**Semester- 1**

| Advanced Engineering Mathematics | | | |
|---|---|---|---|
| Course Code | 22MAT11 | CIE Marks | 50 |
| Teaching Hours/Week (L:P:SDA) | 3:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |

**Course Learning objectives:** This Course will enable students to

- Study an insight into advanced engineering mathematics through linear algebra
- Develop proficiency in calculus of variations.
- Understand probability theory that serve as an essential tool for applications of engineering sciences.
- Compute quantitative parameters for function of single and multiple random variables and random process.

**Module-1**

**Linear Algebra-I**

Introduction to vector spaces and sub-spaces, definitions, illustrative example. Linearly independent and dependent vectors- Basis-definition and problems. Linear transformations-definitions. Matrix form of linear transformations-Illustrative examples.

(Text Book: 1) (RBT Levels: **L1 & L2)**.

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

**Module-2**

**Linear Algebra-II**

Computation of eigen values and eigen vectors of real symmetric matrices- Given's method. Orthogonal vectors and orthogonal bases. Gram-Schmidt orthogonalization process.

(Reference Book: 1) (RBT Levels: **L1 & L2)**.

| | |
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| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

**Module-3**

**Calculus of Variations** : -

Concept of functional-Eulers equation**.** Functional dependent on first and higher order derivatives, Functional on several dependent variables. Isoperimetric problems-variation problems with moving boundaries.

(Reference Books: 2) (RBT Levels: **L1 & L2 )**.

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

**Module-4**

**Probability Theory:-** Review of basic probability theory. Definitions of random variables and probability distributions, probability mass and density functions, expectation, moments, central moments, characteristic functions, probability generating and moment generating functions- illustrations. Poisson, Gaussian and Erlang distributions-examples.

(Text Book: 2 & Reference Books: 4) (RBT Levels: **L1 & L2)**

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|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

**Module-5**

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| | |
|---|---|
| Engineering Applications on Random processes: - Classification. Stationary, WSS and ergodic random process. Auto- correlation function-properties, Gaussian random process.<br>(Text Book: 2 & Reference Books:4 ) (RBT Levels: **L1 & L2)**. | |
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

**Assessment Details (both CIE and SEE):**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Text Books:**


1. David C.Lay, Steven R.Lay and J.J.McDonald: Linear Algebra and its Applications, 5th Edition, Pearson Education Ltd.,2015
2. Scott L.Miller, DonaldG. Childers: "Probability and Random Process with application to Signal Processing", Elsevier Academic Press, 2nd Edition,2013


**Reference Books:**


1. Gilbert Strang: Introduction to Linear Algebra, 5th Edition, Wellesley-Cambridge Press.,2016
2. Elsgolts, L.:"Differential Equations and Calculus of Variations", MIR Publications,3rd Edition, 1977.
3. Richard Bronson: "Schaum's Outlines of Theory and Problems of Matrix Operations", McGraw-Hill, 1988.
4. T. Veerarajan "Probability, Statistics and Random Process", 3rd Edition, Tata Mc-Graw HillCo., 2016.


**Web links and Video Lectures (e-Resources):**

1. http://nptel.ac.in/courses.php?disciplineId=111
2. http://www.class-central.com/subject/math(MOOCs)
3. http://ocw.mit.edu/courses/mathematics/
4. www.wolfram.com

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**Course outcome (Course Skill Set):**

At the end of the course the student will be able to :

| Sl. No. | Description |
|---|---|
| CO1 | Understand vector spaces, basis, linear transformations and the process of obtaining matrix of linear transformations arising in magnification and rotation of images. |
| CO2 | Apply the technique of singular value decomposition for data compression, least square approximation in solving inconsistent linear systems. |
| CO3 | Utilize the concepts of functional and their variations in the applications of communication systems, decision theory, synthesis and optimization of digital circuits. |
| CO4 | Learn the idea of random variables (discrete/continuous) and probability distributions in analyzing the probability models arising in control systems and system communications |
| CO5 | Analyze random process through parameter-dependent variables in various random processes. |

**Program Outcome of this course:**

| Sl. No. | Description | POs |
|---|---|---|
| 1 | Adequate knowledge of fundamentals on sensors, signal conditioning and IoT | PO1 |
| 2 | Ability to design, implement, analyse, interpret data and synthesis of information | PO2 |
| 3 | Ability to analyse a problem critically using scientific approach, relevant IT tools and techniques | PO3 |
| 4 | Appropriate research skills for solving new problem and present a substantial technical report | PO4 |
| 5 | Ability to work ethically and carry out the work with social responsibility | PO5 |
| 6 | Professional skills to carry out work independently or collaboratively in a multidisciplinary environment. | PO6 |

**Mapping of COS and POs:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | | × | | × | | |
| **CO2** | | × | | × | | |
| **CO3** | | × | | × | | |
| **CO4** | | × | | × | | |
| **CO5** | | × | | × | | |

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| IoT Architecture and Protocols | | | |
|---|---|---|---|
| Course Code | 22ISS12 | CIE Marks | 50 |
| Teaching Hours/Week (L:P:SDA) | 3:2:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 hours Theory + 10 Lab slots | Total Marks | 100 |
| Credits | 04 | Exam Hours | 03 |

**Course objectives:** This Course will enable students to

- Understand the Overview of IoT-Architecture and the devices used for IoT.
- Describe the IoT reference model and various protocols.
- Study IoT Data Link Layer & Network Layer Protocols
- Know Transport & Session Layer Protocols
- Identify Service Layer Protocols & Security

**Module-1**

**Overview**: IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. M2M and IoT Technology Fundamentals- Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service (XaaS), M2M and IoT Analytics.
(Text Book: 1) (RBT Levels: **L1 & L2)**.

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

**Module-2**

**Reference Architecture:** IoT Architecture-State of the Art – Introduction, State of the art, Reference Model and architecture, IoT reference Model - IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View. Real-World Design Constraints- Introduction, Technical Design constraints-hardware is popular again, Data representation and visualization, Interaction and remote control.
(Text Book: 1) (RBT Levels: **L1 & L2)**.

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

**Module-3**

**IoT Data Link Layer & Network Layer Protocols:** PHY/MAC Layer(IEEE 802.11, IEEE 802.15), Wireless HART,Z- Wave, Bluetooth Low Energy, Zigbee Smart Energy, Network Layer-IPv4, IPv6, 6LoWPAN, DHCP, ICMP, CORPL, CARP
(**Reference** : Web Resources ) (RBT Levels: **L1 & L2 )**.

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

**Module-4**

**Transport & Session Layer Protocols:** Transport Layer (TCP, MPTCP, UDP, SCTP)-(TLS, DTLS) – Session Layer- HTTP, CoAP, XMPP, MQTT
(**Reference** : Web Resources ) (RBT Levels: **L1 & L2)**.

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

**Module 5**

**Service Layer Protocols & Security:** Service Layer - ETSI M2M, OMA, BBF – Security in IoT Protocols – MAC802.15.4 6LoWPAN, Overview of Application Layer
(**Reference**: Web Resources) (RBT Levels: **L1 & L2)**.

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

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**PRACTICAL COMPONENT OF IPCC**

| Sl. NO. | Experiments |
|---|---|
| 1 | Study of 6LoWPAN protocol |
| 2 | Study of HTTP Protocol |
| 3 | Analysis of CoAP in an IoT environment |
| 4 | Testing MQTT based IoT based Protocol or Experimental study of IoT based topologies on MQTT topologies |
| 5 | Simulation of Bluetooth Low Energy and Zigbee Smart Energy |

**Assessment Details (both CIE and SEE):**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**CIE for the theory component of IPCC:**

1. Two Tests each of **20 Marks**
2. Two assignments each of **10 Marks/One Skill Development Activity of 20 marks**
3. Total Marks of two tests and two assignments/one Skill Development Activity added will be CIE for 60 marks, marks scored will be proportionally scaled down to **30 marks**.

**CIE for the practical component of IPCC:**

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The**15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test at the end /after completion of all the experiments shall be conducted for 50 marks and scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

**SEE for IPCC:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

1. The question paper will be set for 100 marks and marks scored will be scaled down proportionately to 50 marks.
2. The question paper will have ten questions. Each question is set for 20 marks.
3. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
4. The students have to answer 5 full questions, selecting one full question from each module.

**The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component**).

- The minimum marks to be secured in CIE to appear for SEE shall be the 15 (50% of maximum marks-30) in the theory component and 10 (50% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included. The maximum of 04/05 questions to be set from the practical

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component of IPCC, the total marks of all questions should not be more than the 20 marks.

- SEE will be conducted for 100 marks and students shall secure 40% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50. (Student has to secure an aggregate of 50% of maximum marks of the course(CIE+SEE)

**Suggested Learning Resources:**

**Text Books:**


1. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014.


**Reference Books:**


1. Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things", ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer
2. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications
3. Peter Waher, "Learning Internet of Things", PACKT publishing, BIRMINGHAM – MUMBAI
4. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on- Approach)", 1st Edition, VPT, 2014.


**Web links and Video Lectures (e-Resources):**

http://www.cse.wustl.edu/~jain/cse570-15/ftp/iot_prot/index.html

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- The students with the help of the course teacher can take up relevant technical – activities which will enhance their skill.

**Course outcome (Course Skill Set):**

At the end of the course the student will be able to :

| Sl. No. | Description |
|---|---|
| CO1 | Understand the Overview of IoT-Architecture and the devices used for IoT |
| CO2 | Demonstrate the IoT reference model and various protocols. |
| CO3 | Present IoT Data Link Layer & Network Layer Protocols |
| CO4 | Identify Transport & Session Layer Protocols |
| CO5 | Recognize Service Layer Protocols & Security |

**Program Outcome of this course:**

| Sl. No. | Description | POs |
|---|---|---|
| 1 | Adequate knowledge of fundamentals on sensors, signal conditioning and IoT | PO1 |
| 2 | Ability to design, implement, analyse, interpret data and synthesis of information | PO2 |
| 3 | Ability to analyse a problem critically using scientific approach, relevant IT tools and techniques | PO3 |
| 4 | Appropriate research skills for solving new problem and present a substantial technical report | PO4 |
| 5 | Ability to work ethically and carry out the work with social responsibility | PO5 |
| 6 | Professional skills to carry out work independently or collaboratively in a multidisciplinary environment | PO6 |

**Mapping of COS and POs:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | × | | | | | |
| **CO2** | × | × | × | × | | |
| **CO3** | × | × | × | × | | |
| **CO4** | × | × | × | × | | |
| **CO5** | × | × | × | × | | |

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| Principles of Sensors, Signal Conditioning and IoT | | | |
|---|---|---|---|
| Course Code | 22ISS13 | CIE Marks | 50 |
| Teaching Hours/Week (L:P:SDA) | 3:0:2 | SEE Marks | 50 |
| Total Hours of Pedagogy | 50 | Total Marks | 100 |
| Credits | 04 | Exam Hours | 03 |

**Course Learning objectives:** This Course will enable students to

- Outline Instrumentation & measurement system and Sensors.
- Gain knowledge on various Signal conditioning techniques for different sensor transduction.
- Understand non-idealities of amplifiers, reduction of noise, and improvement of system performance.
- Gain knowledge on type of sensors used in modern digital systems.
- Get acquainted about Microcontrollers for IoT.

**Module-1**

Introduction: Sensor-Based Measurement Systems, General Concepts and Terminology, Sensor Classification, General Input-Output Configuration Primary Sensors, Materials for sensors, Micro sensor Technology.
(Text Book: 1) (RBT Levels: **L1 & L2)**.

| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |
|---|---|

**Module-2**

Signal conditioning circuits for resistive sensors: Potentiometers, Wheatstone Bridge Balance and deflection measurements, Signal conditioning circuits: for capacitive sensors, inductive sensors, electromagnetic sensors and self-generating sensors..
(Text Book: 1) (RBT Levels: **L1 & L2)**.

| **Teaching-Learning Process** | .<br>Chalk and talk/PPT/NPTEL Videos/ web content |
|---|---|

**Module-3**

Signal Amplifiers: Non-idealities of Op-Amp, Effect of Non-idealities, Differential Amplifier, Trans-impedance Amplifier, Cascaded Amplifiers, CMRR, Performance Analysis of Amplifiers, Instrumentation amplifier, Charge amplifier, Programmable gain amplifier, Switched capacitor amplifier.
(Text Book: 1 & 2 ) (RBT Levels: **L1, L2)**.

| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |
|---|---|

**Module-4**

Digital and Intelligent Sensors, Position Encoders, Resonant Sensors, Direct Sensor -Microcontroller Interfacing, Communication Systems for Sensors, Intelligent Sensors. Sensors Based on Semiconductor Junctions, Fiber-Optic Sensors, Ultrasonic-Based Sensors, Biosensors.
(Text Book: 1) (RBT Levels: **L1, L2 & L3)**.

| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |
|---|---|

**Module-5**

Microcontrollers for IoT: ESP8266, Node MCU, TI-C3200, Access point and station point mode, HTTP, MQTT, transmission and receiving, Intel-Gallileo boards. Single board computers: Raspberry pi board, porting Raspbian, sensor interface examples, Python programming for cloud access, sensor systems using Arduino boards. Cloud interfacing: Interfacing and data logging with cloud: Thing speak, Things board, Blync platform.
(Reference Books: 3 & 4 ) (RBT Levels: **L1, L2 & L3)**.

| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |
|---|---|

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**Assessment Details (both CIE and SEE):**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Text Books:**


1. Pallás- Areny Ramon, Webster, John G.(2012):Sensors and Signal Conditioning, 2nd Edition.
2. Op-Amps and Linear Integrated Circuits, Ramakant A Gayakwad, 4th Edition, Pearson Education, 2018. ISBN: 978-93-325-4991-3
3. Jacob Fraden, "Hand Book of Modern Sensors: physics, Designs and Applications", 2014, 4thed., Springer, New York.


