IOT APPLICATIONS **Course Code : 315341**

Programme Name/s	**: Digital Electronics/ Electronics & Tele-communication Engg./ Electrical and Electronics Engineering/ Electronics & Communication Engg./ Electronics Engineering/ Industrial Electronics/ Electronics & Computer Engg.**
Programme Code	**: DE/ EJ/ EK/ ET/ EX/ IE/ TE**
Semester	**: Fifth**
Course Title	**: IOT APPLICATIONS**
Course Code	**: 315341**

I. RATIONALE

The Internet of Things (IoT) explores the emerging concept of enabling objects to communicate with each other and with information systems. IoT lies in its ability to create a more connected, efficient, and innovative world by leveraging interconnected devices. The focus of IoT is to explore the capabilities of various technologies and employ creative thinking methods to develop innovative applications. This course will cover all the component IoT like sensor, microcontroller, cloud, communication protocol and it helps to prepare students to be acquainted with this technological transformation, with the ability to design, create and deploy advance smart IoT solutions.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help students to attain the following industry/employer expected outcome through various teaching learning experiences:
" Maintain system based on Internet of Things (IoT)."

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Interpret the architecture of Internet of Things (IoT).
- CO2 - Select IoT system for given application development.
- CO3 - Integrate sensors and actuators in IoT based system.
- CO4 - Manage IoT communication for data handling.
- CO5 - Develop IoT based applications.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme												
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical							
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
315341	IOT APPLICATIONS	IAU	DSE	4	-	2	-	6	2	3	30	70	100	40	25	10	25#	10	-	-	150

Total IKS Hrs for Sem. : 0 Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 10 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Describe the architecture of IoT system. TLO 1.2 List types of IoT system. TLO 1.3 Illustrate Physical and logical design of IoT system. TLO 1.4 Elaborate IoT enabling technology for the given application. TLO 1.5 List challenges in IoT based system.	**Unit - I Basics of Internet of Things (IoT)** 1.1 Basics of IoT: need, history, definition, characteristics, architecture of IoT with block diagram, IoT applications 1.2 Types of IoT system 1.3 Physical and logical design of IoT 1.4 Enabling technologies for IoT : Big Data Analytics, Cloud computing, Wireless Sensor Networks, Embedded Systems with example 1.5 IoT system challenges for design and security	Video Demonstrations Lecture Using Chalk-Board Presentations
2	TLO 2.1 Sketch architectural block diagram of NodeMCU. TLO 2.2 Describe the working of communication port of NodeMCU. TLO 2.3 Write procedure to use NodeMCU open-source IoT (Internet of Things) platform for given application. TLO 2.4 Write simple program to transfer data from NodeMCU (ESP 8266) to Arduino IDE.	**Unit - II Fundamental of NodeMcU** 2.1 NodeMCU ESP8266: features, specifications, hardware architecture, GPIO pins 2.2 NodeMCU communication port: UART, I2C,SPI 2.3 Terms used with NodeMCU: firmware, Wi-Fi, NodeMCU ESP8266 development board and its pin configuration 2.4 Arduino Integrated Development Environment - (IDE), Arduino IDE setup, creating, compiling and uploading programs from Arduino IDE to NodeMCU 2.5 Applications using NodeMCU ESP8266 and Arduino IDE. (Use of functions, string, array, timer, I/O function, PWM, interface LED & switch)	Lecture Using Chalk-Board Video Demonstrations Presentations Hands-on

