**Course Plan**

**B.E. (ECS) (Semester VII)**

Internet of Things

Subject code: ECC 702

Teacher-in-charge: Dr. Sapna Prabhu Academic Term: July-October 2022

|  |  |  |  |
| --- | --- | --- | --- |
| Module  No. | UnitNo. | Contents | Hrs. |
| 1 |  | Introduction to IoT | 5 |
| 1.1 | Definition and Characteristics of IoT |
| 1.2 | IoT Protocols |
| 1.3 | IoT Functional Blocks |
| 1.4 | IoT Communication Models |
| 1.5 | IoT Communication APIs :- REST and WebSockets |
| 1.6 | IoT Enabling Technologies |
| 1.7 | Introduction to M2M and Difference between IoT and M2M |
| 2 |  | Components(Things) in IoT | 5 |
| 2.1 | Sensor Technology, Examples of Sensors |
| 2.2 | Actuators |
| 2.3 | Applications of RFID and WSN in IoT |
| 2.4 | Exemplary Device: - R–Pi and its Interfaces, PCDuino, BeagleBone |
| 3 |  | Data Handling in IoT | 9 |
| 3.1 | Data Acquiring and Storage, Organizing the Data, Transactions and Business Processes, Analytics |
| 3.2 | Data Collection, Storage and Computing Using Cloud Platform, Introduction to Cloud Computing, Virtualization, Cloud Models Cloud Services IoT Cloud-based Data Collection, Storage, Computing using Xively |
| 4 |  | Design Principles for Web Connectivity | 10 |
| 4.1 | Communication Technologies – A comparison |
| 4.2 | Web Communication Protocols for connected devices:-CoRE Environment, CoAP, LWM2M, MQTT, XMPP, HTTP, SOAP Protocols |
| 4.3 | LPWAN Fundamentals: LORA and NBIoT |
| 5 |  | IoT Design Methodology | 6 |
| 5.1 | Defining Specifications About: - Purpose & requirements, process, domain model, information model, service, IoT level, Functional view, Operational view, Device and Component Integration: - Case Studies of Home automation, Weather Monitoring |
| 5.2 | IoT Levels and Deployment Templates |
|  | 5.3 | Supply Chain Management |
| 6 |  | IoT Security and Vulnerabilities Solutions | 4 |
| 6.1 | Iot Security Tomography and Layered Attacker Model |
| 6.2 | Identity Management, Establishment, Access Control and Secure Message Communication |
| 6.3 | Security Protocols |
|  | Total | 39 |

Course Objectives:

1. To understand the basic building blocks of IoT

2. To understand various IoT protocols.

3. To introduce data handling in IoT

4. To understand the Design Methodology in IoT through case studies.

Course Outcomes:

After successful completion of the course students will be able to:

1. Understand concepts, functional blocks and communication methodology relevant to IoT.

2. Identify various components of IoT

3. Understand various methods for data handling in IoT-based systems.

4. Compare various communication protocols for IoT.

5. Design basic applications based on IoT using specific components.

6. Introduce various security issues in IoT

**CO-PO-PSO Mapping**:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| ECC 702 .1 | 2 |  |  |  |  |  |  |  |  |  |  |  |  |  |
| ECC 702 .2 |  | 2 |  |  |  |  |  |  |  |  |  |  |  |  |
| ECC 702 .3 |  | 2 | 2 |  | 2 |  |  |  |  |  |  |  |  |  |
| ECC 702 .4 |  |  | 2 |  | 2 |  |  |  |  |  |  |  |  |  |
| ECC 702 .5 |  |  | 3 |  | 2 | 2 | 2 | 2 |  |  | 2 |  | 3 | 3 |
| ECC 702 .6 |  |  | 2 |  | 2 |  |  | 2 |  |  |  |  |  |  |

