PANIMALAR ENGINEERING COLLEGE

(An Autonomous Institution, Affiliated to Anna University, Chennai)
Bangalore Trunk Road, Varadharajapuram,
Poonamallee, Chennai – 600123

Minor Degree
INTERNET OF THINGS
Curriculum & Syllabus

DEPARTMENT OF

ELECTRONICS AND COMMUNICATION ENGINEERING

REGULATION 2023

B.E. - ELECTRONICS AND COMMUNICATION ENGINEERING

MINOR DEGREE

on

INTERNET OF THINGS

S. No	COURSE CODE	COURSE TITLE	Category	L/T/P	Contact Hours	Credit	Ext / Int Weightage
1.	23EC4001	Introduction To Internet of Things	PE	3/0/0	3	3	60/40
2.	23EC4002	IoT Protocols	PE	3/0/0	3	3	60/40
3.	23EC4003	Communication and Networking	PE	3/0/0	3	3	60/40
4.	23EC4004	IoT Cloud Processing and Anlalytics	PE	3/0/0	3	3	60/40
5.	23EC4005	Introduction to Embedded Systems	PE	3/0/0	3	3	60/40
6.	23EC4006	Embedded Systems for IoT	PE	3/0/0	3	3	60/40
7.	23EC4007	Industrial IoT	PE	3/0/0	3	3	60/40
8.	23EC4008	Artificial IoT	PE	3/0/0	3	3	60/40
			TOTAL		18	18	

23EC3001	INTRODUCTION TO INTERNET OF THINGS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:
- To understand the fundamentals of Internet of Things
- To interpret IoT Reference Architecture
- To illustrate the features of M2M.
- To explain the methodology for developing IoT.
- To summarize the basics of python with IoT.
- To apply the concept of Internet of Things in the real world scenario.

UNIT - I	INTRODUCTION	9

Introduction to IoT–Definition, Characteristics, functional requirements, motivation, Physical design-things in IoT, IoT protocols, Logical Design functional blocks, communication models, Communication APIs.

UNIT – II	M2M AND SYSTEM MANAGEMENT	9

Introduction-M2M, Difference between M2M and IoT, SDN and NFV for IoT, System Management need, SNMP, NETCONF, YANG.

UNIT - III	DEVELOPING INTERNET OF THINGS	9

IoT Methodology-Purpose & Requirements specification, process specification, domain model specification, information model specification, service specification, IoT level specifications.

UNIT – IV	USAGE OF PYTHON	9

IoT systems logical design using python-python data types & data structures, control flow, functions or modules, remote access enablement using cloud.

UNIT - V	CASE STUDY ON IoT SYSTEM	9

Case study for weather monitoring system-modules & package of python, python packages of interest for IoT-JSON, XML, HTTP

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

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

CO1 Understand the fundamentals of IoT.

CO2 Illustrate applications of IoT in real time scenario.

CO3 Interpret M2M and IoT system management

CO4 Discuss IoT System design methodology

CO5 Demonstrate IoT device programming.

CO6 Implement IoT in real time scenario.

TEXT BOOKS:

1. Dr. Ovidiu Vermesan and Dr. Peter Friess, Internet of Things: From research and innovation to market deployment, River Publishers 2014.
2. Honbo Zhou,"The Internet of Things in the Cloud: A Middleware Perspective" - CRC Press 2012.
3. Arshdeep Bahga and Vijay Madisetti, Internet of Things A Hand-on Approach, Universities press, 2015.

REFERENCE BOOKS:

1. Dieter Uckelmann et.al, Architecting the Internet of Things, Springer, 2011
2. Pethuru Raj and Anupama C.Raman, "The Internet of Things: Enabling Technologies and Use Cases, CRC Press

CO- PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	-	-	-	-	-	1	-	2
CO2	3	3	2	-	-	-	-	-	1	-	2
CO3	3	3	2	-	-	-	-	-	1	-	2
CO4	3	3	2	-	-	-	-	-	1	-	2
CO5	3	3	2	-	-	-	-	-	1	-	2
CO6	3	3	2	-	-	-	-	-	1	-	2

Internal Assessment				End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		
Individual Assignment / Case Study / Seminar / Mini Project	Written Test	Individual Assignment / Case Study / Seminar / Mini Project	Written Test	Written Examinations
40	60	40	60	100
40%				**60 %**

23EC3002	IOT PROTOCOLS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:
- To understand various wireless and short-range communication technologies used in IoT.
- To illustrate the interoperability challenges and frameworks of IoT.
- To identify communication protocols and semantic models for efficient IoT data exchange.
- To explain the fundamentals of cloud computing and its role in IoT.
- To explore the knowledge of cloud implementation and simulation tool.
- To analyze the concept of Sensor-Cloud platforms.