**Reference Books:**


1. Jon. S. Wilson, "Sensor Technology Hand Book", 2011, 1st edition, Elsevier, Netherland.
2. Sergey Y. Yurish,"Digital Sensors and Sensor Systems: Practical Design", 2011, 1st ed., IFSA Publishing, New York.
3. Jonathan W Valvano, "Introduction to ARM Cortex –M3 Microcontrollers", 2012, 5th ed., Create Space publishing, New York.
4. Muhammad Ali Mazidi, Shujen Chen, Sarmad Naimi, Sepehr Naimi, "TI ARM Peripherals Programming and Interfacing: Using C Language", 2015, 2nd ed., Mazidi and Naimi publishing, New York.


**Web links and Video Lectures (e-Resources):**

- https://youtu.be/bHILcgtR0Sc
- https://youtu.be/m9mSzWiH1RQ
- https://youtu.be/IIf7zH5cIX8
- https://youtu.be/uku6PpRdt4w
- https://youtu.be/5fCrpBADTBE.

**Skill Development Activities Suggested:**

- The students with the help of the course teacher can take up relevant technical – activities which will enhance their skill.

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**Course outcome (Course Skill Set):**

At the end of the course the student will be able to :

| Sl. No. | Description |
|---|---|
| CO1 | Understand the Instrumentation & measurement system and Sensors. |
| CO2 | Apply the knowledge on Signal conditioning techniques for different sensor transduction |
| CO3 | Design amplifiers for the improvement of system performance. |
| CO4 | Understand the interfacing of sensors used in modern digital systems |
| CO5 | Apply the knowledge of Microcontrollers for IoT applications. |

**Program Outcome of this course:**

| Sl. No. | Description | POs |
|---|---|---|
| 1 | Adequate knowledge of fundamentals on sensors, signal conditioning and IoT | PO1 |
| 2 | Ability to design, implement, analyse, interpret data and synthesis of information | PO2 |
| 3 | Ability to analyse a problem critically using scientific approach, relevant IT tools and techniques | PO3 |
| 4 | Appropriate research skills for solving new problem and present a substantial technical report | PO4 |
| 5 | Ability to work ethically and carry out the work with social responsibility | PO5 |
| 6 | Professional skills to carry out work independently or collaboratively in a multidisciplinary environment | PO6 |

**Mapping of COS and POs:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | × | | | | | × |
| **CO2** | × | × | × | | | × |
| **CO3** | × | × | × | | | × |
| **CO4** | × | × | × | | | × |
| **CO5** | × | × | × | | | × |

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| Cloud Architecture and Management | | | |
|---|---|---|---|
| Course Code | 22ISS14 | CIE Marks | 50 |
| Teaching Hours/Week (L:P:SDA) | 2:0:2 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |

**Course Learning objectives:** This Course will enable students to

- Learn the basics and types of computing.
- Understand the architecture and services of Cloud computing.
- Familiarize with the types and taxonomy of virtualization.
- Analyze the capacity planning and platform as a service.
- Describe the tools and technologies used to manage and secure cloud services

**Module-1**

**Overview of Cloud computing:** Defining Cloud Computing, Cloud Types - The NIST model , The Cloud Cube Model, Deployment models, Service models, Characteristics of Cloud Computing-Paradigm shift, Benefits of cloud computing, Disadvantages of cloud computing, Measuring the Cloud's Value
(Text Book: 1) (RBT Levels: **L1 & L2)**.

| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |
|---|---|

**Module-2**

**Cloud Architecture and Services:** Cloud Computing Stack- Composability, Infrastructure, Platforms, Virtual Appliances, Communication Protocols, Applications, Connecting to the Cloud, Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS), Identity as a Service (IDaaS), Compliance as a Service (CaaS)
(Text Book: 1) (RBT Levels: **L1 & L2)**.

| **Teaching-Learning Process** | .<br>Chalk and talk/PPT/NPTEL Videos/ web content |
|---|---|

**Module-3**

**Virtualization:** Virtualization Technologies, Load Balancing and Virtualization- Advanced load balancing, The Google cloud, Hypervisors- Virtual machine types, Machine Imaging, Porting Applications.
(Text Book: 1) (RBT Levels: **L1 & L2)**.

| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |
|---|---|

**Module-4**

**Capacity Planning:** Capacity Planning, Baseline and Metrics-Baseline measurements, System metrics, Load testing, Resource ceilings, Server and instance types, Network Capacity, Scaling
**Platform as a Service:** Defining Services-Salesforce.com versus Force.com: SaaS versus PaaS, Application development, PaaS Application Frameworks- Drupal, Eccentex AppBase 3.0, Long Jump, Square space, Wave Maker, Wolf Frameworks.
(Text Book:1 ) (RBT Levels: **L1 & L2)**.

| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |
|---|---|

**Module-5**

**Cloud Management:** Administrating the Clouds- Management responsibilities, Lifecycle management, Cloud Management Products, Emerging Cloud Management Standards.
**Cloud Security:** Securing the Cloud- The security boundary, Security service boundary, Security mapping, Securing Data- Brokered cloud storage access, Storage location and tenancy, Encryption, Auditing and compliance.
(Text Book: 1) (RBT Levels: **L1 & L2)**.

| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |
|---|---|

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**Assessment Details (both CIE and SEE):**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.

**Suggested Learning Resources:**

**Text Books:**

1. Barrie Sosinsky, "Cloud Computing Bible", Wiley-India, 2010

**Reference Books:**

1. Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, ",Cloud Computing: Principles and Paradigms", Wiley, 2011
2. Nikos Antonopoulos, Lee Gillam, "Cloud Computing: Principles, Systems and Applications", Springer, 2012. Ronald L. Krutz, Russell Dean Vines,"Cloud Security: A Comprehensive Guide to Secure Cloud Computing", Wiley-India, 2010.

**Web links and Video Lectures (e-Resources):**

NPTEL Video Lectures:

- https://www.youtube.com/watch?v=NzZXz3fJf6o&list=PLShJJCRzJWxhz7SfG4hpaBD5bKOloWx9J.
- https://www.youtube.com/watch?v=fZ3D6HQrWzs&list=PLShJJCRzJWxhz7SfG4hpaBD5bKOloWx9J&index=4
- https://www.youtube.com/watch?v=R4spydpBbYk&list=PLShJJCRzJWxhz7SfG4hpaBD5bKOloWx9J&index=6
- https://www.youtube.com/watch?v=Dr6MSqRFaZQ&list=PLShJJCRzJWxhz7SfG4hpaBD5bKOloWx9J&index=12

WEB Links:

- https://www.javatpoint.com/cloud-computing-tutorial
- https://www.tutorialspoint.com/cloud_computing/index.htm

**Skill Development Activities Suggested**

- The students with the help of the course teacher can take up relevant technical – activities which will enhance their skill.

**Course outcome (Course Skill Set):**

At the end of the course the student will be able to :

| Sl. No. | Description |
|---|---|
| CO1 | Describe the types of computing paradigms. |
| CO2 | Explain the architecture and services of Cloud Computing. |
| CO3 | Explain the concept of Virtualization and hypervisors as a prime Enabling Technology of Cloud Computing. |
| CO4 | Compare different metrics related to cloud capacity |
| CO5 | Differentiate Service such as Saas and Paas |

**Program Outcome of this course:**

| Sl. No. | Description | POs |
|---|---|---|
| 1 | Adequate knowledge of fundamentals on sensors, signal conditioning and IoT | PO1 |
| 2 | Ability to design, implement, analyse, interpret data and synthesis of information | PO2 |
| 3 | Ability to analyse a problem critically using scientific approach, relevant IT tools and techniques | PO3 |
| 4 | Appropriate research skills for solving new problem and present a substantial technical report | PO4 |
| 5 | Ability to work ethically and carry out the work with social responsibility | PO5 |
| 6 | Professional skills to carry out work independently or collaboratively in a multidisciplinary environment | PO6 |

**Mapping of COS and POs:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | × | | | | | × |
| **CO2** | × | × | × | | | × |
| **CO3** | × | × | × | | | × |
| **CO4** | × | × | × | | | × |
| **CO5** | × | × | × | | | × |

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| Python for IoT | | | |
|---|---|---|---|
| Course Code | 22ISS15 | CIE Marks | 50 |
| Teaching Hours/Week (L:P:SDA) | 2:0:2 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |

**Course Learning objectives: The students will be able to,**

1. **Learn basics of python**
2. **Understand arrays, classes and objects in python**
3. **Understand network programming using python and SQL**
4. **Analyze how to use MQTT in the python**
5. **Understand the concept of programming for IoT devices**

.

| **Module-1** | |
|---|---|
| Introduction to python, Variables, expressions and statements, Conditional execution, Functions, Iteration, Strings, Files, Lists, Dictionaries, Tuples, Regular Expressions (Text Book:1) (RBT Levels: **L1 & L2 ).** | |
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |
| **Module-2** | |
| Arrays, Classes and objects, Classes and functions, Classes and methods, Introducing the Flask microservices framework (Text Book: 1& 3) (RBT Levels: **L1 & L2 ).** | |
| **Teaching-Learning Process** | . Chalk and talk/PPT/NPTEL Videos/ web content |
| **Module-3** | |
| Networked programs Using Web Services, Using databases and SQL, Networking with MQTT, python, and Mosquito MQTT broker (Text Book: 3) (RBT Levels: **L1 & L2 ).** | |
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |
| **Module-4** | |
| Getting started with python and IoT Technical requirement (Text Book: 3 ) (RBT Levels: **L1 & L2 )** | |
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |
| **Module-5** | |
| Practical Electronics for interfacing with Physical world, IoT Playground :practical examples to interact with physical world (Text Book: 3 ) (RBT Levels: **L1 & L2 ).** | |
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

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## Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

## Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

## Semester-End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

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**Suggested Learning Resources:**

**Text Books:**


1. Charles R. Sperance, "Python for Everybody: Exploring Data Using Python 3", 1 Edition, Create Space Independent Publishing Platform,
2. Brandon Rhodes, John Goerzen, "Foundations of Python Network Programming", 2014, 3rd ed. edition Apress Publisher
3. Gary Smart," Practical Python Programming for IoT", Packt publishing
4. Tim Cox , Dr. Steven Lawrence Fernandes , Sai Yamanoor, Srihari Yamanoor , Prof. Diwakar Vaish "Learning path Getting started with python for Internet of things" 2019, Packt publishing
5. Allen B. Downey, 'Think Python: How to Think like a Computer Scientist", 2nd Edition, Green Tea Press, 2015


**Web links and Video Lectures (e-Resources):**

**NPTEL Video Lectures:**

- **https://onlinecourses.nptel.ac.in › noc19_cs65**
- **https://onlinecourses.nptel.ac.in › noc22_cs53**

**Course outcome (Course Skill Set)**

At the end of the course the student will be able to :

| Sl. No. | Description |
|---|---|
| CO1 | Examine Python syntax and semantics and be fluent in the use of Python flow control and functions. |
| CO2 | Demonstrate proficiency in Arrays, Classes and objects used in python |
| CO3 | Evaluate network programming using python and SQL |
| CO4 | Demonstrate use of MQTT |
| CO5 | Analyse Python programming used for IoT devices |

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| Sl. No. | Description | POs |
|---|---|---|
| 1 | Adequate knowledge of fundamentals on sensors, signal conditioning and IoT | PO1 |
| 2 | Ability to design, implement, analyse, interpret data and synthesis of information | PO2 |
| 3 | Ability to analyse a problem critically using scientific approach, relevant IT tools and techniques | PO3 |
| 4 | Appropriate research skills for solving new problem and present a substantial technical report | PO4 |
| 5 | Ability to work ethically and carry out the work with social responsibility | PO5 |
| 6 | Professional skills to carry out work independently or collaboratively in a multidisciplinary environment. | PO6 |

**Mapping of COS and POs**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | × | × | × | | | |
| **CO2** | × | × | × | | | |
| **CO3** | × | × | × | | | |
| **CO4** | × | × | × | | × | × |
| **CO5** | × | × | × | | | × |

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| Research Methodology and IPR | | | |
|---|---|---|---|
| Course Code | 22RMI16 | CIE Marks | 50 |
| Teaching Hours/Week (L:P:SDA) | 3:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |

**Course Learning objectives:** This Course will enable students to

- Give an overview of the research methodology and explain the technique of defining a research problem
- Explain carrying out a literature search, its review, developing theoretical and conceptual frameworks and writing a review.
- Discuss various research designs and their characteristics.
- Outline the details of research and sampling designs, measurement and scaling techniques and also different methods of data collections.
- Investigate several parametric tests of hypotheses and Chi-square test.
- Explain the art of interpretation and the art of writing research reports.
- Describe various forms of the intellectual property, its relevance, business impact in the changing global business environment and to discuss leading International Instruments.