**Provide justification of PO to CO mapping**

|  |  |  |
| --- | --- | --- |
| ECC 702 .1 | PO1 | Apply the knowledge of engineering fundamentals to understand concepts, functional blocks and communication methodology relevant to IoT. |
| ECC 702.2 | PO2 | Identify various components of IoT reaching to substantiated conclusions |
| ECC 702 .3 | PO2 | Identify, formulate and analyze various methods for data handling in IoT-based systems. |
| PO3 | Design solutions for engineering problems and design system  processes by incorporating various methods for data handling in IoT-based systems. |
| PO5 | Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools for data handling |
| ECC 702 .4 | PO3 | Compare various communication protocols for IoT and design solutions for  engineering problems |
| PO5 | Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools for implementing various communication protocols |
| ECC 702 .5 | PO3 | Design basic applications based on IoT using specific components. |
| PO5 | Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools for designing basic applications based on IoT using specific components |
| PO6 | Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues while designing basic applications based on IoT |
| PO7 | Understand the impact of the professional engineering solutions in societal and environmental contexts, while designing basic applications based on IoT |
| PO8 | Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. while designing basic applications based on IoT |
| PO11 | Demonstrate knowledge and understanding of the engineering and management principles while designing basic applications based on IoT |
| PSO1 | Design and implement cost-effective hardware/software systems for IOT based systems |
| PSO2 | Adapt to new generation technologies in Electronics & Computer Science domains with an innovative approach. while designing applications based on IoT |
| ECC 702 .6 | PO3 | Design solutions for engineering problems and design system  processes by addressing various security issues in IoT |
| PO5 | Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools to address various security issues in IoT |
| PO8 | Apply ethical principles and commit to professional ethics and responsibilities by ensuring security in IoT based systems |

**CO Assessment Tools:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Course Outcomes | Tests | | Participation in Additional activities | End Semester  Examination | Course Exit Survey |
|  | 1 | 2 |  |  |  |
| ECC 702 .1 | 30% | - | 10% | 60% | 100% |
| ECC 702 .2 | 30% | - | 10% | 60% | 100% |
| ECC 702 .3 | 40% | - | - | 60% | 100% |
| ECC 702 .4 | - | 20% | 20% | 60% | 100% |
| ECC 702 .5 | - | 20% | 20% | 60% | 100% |
| ECC 702 .6 | - | 40% | - | 60% | 100% |

CO calculation= (0.8 \*Direct method + 0.2\*Indirect method)

Rubrics for assessing Course Outcome with each assessment tool:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Indicator |  |  |  |  |
| Timeline (3) | More than two sessions late (0) | More than one session late (1) | One session late (2) | On time (3) |
| Depth of Understanding (4) | Unsatisfactory (1) | Superficial (2) | Satisfactory (3) | Adequate (4) |
| Completeness (3) | Not submitted (0) | Major topics are omitted or addressed minimally (1) | Most major and some minor points are covered and are accurate (2) | All major and minor points are covered and are accurate (3) |

**Content beyond syllabus:** 1**.**Study of the various challenges faced by IoT as a technology

2. Discussion on technical paper “DATABASE SYSTEMS PERFORMANCE EVALUATION FOR IOT APPLICATIONS “

**Modes of content delivery**

|  |  |
| --- | --- |
| Modes of Delivery | Brief description of content delivered |
| Class room lectures | PowerPoint presentations as well as White Board teaching was  Used. NPTEL videos to be used for certain topics |
| Class discussions | Case study topics |
| Flip- Classroom | Topic: Communication Technologies |

**Text books:**

1. Arshdeep Bahga and Vijay Madisetti, “Internet of Things: A Hands-on Approach, Universities Press.

2. Raj Kamal, “ Internet of Things: Architecture and Design Principles”, McGraw Hill Education ,First edition

3. David Hanes, Gonzalos algueiro“IoT Fundamentals Networking Technologies, Protocols and Use Cases for Internet of Things”, Cisco Press, Kindle 2017 Edition

