VJEC B. Tech. Syllabus 2024

Minor
in
Internet of Things

Offered by
Electronics and Communication Engineering

Curriculum – Minor in ECE

Semester	Course Code	Course Title	L	T	P	R	C	CIA	ESE
S3	MNECT309	FOUNDATIONS OF IOT	3	1	0	0	4	40	60
S4	MNECT409	IOT NETWORKING AND SECURITY	3	1	0	0	4	40	60
S5	MNECT509	IOT PROTOCOLS AND EDGE COMPUTING	3	1	0	0	4	40	60
S6	MNECT609	IOT SYSTEM DESIGN AND APPLICATIONS	3	0	0	0	3	40	60
Total Credit							**15**		

SEMESTER S3

FOUNDATIONS OF IOT

Course Code	MNECT309	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	**ESE Marks**	60
Credits	4	**ESE Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. Understand the fundamentals and architecture of Cyber-Physical Systems and IoT.
2. Learn the basics of microcontroller programming and integration with sensors and actuators.
3. Explore end-to-end IoT system design using modern processing and communication technologies.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Embedded Systems, Basics of IoT, History and Applications of IoT, Overview of CPS (Cyber-Physical Systems), CPS Architecture and Applications , IoT vs M2M, IoT vs WoT, Wireless Sensor Networks (WSNs), Enabling Technologies for IoT (RFID, Bluetooth, ZigBee, 6LoWPAN, etc.), IoT Architecture Reference Model, Software Aspects of IoT Design, Overview of Cloud Services for IoT Development (AWS IoT, Azure IoT Hub, Google IoT).	**9**
2	Introduction to microcontrollers, Programming microcontrollers (basics), Overview of popular development boards: Arduino, Raspberry Pi, ESP32, Rapid prototyping and hardware selection, Microcontroller peripherals: GPIO (General Purpose I/O), ADC (Analog-to-Digital Converter), Timers, PWM (Pulse Width Modulation) Communication Interfaces: UART, SPI, I2C, CAN. Basics of embedded C/Python.	**8**
3	IoT Sensing and Actuation: Introduction to sensors, Types of sensors & their characteristics, Sensor selection criteria and considerations, Introduction to actuators, Types and characteristics of actuators, IoT device design considerations: power, interfacing, and compatibility, Case studies in sensor and actuator integration	**7**
4	IoT processing topologies (Edge, Fog, and Cloud), Types of IoT devices based on processing needs, Integration of sensing, actuation, and communication in IoT systems, Power supply design and interfacing circuit essentials, End-to-end system design considerations for IoT.	**7**

Course Assessment Method

(CIA: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Internal Examination- 3 (Written)	Total
5	15	5	10	5	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, Each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 subdivisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain basic concepts of embedded systems and IoT	**K2**
CO2	Develop basic programs and interface hardware using platforms like Arduino or ESP32.	**K3**
CO3	Identify and connect basic sensors and actuators to microcontrollers.	**K3**
CO4	Design and implement simple IoT systems considering processing needs and communication protocols.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyze, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	-	-	-	-	-	-	-	-	-	-
CO2	2	3	3	3	3	-	-	-	-	-	1
CO3	2	2	3	3	3	-	-	-	-	-	1
CO4	3	3	3	3	3	-	-	-	-	-	1

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Introduction to IOT	Sudip Mishra, Anandarup Mukherjee, Arijit Roy	Cambridge University Press	2021
2	Internet of Things, A Hands-on approach	Vijay madisetti, Arshdeep Bahga	University Press	2015

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Getting Started with the Arduino	Massimo Banzi, Michael Shiloh Make	Shroff Publisher/Maker Media Publishers	2016
2	Internet of Things	Shriram K Vasudevan, Abhishek S Nagarajan, RMD Sundaram	John Wiley & Sons	2019

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/106/105/106105166/

SEMESTER S4

IOT NETWORKING AND SECURITY

Course Code	MNECT409	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	**ESE Marks**	60
Credits	4	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None/ (Course code)	**Course Type**	Theory

