Security Requirements in IoT, Insufficient Authentication/Authorization, Insecure Access Control, Threats to Access Control, Privacy, and Availability , Attacks Specific to IoT						10
	Total Hrs.						45

Text Books:

1. Programming the Raspberry Pi: Getting Started with Python, Simon Monk, 3rd Edition, Tata McGraw Hill Publication. 2021
2. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press,2017
3. Securing the Internet of Things, Shancang Li Li Da Xu, Syngress, 2017, Elsevier, ISBN: 978-0-12-804458-2

Reference Books:

1. Programming Arduino: Getting started with sketches, 2ndEdition,Simon Monk, ISBN: 978-1259641633, Tata McGraw Hill Publication.
2. Exploring Raspberry Pi: Interfacing to the real world with Embedded Linux, Derex Molly, 1st Edition, ISBN: 978-1119188681, Wiley Publication,2016
3. Arduino Programming in 24 hours, Richard Blum, 1st Edition, ISBN: 978-0672337123, Sams Teach Yourself Publishing.2014
4. Aditya Gupta, "The IoT Hacker"s Handbook: A Practical Guide to Hacking the Internet of Things", ISBN: 1484242998, Apress publisher, 2019

Online courses Links:

1. <https://nptel.ac.in/courses/108108179>

MDM :		Internet of Things (offered by E&Tc Engg.) (Applicable to: Comp, IT, AIML, Mech, Civil)		Semester : V			
Course :		IoT System Design Lab		Code :		BET25MD 12	
Credits	Practical Scheme (Hrs./Week)			Evaluation Scheme and Marks			
	Practical	Tutorial		Practical	Oral	TW	Total
1	2	-		-	-	50	50
Prior knowledge of: 1. Programming languages 'C' & Python. 2. Interfacing with IoT boards Is essential							
Course Objectives: This course aims at enabling students, 1. To deliver practical knowledge of interfacing of sensors and actuators with Raspberry Pi. 2. To deliver practical hands-on using cloud-based interfacing with Arduino Uno, nodeMCU and RPi.							
Course Outcomes: After learning the course, the students should be able to: 1. Select appropriate sensors, actuators, cloud platform for designing IoT applications. 2. Design IoT based Realtime monitoring system using an appropriate cloud platform. 3. Automate the systems using various sensors, actuators and cloud platforms							
General Guidelines: Any Eight Experiments have to be performed to meet the above outcomes.							
Syllabus:							
Expt. No	List of Experiments						
1	Basics of Internet of Things: Sensors, Actuators, IoT architecture and Gateway						
2	LED blinking with Arduino Uno.						
3	IoT sensors interface with Arduino (Temperature/Light sensors)						
4	Integration of Actuators with nodeMCU (Servo motor/Relay).						
5	Web-based home automation using Arduino Uno and Bluetooth						
6	Installation of Noobs/Raspbian OS in Raspberry Pi						
7	Home Automation using Node-RED and Raspberry Pi						
8	Temperature and Humidity monitoring using Node-Red and Raspberry Pi						
9	Motion based intrusion detection system using nodeMCU/RPi						
10	Automatic Irrigation System using nodeMCU/RPi						
11	Installation of Smart Television setup using Raspberry Pi						

Reference Books:

1. 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,2013
2. Programming Arduino: Getting started with sketches, 2ndEdition,Simon Monk, ISBN: 978-1259641633, Tata McGraw Hill Publication.
3. Exploring Raspberry Pi: Interfacing to the real world with Embedded Linux, Derex Molly, 1st Edition, ISBN: 978-1119188681, Wiley Publication,2016
4. Arduino Programming in 24 hours, Richard Blum, 1st Edition, ISBN: 978-0672337123, Sams Tech Yourself Publishing,2014.

Course Syllabus

Sem VI

MDM :	Internet of Things (offered by E&Tc Engg.) (Applicable to: Comp, IT, AIML, Mech, Civil)			Semester : VI			
Course :	Industrial IoT			Code :	BET26MD 11		
Credits	Teaching Scheme (Hrs./Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	FA		SA	Total
				FA1	FA2		
2	2	-	-	10	10	30	50

Prior knowledge of Fundamentals of IoT is essential.

Course Objectives:

This course aims at enabling students,

1. To provide knowledge for the design and analysis of Industry 4.0 Systems
2. To provide students with good depth of knowledge of Designing Industrial IoT Systems for various application

Course Outcomes:

After learning the course, the students should be able to:

1. **Apply** IoT principles to design Industrial 4.0 Systems for various applications.
2. **Interface** IIoT monitoring manufacturing processes by providing real-time insights and supporting data-driven decision-making.
3. **Analyze** next generation sensors and AR, VR concepts.
4. **Implement** real field problems of Industrial applications with IoT capability.