**Module-1**

**Research Methodology:** Introduction, Meaning of Research, Objectives of Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India.

**Defining the Research Problem:** Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration

(Text Book: 1 )(RBT Levels: **L1 & L2 )**.

| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |
|---|---|

**Module-2**

**Reviewing the literature:** Place of the literature review in research, Bringing clarity and focus to research problem, Improving research methodology, Broadening knowledge base in research area, Enabling contextual findings, Review of the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed.

**Research Design:** Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs

| **Teaching-Learning Process** | . Chalk and talk/PPT/NPTEL Videos/ web content |
|---|---|

**Module-3**

**Design of Sample Surveys:** Design of Sampling: Introduction, Sample Design, Sampling and Non-sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs.

**Measurement and Scaling:** Qualitative and Quantitative Data, Classifications of Measurement Scales, Goodness of Measurement Scales, Sources of Error in Measurement, Techniques of Developing Measurement Tools, Scaling, Scale Classification Bases, Scaling Technics, Multidimensional Scaling, Deciding the Scale.

**Data Collection**: Introduction, Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method.

(Text Book: 1) (RBT Levels: **L1 & L2)**.

| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |
|---|---|

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| Module-4 | |
|---|---|
| **Testing of Hypotheses:** Hypothesis, Basic Concepts Concerning Testing of Hypotheses, Testing of Hypothesis, Test Statistics and Critical Region, Critical Value and Decision Rule, Procedure for Hypothesis Testing, Hypothesis Testing for Mean, Proportion, Variance, for Difference of Two Mean, for Difference of Two Proportions, for Difference of Two Variances, P-Value approach, Power of Test, Limitations of the Tests of Hypothesis.<br>**Chi-square Test:** Test of Difference of more than Two Proportions, Test of Independence of Attributes, Test of Goodness of Fit, Cautions in Using Chi Square Tests.<br>(Text Book: 1) (RBT Levels: **L1 & L2)**. | |
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |
| **Module-5** | |
| **Interpretation and Report Writing:** Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports.<br>**Intellectual Property:** The Concept, Intellectual Property System in India, Development of TRIPS Complied Regime in India, Patents Act, 1970, Trade Mark Act, 1999,The Designs Act, 2000, The Geographical Indications of Goods (Registration and Protection) Act1999, Copyright Act,1957,The Protection of Plant Varieties and Farmers' Rights Act, 2001,The Semi-Conductor Integrated Circuits Layout Design Act, 2000, Trade Secrets, Utility Models, IPR and Biodiversity, The Convention on Biological Diversity (CBD) 1992, Competing Rationales for Protection of IPRs, Leading International Instruments Concerning IPR, World Intellectual Property Organization (WIPO),WIPO and WTO, Paris Convention for the Protection of Industrial Property, National Treatment, Right of Priority, Common Rules, Patents, Marks, Industrial Designs, Trade Names, Indications of Source, Unfair Competition, Patent Cooperation Treaty (PCT), Advantages of PCT Filing, Berne Convention for the Protection of Literary and Artistic Works, Basic Principles, Duration of Protection, Trade Related Aspects of Intellectual Property Rights(TRIPS) Agreement, Covered under TRIPS Agreement, Features of the Agreement, Protection of Intellectual Property under TRIPS, Copyright and Related Rights, Trademarks, Geographical indications, Industrial Designs, Patents, Patentable Subject Matter, Rights Conferred, Exceptions, Term of protection, Conditions on Patent Applicants, Process Patents, Other Use without Authorization of the Right Holder, Layout-Designs of Integrated Circuits, Protection of Undisclosed Information, Enforcement of Intellectual Property Rights, UNSECO.<br>(Text Book: 1& 3) (RBT Levels: **L1 & L2)**. | |
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

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**Assessment Details (both CIE and SEE):**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Text Books:**


1. Research Methodology: Methods and Techniques, C.R. Kothari, Gaurav Garg, New Age International 4th Edition,2018
2. Research Methodology a step-by- step guide for beginners. (For the topic Reviewing the literature under module 2) SAGE PublicationsL3rd Edition, 2011.
3. Study Material(For the topic Intellectual Property under module 5) Professional Programme Intellectual Property Rights, Law and Practice, The Institute of Company Secretaries of India, Statutory Body Under an Act of Parliament, September 2013


**Reference Books:**


1. Research Methods: the concise knowledge base, Trochim, Atomic Dog Publishing, 2005.
2. Conducting Research Literature Reviews: From the Internet to Paper, Fink A Sage Publications, 2009.


**Course outcome (Course Skill Set):**

At the end of the course the student will be able to :

| Sl. No. | Description |
|---|---|
| CO1 | Understand an overview of the research methodology and Literature review. |
| CO2 | Analyze various research designs and their characteristics and different methods of data collections. |
| CO3 | Evaluate several parametric tests of hypotheses and Chi-square test. |
| CO4 | Enhance the art of interpretation and the art of writing research reports. |
| CO5 | Demonstrate various forms of the intellectual property and its business impact in the changing global business environment |

@#15042024

**Program Outcome of this course:**

| Sl. No. | Description | POs |
|---|---|---|
| 1 | Adequate knowledge of fundamentals on sensors, signal conditioning and IoT | PO1 |
| 2 | Ability to design, implement, analyse, interpret data and synthesis of information | PO2 |
| 3 | Ability to analyse a problem critically using scientific approach, relevant IT tools and techniques | PO3 |
| 4 | Appropriate research skills for solving new problem and present a substantial technical report | PO4 |
| 5 | Ability to work ethically and carry out the work with social responsibility | PO5 |
| 6 | Professional skills to carry out work independently or collaboratively in a multidisciplinary environment. | PO6 |

**Mapping of COS and POs:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | | | | × | × | × |
| **CO2** | | | | × | × | × |
| **CO3** | | | | × | × | × |
| **CO4** | | | | × | × | × |
| **CO5** | | | | × | × | × |

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| Laboratory on Sensors, Signal Conditioning and IoT | | | |
|---|---|---|---|
| Course Code | 22ISSL17 | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 1:2:0 | SEE Marks | 50 |
| Credits | 02 | Exam Hours | 03 |

**Course objectives:** This Course will enable students to

- Introduce the concept of design and development using IoT
- Study the IoT protocols for communication
- Expose students to IoT and its implementations
- Demonstrate IoT systems using Arduino platform with open source clouds

| Sl. No. | Experiments |
|---|---|
| 1 | Write a program to sense the Temperature and Pressure using Arduino/Raspberry Pi |
| 2 | Write a program to indicate the water level using Arduino/Raspberry Pi |
| 3 | Write a program to compute the wind speed using proximity sensor and Arduino/Raspberry Pi |
| 4 | Write a program to detect the rainfall level and Moisture Content using Arduino/Raspberry Pi |
| 5 | Write a program to detect the Motion using Arduino/Raspberry Pi |
| 6 | Write a program to display the distance the object is placed from the sensor using Arduino/Raspberry Pi |
| 7 | To interface LED/Buzzer with Arduino/Raspberry Pi and write a program to turn ON LED for 1sec for every 2 sec |
| 8 | To interface OLED with Arduino/Raspberry Pi and write a program to print temperature and humidity readings. |
| | **Demonstration Experiments ( For CIE )** |
| 9 | To interface Bluetooth with Arduino/Raspberry Pi to send sensor data to smart phone using Bluetooth |
| 10 | To interface sensor with Arduino/Raspberry Pi to subscribe the MQTT broker for temperature data and print it. |
| 11 | To interface sensor Arduino/Raspberry Pi to upload and retrieve Temperature and Humidity data to Thingspeak cloud. |
| 12 | To interface and control servo motor with Arduino/Raspberry Pi. |

**Course outcomes (Course Skill Set):**

At the end of the course the student will be able to:

- Understand the concept of IoT and its working
- Learn and apply IoT protocols for communication
- Implement IoT based application
- Validate IoT systems using Arduino/Raspberry pi with open source cloud platform

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**Assessment Details (both CIE and SEE):**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 40% of maximum marks in the semester-end examination (SEE). In total of CIE and SEE student has to secure 50% maximum marks of the course.

**Continuous Internal Evaluation (CIE):**

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8$^{th}$ week of the semester and the second test shall be conducted after the 14$^{th}$ week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will

**Semester End Evaluation (SEE):**

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University.

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 10% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

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**Program Outcome of this course:**

| Sl. No. | Description | POs |
|---|---|---|
| 1 | Adequate knowledge of fundamentals on sensors, signal conditioning and IoT | PO1 |
| 2 | Ability to design, implement, analyse, interpret data and synthesis of information | PO2 |
| 3 | Ability to analyse a problem critically using scientific approach, relevant IT tools and techniques | PO3 |
| 4 | Appropriate research skills for solving new problem and present a substantial technical report | PO4 |
| 5 | Ability to work ethically and carry out the work with social responsibility | PO5 |
| 6 | Professional skills to carry out work independently or collaboratively in a multidisciplinary environment. | PO6 |

**Mapping of COS and POs:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | × | | × | | | |
| **CO2** | × | × | × | | | |
| **CO3** | × | × | × | | | |
| **CO4** | × | × | × | | × | × |

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| MACHINE LEARNING | | | |
|---|---|---|---|
| Course Code | **22ISS21** | CIE Marks | 50 |
| Teaching Hours/Week (L:P:SDA) | 2:0:2 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 3 | Exam Hours | 3 |

**Course Learning objectives:** This Course will enable students to

- Define machine learning and understand the basic theory underlying machine learning.
- Differentiate supervised, unsupervised and reinforcement
- Understand the basic concepts of statistical learning and decision trees.
- Understand Bayesian techniques for problems appear in machine learning
  Perform statistical analysis of machine learning techniques

**Module-1**

Introduction-Towards Intelligent Machines, Well posed Problems, Example of Applications in diverse fields, Data Representation, Domain Knowledge for Productive use of Machine Learning, Diversity of Data: Structured Unstructured, Forms of Learning, Machine Learning and Data Mining, Basic Linear Algebra in Machine Learning Techniques.

(Text Book: 1) (RBT Levels: L1 & L2).

| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |
|---|---|

**Module-2**

Supervised Learning- Rationale and Basics: Learning from Observations, Bias and Why Learning Works: Computational Learning Theory, Occam's Razor Principle and Over fitting Avoidance Heuristic Search in inductive Learning, Estimating Generalization Errors, Metrics for assessing regression, Metrics for assessing classification.
(Text Book: 1) (RBT Levels: **L1 , L2& L3)**.

| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content. |
|---|---|

**Module-3**

Statistical Learning- Machine Learning and Inferential Statistical Analysis, Descriptive Statistics in learning techniques, Bayesian Reasoning a probabilistic approach to inference, K-Nearest Neighbor Classifier. Discriminant functions and regression functions, Linear Regression with Least Square Error Criterion, Logistic Regression for Classification Tasks, Fisher's Linear Discriminant and Thresholding for Classification, Minimum Description Length Principle.
(Text Book: 1) (RBT Levels: **L1, L2 & L3)**.

| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |
|---|---|

**Module-4**

Support Vector Machines (SVM) - Introduction, Linear Discriminant Functions for Binary Classification, Perceptron Algorithm, Large Margin Classifier for linearly separable data, Linear Soft Margin Classifier for Overlapping Classes, Kernel Induced Feature Spaces, Nonlinear Classifier, Regression by Support vector Machines.
Learning with Neural Networks: Towards Cognitive Machine, Neuron Models, Network Architectures, Perceptrons, Linear neuron and the Widrow-Hoff Learning Rule, The error correction delta rule.
(Text Book: 1) (RBT Levels: **L1, L2& L3)**.

| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |
|---|---|

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| Module-5 | |
|---|---|
| Decision Tree Learning: Introduction, Example of classification decision tree, measures of impurity for evaluating splits in decision trees, ID3, C4.5, and CART decision trees, pruning the tree, strengths and weakness of decision tree approach.<br>(Text Book: 1) (RBT Levels: **L1 & L2)**. | |
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs
3. The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module.