UNIT I   IOT CONNECTIVITY TECHNOLOGIES   9

RFID, NFC, Wi-Fi, Bluetooth low energy, IEEE 802.15.4, Zigbee, Thread, Wireless HART, Z-Wave, LoRa, NB-IoT, 6LoWPAN

UNIT II   IOT INTEROPERABILITY   9

Introduction, Taxonomy of interoperability, Standards, DLNA, Konnex, UPnP, Frameworks, universal, IoTivity, HomeKit.

UNIT III   IOT DATA PROTOCOLS   9

MQTT, CoAP, AMQP, XMPP, REST, WebSocket, Identification Protocols, EPC, URIs, Device Management, Semantic Protocols, JSON-LD, Web thing model.

UNIT IV   CLOUD COMPUTING   9

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

UNIT V   CLOUD IMPLEMENTATION   9
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.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, student will be able to:

CO1 Identify and compare different IoT connectivity technologies.

CO2 Illustrate interoperability standards and frameworks enabling device.

CO3 Summarize various IoT data protocols and semantic models.

CO4 Explain cloud computing principles including virtualization,

CO5 Demonstrate the ability to simulate cloud environments.

CO6 Explain the architecture and significance of Sensor-Cloud platforms.

TEXT BOOKS

1. Rahul Dubey, "An Introduction to Internet of Things: Connecting Devices, Edge Gateway, and Cloud with Applications", Cengage India Publication, 2019.

2. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Thing– Key applications and Protocols", Wiley and Sons, 2012.

REFERENCE BOOKS

1. David Hanes, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", Cisco Press 2017.

2. Mangla, Monika, Suneeta Satpathy, Bhagirathi Nayak, and Sachi Nandan Mohanty, eds. " Integration of Cloud Computing with Internet of Things: Foundations, Analytics and Applications" John Wiley & Sons, 2021.

3. Cirani, Simone, Gianluigi Ferrari, Marco Picone, and Luca Veltri. "Internet of things: architectures, protocols and standards", John Wiley & Sons, 2018.

CO- PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	-	-	-	-	-	1	-	1
CO2	3	3	2	-	-	-	-	-	1	-	1
CO3	3	3	2	-	-	-	-	-	1	-	1
CO4	3	3	2	-	-	-	-	-	1	-	1
CO5	3	3	2	-	-	-	-	-	1	-	1
CO6	3	3	2	-	-	-	-	-	1	-	1

Internal Assessment				End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		
Individual Assignment / Case Study / Seminar / Mini Project	Written Test	Individual Assignment / Case Study / Seminar / Mini Project	Written Test	Written Examinations
40	60	40	60	100
40%				60 %

23EC3003	COMMUNICATION AND NETWORKING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:
- To understand the protocol layering and physical level communication.
- To interpret the network architecture to customize communication.
- To identify networking technologies and standards.
- To analyze the network threats and provide security.
- To apply various communication networks and develop an application.
- To asses the simulation tools for real time application.

UNIT I   INTRODUCTION TO NETWORKING   9

Networks–Types–OSI Model-Layers in OSI Model- TCP/ IP Protocol suite–Addressing-Performance – Transmission media – Switching – Circuit- switched Networks–Packet Switching-Communication Models-Client-Server- Publisher Subscriber-P2P.

UNIT II   NETWORK ARCHITECTURE   9

AdHoc- WSN-MANET-VANET-Routing-Unicast, Multicast-IPV4&IPV6-MAC.

UNIT III   NETWORK STANDARDS   9

802.11 & variants-Bluetooth & variants-802.15.4 & variants-Other Standards-NFC -LORA -DSRC, WAVE –Industrial & Automotive Networks –Vehicular networks.