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	TLO 3.1 Select relevant sensor for the given application. TLO 3.2 Select relevant actuators for the given application. TLO 3.3 Describe the function of different input and outputs of the given sensors and actuators along with its technical specifications. TLO 3.4 Write program to interface sensors and actuators for given IoT application.	**Unit - III IoT Sensors and Actuators** 3.1 Linear and Digital input devices, Sensors: LDR, PIR, LM35, DHT11, IR, Gas sensor-MQ 4 3.2 Actuators: Linear and Rotary Actuators, servo motor and servo drive, solenoid valve, motorised actuators relay, stepper motor, IoT enabled actuators 3.3 Programming and Interfacing sensors and actuators with Node MCU: Interfacing Temperature sensor- LM-35, Gas sensor -MQ 4, Humidity sensor- DHT11, Photo sensors- LDR, PIR, IR with NodeMCU (only technical specifications, pin diagram and working expected)	Video Demonstrations Lecture Using Chalk-Board Presentations Hands-on
4	TLO 4.1 Describe the given IoT communication protocol with suitable example. TLO 4.2 Write steps to connect NodeMCU to Wi-Fi network. TLO 4.3 Write step by step procedure to create web Server with NodeMCU. TLO 4.4 Select IoT platform for the given application with suitable reason. TLO 4.5 Describe the procedure for data communication using MQTT protocol. TLO 4.6 Describe the given IoT network technology with suitable application.	**Unit - IV IoT Communication Protocol** 4.1 IoT Protocols: HTTP-REST, MQTT, CoAP, LoRa, NbIoT (features, methods, communication, applications) 4.2 IEEE802.11: Wi-Fi (features, applications), configure Wi-Fi on NodeMCU, Wi-Fi libraries, code for connecting to Wi-Fi networks 4.3 Procedure to create webserver with NodeMCU 4.4 Introduction to IoT cloud platforms: AWS IoT, ThingSpeak, Google Cloud IoT, Microsoft Azure IoT. (Use cases and features) 4.5 Data Communication using MQTT with NodeMCU: connect to a broker, publish and subscribe topics, collect, send and receive data using MQTT 4.6 IoT networking technology : LoRa, NbIoT (Features and applications)	Lecture Using Chalk-Board Presentations Video Demonstrations Hands-on Flipped Classroom

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
5	TLO 5.1 Explain the role of IoT in Industrial maintenance. TLO 5.2 Describe the integration of IoT in Agriculture. TLO 5.3 Illustrate IoT based smart city application with suitable sketch. TLO 5.4 Describe IoT based smart Energy meter with the help of block diagram. TLO 5.5 Describe IoT based surveillance system. TLO 5.6 Demonstrate IoT system for Smart home with the help of example. TLO 5.7 Explain the role of IoT in Electric vehicle for battery.	**Unit - V IoT Applications** 5.1 Industrial IoT (IIoT): predictive maintenance in manufacturing using IoT sensors to monitor equipment health and prevent failures 5.2 Agriculture: Green house control using IoT, Weather forecasting 5.3 Smart City: Street light control system, Traffic control System, Waste management 5.4 IoT based smart energy meter 5.5 IoT based surveillance system 5.6 Home automation: controlling lights, Fans and smart lock 5.7 EV(Electrical Vehicles) battery management using IoT (only basic working with conceptual block diagram)	Presentations Video Demonstrations Lecture Using Chalk-Board

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Establish a connection between the NodeMCU-ESP8266 and a computer using appropriate cables and drivers. LLO 1.2 Install and configure Arduino IDE for NodeMCU programming.	1	*Installation and configuration of Arduino IDE for NodeMCU	2	CO2
LLO 2.1 Interface LED and switch with NodeMCU to turn ON and OFF LED.	2	Interfacing LED and Switch with NodeMCU	2	CO2
LLO 3.1 Control relay operation using NodeMCU and IR sensor.	3	*Interfacing relay and IR sensor with NodeMCU	2	CO3
LLO 4.1 Measure and display humidity and temperature using DHT 11 and NodeMCU.	4	Interfacing Humidity sensor with NodeMCU	2	CO3
LLO 5.1 Motion detection using PIR sensor and NodeMCU.	5	Interfacing PIR Sensor with NodeMCU	2	CO3
LLO 6.1 Configure NodeMCU to connect to a Wi-Fi network and troubleshoot connectivity issue.	6	*Connecting NodeMCU to Wi-Fi network	2	CO4
LLO 7.1 Use HTTP protocol to send sensor data from NodeMCU to a web server (use any cloud service).	7	*Data Transmission from NodeMCU to Web Server.	2	CO4
LLO 8.1 Set up MQTT communication to publish and subscribe to topics using NodeMCU.	8	Implemention of MQTT Protocol with NodeMCU	2	CO4
LLO 9.1 Measure data from LDR to monitor light intensity and transmit it to cloud. LLO 9.2 Control intensity of LED according to the data received from cloud. (use any cloud service)	9	*Monitoring and controlling light intensity using NodeMCU	2	CO4