**Suggested Learning Resources:**

**Text Books:**


- Gopal, M., "Applied machine learning", McGraw-Hill Education, 2019.
- Tom M Mitchell, "Machine Learning" , McGraw-Hill science. Engineering/Math; 1997, ISBN: 0070428077.


**Reference Books:**


- Müller, A. C., & Guido, S., "Introduction to machine learning with Python: a guide for data scientists", "O'Reilly Media, Inc." 2016.
- Flach, P., "Machine learning: the art and science of algorithms that make sense of data" , Cambridge University Press, 2012.


**Web links and Video Lectures (e-Resources):**

- **https://nptel.ac.in/courses/106106139**

**Skill Development Activities Suggested**

- The students with the help of the course teacher can take up relevant technical – activities which will enhance their skill.

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**Course outcome (Course Skill Set)**

At the end of the course the student will be able to :

| Sl. No. | Description |
|---|---|
| CO1 | Understand the concept of Machine Learning and Concept Learning |
| CO2 | Apply the concept of ML and various classification methods. |
| CO3 | Apply the ML concept in a decision tree structure and implementation of Ensemble learning and Random Forest. |
| CO4 | Analyse various training models in ML and the SVM algorithm to be implemented |
| CO5 | Apply Bayes techniques and explore more about the classification in ML. |

**Program Outcome of this course**

| Sl. No. | Description | POs |
|---|---|---|
| 1 | Adequate knowledge of fundamentals on sensors, signal conditioning and IoT | PO1 |
| 2 | Ability to design, implement, analyse, interpret data and synthesis of information | PO2 |
| 3 | Ability to analyse a problem critically using scientific approach, relevant IT tools and techniques | PO3 |
| 4 | Appropriate research skills for solving new problem and present a substantial technical report | PO4 |
| 5 | Ability to work ethically and carry out the work with social responsibility | PO5 |
| 6 | Professional skills to carry out work independently or collaboratively in a multidisciplinary environment | PO6 |

**Mapping of COS and POs**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | × | | | | | |
| **CO2** | × | × | × | | | × |
| **CO3** | × | × | × | | | × |
| **CO4** | × | × | × | | | × |
| **CO5** | × | × | × | | | × |

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## EMBEDDED SYSTEMS AND IOT

| | | | |
|---|---|---|---|
| Course Code | **22ISS22** | CIE Marks | 50 |
| Teaching Hours/Week (L:P:SDA) | 3:2:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 hours Theory + 10 Lab slots | Total Marks | 100 |
| Credits | 4 | Exam Hours | 03 |

**Course objectives:** This Course will enable students to

- Learn the basics of IoT enabling Technologies
- Understand different types of IoT platforms.
- Learn how to use the Analog and Digital input and Output in microcontroller
- Understand the different Networking Communication protocol.
- Apply IoT in different Application

### MODULE-1

Introduction to Arm® Mbed™ , IoT and IoT Enabling Technologies: Introduction to Arm® Mbed™,Introduction to the Internet of Things (IoT), IoT Enabling Technologies: Sensors and Actuators, Communications, Protocols, Node-RED.

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |

### MODULE-2

IoT Enabled Platforms:
IBM Watson IoT, Eclipse IoT, AWS IoT, Microsoft Azure IoT Suite, Google Cloud IoT, ThingWorx IoT Physical Servers & Cloud Offerings, Introduction to Cloud Storage Models & Communication APIs, WAMP-AutoBahn for IoT, Xively Cloud for IoT, Python Web Application Framework-Django:Django Architecture, Starting Development, with Django Designing a RESTful Web API

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |

### MODULE-3

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

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |

### MODULE-4

**Digital Interfaces:**
Serial, SPI, I2C, CAN.
**Networking and Communications :**
Ethernet, Ethernet Web Client and Web Server, TCP Socket and UDP Socket, Web Socket, WiFi.

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |

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| MODULE-5 | |
|---|---|
| Case studies illustrating IoT Design:<br>Introduction, Home Automation, cities, Environment, Agriculture, Productivity Application | |
| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |

**PRACTICAL COMPONENT OF IPCC**

| Sl.NO | Experiments |
|---|---|
| 1 | Demonstrate the Audio signal Amplification using LM741 |
| 2 | Interface 12V Relay with Arduino |
| 3 | Illustrate to study sound intensity and frequency characteristics of Buzzer with respect to variation in input voltage. |
| 4 | Set up Temporary IoT Hub instance in Azure Cloud for the lab. This guarantees that any outside access goes only through this temporary hub. When you remove the hub all further access will be denied. |
| 5 | Create application to monitor device locate, device storage temperature, humidity in Azure central IoT services. |

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**CIE for the theory component of IPCC**

1. Two Tests each of **20 Marks.**
2. Two assignments each of **10 Marks/One Skill Development Activity of 20 marks**
3. Total Marks of two tests and two assignments/one Skill Development Activity added will be CIE for 60 marks, marks scored will be proportionally scaled down to **30 marks**.

**CIE for the practical component of IPCC**

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The**15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test at the end /after completion of all the experiments shall be conducted for 50 marks and scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

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**SEE for IPCC**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

1. The question paper will be set for 100 marks and marks scored will be scaled down proportionately to 50 marks.
2. The question paper will have ten questions. Each question is set for 20 marks.
3. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
4. The students have to answer 5 full questions, selecting one full question from each module.

**The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component**).

- The minimum marks to be secured in CIE to appear for SEE shall be the 15 (50% of maximum marks-30) in the theory component and 10 (50% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.
- SEE will be conducted for 100 marks and students shall secure 40% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50. (Student has to secure an aggregate of 50% of maximum marks of the course(CIE+SEE)

**Suggested Learning Resources:**

**Text Books:**


1. Perry Xiao , "Designing Embedded Systems and the Internet of Things (IoT) with the ARM® Mbed™", London south Bank University UK, Wiley Edition.
2. ArsheepBahga, Vijay Madisetti, " Internet of Things: A Hands on Approach"-2015


**Web links and Video Lectures (e-Resources):**

- **https://nptel.ac.in/courses/106106139**

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

The students with the help of the course teacher can take up relevant technical – activities which will enhance their skill.

**Course outcome (Course Skill Set)**

**At the end of the course the student will be able to :**

| Sl. No. | Description |
|---|---|
| CO1 | Able to understand different IoT enabling Technologies |
| CO2 | Able to understand different types of IoT platforms. |
| CO3 | Able to use the Analog and Digital input and Output for microcontroller Application |
| CO4 | Able to understand the different Networking Communication protocol. |
| CO5 | Apply IoT in different Application |

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**Program Outcome of this course**

| Sl. No. | Description | POs |
|---|---|---|
| 1 | Adequate knowledge of fundamentals on sensors, signal conditioning and IoT | PO1 |
| 2 | Ability to design, implement, analyse, interpret data and synthesis of information | PO2 |
| 3 | Ability to analyse a problem critically using scientific approach, relevant IT tools and techniques | PO3 |
| 4 | Appropriate research skills for solving new problem and present a substantial technical report | PO4 |
| 5 | Ability to work ethically and carry out the work with social responsibility | PO5 |
| 6 | Professional skills to carry out work independently or collaboratively in a multidisciplinary environment | PO6 |

**Mapping of COS and POs**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | x | | | | | |
| **CO2** | **x** | | | | | |
| **CO3** | | **x** | | | | **x** |
| **CO4** | | **x** | | | | **x** |
| **CO5** | | | **x** | **x** | **x** | **x** |

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| FLEXIBLE AND WEARABLE SENSORS | | | |
|---|---|---|---|
| Course Code | **22ISS231** | CIE Marks | 50 |
| Teaching Hours/Week (L:P:SDA) | 3:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 3 | Exam Hours | 3 |

**Course Learning objectives:** This Course will enable students to

- To provide the overview of flexible electronics technology and the issues with materials processing for thin film electronics.
- To expose the students for the materials selection and patterning methods for thin film electronics development.
- To describe the process involved in transferring the flexible electronics from foils to textiles and also the challenges, opportunities and the future of wearable devices.
- To expose the students to the design, challenges of wearable sensors employed for sensing the physical and biological parameters and the process involved in the conversion of conducting and semiconducting fibers to smart textiles.

**Module-1**

**Overview of flexible electronics technology**: History of flexible electronics - Materials for flexible electronics: degrees of flexiblility, substrates, backplane electronics, front plane technologies, encapsulation - Fabrication technology for flexible electronics - Fabrication on sheets by batch processing, fabrication on web by Roll-to-Roll processing - Additive printing.

**Amorphous and nano-crystalline silicon materials and Thin film transistors**

Fundamental issues for low temperature processing - low temperature amorphous and nano- crystalline silicon - characteristics of low temperature dielectric thin film deposition - low temperature silicon nitride and silicon oxide characteristics - Device structures and materials processing - Device performance - Contacts for the device - Device stability.

(Text Book: 1) (RBT Levels: L1 & L2 ).

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

**Module-2**

**Materials and Novel patterning methods for flexible electronics**

Materials considerations for flexible electronics: Overview, Inorganics semiconductors and dielectrics, organic semiconductors and dielectrics, conductors - Print processing options for device fabrication: Overview, control of feature sizes of jet printed liquids, jet printing for etch mask patterning, methods for minimizing feature size, printing active materials.

(Text Book: 1) (RBT Levels: L1 & L2 ).

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content. |

**Module-3**

**Flexible electronics from foils to textiles**

Introduction -Thin film transistors: Materials and Technologies - Review of semiconductors employed in flexible electronics - Thin film transistors based on IGZO - Plastic electronics for smart textiles - Improvements and limitations.

(Text Book: 2) (RBT Levels: L1 & L2 ).

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

**Module-4**

**Wearable haptics:** World of wearables - Attributes of wearables - Textiles and clothing: The meta wearable - Challenges and opportunities - Future of wearables - Need for wearable haptic devices -Categories of wearable haptic and tactile display

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**Wearable Bio, Chemical and Inertial sensors:** Introduction-Systems design - Challenges in chemical and biochemical sensing - Application areas

Wearable inertial sensors - obtained parameters from inertial sensors - Applications for wearable motion sensors - Practical considerations for wearable inertial sensor - Application in clinical practice and future scope.

(Text Book: 2) (RBT Levels: L1 & L2 ).

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

**Module-5**

**Knitted electronic textiles:** From fibers to textile sensors - Interlaced network -Textile sensors for physiological state monitoring - Biomechanical sensing - Noninvasive sweat monitoring by textile sensors and other applications. FBG sensor in Intelligent Clothing and Biomechanics.

(Text Book: 2) (RBT Levels: L1 & L2 ).

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs
3. The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module.

**Suggested Learning Resources:**

**Text Books:**


1. Michael J. McGrath, Cliodhna Ni Scanaill, Dawn Nafus, "Sensor Technologies: Healthcare, Wellness and Environmental Applications", 201, 1st Edition , Apress Media LLC, New York.
2. Edward Sazonov, Michael R. Newman, "Wearable Sensors: Fundamentals, Implementation and Applications", 2014, 1st Edition, Academic Press, Cambridge.


**Reference books:**


1. William S. Wong, Alberto Salleo, Flexible Electronics: Materials and Applications, 2011, 1st Edition, Springer, New York.


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interactive garments", 2014, 1st Edition, Marker Media, Netherlands.
3. Guozhen Shen, Zhiyong Fan, "Flexible Electronics: From Materials to Devices", 2015, 1st Edition, World Scientific Publishing Co, Singapore.
4. Yugang Sun, John A. Rogers, "Semiconductor Nanomaterials for Flexible Technologies: from Photovoltaics and Electronics to Sensors and Energy Storage (Micro and Nano Technologies)", 2011, 1st Edition, William Andrew, New York.

**Web links and Video Lectures (e-Resources):**

- https://10.1016/b978-0-12-418662-0.00020-9
- https://10.1016/b978-0-12-418662-0.00025-8
- https://10.1016/b978-0-12-418662-0.00003-9

**Skill Development Activities Suggested**

- The students with the help of the course teacher can take up relevant technical – activities which will enhance their skill.