4. Andrew Minteer,”Analytics for the Internet of Things(IoT)”, Kindle Edition

**Reference Books:**

1. Adrian McEwen, Hakim Cassimally, : Designing the Internet of Things”, Paperback, First Edition

2. Yashavant Kanetkar, ShrirangKorde: Paperback “21 Internet of Things (IOT) Experiments”, BPB Publications

**Lesson Plan**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | | | | |
| BE Electronics and Computer Science, Semester VII | | | | |
| July-October 2022 | | | | |
| Internet of things (ECC 702) | | | | |
| Lectures | | | 3 per week | |
|  | | | Hours | | Marks |
| Theory examination | | | 3 | | 80 |
| Internal Assessment | | | - | | 20 |
| Total | | | -- | | 100 |
| Day | | | Time | |
| Tuesday | | | 12 pm-1 pm | |
| Wednesday | | | 11 am-12 pm | |
| Thursday | | | 11 am-12 pm | |
| Lecture No. | Dates | | | Topic | Remarks | |
| Planned | Actual | |
| 1 | 18/7/2022 | 18/7/2022 | | Definition and Characteristics of IoT |  | |
| 2 | 20/7/2022 | 20/7/2022 | | IoT Protocols |  | |
| 3 | 22/7/2022 | 22/7/2022 | | IoT Functional Blocks, IoT Communication Models |  | |
| 4 | 25/7/2022 | 25/7/2022 | | IoT Communication APIs :- REST and WebSockets |  | |
| 5 | 27/7/2022 | 27/7/2022 | | IoT Enabling Technologies |  | |
| 6 | 29/7/2022 | 29/7/2022 | |  | No class (due to placements) | |
| 7 | 1/8/2022 | 1/8/2022 | | Introduction to M2M and Difference between IoT and M2M |  | |
| 8 | 3/8/2022 | 3/8/2022 | | Case study on Smart Cities | **Class discussion** | |
| 9 | 5/8/2022 | 5/8/2022 | | Sensor Technology, Examples of Sensors |  | |
| 10 | 8/8/2022 | 8/8/2022 | | Design class | **Open Book** | |
| 11 | 10/8/2022 | 10/8/2022 | | Actuators |  | |
| 12 | 12/8/2022 | 12/8/2022 | | Applications of RFID and WSN in IoT |  | |
| 13 | 17/8/2022 | 17/8/2022 | | Exemplary Device: - R–Pi and its Interfaces, PCDuino, BeagleBone |  | |
| 14 | 19/8/2022 | 19/8/2022 | | Data Acquiring and Storage, Organizing the Data, |  | |
| 15 | 22/8/2022 | 22/8/2022 | | Transactions and Business Processes |  | |
| 16 | 24/8/2022 | 24/8/2022 | | Analytics |  | |
| 17 | 26/8/2022 | 26/8/2022 | | Data Collection, Storage and Computing Using Cloud Platform |  | |
| 18 | 29/8/2022 | 29/8/2022 | | Introduction to Cloud Computing, Virtualization, Cloud Models Cloud Services |  | |
|  | Unit Test 1- September 7-9,2022 | | | | | |
| 19 | 9/9/2022 | 9/9/2022 | | IoT Cloud-based Data Collection, |  | |
| 20 | 12/9/2022 | 12/9/2022 | | Storage, Computing using Xively |  | |
| 21 | 14/9/2022 | 14/9/2022 | | Computing using Xively |  | |
| 22 | 16/9/2022 | 16/9/2022 | | Communication Technologies – A comparison | **Flip- Classroom** | |
| 23 | 19/9/2022 | 19/9/2022 | | Web Communication Protocols for connected devices:-CoRE Environment, |  | |
| 24 | 21/9/2022 | 21/9/2022 | | CoAP, LWM2M |  | |
| 25 | 23/9/2022 | 23/9/2022 | | MQTT, XMPP, HTTP, SOAP Protocols |  | |
| 26 | 26/9/2022 | 26/9/2022 | |  | **Guest Lecture** | |
| 27 | 30/9/2022 | 30/9/2022 | | LPWAN Fundamentals: LORA and NBIoT |  | |
| 28 | 3/10/2022 | 3/10/2022 | | IoT Design Methodology, Defining Specifications About: - Purpose & requirements |  | |
| 29 | 7/10/2022 | 7/10/2022 | | Process, Domain model, Information model, Service |  | |
| 30 | 10/10/2022 | 10/10/2022 | | IoT level, Functional view, Operational view, |  | |
| 31 | 12/10/2022 | 12/10/2022 | | Device and Component Integration |  | |
| 32 | 14/10/2022 | 14/10/2022 | | Case Studies of Home automation, Weather Monitoring |  | |
| 33 | 21/10/2022 | 21/10/2022 | | IoT Levels and Deployment Template, Supply Chain Management |  | |
| 34 | 21/10/2022 | 21/10/2022 | | Iot Security Tomography and Layered Attacker Model |  | |
| 35 | 21/10/2022 | 21/10/2022 | | Identity Management, Establishment, Access Control and Secure Message Communication |  | |
| 36 | 21/10/22 | 21/10/22 | | Security Protocols | **Extra Class** | |

**Examination Scheme**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Module | | Lecture Hours | Marks distribution in Test (For internal assessment/TW) | | Approximate Marks distribution in Sem. End Examination |
| Test 1 | Test 2 |
| 1 | Introduction to IoT | 5 | 6 | - | 10 |
| 2 | Components(Things) in IoT | 5 | 8 | - | 8 |
| 3 | Data Handling in IoT | 9 | 6 | 4 | 20 |
| 4 | Design Principles for Web Connectivity | 10 | - | 6 | 22 |
| 5 | IoT Design Methodology | 6 | - | 5 | 12 |
| 6 | IoT Security and Vulnerabilities Solutions | 4 | - | 5 | 8 |

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| Submitted By | Approved By |
| Dr Sapna Prabhu | Dr D.V. Bhoir |
| Sign: | Sign: Sd/- |
|  |  |
| Date of Submission: | Date of Approval:17/08/2022 |
|  | |
| Remarks by PAC (if any): **Guest lectures can be carried out with the help of our Alumnus working in the**  **field. Practical assignments are recommended.** | |