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 10.1 Design a smart home system using NodeMCU to Control the lights, Fans and Locking system. (use any cloud service)	10	*Implemention of IoT enabled Smart Home applications	2	CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Micro project

- Interface a glucometer with Node MCU to measure glucose level and it to WebServer.
- Prepare a report of IoT based remote patient Monitoring system (case study).
- Develop IoT based Smart parking system for your institute using NodeMCU.
- Develop IoT Based IPL Scoreboard using NodeMCU to Display Live Score using Cricket API.

Assignment

- Describe the Use of IoT in Electrical Vehicles for Battery charging.
- Describe the architectural block diagram of ESP32 NodeMCU.
- Describe the Use of IoT in Drone Technology.

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Acuators-5v Relay, DC Motor	3,10
2	Sensors:LDR-Light dependent resistor, IR- Infrared sensor, PIR sensor, DHT11-Humidity and temperature sensor.	3,4,5,7,9,10
3	Any open source cloud service available (viz. ThingSpeak/ Google cloud / Microsoft Azure/AWS/ others).	7,9,10
4	IoT Trainer kit using NodeMCU with switches and LED's	All
5	Computers/Laptops: with operating system windows 10 or higher version.	All

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
6	Software tools- Arduino IDE (open Source)	All

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Basics of Internet of Things (IoT)	CO1	6	2	6	4	12
2	II	Fundamental of NodeMcU	CO2	8	4	4	6	14
3	III	IoT Sensors and Actuators	CO3	10	2	4	12	18
4	IV	IoT Communication Protocol	CO4	8	2	4	6	12
5	V	IoT Applications	CO5	8	2	4	8	14
Grand Total				**40**	**12**	**22**	**36**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Two offline unit test of 30 marks and average of two-unit test will considered for out of 30 marks.

For formative assessment of laboratory learning 25 marks.
Each practical will be assessed considering 60% weightage to process, 40% weightage to product.

Summative Assessment (Assessment of Learning)

- End semester assessment of 70 marks.

End semester summative assessment of 25 marks for laboratory learning.

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	2	2	1	-	1	1	2			
CO2	3	3	3	2	1	1	2			
CO3	3	3	3	2	2	2	3			
CO4	2	2	1	2	1	2	2			
CO5	3	3	3	2	2	2	3			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Arshdeep Bahga, Vijay Madisetti	Internet of Things: A Hands-On Approach	University Press, ISBN: 9788173719547
2	Raj Kamal	INTERNET OF THINGS Architecture and Design Principles	McGraw Hill Education (India) Private Limited, ISBN: 9789390727384
3	Adrin McEwen & Hakim Cassimality	Designing the Internet of things	Wiley India, ISBN: 9781118430620
4	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton, Jerome Henry	IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things	Cisco Press, ISBN: 9781587144561
5	Richard Blum	Sams Teach Yourself Arduino™ Programming in 24 Hours	Pearson Education, Inc. ISBN: 9780672337123
6	Sudip Misra, Anandarup Mukherjee, Arijit Roy	Introduction to IoT	Cambridge University Press, ISBN:9781108842952
7	Rahul Dubey	An Introduction to Internet of Things: Connecting Devices, Edge Gateway, and Cloud with Applications	Cengage India Private Limited, ISBN: 9789353500931931

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01300094497305395218 75_shared/overview	IoT Platform
2	https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01329474210427699229893_shared/overview	"Mastering IoT with Arduino". Infosys Spring board online course for Thinkspeak platform.
3	https://www.arduino.cc/en/software	Arduino IDE software
4	https://www.tinkercad.com/projects?subject=arduino&sort=views	Arduino projects on Tinkercad
5	Introduction to Internet of Things - Course (nptel.ac.in)	Complete coverage of IoT
6	https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01384301295320268828657_shared/overview	IoT Automation with ESP8266 with Projects
7	https://www.guru99.com/iot-tutorial.html	IoT Tutorial: Introduction to Internet of Things (IoT Basics)
8	https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01300094497305395218 75_shared/overview	IoT Platform

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students