**Course outcome (Course Skill Set)**

At the end of the course the student will be able to :

| Sl. No. | Description |
|---|---|
| CO1 | Realize the technology developments in the flexible electronics technology. |
| CO2 | Ability to identify the suitable materials and its processing for the development of thin film electronics. |
| CO3 | Ability to design the pattern and develop with suitable patterning methods. |
| CO4 | Realize the process involved in the transformation of electronics from foils to textiles. |
| CO5 | Acquire the design knowledge for developing wearable sensors for physical and chemical parameters. |
| CO6 | Gain the competency in transferring the conducting and semiconducting fibers to smart textiles |

**Program Outcome of this course**

| Sl. No. | Description | POs |
|---|---|---|
| 1 | Adequate knowledge of fundamentals on sensors, signal conditioning and IoT | PO1 |
| 2 | Ability to design, implement, analyse, interpret data and synthesis of information | PO2 |
| 3 | Ability to analyse a problem critically using scientific approach, relevant IT tools and techniques | PO3 |
| 4 | Appropriate research skills for solving new problem and present a substantial technical report | PO4 |
| 5 | Ability to work ethically and carry out the work with social responsibility | PO5 |
| 6 | Professional skills to carry out work independently or collaboratively in a multidisciplinary environment | PO6 |

**Mapping of COS and POs**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | × | | | | | |
| **CO2** | × | × | × | | | |
| **CO3** | × | | | | | |
| **CO4** | × | | | | | |
| **CO5** | × | | | | | × |
| **CO6** | × | | | | | × |

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| BIOMEDICAL SENSORS | | | |
|---|---|---|---|
| Course Code | **22ISS232** | CIE Marks | 50 |
| Teaching Hours/Week (L:P:SDA) | 3:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 3 | Exam Hours | 3 |

**Course Learning objectives:** This Course will enable students to

- Different types of electrodes used in bio potential recording.
- Perceive the need for bio amplifiers and their characteristics needed to be design for various bandwidth and frequency response.
- Introduce the concept of Heart rate, Blood pressure and Blood Flow measurements.
- Students will be introduced to fundamentals of x-ray radiography and computed tomography
- Students will be introduced to principles of ultrasound imaging and thermal imaging.

**Module-1**

**Biopotential Electrodes:**
Origin of bio potential and its propagation. Electrode-electrolyte interface, electrode–skin interface, half-cell potential, impedance, polarization effects of electrode – nonpolarizable electrodes. Types of electrodes - surface, needle and micro electrodes and their equivalent circuits. Recording problems - measurement with two electrodes.
**EEG, EMG & ECG:** Bio signal characteristics – frequency and amplitude ranges. ECG – Einthoven's triangle, standard 12 lead system. EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode. EEG- procedure, signal artefacts, signal analysis, evoked potential, EMG- procedure and signal analysis, Nerve conduction study.
(Text Book: 1) (RBT Levels: L1 & L2 ).

| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |
|---|---|

**Module-2**

**Bio Amplifiers:** Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier – right leg driven ECG amplifier. Band pass filtering, isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier. Chopper amplifier. Power line interference.
(Text Book: 1) (RBT Levels: L1 & L2 ).

| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content. |
|---|---|

**Module-3**

**Measurement of Heart Rate**: Average heart rate meter, Instantaneous heart rate meter, Measurement of pulse rate, Oximeter.
**Blood Flow Measurement:** Electromagnetic blood flow meter- Principle and Square wave electromagnetic flow meter. Doppler shift blood flow velocity meter.
**Blood Pressure Measurement:** Introduction, Indirect methods of blood pressure measurement: Korotkoff"s method, Rheographic method, differential auscultatory technique, Oscillometric technique.
(Text Book: 1) (RBT Levels: L1 & L2 ).

| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |
|---|---|

**Module-4**

**X-Ray Imaging:** Generation and Detection of X-rays – X-ray generation, X-ray generators, Filters, Beam restrictors and grids, Intensifying screens, fluorescent screens, and image intensifiers, X-ray

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detectors. X-Ray Diagnostic Methods: Conventional X-ray radiography, Fluoroscopy, Angiography, Mammography.

**Computed Tomography:** Conventional tomography, Computed tomography – Projection function, CT number. Recent developments – Digital radiography, Digital subtraction angiography (DSA). Biological effects of ionizing radiation.

(Text Book: 2) (RBT Levels: L1 & L2 ).

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

**Module-5**

**Ultrasound Imaging:** Definition of ultrasound, Fundamentals of acoustic propagation (only theoretical concepts, no derivations) - Reflection and refraction, Attenuation, absorption & scattering, Doppler effect, Generation and detection of Ultrasound-Piezoelectric effect, Ultrasonic transducers, Axial and Lateral resolution.

**Thermal Imaging:** Medical thermography, Physics of thermography, Infrared detectors, Thermographic equipment, Quantitative medical thermography, Pyroelectric vidicon camera.

(Text Book: 2) (RBT Levels: L1 & L2 ).

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module.

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**Suggested Learning Resources:**

**Text Books:**


1. Khandpur R.S, "Handbook of Biomedical Instrumentation" , Tata McGraw-Hill, New Delhi,3rd edition , 2014
2. Kirk Shung, Michael B. Smith and BanjaminTsui , "Principles of Medical Imaging" , Academic Press, 1992.


**Reference books:**


1. John Enderle, Joseph Bronzino, "Introduction to Biomedical Engineering", Academic Press, 3rd Edition, 2011.
2. Myer Kutz, "Biomedical Engineering and Design Handbook, Volume 1: Volume I:
3. Biomedical Engineering Fundamentals", McGraw Hill Publisher, USA, 2nd Edition 2009.
4. J. G. Webster, J. G. Webster ,"Medical Instrumentation; Application and Design", John Wiley & Sons, Inc., New York, 4th Edition, 2015


**Web links and Video Lectures (e-Resources):**

https://archive.nptel.ac.in/courses/108/108/108108147/

**Skill Development Activities Suggested**

- The students with the help of the course teacher can take up relevant technical – activities which will enhance their skill.

**Course outcome (Course Skill Set)**

At the end of the course the student will be able to :

| CO's | Description |
|---|---|
| CO1 | Realize the need for reusable electrodes and understand electrode placements for various bio potential recordings. |
| CO2 | Understanding the design concepts of bio-amplifiers and filters. |
| CO3 | Analyze Heart Rate, Blood Pressure and Blood Flow measurements. |
| CO4 | Understand the concepts of x-ray radiography and computed tomography. |
| CO5 | Understanding the concepts of ultrasound imaging and thermal imaging. |

**Program Outcome of this course**

| Sl. No. | Description | POs |
|---|---|---|
| 1 | Adequate knowledge of fundamentals on sensors, signal conditioning and IoT | PO1 |
| 2 | Ability to design, implement, analyse, interpret data and synthesis of information | PO2 |
| 3 | Ability to analyse a problem critically using scientific approach, relevant IT tools and techniques | PO3 |
| 4 | Appropriate research skills for solving new problem and present a substantial technical report | PO4 |
| 5 | Ability to work ethically and carry out the work with social responsibility | PO5 |
| 6 | Professional skills to carry out work independently or collaboratively in a multidisciplinary environment | PO6 |

**Mapping of COS and POs**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | × | | | | | |
| **CO2** | × | × | | | | × |
| **CO3** | × | × | × | | | |
| **CO4** | × | × | | | | × |
| **CO5** | × | | | | | × |

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| RADIO FREQUENCY AND MICROWAVE SENSORS | | | |
|---|---|---|---|
| Course Code | **22ISS233** | CIE Marks | 50 |
| Teaching Hours/Week (L:P:SDA) | 3:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 3 | Exam Hours | 03 |

**Course Learning objectives:** This Course will enable students to

- To introduce the students with different RF and Microwave sensors.
- To familiarize antenna design with a good understanding of their parameters and applications.
- To introduce the concepts of RADAR and its Application.
- To introduce comprehensive knowledge of wearable antenna.
- To understand basics of different microwave sensors.

| **Module-1** | |
|---|---|
| RF Sensors Microwave Antenna-Introduction, types of Antenna, fundamental parameters of antennas, radiation mechanism, Fresnel and Fraunhofer regions. Antenna for communication and Antenna for sensing, radiometer and radar<br>(RBT Levels: **L1 & L2 )**.. | |
| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |
| **Module-2** | |
| Antenna for personal area communication: Concepts of Printed Antennas, Broadband Microstrip Patch Antennas, Antennas for Wearable Devices, Design Requirements, Modeling and Characterization of Wearable Antennas, WBAN Radio Channel Characterization and Effect of Wearable Antennas, Domains of Operation, Sources on the Human Body, Compact Wearable Antenna for different applications.<br>(RBT Levels: **L1 & L2 )**.. | |
| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |
| **Module-3** | |
| Radar Introduction to RADAR, RADAR range equation, MTI and pulse Doppler RADAR, Tracking RADAR, SAR pulse RADAR, CW RADAR. Applications of Radar Automotive, remote sensing, agriculture, medicine, detection of buried objects, NDT, defense factors affecting the performance of RADAR, RADAR transmitters, Receivers.<br>(RBT Levels: **L1 & L2 )**.. | |
| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |
| **Module-4** | |
| Radiometers Radiative transfer theory, SMMR, Types of radiometers - and Bolometers, Applications in automotive, agriculture, medicine and weather forecasting.<br>(RBT Levels: **L1 & L2 )**.. | |
| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |
| **Module-5** | |
| Microwave power Sensors Diode: Diode detector principles, dynamic range average power sensors, signal waveform effects on the measurement uncertainty of diode sensors. Thermocouple Sensors: Principles of Thermocouple sensor, power meters for thermocouple sensors.<br>(RBT Levels: **L1 & L2 )**. | |
| **Teaching-** | Chalk and talk/PPT/case study/web content |

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| Process | |
|---|---|

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module.

**Suggested Learning Resources:**

**Text Books:**


1. Balanis Constantine A. (2016): "Antenna Theory Analysis and Design" , 4th Edition, New Jersey: John Wiley and Sons.
2. Peter S Hall, Yang Hao , "Antenna and Propagation for Body Centric Wireless Communications",Second Edition , Artech House.
3. Shiban Kishan Koul, Richa Bharadwaj , "Wearable Antennas and Body Centric Communication", Springer Lecture Notes in Electrical Engineering
4. Merrill I Skolnik ,"Introduction to Radar Systems "Tata McGraw-Hill.
5. Niels Skou, D. M. Le Vine," Microwave Radiometer Systems Design and Analysis " Artech House.


**Web links and Video Lectures (e-Resources):**

- https://youtu.be/c6lqXb14c0I

**Skill Development Activities Suggested**

- The students with the help of the course teacher can take up relevant technical – activities which will enhance their skill.

**Course outcome (Course Skill Set)**

At the end of the course the student will be able to :

| Sl. No. | Description |
|---|---|
| CO1 | Select a proper antenna design to be used in the RF spectral region. |
| CO2 | Apply the basic knowledge in the measurement of RF radiation. |
| CO3 | Understand about the RADAR and It's application. |
| CO4 | Correlate the principle behind different radar systems and determine various applications based on the radar systems. |
| CO5 | Interpret about the power sensor and diode sensor. |

**Program Outcome of this course**

| Sl. No. | Description | POs |
|---|---|---|
| 1 | Adequate knowledge of fundamentals on sensors, signal conditioning and IoT | PO1 |
| 2 | Ability to design, implement, analyse, interpret data and synthesis of information | PO2 |
| 3 | Ability to analyse a problem critically using scientific approach, relevant IT tools and techniques | PO3 |
| 4 | Appropriate research skills for solving new problem and present a substantial technical report | PO4 |
| 5 | Ability to work ethically and carry out the work with social responsibility | PO5 |
| 6 | Professional skills to carry out work independently or collaboratively in a multidisciplinary environment | PO6 |

**Mapping of COS and POs**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | × | | | | | |
| **CO2** | × | × | × | | | |
| **CO3** | × | | | | | × |
| **CO4** | × | | | | | × |
| **CO5** | × | × | | | | |

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| RFID AND MICROCONTROLLER | | | |
|---|---|---|---|
| Course Code | **22ISS234** | CIE Marks | 50 |
| Teaching Hours/Week (L:P:SDA) | 3:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 3 | Exam Hours | 03 |

**Course Learning objectives:**

- To learn the basics of RFID and 8051 microcontrollers.
- Interfacing RFID with microcontrollers.
- To develop real time applications based on microcontrollers.
- Analyse different case studies.

**Module-1**

**BAR CODES AND RFID**:
Bar codes and RFID basics- Components of an RFID system-Data -Tags-Antennas Connectors- Cables-Readers- encoder/ printers for smart labels- Controllers software- RFID advantages over Bar codes.
(RBT Levels: **L1 & L2)**.

| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |
|---|---|

**Module-2**

**MICROCONTROLLERS:**
Intel 8051 - architecture- memory organization- special function registers- timing and control- port operation- memory interfacing - I/O interfacing- Programming the 8051 resources- interrupts- Measurement of frequency, period and pulse width of a signal power down operation.
(RBT Levels: **L1 ,L2 & L3 )**.

| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |
|---|---|

**Module-3**

**INTEL 8051 MICROCONTROLLER- INSTRUCTION SET AND PROGRAMMING:**
Programmers model of Intel-Operand types- Operand addressing- Data transfer instructions- Arithmetic Instructions - Logic instructions- Control transfer instructions.- 8051 Interfacing and applications- ADC, Stepper Motor, LCD.
(RBT Levels: **L1, L2 & L3)**.

| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |
|---|---|

**Module-4**

**RFID APPLICATIONS:**
Short range RFID applications- access control - personal identification - Transportation ticketing- blood tissue and organ identification- fleet management personal identification- car body production-passport security. Long range RFID applications- supply chain management- Mail and shipping- Clothing Tags.
(RBT Levels: **L1 & L2)**.

| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |
|---|---|

**Module-5**

**CASE STUDIES:**
Reading RFID cards using 8051- RFID in the supply chain- Vehicles parking using RFID- library management system- electronic toll payment- smart shipping containers fleet monitoring and management.
(RBT Levels: **L1, L2 & L3)**

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| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module.