UNIT IV   NETWORK SECURITY & PRIVACY   9

Issues & Challenges - Security attacks - Security solutions- Electronic MailSecurity–PGP-S/MIME–IPSecurity–WebSecurity–SystemSecurity- Intruders-Malicious Software - Cloud Security – Transport Level Security.

UNIT V   CASE STUDY & TOOLS   9

Asset Management, Industrial Automation, Smart Grid, Commercial Building Automation, Smart Cities.Simulation tools for real time application.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon successful completion of the course, student will be able to:
- **CO1** Understand the basic layers and its functions in networks.
- **CO2** Compare different network models in communication.
- **CO3** Identify different network techniques and standards in IoT systems.
- **CO4** Classify security threats in networks privacy.
- **CO5** Examine network applications in real time scenario.
- **CO6** To inspect the performance of network using simulation tools.

TEXT BOOKS:
1. Behrouz A. Forouzan, "Data communication and Networking", Fifth Edition, Tata McGraw Hill, 2013.
2. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6:TheEvolvingWorldofM2MCommunications", ISBN:978-1-118-   47347-

4,WillyPublications,2016.

3. Jan Holler, "From Machine to Machine to the Internet of Things", first edition academic Press,2014.

REFERENCES:

1. William Stallings, "Data and Computer Communications", Tenth Edition,PearsonEducation, 2014.
2. Nader F. Mir, "Computer and Communication Networks", Second EditionPrenticeHall, 2014.

WEB REFERENCES:

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

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

3. https://onlinecourses.nptel.ac.in/noc22_cs19/preview.

ONLINE REFERENCES:

1. https://www.tutorialspoint.com/data_communication_computer_ network/data_communication_computer_network_tutorial.pdf.

2. https:// www. khanacademy. org/ computing/ computers- and- internet/xcae6f4a7ff015e7d:the-internet/xcae6f4a7ff015e7d: connecting- networks/a/computer-networks-overview.

CO- PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	-	-	-	-	-	1	1	2
CO2	3	3	2	-	-	-	-	-	1	1	2
CO3	3	3	2	-	-	-	-	-	1	1	2
CO4	3	3	2	-	-	-	-	-	1	1	2
CO5	3	3	2	-	1	-	-	-	1	1	2
CO6	3	3	2	-	1	-	-	-	1	1	2

Internal Assessment				End Semester Examinations
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23EC3004	IOT CLOUD PROCESSING AND ANALYTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:
- To understand the fundamentals and architecture of the Internet of Things
- To interpret various IoT technologies, protocols, and connectivity options.
- To illustrate layer design models and business aspects of IoT/M2M systems.
- To apply suitable protocols for web and message communication in IoT systems.
- To analyze methods for data acquisition, storage, and analytics in IoT.
- To investigate cloud platforms and sensor technologies used in IoT applications.

UNIT I   INTRODUTION TO INTERNET OF THINGS   9

The Internet of Things- An Overview of Internet of things, Internet of Things Technology, behind IoTs Sources of the IoTs, Examples OF IoTs, Design Principles For Connected Devices, Internet connectivity, Application Layer Protocols- HTTP, HTTPS, FTP.

UNIT II   LAYER DESIGNING AND AFFORDABILITY   9

Business Models for Business Processes in the Internet of Things, IoT/M2M systems LAYERS AND designs standardizations, Modified OSI Stack for the IoT/M2M Systems ,ETSI M2M domains and High-level capabilities, Communication Technologies, Data Enrichment and Consolidation and Device Management Gateway Ease of designing and affordability.

UNIT III   PROTOCOLS   9

Design Principles for the Web Connectivity for connected-Devices, Web Communication protocols for Connected Devices, Message Communication protocols for Connected Devices, Web Connectivity for connected-Devices.

UNIT IV   DATA ANALYTICS   9

Data Acquiring, Organizing and Analytics in IoT/M2M, Applications/Services/Business Processes, IOT/M2M Data Acquiring and Storage, Business Models for Business Processes in the Internet Of Things, Organizing Data, Transactions, Business Processes, Integration and Enterprise Systems.