Course Objectives:

1. Understand the fundamentals of networking, sensor networks, and their role in IoT.
2. Explore the IoT communication stack, protocols, and power-efficient strategies.
3. Introduce core concepts of cybersecurity relevant to IoT systems.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Networking and Sensor Networks: Basics of computer networking: OSI and TCP/IP Models , Architecture and design principles of sensor networks, Applications and challenges of sensor networks, Low-power and lossy networks (LLNs), IoT networking components: roles and functions, Gateways in IoT: types, configurations, and cloud integration, Introduction to IoT data processing	**9**
2	IoT Communication and Protocol Stack: Overview of the IoT technology stack Protocols in each layer of IoT architecture, Medium Access Control (MAC), Device discovery and addressing strategies, Error control mechanisms and routing in IoT, Use of sockets in IoT applications, Power-aware networking strategies	**8**
3	Fundamentals of IoT Security:Introduction to network types and addressing Basics of network security and confidentiality, Cryptography techniques: AES, DES, Digital signatures and authentication protocols, Standard authentication applications,Security architecture for IoT, Web security concepts, Transport Layer and Secure Socket Layer (SSL/TLS)	**8**
4	Common network threats: intruders, detection systems, Malicious software: viruses, malware, spyware, Denial of Service (DoS) and spoofing attacks, Countermeasures and prevention techniques.	**6**

Suggestion on Project Topics:

- Basic IoT Light Control System Using ESP32 and Mobile App
- Room Temperature & Humidity Monitoring with DHT11 Sensor and ESP32
- Heart Rate Monitoring with Pulse Sensor and ESP32
- Traffic Light Simulation with Sensors on ESP32
- Basic Earthquake Alert System Using Vibration Sensor and Buzzer
- Smart Dustbin Using Ultrasonic Sensor and ESP32

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Project	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Internal Examination- 3 (Written)	Total
5	15	5	10	5	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each • Total of 8 Questions, each carrying 3 marks **(8x3 =24 marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the structure of sensor networks, IoT architecture, and network models	**K2**
CO2	Describe key communication protocols and strategies across the IoT technology stack.	**K2**
CO3	Explain cryptographic methods and authentication techniques used in securing IoT communication.	**K3**
CO4	Describe security threats such as malware, phishing, and DoS attacks using relevant case studies.	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	-	-	-	-	-	-
CO2	2	3	2	2	3	-	-	-	-	-	-
CO3	3	2	2	2	2	-	-	-	-	-	-
CO4	2	3	2	2	1	-	-	-	-	-	3

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things	David Hanes, Gonzalo Salgueiro, Patrick Grosseteste, Robert Barton, Jerome Henry	CISCO Press	2017
2	"Orchestrating and Automating Security for the Internet of Things: Delivering Advanced Security Capabilities from Edge to Cloud for Io	Anthony Sabella, Rik Irons Mclean, Marcelo Yannuzzi	Cisco Press	2018

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Securing the Internet of Things	Shancang Li Li Da Xu, Syngress	Elsevier	2017
2	Security and Privacy in Internet of Things (IoTs)-Model, Algorithms and Implementation	Fei Hu	CRC Press	2016
3	Data and Computer Communications	William Stallings	Pearson Education Pvt Ltd.,	8th Edition, 2017

Project Assessment and Evaluation criteria (15 Marks)

1. **Project Planning and Proposal** (2 **Marks)**
   - Clarity and feasibility of the project plan
   - Research and background understanding
   - Defined objectives and methodology
2. **Design & Architecture** (3 **Marks)**
   - Proper IoT architecture/model, with appropriate selection of sensors
   - Thoughtful design of hardware
   - Well-structured system components with proper integration
3. **Involvement in the Project Work and Team Work (2 Marks)**
   - Active participation and individual contribution
   - Teamwork and collaboration
4. **Execution and Implementation (3 Marks)**
   - Adherence to the project timeline and milestones
   - Application of theoretical knowledge and problem-solving
   - Implementation using FPGA
   - Final Result
5. **Final Presentation (2 Marks)**
   - Quality and clarity of the overall presentation
   - Individual contribution to the presentation
   - Effectiveness in answering questions
6. **Project Quality, Innovation, and Creativity (3Marks)**
   - Overall quality and technical excellence of the project
   - Innovation and originality in the project