**Suggested Learning Resources:**

**Text Books**


1. Brown Dennis E. "RFID implementation**",** Tata McGraw – Hill, 2007.
2. Pal Ajit , " Microcontrollers- principles and applications", India: Prentice hall, 2011


**Reference Books**


1. Shepard Steven: RFID: Radio frequency and Identification, Tata McGraw – Hill.
2. Kant Krishna : Microprocessors and Microcontrollers, India: Prentice hall, 2011


**Web links and Video Lectures (e-Resources):**

1. https://noc19-ee28 lec08 RFID based localization – I
2. https://youtu.be/6nFwWp6iJvs

**Skill Development Activities Suggested**

- The students with the help of the course teacher can take up relevant technical – activities which will enhance their skill.

**Course outcome (Course Skill Set)**

At the end of the course the student will be able to :

| Sl. No. | Description |
|---|---|
| CO1 | Understand the basic of bar codes & RFID |
| CO2 | Analyse the basics of Microcontroller 8051. |
| CO3 | Apply the concepts of Microcontroller programming. |
| CO4 | Examine the use of RFID application. |
| CO5 | Illustrate the use of RFID in supply chain. |

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**Program Outcome of this course**

| Sl. No. | Description | POs |
|---|---|---|
| 1 | Adequate knowledge of fundamentals on sensors, signal conditioning and IoT | PO1 |
| 2 | Ability to design, implement, analyse, interpret data and synthesis of information | PO2 |
| 3 | Ability to analyse a problem critically using scientific approach, relevant IT tools and techniques | PO3 |
| 4 | Appropriate research skills for solving new problem and present a substantial technical report | PO4 |
| 5 | Ability to work ethically and carry out the work with social responsibility | PO5 |
| 6 | Professional skills to carry out work independently or collaboratively in a multidisciplinary environment | PO6 |

**Mapping of COS and POs**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | × | | | | | |
| **CO2** | × | × | | | | |
| **CO3** | × | × | × | | | |
| **CO4** | × | | × | | | |
| **CO5** | | | × | × | × | × |

@#15042024

| SIGNAL PROCESSING AND DATA ANALYTICS | | | |
|---|---|---|---|
| Course Code | **22ISS235** | CIE Marks | 50 |
| Teaching Hours/Week (L:P:SDA) | 3:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 3 | Exam Hours | 3 |

**Course Learning objectives:** This Course will enable students to

- To introduce the concepts of discrete time signal processing and the characterization of random signals.
- To present the basic theory of modeling the signals and the methods of estimating the unknowns using prediction filters
- To provide a comprehensive understanding on applying FFT, DCT, and wavelet techniques for extracting the signal features.
- To provide an overview of analysing big data using intelligent techniques and an in-depth introduction to two main areas of Machine Learning*:* supervised and unsupervised.

| **Module-1** | |
|---|---|
| **Discrete Random Signal Processing** :Random Processes, Ensemble Average, Gaussian Process, Multi variate Gausssian Process, Stationary process, Autocorrelation, Auto Covariance, Ergodicity, White noise, Power Spectrum, Filtering of Random Process<br>**Signal Modeling:** ARMA, AR, MA Models. Wiener filter, Linear prediction, Kalman Filter.<br>(RBT Levels: **L1 & L2)**. | |
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

| **Module-2** | |
|---|---|
| **Feature extraction:** FFT, Power spectrum, DCT, filter banks, Wavelet, Wavelet Packets, Cepstrum | |
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content. |

| **Module-3** | |
|---|---|
| **Time series analysis:** Basic analysis, Univariate time series analysis, Multivariate time series analysis, non-stationary time series.<br>(RBT Levels: **L1 & L2)**. | |
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

| **Module-4** | |
|---|---|
| **Reduction of dimensionality:** Bayesian decision, Linear discrimination, Principal Component analysis, SVD, Independent Component Analysis.<br>(RBT Levels: **L1 & L2)**. | |
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

| **Module-5** | |
|---|---|
| **Machine learning:** Supervised learning, generative algorithms, Support Vector machines, Unsupervised learning, K means clustering, Neural network (SOM, ART), Expectation maximization.<br>**Big Data Analytics:** Introduction Big data analytics, visualization and data exploration, basic and intermediate analysis, linear and logistic regression, decision tree.<br>(RBT Levels: **L1 & L2)**. | |
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

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**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module.

**Suggested Learning Resources:**

**Text Books:**


1. J. G. Proakis, DG. Manolakis and D. Sharma, "Digital signal processing principles, algorithms and applications", 2012, 4th ed., Person education, USA
2. Sophocles J. Orfanidis, "Introduction to signal Processing" 2010, 2nd ed., Prentice Hall, New Delhi India.


**Reference books:**


1. Oppenhiem V. A.V and Schaffer R. W, "Discrete- time signal Processing", 2014, 3rd ed., Prentice Hall,. New Delhi, India.
2. Thomas A. Runkler, "Data Analytics: Models and Algorithms for Intelligent Data Analysis", 2016, 2nd ed., Springer Verlag, UK
3. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective" 2012, 1st ed., MIT Press, USA


**Web links and Video Lectures (e-Resources):**

- https://youtu.be/CXF3z8xdIeo

**Skill Development Activities Suggested**

- The students with the help of the course teacher can take up relevant technical – activities which will enhance their skill.

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**Course outcome (Course Skill Set)**

| Sl. No. | Description |
|---|---|
| CO1 | Apply FFT, DCT wavelet techniques for extracting the features from the big data. |
| CO2 | Develop algorithms that can be used to analyse the real-world univariate and multivariate time series data. |
| CO3 | Design an approach to leverage data using the steps in the machine learning process. |
| CO4 | Understand and apply both supervised and unsupervised classification methods to detect and characterize patterns in real-world data. |
| CO5 | Estimate the signal parameters and identify the model using ARMA models and prediction filters. |
| CO6 | Understand the methods of visualization and analysis of big data. |

At the end of the course the student will be able to :

**Program Outcome of this course**

| Sl. No. | Description | POs |
|---|---|---|
| 1 | Adequate knowledge of fundamentals on sensors, signal conditioning and IoT | PO1 |
| 2 | Ability to design, implement, analyse, interpret data and synthesis of information | PO2 |
| 3 | Ability to analyse a problem critically using scientific approach, relevant IT tools and techniques | PO3 |
| 4 | Appropriate research skills for solving new problem and present a substantial technical report | PO4 |
| 5 | Ability to work ethically and carry out the work with social responsibility | PO5 |
| 6 | Professional skills to carry out work independently or collaboratively in a multidisciplinary environment | PO6 |

**Mapping of COS and POs**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | × | | | | | |
| **CO2** | × | × | × | | | |
| **CO3** | × | | × | | | |
| **CO4** | × | | × | | | |
| **CO5** | × | | × | | | |
| **CO6** | × | × | | | | × |

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**Professional Elective-2**

| CLOUD APPLICATION DEVELOPMENT WITH JAVA | | | |
|---|---|---|---|
| Course Code | 22ISS241 | CIE Marks | 50 |
| Teaching Hours/Week (L:P:SDA) | 3:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 3 | Exam Hours | 03 |

**Course Learning objectives:** This Course will enable students to

1. Learn Java application using swings.
2. Identify Java language components and how they work together in applications.
3. Explain devices, network structure, and cloud technology that allows IoT devices to communicate with each other.
4. Understand to use REST APIs for web-based applications.

| **Module-1** | |
|---|---|
| **Introduction:** Design Considerations for cloud Applications: Scalability – Reliability & Availability – reference Architecture for Cloud Applications – cloud Application Design Methodologies: Service Oriented Architecture – Cloud Component Model – Services of cloud Applications – Model View Controller – Restful Web Services – Data Storage Approaches: SQL – NOSQL Approaches.<br>(RBT Levels: **L1 & L2)**. | |
| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |

| **Module-2** | |
|---|---|
| **Introduction to OOPS:** OOPS – Procedural vs Object Oriented languages Abstraction –Encapsulation – Polymorphism – Inheritance.<br>**Introduction to JAVA:** JAVA Features– Present JAVA language and - JVM – JVM Architecture - JAVA Datatypes, Variables, Arrays– JAVA Basic Constructs.<br>(RBT Levels: **L1 , L2 & L3)**. | |
| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |

| **Module-3** | |
|---|---|
| **Class Concepts:** Objects – Methods – Revisiting Inheritance – Multilevel – Method Overriding – Abstract Class – Interface – Package-IO.<br>(RBT Levels: **L1 , L2 & L3)**. | |
| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |

| **Module-4** | |
|---|---|
| **Internet of Things:** Introduction – IoT Architecture – Physical Design – Logical Design – IoT Enabling technologies –IoT Levels and Deployment Templates –IoT-Cloud Platform - IoT Protocols: MQTT – WebSocket.<br>**JAVA WebSocket:** WebSocket Lifecycle – Basic Messaging – Advanced Messaging – Securing Web Sockets.<br>(RBT Levels: **L1 & L2)**. | |
| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |

| **Module-5** |
|---|

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**REST API:** REST Style Architecture – http – URI – Request Methods – Status Codes – JAVA JSON Processing – JAX RS API.
**JAVA MQTT:** M2M with JAVA – MQTT Applications with PAHO.
(RBT Levels: **L1 & L2)**.

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |

**Assessment Details (both CIE and SEE)**

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**Continuous Internal Evaluation:**

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Text Books:**


1. Archdeep Bahaga, Vijay Madisetti , "Cloud Computing: A hands-On Approach".
2. Paul Deitel, Harvey Deitel, "How to program with JAVA", 9th Edition , Deitel Publications, 2012.
3. Beginning Java 8 Language Features: Lambda Expressions, Inner Classes, Threads, I/O Collections and Streams.
4. Archdeep Bahaga, Vijay Madisetti, "Internet of Things - A hands on Approach", Universities Press,2015.
5. Danny Coward, "Java WebSocket Programming", McGraw-Hill Education, 2014.
6. Jobinesh Purushothaman, " RESTful Java Web Services", Second Edition, , Packt Publishing, 2015.


**Web links and Video Lectures (e-Resources):**

- https://youtu.be/NzZXz3fJf6o

**Skill Development Activities Suggested**

- The students with the help of the course teacher can take up relevant technical – activities which will enhance their skill.