UNIT V   DATA STORAGE AND APPLICATIONS   9
Data Collection, Storage and Computing Using a Cloud Platform for IoT/M2M Applications/Services, Data Collection, Storage and Computing Using cloud platform ,IOT cloud-based services using the Xively (Pachube/COSM), Nimbits and other platforms Sensor, Participatory Sensing, Actuator, Radio Frequency Identification, and Wireless, Sensor Network Technology.

TOTAL: 45 PERIODS

COURSE OUTCOMES;

Upon successful completion of the course, student will be able to

CO1 Outline the basic concepts, technologies, and applications of IoT.

CO2 Interpret IoT system layers and describe business models related to M2M systems.

CO3 Compare various protocols for communication and connectivity in IoT.

CO4 Illustrate the use of analytics and data handling techniques for IoT services.

CO5 Analyze cloud platforms for IoT data storage and computing.

CO6 Examine the role of sensors and wireless technologies in real-world IoT deployments.

TEXT BOOKS:

1. Internet of Things: Architecture, Design Principles And Applications, Rajkamal, McGraw Hill Higher Education,2015.
2. Internet of Things, A.Bahgya and V.Madisetti, University Press, 2015

REFERENCE BOOKS:

1. Designing the Internet of Things, Adrian McEwen and Hakim Cassimally, Wiley,2012.
2. Getting Started with the Internet of Things, Cuno Pfister , Oreilly,2010.

CO- PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	-	-	-	-	-	1	1	2
CO2	3	3	2	-	-	-	-	-	1	1	2
CO3	3	3	2	-	-	-	-	-	1	1	2
CO4	3	3	2	-	1	-	-	-	1	1	2
CO5	3	3	2	-	1	-	-	-	1	1	2
CO6	3	3	2	-	1	-	-	-	1	1	2

Internal Assessment				End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		
Individual Assignment / Case Study / Seminar / Mini Project	Written Test	Individual Assignment / Case Study / Seminar / Mini Project	Written Test	Written Examinations
40	60	40	60	100
40%				60 %

23EC3005	INTRODUCTION TO EMBEDDED SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:
- To understand the concepts of embedded system.
- To study the architecture of ARM processor.
- To identify the basic concepts of embedded interfacing.
- To interpret the interfacing of ARM Processor.
- To explain the real time systems.
- To categorize the real time operating systems.

UNIT - I   INTRODUCTION TO EMBEDDED SYSTEM   9

Introduction Embedded systems, Definition, components of embedded Systems, Embedded System Design Process, Design example: GPS , Design flows - Requirement Analysis – Specifications- System analysis and architecture design.

UNIT - II   ARM PROCESSOR   9

ARM design philosophy, data flow model and core architecture, registers, program status register, instruction pipeline, interrupts and vector table, operating modes and ARM processor families.

UNIT - III   INTERFACING WITH ARM   9

Addressing modes, Instruction Sets: Data processing instructions, branch, load, store
 instructions, PSR instructions, and conditional instructions. Interfacings- LED blinking, simple I/O Switch, ADC, DAC, Stepper Motor and Sensor Interfacing.

UNIT - IV   REAL TIME SYSTEMS   9

Structure of a Real Time System — Estimating program run times – Task Assignment and Scheduling Scheduling Algorithms, Classical Uniprocessor Scheduling Algorithms-Rate-Monotonic Scheduling Algorithm, Earliest-Deadline-First Scheduling, Uniprocessor Scheduling of Iris Tasks.

UNIT - V   PROCESSES AND OPERATING SYSTEMS   9

Introduction — Multiple tasks and multiple processes — Multirate systems-Preemptive realtime operating systems- Interprocess communication mechanisms, Example Real time operating systems-POSIX-Windows CE.

TOTAL :45 PERIODS

COURSE OUTCOMES:

Upon completion of the course, students will be able to;
- **CO1**   Summarize the concepts of embedded systems.
- **CO2**   Interpret the architecture ARM processor.
- **CO3**   Outline the basic concepts of embedded interfacing.
- **CO4**   Illustrate interfacing techniques with ARM processor.
- **CO5**   Analyze the real time systems
- **CO6**   Discuss the real-time real time operating systems.