Project Group Size:

Group Size Limit: The number of students per group shall not exceed 3 for the project

SEMESTER S5

IOT PROTOCOLS AND EDGE COMPUTING

Course Code	MNECT509	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	**ESE Marks**	60
Credits	4	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. Introduce a wide range of IoT connectivity technologies and data communication protocols.
2. Explain IoT interoperability standards, frameworks, and identification methods.
3. Explore cloud and edge computing concepts, including virtualization and sensor-cloud architectures.
4. Illustrate the role of edge devices and gateways in IoT system deployment using real-world examples.

SYLLABUS

Module No	Syllabus Description	Contact Hours
1	IoT Connectivity Technologies: RFID, NFC, Wi-Fi, Bluetooth low energy, IEEE 802.15.4, Zigbee, Thread, Wireless HART, Z-Wave, LoRa, NB-IoT, 6LoWPAN, IoT Interoperability: Introduction, Taxonomy of interoperability, Standards, DLNA, Konnex, UPnP, Frameworks, universal, IoTivity, HomeKit.	**8**
2	IoT Data Protocols- MQTT, CoAP, AMQP, XMPP, REST, WebSocket, Identification Protocols, EPC, URIs, Device Management, Semantic Protocols, JSON-LD, Web thing model.	**8**
3	Cloud Computing-IOT Associated Technologies: Introduction, Virtualization, Advantages of virtualization, Types of virtualizations, Cloud Models, Service-Level Agreement in Cloud Computing, Importance of SLA, Metrics for SLA, Cloud Implementation, Cloud simulation, An open-source cloud: OpenStack, Cloud Platforms - Basic & Advanced Sensor-Cloud: Sensors-as-a-Service, Importance of sensor-cloud, Architecture of a sensor-cloud platform.	**10**

4	Edge Devices-Architecture, Building blocks. IoT Gateways - Edge device as a protocol converter, Edge Computing and Fog Computing. Edge device as a computing platform. Case Study: Edge device in various IoT applications.	**8**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Internal Examination- 3 (Written)	Total
5	15	5	10	5	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each • Total of 8 Questions, each carrying 3 marks **(8x3 =24 marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	60

Course Outcomes (COs)

At the end of the course students should be able to:

	Course Outcome	Bloom's Knowledge Level (KL)
CO l	Identify and describe different IoT connectivity technologies such as RFID, Zigbee, LoRa, and NB-IoT.	K2
CO 2	Explain IoT data protocols and standards for device interoperability.	K2
CO 3	Understand the fundamentals of cloud computing, virtualization, and sensor-cloud architectures in IoT.	K2
CO 4	Apply basic concepts of edge computing and gateways in the context of IoT applications.	K3

CO-PO Mapping Table

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	-	-	-	-	-	1
CO2	3	2	-	-	1	-	-	-	-	-	2
CO3	2	2	-	-	2	-	-	-	-	-	3
CO4	2	2	2	-	3	-	-	-	-	-	2

Note: *1.' Slight (Low), 2.- Moderate (Medium), 3. Substantial (High), - No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	An Introduction to Internet of Things: Connecting Devices, Edge Gateway, and Cloud with Applications	Rahul Dubey	Cengage India Publication	2019
2	The Internet of Things – Key applications and Protocols	Olivier Hersent, David Boswarthick, Omar Elloumi	Wiley and Sons.	2012
3	IoT Machine Learning Applications in Telecom, Energy, and Agriculture, with Raspberry Pi and Arduino Using Python	Puneet Mathur	ISBN 978-1-4842-5549-0	