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**Course outcome (Course Skill Set)**

At the end of the course the student will be able to :

| Sl. No. | Description |
|---|---|
| CO1 | Write Java application using swings. |
| CO2 | Model Relational database to communicate with Java application. |
| CO3 | Show interactive communication with IoT enabled devices. |
| CO4 | Model application as RESTful API and deploy in Cloud Application Platform. |

**Program Outcome of this course**

| Sl. No. | Description | POs |
|---|---|---|
| 1 | Adequate knowledge of fundamentals on sensors, signal conditioning and IoT | PO1 |
| 2 | Ability to design, implement, analyse, interpret data and synthesis of information | PO2 |
| 3 | Ability to analyse a problem critically using scientific approach, relevant IT tools and techniques | PO3 |
| 4 | Appropriate research skills for solving new problem and present a substantial technical report | PO4 |
| 5 | Ability to work ethically and carry out the work with social responsibility | PO5 |
| 6 | Professional skills to carry out work independently or collaboratively in a multidisciplinary environment | PO6 |

**Mapping of COS and POs**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | | | x | x | | |
| **CO2** | | x | x | | | |
| **CO3** | x | | | | x | |
| **CO4** | | x | | | | x |

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| MACHINE LEARNING FOR BIG DATA | | | |
|---|---|---|---|
| Course Code | **22ISS242** | CIE Marks | 50 |
| Teaching Hours/Week (L:P:SDA) | 3:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 3 | Exam Hours | 03 |

**Course Learning objectives:** This Course will enable students to

- Understand the basics of ANN and comparison with Human brain
- Learn about different type of clustering
- Apply Kernels for non-linear function and SVM as a linear separator and classifier
- Understand the basics of deep learning and CNN algorithms
- Understand characteristics, problems & associative learning of reinforcement learning

**Module-1**

**Artificial Neural Networks:** Neurons and biological motivation, Activation functions and threshold units, Supervised and unsupervised learning, Perceptron Model: representational limitation and gradient descent training, Multilayer networks and back propagation, Overfitting.
(RBT Levels: **L1 & L2)**.

| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |
|---|---|

**Module-2**

**Clustering:** Learning from unclassified data, Clustering. Hierarchical Agglomerative Clustering, Non-Hierarchical Clustering - k-means partitional clustering, Expectation maximization (EM) for soft clustering, Semi-supervised learning with EM using labelled and unlabelled data.
(RBT Levels: **L1 & L2)**.

| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |
|---|---|

**Module-3**

**Kernel Methods:** Dual Representations, Design of Kernels .
**Support Vector Machines (SVM):** Maximum margin linear separators, Quadratic programming solution to finding maximum margin separators, Kernels for learning non-linear functions, Varying length pattern classification using SVM.
(RBT Levels: **L1 & L2)**.

| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |
|---|---|

**Module-4**

**Deep Learning:** Introduction to Deep Learning, Introduction to convolutional Neural Network (CNN), CNN Architecture and layers, Building simple CNN model for classification, Training and Testing the CNN model.
(RBT Levels: **L1 & L2)**.

| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |
|---|---|

**Module-5**

**Reinforcement Learning:** Characteristics, N-arm Bandit Problem, Calculating the Value Function, Associative Learning – Adding States, The Markov Property & Markov Decision Process.
(RBT Levels: **L1 & L2)**.

| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |
|---|---|

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**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Text Books:**


1. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, "Foundations of Machine Learning", Second Edition, MIT Press.
2. E. Alpaydin, "Introduction to Machine Learning", MIT Press, 2010.
3. C. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.
4. Satish Kumar, "Neural Networks - A Class Room Approach", Second Edition, Tata McGraw- Hill, 2013.
5. J. Shawe-Taylor and N. Cristianini, "Kernel Methods for Pattern Analysis", Cambridge University Press, 2004.


**Reference Books:**


1. R. Duda, E. Hart, and D. Stork, "Pattern Classification", Wiley Interscience, 2000.
2. T. Hastie, R. Tibshirani and J. Friedman, "The Elements of Statistical Learning: Data Mining", Inference and Prediction, Springer, 2nd Edition, 2009.
3. Jason Bell, "Machine Learning for Big Data", Wiley Big Data Series, 2016.
4. S. Haykin, "Neural Networks and Learning Machines", Prentice Hall of India, 2010.
5. Rama Murthy G, "Multidimensional Neural Networks Unified Theory", New Age International, 2008.
6. F. Camastra and A. Vinciarelli, "Machine Learning for Audio, Image and Video Analysis – Theory and Applications", Springer, 2008.


**Web links and Video Lectures (e-Resources):**

- https://youtu.be/r4sgKrRL2Ys.

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**Skill Development Activities Suggested**

- The students with the help of the course teacher can take up relevant technical – activities which will enhance their skill.

**Course outcome (Course Skill Set)**

At the end of the course the student will be able to :

| Sl. No. | Description |
|---|---|
| CO1 | Describe activation functions, weights and threshold units used in artificial neural networks, supervised and unsupervised learning, gradient descent approach, types of perceptron models, overfitting. |
| CO2 | Explain the concept of hierarchical clustering and non-hierarchical clustering, support vector machine, deep neural networks and reinforcement learning. |
| CO3 | Demonstrate artificial neural network models, clustering models, support vector classifier models, Deep learning models and reinforcement learning models. |
| CO4 | Compare and contrast single layer, multilayer and deep neural networks in terms of accuracy in classification. |
| CO5 | Design back propagation neural network, K-means and agglomerative clustering, deep neural network, reinforcement learning models and selection of a machine learning algorithm for the given data analysis. |

**Program Outcome of this course**

| Sl. No. | Description | POs |
|---|---|---|
| 1 | Adequate knowledge of fundamentals on sensors, signal conditioning and IoT | PO1 |
| 2 | Ability to design, implement, analyse, interpret data and synthesis of information | PO2 |
| 3 | Ability to analyse a problem critically using scientific approach, relevant IT tools and techniques | PO3 |
| 4 | Appropriate research skills for solving new problem and present a substantial technical report | PO4 |
| 5 | Ability to work ethically and carry out the work with social responsibility | PO5 |
| 6 | Professional skills to carry out work independently or collaboratively in a multidisciplinary environment | PO6 |

**Mapping of COS and POs**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | x | | | | | |
| **CO2** | | x | | | | |
| **CO3** | | | x | | | |
| **CO4** | | x | | | | |
| **CO5** | | | x | x | x | x |

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| DATA STRUCTURES AND ALGORITHMS | | | |
|---|---|---|---|
| Course Code | **22ISS243** | CIE Marks | 50 |
| Teaching Hours/Week (L:P:SDA) | 3:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |

**Course Learning objectives:** This Course will enable students to

1. Analyse and estimate the algorithmic complexity of simple, non-recursive programs
2. Understand the fundamental Data Structures and implementation of sorting and searching techniques
3. Understand the operations and implementation of sets, dictionary and hash-table data structure.
4. Understand the terminology and implementation of Trees, binary trees, binary search trees, and graphs, representation and writing programs.
5. Identify problems using algorithm design methods such as the divide and conquer, dynamic programming,, greedy algorithms, backtracking

**Module-1**

**Introduction:** Algorithm Specification, Performance Analysis.
**Algorithm Analysis Techniques:** Analysis of Recursive Programs, Solving Recurrence Equations, General Solution for a large class of Recurrences.
(RBT Levels: **L1 & L2)**.

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |

**Module-2**

**Elementary data structures:** Implementation of Lists, Stacks, Queues
**Sorting & Searching Techniques:** Quick sort, Heap sort, Merge sort, Binary search, linear search, Fibonacci search.
(RBT Levels: **L1 , L2 & L3)**.

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |

**Module-3**

**Operations on Sets:** Introduction to Sets, A Linked- List implementation of Set, The Dictionary, The Hash Table Data Structure.
(RBT Levels: **L1 , L2 & L3)**.

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |

**Module-4**

**Trees:** Basic Terminology, Implementation of Trees, Binary Trees, Binary Search Trees
**Graphs:** Basic definitions, Representation of Graphs, Minimum Cost Spanning Tree, Single Source Shortest Paths, All-Pairs Shortest Path.
(RBT Levels: **L1 , L2 & L3)**.

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |

**Module-5**

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**Algorithm Design Techniques:** Divide-and-Conquer Algorithms, Dynamic Programming, Greedy Algorithms, Backtracking.
(RBT Levels: **L1 , L2 & L3)**.

| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |
|---|---|

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Text Books**


1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, "Introduction to Algorithms", 3rd Edition. The MIT Press.
2. Aho, Hopcroft and Ulmann, "Data Structures& Algorithms".
3. Mark Allen Weiss, "Data structures and algorithm analysis in C" 2nd Edition, Pearson publication.
4. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, "Computer Algorithms", Silicon power press publisher.


**Web links and Video Lectures (e-Resources):**

- https://youtu.be/VhdOEY6B3BU

**Skill Development Activities Suggested**

- The students with the help of the course teacher can take up relevant technical – activities which will enhance their skill.

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**Course outcome (Course Skill Set)**

At the end of the course the student will be able to :

| Sl. No. | Description |
|---|---|
| CO1 | Understand and Analyse the fundamentals of data structure algorithms |
| CO2 | Implement different types of trees and graphs |
| CO3 | Understand and Analyse algorithm design techniques |

**Program Outcome of this course**

| Sl. No. | Description | POs |
|---|---|---|
| 1 | Adequate knowledge of fundamentals on sensors, signal conditioning and IoT | PO1 |
| 2 | Ability to design, implement, analyse, interpret data and synthesis of information | PO2 |
| 3 | Ability to analyse a problem critically using scientific approach, relevant IT tools and techniques | PO3 |
| 4 | Appropriate research skills for solving new problem and present a substantial technical report | PO4 |
| 5 | Ability to work ethically and carry out the work with social responsibility | PO5 |
| 6 | Professional skills to carry out work independently or collaboratively in a multidisciplinary environment | PO6 |

**Mapping of COS and POs**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | **x** | **x** | | | | |
| **CO2** | | **x** | **x** | | | |
| **CO3** | **x** | **x** | | | | |

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| OPERATING SYSTEM FOR IOT | | | |
|---|---|---|---|
| Course Code | **22ISS244** | CIE Marks | 50 |
| Teaching Hours/Week (L:P:SDA) | 3:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |

**Course Learning objectives:** This Course will enable students to

- Understand the fundaments of OS, process creation and multi thread concepts.
- Understand the process-scheduling algorithms and process synchronization concepts on various scenarios
- Understand the process of memory management techniques and Time management handled by operating system.
- Understand the concept of event driven programming on tiny OS and Contiki.

**Module-1**

**Introduction to Operating Systems:** OS vs RTOS, Functions of Operating Systems, Introduction to Kernel, Types of Kernel, User space vs Kernel Space.
**Process Management:** The process concept, synchronization, mutual exclusion, semaphores, and monitors, Threads, Inter-process communication Data Aggregation and Group Operations Case study: Exploratory analysis of public / scrapped datasets.
(RBT Levels: **L1 & L2)**.

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |

**Module-2**

Resource Allocation, Deadlock prevention, avoidance, and detection.
The OS Kernel, Micro and Monolithic kernels, Multi-tasking, privilege, interrupt handling, System and user processes, System calls.
(RBT Levels: **L1 & L2)**.

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |

**Module-3**

**Memory Management :** Description of problems of allocation, protection and sharing, Virtual to Physical memory mapping schemes, Segmented paged virtual memory, Paging control, replacement algorithms, the working set model, Sharing code and data.
(RBT Levels: **L1 & L2)**.

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |

**Module-4**

**Time Management:** Time Management, CPU scheduling algorithms, Real-time scheduling, Disc access scheduling.
(RBT Levels: **L1 & L2)**.

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |

**Module-5**

**Real Time OS:** Real Time OS, OS calls in RTOS, RTx Kernel OS calls – Examples
**Real Time Systems:** Operating systems for IoT, Pre-emption vs Event Driven, Event Driven Programming, Tiny OS vs Contiki.
(RBT Levels: L1 & L2)

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| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |

**Assessment Details (both CIE and SEE)**

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**Continuous Internal Evaluation:**

1 Three Unit Tests each of **20 Marks**

2 Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Text Books**


1. Abraham Silberschatz, Peter Galvin, Grag Gagne, "Operating System principles", Seventh Edition, John Wiley Publications, 2006.
2. Allan Burns, Andy Wellings, "Real – Time Systems and Programming Languages", Fourth Edition, Pearson Education Canada, 2009.
3. Milan Milenkovic, "Operating Stems Concepts and Design", McGraw Hill Higher Education, 1987.
4. Maurice Bach (IPC), "Design of Unix Operating System", Prentice-Hall, Inc., 1986.
5. Kerninghan & Ritchie, "The C Programming Language", Second Edition, Prentice-Hall, 1988.
6. www.freertos.org, "The FreeRTOS Reference Manual", Real Time Engineers Ltd. 2016


**Skill Development Activities Suggested**

- The students with the help of the course teacher can take up relevant technical – activities which will enhance their skill.