Detailed Syllabus:

Unit	Description	Duration
1	Introduction to Industrial IoT (IIoT) Systems: The Various Industrial Revolutions, Role of Internet of Things (IoT) & Industrial Internet of Things (IIoT) in Industry, Industry 4.0 revolutions, Support System for Industry 4.0	06
2	IIoT Data Monitoring:- IoT Gate way, IoT Edge Systems and It's Programming, Cloud computing, Real Time Dashboard for Data Monitoring, Data Analytics and Predictive Maintenance with IIoT technology	09
3	Cyber Physical Systems: Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artificial Intelligence, Big Data and Advanced Analysis	08
4	Industrial IoT- Applications:- Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management	07
	Total Hrs.	30

Text Books:

1. Industry 4.0: The Industrial Internet of Things Alasdair Gilchrist Publications: (Apress Released June 2016)
2. "Industrial IoT: Technologies and Applications"; by Bhawani Shankar Chowdhry, Muhammad Shafique, and Habib M. Ammari (2nd Edition, 2021 Springer)

3. “Industrial IoT: Building Smarter Manufacturing and Energy Infrastructures”; by Krishnendu Chakrabarty and Elias Kyriakides (1st Edition, 2018 CRC Press)

Reference Books:

1. Hakima Chaouchi, “ The Internet of Things Connecting Objects to the Web” ISBN : 978-1-84821-140-7, Willy Publications.
2. Internet of Things- From Research and Innovation to Market Deployment; ; By Ovidiu Peter; River Publishers Series

NPTEL Course:

<https://nptel.ac.in/courses/108/105/108105088/>

<https://nptel.ac.in/courses/108/105/108105063/>

Course Syllabus

Sem VII

MDM :	Internet of Things (offered by E&Tc Engg.) (Applicable to: Comp, IT, AIML, Mech, Civil)			Semester : VII/VIII			
Course :	Capstone Project/Seminar			Code :	BET27MD 11/ BET28MD 11		
Credits	Practical Scheme (Hrs./Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Oral	TW		Total
4	-	8	-	50	100		150

Prior knowledge of

Basics of hardware, software and services required for an IoT application is essential.

Course Objectives:

This course aims at enabling students,

- To test students' knowledge of course implementation.
- To make students ready for development of an IoT system

Course Outcomes:

After learning the course, the students should be able to:

- Apply** Knowledge of IoT for solving real time issues.
- Design** a IoT system to solve Societal Issue.
- Develop** the project and communicate it to outside world.

Detailed Guidelines:

- The student should let the course instructor know in advance the intended topic of the project and seminar.
- The students are encouraged to take projects for developing software solutions and hardware platforms using the concept of course taken under the certification.
- The project guidelines mentioned in B.Tech (E&TC) structure will be followed for evaluation of performance and certification compliance.
- The seminar guidelines mentioned in B.Tech (E&TC) structure will be followed for evaluation of performance and certification compliance.

Detailed Syllabus:

Integrated Mini-Project

Sr. No.	Activity	Duration in hours
1.	Week 1 &2 : Mini-project guide allotment, finalization of topic and platform, Planning of the work	8
2.	Week 3&4: Literature review and specification and Methodology Finalization, Review 1 for finalization of topic and specification.	8
3.	Week 5&6 : Simulation of Idea on appropriate software tools and finalization of hardware platform	8
4.	Week 7 & 8 : understanding platform implementation and related software flow and execute block level design , Review 2 to understand the progress of the project	8

5.	Week 9 & 10: Mini Project Report writing and publication or copyright planning and execution.	8
6.	Week 11&12: Demonstration of Project work and Final Review for submission and term work compliances.	8
	Total	48

Annexure

Sr. No.	Course Code	Name of the Course	Semester	Course Credit	Academic Year	Total Marks	Total Hours
1	BET23MD11	Principles of Internet of Things	III	2	2023-2024	50	30
2	BET24MD11	Technologies Enabling IoT	IV	2	2024-2025	50	30
3	BET25MD11	IoT System Design	V	3	2025-2026	100	45
4	BET25MD12	IoT System Design Lab	V	1	2025--2026	50	30
5	BET26MD11	Industrial IoT (IIoT)	VI	2	2026--2027	50	30
6	BET27MD11 / BET28MD11	Capstone Project	VII / VIII	4	2027--2028	150	120

Vision and Mission of the E&TC Department

VISION:

To be recognized as a distinguished department in the field of electronics and telecommunication transforming students into competent technocrats by providing an Ethical, Sustainable and ValueAdded Quality Education.

MISSION:

- 1. To create competent Electronics and Tele-communication engineers with Knowledge, Skill and Attitude by establishing a conducive learning environment.**
- 2. To nurture technical competency, entrepreneurship skills and promote higher studies through the state-of-art facilities for building successful careers.**
- 3. To facilitate research by engaging in projects of industrial requirement and national importance.**
- 4. To impart Life skills, Ethical and Social values for self-sustainability.**