TEXT BOOKS:
1. Marilyn Wolf, Computers as Components – Principles of Embedded Computing System Design, Third Edition, Morgan Kaufmann, 2012.
2. Jane W.S.Liu," Real Time Systems", Pearson Education, Third Indian Reprint, 2003.

REFERENCE BOOKS:
1. Lyla B.Das, "Embedded Systems : An Integrated Approach" Pearson Education, 2013.
2. Jonathan W.Valvano, "Embedded Microcomputer Systems Real Time Interfacing", Third Edition Cengage Learning, 2012.
3. David. E. Simon, "An Embedded Software Primer", 1st Edition, Fifth Impression, Addison Wesley Professional, 2007.
4. Raymond J.A. Buhr, Donald L.Bailey, "An Introduction to Real-Time Systems- From Design to Networking with C/C++", Prentice Hall, 1999.
5. K.V.K.K.Prasad, "Embedded Real-Time Systems: Concepts, Design & Programming", Dream Tech Press, 2005.

CO- PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	-	1	1	-	1	1	1	3
CO2	3	3	2	-	1	1	-	1	1	1	3
CO3	3	3	2	-	1	1	-	1	1	1	3
CO4	3	3	2	-	1	1	-	1	1	1	3
CO5	3	3	2	-	1	1	-	1	1	1	3
CO6	3	3	2	-	1	1	-	1	1	1	3

Internal Assessment				End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		
Individual Assignment / Case Study / Seminar / Mini Project	Written Test	Individual Assignment / Case Study / Seminar / Mini Project	Written Test	Written Examinations
40	60	40	60	100
40%				60 %

23EC3006	EMBEDDED SYSTEMS FOR IOT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:
- To understand IoT system design and device integration.
- To summarize embedded system components and design principles
- To interpret sensor interfaces and I/O operations practically.
- To analyze various IoT enabling communication technologies effectively.
- To examine Web and Cloud of Things architecture.
- To implement IoT solutions using cloud platforms.

UNIT I   IOT SYSTEM DESIGN AND DEVICE INTEGRATION   9

Purpose and requirement specification, IoT level specification, Functional view specification, Operational view specification, Device and component integration, Pillars of Embedded IoT and Physical Devices: The internet of devices.

UNIT II   COMPONENTS OF EMBEDDED SYSTEMS DESIGN   9

Design of Embedded Systems: Common Sensors, Actuators, Embedded rocessors,Memory Architectures, Software architecture.

UNIT III EMBEDDED I/O OPERATIONS AND SENSOR INTERFACES   9

Inputs and Outputs: Digital Inputs and Outputs, Digital Inputs, Digital Outputs, BusIn,BusOut, and BusInOut, Analog Inputs and Outputs, Analog Inputs, Analog Outputs, Pulse Width Modulation (PWM), Accelerometer and Magnetometer, SD Card, Local File System (LPC1768).

UNIT IV   WEB OF THINGS AND CLOUD OF THINGS   9
Bluetooth Low Energy (BLE), LiFi, 6LowPAN, ZigBee, Z-Wave, LoRa, Protocols, HTTP, WebSocket, MQTT, CoAP, XMPP, Node-RED, Platforms, IBM Watson IoT—Bluemix, Eclipse IoT, AWS IoT, Microsoft Azure IoT Suite, Google Cloud IoT, ThingWorx, GE Predix, Xively, macchina.io, CarrIoTs.

UNIT V   WEB OF THINGS AND CLOUD OF THINGS   9
Web of Things versus Internet of Things, Two Pillars of the Web, Architecture Standardization for WoT, Platform Middleware for WoT, Cloud of Things. IoT Physical Servers, Cloud Offerings and IoT Case Studies: Introduction to Cloud Storage Models, Communication API.

TOTAL: 45 PERIODS

COURSE OUTCOMES;

Upon successful completion of the course, student will be able to

CO1 Outline IoT system specifications and device integration.

CO2 Identify and analyze embedded system components accurately.

CO3 Explain sensor interfacing using embedded I/O operations.

CO4 Apply protocols and platforms enabling IoT communication.

CO5 Analyze Web versus Cloud of Things architecture.

CO6 Design cloud-integrated IoT system using middleware platforms.