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things	David Hanes	Cisco Press	2017
2	Integration of Cloud Computing with Internet of Things: Foundations, Analytics and Applications	Mangla, Monika, Suneeta Satpathy, Bhagirathi Nayak, and Sachi Nandan Mohanty, eds	John Wiley & Sons	2021
3	Internet of things: architectures, protocols and standards	Cirani, Simone, Gianluigi Ferrari, Marco Picone, and Luca Veltri	John Wiley & Sons	2018
4	An Introduction to Internet of Things: Connecting Devices Edge Gateway, and Cloud with Applications	Rahul Dubey	Cengage India Publication	

SEMESTER-S6

IOT SYSTEM DESIGN AND APPLICATIONS

Course Code	MNECT609	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. Introduce advanced embedded platforms like ARM Cortex, FPGA, and GPU used in IoT application development.
2. Explain server-side development and UI/database integration for IoT-based web applications.
3. Familiarize students with emerging technologies such as AR/VR, Lean Systems, and global IoT trends.

SYLLABUS

Module No	Syllabus Description	Contact Hours
1	Sophisticated embedded/computing platforms - ARM Cortex based/FPGA/GPU/Open GL. Architecture of computing engine, peripherals, programming. Case Study: Application development for specific real world IoT solutions.	**8**
2	Servers – User Interface & Database-architecture of web applications-3-tier architecture-Presentation logic: HTML, business logic: python, database: RDBMS.	**7**
3	Introduction: Globalization, The Fourth Revolution, LEAN Production Systems; Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Convergence of Augmented Reality and Virtual Reality with IoT, IoT Minimum Viable Product building guidelines.	**8**
4	Business Model and Reference Architecture. Sensing & Actuation for Agriculture/Home automation/vehicle technology/smart cities/healthcare/ smart grid/ data critical applications/logistics/planetary explorations	**8**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Internal Examination- 3 (Written)	Total
5	15	5	10	5	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each • Total of 8 Questions, each carrying 3 marks **(8x3 =24 marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out Of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO 1	Identify and describe advanced computing platforms and their architecture for IoT solutions.	K2
CO 2	Understand server-based IoT application structures including UI, logic, and databases in a 3-tier system.	K2
CO 3	Recognize the impact of globalization, lean manufacturing, and emerging tech like AR/VR on IoT development.	K2
CO 4	Apply IoT solution-building guidelines to design basic applications in sectors such as agriculture, healthcare, or smart cities.	K3

CO-PO Mapping Table

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	2	-	-	-	-	-	2
CO2	2	2	2	-	3	-	-	-	-	-	2
CO3	2	2	-	-	1	2	-	-	-	-	3
CO4	2	3	3	-	3	-	-	-	-	-	3

Note: *1.' Slight (Low), 2.- Moderate (Medium), 3. Substantial (High), - No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	IoT Machine Learning Applications in Telecom, Energy, and Agriculture, with Raspberry Pi and Arduino Using Python	Puneet Mathur	ISBN 978-1-4842-5549-0	
2	Introduction to Industrial Internet of Things and Industry 4.0	Sudip Misra, Chandana Roy and Anandarup Mukherjee	CRC Press	
3	Hands-on Industrial Internet of Things	G Veneri Antonio	Packt Publication	2018
4	Internet of Things A Hands-on approach	Vijay Madisetti, Arshdeep Bahga	University Press	

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	The Internet of Things: Do-It-Yourself at Home Projects for Arduino, Raspberry Pi and BeagleBone Black	Donald Norris	McGraw-Hill Education TAB	2015
2	Integration of Cloud Computing with Internet of Things: Foundations, Analytics and Applications	Mangla, Monika, Suneeta Satpathy, Bhagirathi Nayak, and Sachi Nandan Mohanty, eds	John Wiley & Sons	2021
3	IoT Applications for Healthcare Systems	Rahul K. Kher, Chirag Paunwala, Falgun Thakka, et.al	EAI/Springer Innovations in Communication and Computing	1st Edition, 2022
4	Introduction to IOT with Machine learning and Image Processing using Raspberry P	Shrirang Ambaji Kulkarni:	Packt Publishing Ltd	2018