TEXT BOOKS

1. RMD Sundaram Shriram K Vasudevan, Abhishek S Nagarajan, Internet of Things, John Wiley and Sons. 2015.

2. Klaus Elk, "Embedded Software for the IoT".3rd Edition, 2010.

REFERENCE BOOKS

1. Perry Xiao, "Designing Embedded Systems and the Internet of Things (IoT) with the ARM Mbed",2009

2. Elizabeth Gootman et. al, "Designing Connected Products", Shroff Publisher/O'Reilly Publisher, 2012

CO- PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	-	1	-	-	1	1	1	1
CO2	3	2	2	-	1	-	-	1	1	1	1
CO3	3	2	2	-	1	-	-	1	1	1	1
CO4	3	2	2	-	1	-	-	1	1	1	1
CO5	3	2	2	-	1	-	-	1	1	1	1
CO6	3	2	2	-	1	-	-	1	1	1	1

Internal Assessment				End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		
Individual Assignment / Case Study / Seminar / Mini Project	Written Test	Individual Assignment / Case Study / Seminar / Mini Project	Written Test	Written Examinations
40	60	40	60	100
40%				60 %

23EC3007	INDUSTRIAL IOT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:
- To understand the IIoT and its architecture.
- To summarize the charecterstics of Illustrate the Sensors and Actuators.
- To illustrate the business model and lean production systems.
- To explain the IIoT perspective in thinking and building solutions.
- To apply the tools that enable IIoT solutions and Security aspects.
- To examine the techniques that enable IIoT solutions and Security aspects

UNIT I INTRODUCTION AND ARCHITECTURE 9
Introductionto IoT, IoT vs. IIoT,History of IIoT,fundamental terms in IIoT, Components of IIoT – Architectures of IIoT, Challenges & Benefits in implementing IIoT-Enablers of IIoT: sensitivity and connectivity, security threats and challenges.

UNIT II SENSOR AND ACTUATORS 9

Introduction to sensors, Roles of sensors in IIoT, Characteristics of Sensors, types of sensors- thermal sensors, Mechanical sensors, Chemical sensors, Electrical Sensors, Optical Sensors, Acoustic sensors, Actuators.

UNIT III BUSINESS MODEL AND LEAN PRODUCTION SYSTEMS 9

Business Models-Business opportunities and categorization in IIoT-IIRA frameworksProduct lifecycle management streams in the lean production system - Necessity of lean production system -Implementation of lean manufacturing system.

UNIT IV KEY TECHNOLOGIES AND IIoT ANALYTICS 9

Requirements of Cybersecurity-Augmented Reality-Virtual Reality-Big Data Advanced Analytics-Industrial Sensing-Industrial internet systems-Cloud computing-Fog computing, Introduction to IoT analytics.

UNIT V APPLICATION DOMAIN IN IIo 9
Health care, Inventory Management, Quality Control, Plant Safety and Security, Oil, Chemical, and Pharmaceutical industries, applications of UAVs in industries, Case study on the Manufacturing industry, Mining Industry, and Automotive Industry.

TOTAL: 45 PERIODS

COURSE OUTCOMES;
Upon successful completion of the course, student will be able to
- **CO1** Familiarise the architectures and security issues in IIoT.
- **CO2** Identify the various sensors and Actuators and their applications.
- **CO3** Interpret the business model and lean production systemse.
- **CO4** Comprehend the augmented reality, virtual reality .
- **CO5** Analyse the Data Analytics in IIoT.
- **CO6** Describe real-life applications using off-the-shelf hardware and software.

TEXT BOOKS

1. Sudip Misra, Chandana Roy, and AnandarupMukherjee,"Introduction to Industrial Internet of Things and Industry 4.0",CRC Press,edition 2020.
2. R. Anandan, Suseendran Gopalakrishnan , Souvik Pal and Noor Zaman ,"The Industrial Internet of Things (IIoT), Intelligent Analytics for Predictive Maintenance" Wily publications,2010.
3. Alasdair Gilchrist, Industrial 4.0, the industrial internet of things, Apress.,2014.

REFERENCE BOOKS

1. Hakima Chaouchi, "The Internet of Things Connecting Objects to the Web" ISBN : 978-1-84821-140-7, Willy Publications,2012.
2. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key Applications and Protocols, ISBN: 978-1-119-99435-0, 2 nd Edition, Willy Publications,2008.
3. Ovidiu & Peter-Internet of Things-From Research and Innovation to Market Deployment; River Publishers Series,2015.

CO- PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	-	-	-	-	-	-	-	1	1
CO2	3	1	2	2	-	2	-	-	-	2	2
CO3	3	1	3	2	-	2	-	-	-	2	2
CO4	3	1	3	2	-	2	-	-	-	2	2
CO5	3	1	3	2	2	2	-	-	-	2	2
CO6	3	1	3	2	2	2	-	-	2	2	2

Internal Assessment				End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		
Individual Assignment / Case Study / Seminar / Mini Project	Written Test	Individual Assignment / Case Study / Seminar / Mini Project	Written Test	Written Examinations
40	60	40	60	100
40%				60 %

23EC3008	ARTIFICIAL IOT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:
- To learn the concepts and principles of AI empowered IoT.
- To illustrate preliminary background in computer programming and AI.
- To understand the fundamentals of AIoT
- To explore the components of AIoT
- To develop AIoT systems
- To apply AIoT to real-world applications.

UNIT I   INTRODUCTION TO IOT   9

Introduction to IoT-IoT applications- sensor systems- IoT sensing techniques- IoT networking-   IoT Data analytics- IoT platforms and systems-Raspberry Pi ArduinoProgramming

UNIT II   INTRODUCTION TO AI   9

AI problems, foundation of AI and history of AI intelligent agents: Agents and Environments, the concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation.

UNIT III   INTRODUCTION TO AIOT   9
Introduction to AIoT-AIoT concepts and issues-Technologies behind AIoT- AIoT application segments-Distributed intelligence at the edge of IoT systems (edge computing; blockchain, etc.) -Robotics for AIoT.

UNIT IV   AIOT COMPONENTS   9

Technical architecture of AIoT - Smart sensors and devices- Wearables- Smart object and human sensing- Challenges of AI in networks for IoT- AI for IoT data analytics and automation

UNIT V   APPLICATIONS   9
Intelligent manufacturing-Smart health-Smart infrastructure and construction-Smart Appliances in home and Industry-smart Vehicle- Intelligent Agriculture.

TOTAL: 45 PERIODS

COURSE OUTCOMES;
Upon successful completion of the course, student will be able to
CO1   Summarize the fundamental concepts and applications of IoT.
CO2   Interpret technical challenges of AI.
CO3   Identify the state- of-the-art technology development.
CO4   Explain the algorithms and techniques for IoT operation efficiency.
CO5   Analyze potential AI-oriented usage scenarios in IoT.
CO6   Apply AIoT methods and techniques to solve various challenging IoT problems.

TEXT BOOKS:

1. Eugene Chang, "The Future of Artificial Intelligence, the Internet of Things, and Blockchain: From AI to AIoT to AIoTB", Publisher: Amazon. 2019.
2. Amita Kapoor, "Hands-On Artificial Intelligence for IoT: Expert machine learning and deep learning techniques for developing smarter IoT systems", Publisher: Packt Publishing Ltd. 2018.

REFERENCE BOOKS

1. Vlasios Tsiatsis Stamatis Karnouskos ,Jan Holler David Boyle, Catherine Mulligan, "Internet of Things", Publisher: Elsevier. 2nd edition. 2018.
2. Kai Hwang and Min Chen,"Big-Data Analytics for Cloud, IoT and Cognitive Computing", Wiley. 2017.
3. Fadi AI-Turjman, "AIoT Innovation", Publisher: Springer. 2020.

CO- PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	1	1	-	-	-	-	2	3
CO2	3	3	3	2	2	-	-	-	-	2	3
CO3	3	3	1	2	2	2	1	-	-	2	3
CO4	3	3	1	3	3	3	2	-	-	2	3
CO5	3	3	3	3	1	2	3	-	-	2	3
CO6	2	2	2	1	3	3	3	-	-	1	2

Internal Assessment				End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		
Individual Assignment / Case Study / Seminar / Mini Project	Written Test	Individual Assignment / Case Study / Seminar / Mini Project	Written Test	Written Examinations
40	60	40	60	100
40%				60 %