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**Course outcome (Course Skill Set)**

At the end of the course the student will be able to :

| Sl. No. | Description |
|---|---|
| CO1 | Illustrate OS fundamentals, process creation, process hierarchies and multi-thread concepts |
| CO2 | Apply process-scheduling algorithms and process synchronization concepts on various scenarios. |
| CO3 | Analyse the memory management techniques handled by operating system. |
| CO4 | Identify the salient features of real time operating systems with programming on RTx. |
| CO5 | Infer the concept of event driven programming on tiny OS and Contiki |

**Program Outcome of this course**

| Sl. No. | Description | POs |
|---|---|---|
| 1 | Adequate knowledge of fundamentals on sensors, signal conditioning and IoT | PO1 |
| 2 | Ability to design, implement, analyse, interpret data and synthesis of information | PO2 |
| 3 | Ability to analyse a problem critically using scientific approach, relevant IT tools and techniques | PO3 |
| 4 | Appropriate research skills for solving new problem and present a substantial technical report | PO4 |
| 5 | Ability to work ethically and carry out the work with social responsibility | PO5 |
| 6 | Professional skills to carry out work independently or collaboratively in a multidisciplinary environment | PO6 |

**Mapping of COS and POs**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | x | x | | | | |
| **CO2** | | x | x | | | |
| **CO3** | x | x | | | | |

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| MOBILE APP DEVELOPMENT WITH ANDROID | | | |
|---|---|---|---|
| Course Code | **22ISS245** | CIE Marks | 50 |
| Teaching Hours/Week (L:P:SDA) | 3:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 3 | Exam Hours | 03 |

**Course Learning objectives:** This Course will enable students to

- Discuss major building blocks of an android application
- Write android applications using various UI components and data handling using SQLiIte
- Discuss advanced topics such as LBS, Mapping, Network connectivity, background threads, adapters

| **Module-1** | |
|---|---|
| **Introduction:** Introduction to Android and Eclipse environment, Android application framework, Unique aspects of mobile application, Why develop for Android, What has and will continue to drive Android adoption. (RBT Levels: **L1 & L2)**. | |
| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |

| **Module-2** | |
|---|---|
| **Android building blocks:** Android manifest file, Dalvik virtual machine, DDMS, ADT, Adb, Android emulator, Activities and intents, creating a project, Android activity lifecycle, starting a new 'Hello World' Android application, Running and Debugging applications. (RBT Levels: **L1 & L2)**. | |
| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |

| **Module-3** | |
|---|---|
| **Android Screen Screen UI Components:** Layouts Linear Layout, Absolute Layout, Table Layout, Relative Layout, Frame Layout, Scroll View, Views: Text View, Edit Text, and Button views, Time Picker and Date Picker views, List View and the Spinner views, Gallery and Image Switcher views, context sensitive menu. (RBT Levels: **L1 & L2)**. | |
| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |

| **Module-4** | |
|---|---|
| **Data management with SQLite:** SQLite architecture, creating and using databases, DBAdapter class, Common SQLite commands, creating triggers, logging insert, delete, update using SQLite, managing persistent data. (RBT Levels: **L1 & L2)**. | |
| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |

| **Module-5** | |
|---|---|
| **Advanced topics:** Adapters, background threads, Notifications, Location based services, Mapping, network connectivity services, telephony services. (RBT Levels: **L1 & L2)**. | |
| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |

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**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module.

**Web links and Video Lectures (e-Resources):**

- https://youtu.be/-foyVzTOf8o.

**Suggested Learning Resources:**

**Text Books**


1. Lauren Darcey and Shane Conder, "Sams Teach Yourself Android Application Development in 24 Hours", Sams Publishing, First Edition, ISBN-10: 0321673352, ISBN-13: 978-0321673350, 2010.
2. Ed Burnette, "Hello, Android: Introducing Google'
3. s Mobile Development Platform", Pragamatic, Third Edition, ISBN-10: 1934356565, ISBN-13: 978-1934356562, 2011.
4. Rick Rogers and John Lombardo, "Android Application Development: Programming", O'Reilly Media, First Edition, ISBN-10: 0596521472 , ISBN-13: 978-0596521479 , 2009.
5. Reto Meier , "Professional Android 2 Application Development (Wrox Programmer to Programmer)", Wrox, Second Edition, ISBN-10: 0470565527, ISBN-13: 978-0470565520, 2010.


**Skill Development Activities Suggested**

- The students with the help of the course teacher can take up relevant technical – activities which will enhance their skill.

**Course outcome (Course Skill Set)**

At the end of the course the student will be able to :

| Sl. No. | Description |
|---|---|
| CO1 | Explain android architecture and framework |
| CO2 | Discuss major building blocks of an android application |
| CO3 | Write android applications using various UI components and data handling using SQLiIte |
| CO4 | Discuss advanced topics such as LBS, Mapping, Network connectivity, background threads, adapters |

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**Program Outcome of this course**

| Sl. No. | Description | POs |
|---|---|---|
| 1 | Adequate knowledge of fundamentals on sensors, signal conditioning and IoT | PO1 |
| 2 | Ability to design, implement, analyse, interpret data and synthesis of information | PO2 |
| 3 | Ability to analyse a problem critically using scientific approach, relevant IT tools and techniques | PO3 |
| 4 | Appropriate research skills for solving new problem and present a substantial technical report | PO4 |
| 5 | Ability to work ethically and carry out the work with social responsibility | PO5 |
| 6 | Professional skills to carry out work independently or collaboratively in a multidisciplinary environment | PO6 |

**Mapping of COS and POs**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | x | | | | | |
| **CO2** | | x | | | | |
| **CO3** | | | x | | | |
| **CO4** | | x | | | | |
| **CO5** | | | x | x | x | x |

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| MACHINE LEARNING LABORATORY | | | |
|---|---|---|---|
| Course Code | 22ISSL26 | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 1:2:0 | SEE Marks | 50 |
| Credits | 02 | Exam Hours | 03 |

**Course objectives:** This Course will enable students to

- Define machine learning and understand the basic theory underlying machine learning.
- Differentiate supervised, unsupervised and reinforcement
- Understand the basic concepts of statistical learning and decision trees.
- Understand Bayesian techniques for problems appear in machine learning
- Perform statistical analysis of machine learning techniques

| Sl. No. | Experiments |
|---|---|
| 1 | Illustrate and Demonstrate the working model and principle of Find-S algorithm. |
| 2 | Demonstrate the working model and principle of candidate elimination algorithm. |
| 3 | To construct the Decision tree using the training data sets under supervised learning concept. |
| 4 | To understand the working principle of Artificial Neural network with feed forward and feed backward principle. |
| 5 | Demonstrate the text classifier using Naïve bayes classifier algorithm. |
| 6 | Demonstrate and Analyse the results sets obtained from Bayesian belief network Principle. |
| 7 | Implement and demonstrate the working model of K-means clustering algorithm with Expectation Maximization Concept |
| 8 | Demonstrate and analyse the results of classification based on KNN Algorithm. Program: Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem. |
| 9 | Understand and analyse the concept of Regression algorithm techniques. |
| 10 | Implement and demonstrate classification algorithm using Support vector machine Algorithm. |

**Course outcomes (Course Skill Set):**

At the end of the course the student will be able to:

1. Understand the concept of Machine Learning and Concept Learning
2. Apply the concept of ML and various classification methods.
3. Apply the ML concept in a decision tree structure and implementation of Ensemble learning and Random Forest.
4. Analyse various training models in ML and the SVM algorithm to be implemented
5. Apply Bayes techniques and explore more about the classification in ML.

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**Assessment Details (both CIE and SEE):**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 40% of maximum marks in the semester-end examination (SEE). In total of CIE and SEE student has to secure 50% maximum marks of the course.

**Continuous Internal Evaluation (CIE):**

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8$^{th}$ week of the semester and the second test shall be conducted after the 14$^{th}$ week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will

**Semester End Evaluation (SEE):**

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University.

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 10% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

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**Program Outcome of this course:**

| Sl. No. | Description | POs |
|---|---|---|
| 1 | Adequate knowledge of fundamentals on sensors, signal conditioning and IoT | PO1 |
| 2 | Ability to design, implement, analyse, interpret data and synthesis of information | PO2 |
| 3 | Ability to analyse a problem critically using scientific approach, relevant IT tools and techniques | PO3 |
| 4 | Appropriate research skills for solving new problem and present a substantial technical report | PO4 |
| 5 | Ability to work ethically and carry out the work with social responsibility | PO5 |
| 6 | Professional skills to carry out work independently or collaboratively in a multidisciplinary environment. | PO6 |

**Mapping of COS and POs:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | × | | | | | |
| **CO2** | × | × | × | | | × |
| **CO3** | × | × | × | | | × |
| **CO4** | × | × | × | | | × |
| **CO5** | × | × | × | | | × |

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| WIRELESS SENSOR NETWORK | | | |
|---|---|---|---|
| Course Code | **22ISS31** | CIE Marks | 50 |
| Teaching Hours/Week (L:P:SDA) | 3:0:2 | SEE Marks | 50 |
| Total Hours of Pedagogy | 50 | Total Marks | 100 |
| Credits | 4 | Exam Hours | 3 |

**Course Learning objectives:** This Course will enable students to

- Understand basic sensor network concepts
- Know physical layer issues, understand and analyze Medium Access Control Protocols
- Comprehend network and transport layer characteristics and protocols and implement conventional protocols
- Understand the network management and Middleware services

**Module-1**

**FUNDAMENTALS OF SENSOR NETWORKS**: Introduction to computer and wireless sensor networks and Overview of the syllabus Motivation for a network of Wireless Sensor nodes- Sensing and sensors- challenges and constraints - node architecture-sensing subsystem, processor subsystem communication interfaces- prototypes, Application of Wireless sensors- Introduction of Tiny OS Programming and TOSSIM Simulator.

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

**Module-2**

**COMMUNICATION CHARACTERISTICS AND DEPLOYMENT MECHANISMS:** Wireless Transmission Technology and systems-Radio Technology Primer- Available Wireless Technologies - Hardware- Telosb, Micaz motes- Time Synchronization, Clock and the Synchronization Problem - Basics of time synchronization-Time synchronization protocols - Localization- Ranging Techniques- Range based Localization-Range Free Localization- Event driven Localization.

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content. |

**Module-3**

**MAC LAYER:** Overview-Wireless Mac Protocols-Characteristics of MAC protocols in Sensor networks – Contention free MAC Protocols- characteristics- Traffic Adaptive Medium Access-Y-MAC, Low energy Adaptive Clustering - Contention based MAC Protocols Power Aware Multi-Access with signaling, Sensor MAC-Timeout MAC-Data gathering MAC- Case study –Implementation and Analysis of MAC player protocol in TinyOS.

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

**Module-4**

**ROUTING IN WIRELESS SENSOR NETWORKS:** Design Issues in WSN routing- Data Dissemination and Gathering-Routing Challenges in WSN - Flooding-Flat Based Routing – SAR, Directed Diffusion, Hierarchical Routing- LEACH, PEGASIS - Query Based Routing- Negotiation Based Routing- Geographical Based Routing- Transport layer- Transport protocol Design issues, Performance of Transport Control Protocols. Case study- Implementation and analysis of Routing protocol or transport layer protocol in Tiny OS.

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

**Module-5**

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| | |
|---|---|
| **MIDDLEWARE AND SECURITY ISSUES:** WSN middleware principles-Middleware architecture-Existing middleware - operating systems for wireless sensor networks-performance and traffic management - Fundamentals of network security-challenges and attacks - Protocols and mechanisms for security. Case study- Handling attacks in Tiny OS. | |
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

**Assessment Details (both CIE and SEE)**

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**Continuous Internal Evaluation:**

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module.

**Suggested Learning Resources:**

**Text Books:**


1. Dargie Waltenegus, Poellabauer Christian (2011): **Fundamentals of Wireless Sensor Networks, Theory and Practice**: Wiley Series on wireless Communication and Mobile Computing.
2. Sohraby Kazem, Manoli Daniel (2010): **Wireless Sensor networks- Technology, Protocols and Applications,** New Jersey: Wiley Inter Science Publications


**Reference books:**


1. Krishnamachari Bhaskar (2005): **Networking Wireless Sensors**, Cambridge: Cambridge University Press.
2. Raghavendra C.S., Sivalingam Krishna M., Taiebznati(2004): **Wireless Sensor Networks**: Springer Science.


**Web links and Video Lectures (e-Resources):**

https://youtu.be/ycaz99NogS4

**Skill Development Activities Suggested**

- The students with the help of the course teacher can take up relevant technical – activities which will enhance their skill.

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**Course outcome (Course Skill Set)**

At the end of the course the student will be able to :

| Sl. No. | Description |
|---|---|
| CO1 | Evaluate the performance of schedule based and random Medium Access Control protocols for power consumption, fairness, channel utilization and control packet overhead. |
| CO2 | Evaluate the performance of Geographic routing protocols for power consumption, scalability and latency parameters. |
| CO3 | Relate the performance of transport control protocols for congestion detection and avoidance, reliability and control packet overhead parameters. |
| CO4 | Understand about the Routing Challenges in WSN |
| CO5 | Classify the security issues in wireless network |
| CO6 | Gain the competency in transferring the conducting and semiconducting fibers to smart textiles |

**Program Outcome of this course**

| Sl. No. | Description | POs |
|---|---|---|
| 1 | Adequate knowledge of fundamentals on sensors, signal conditioning and IoT | PO1 |
| 2 | Ability to design, implement, analyse, interpret data and synthesis of information | PO2 |
| 3 | Ability to analyse a problem critically using scientific approach, relevant IT tools and techniques | PO3 |
| 4 | Appropriate research skills for solving new problem and present a substantial technical report | PO4 |
| 5 | Ability to work ethically and carry out the work with social responsibility | PO5 |
| 6 | Professional skills to carry out work independently or collaboratively in a multidisciplinary environment | PO6 |

**Mapping of COS and POs**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | x | x | | | | |
| **CO2** | x | x | | | | |
| **CO3** | x | x | | | | |
| **CO4** | x | x | | | | |
| **CO5** | x | x | | | | |
| **CO6** | x | x | | | | |

@#15042024

| PRIVACY AND SECURITY IN IOT | | | |
|---|---|---|---|
| Course Code | **22ISS321** | CIE Marks | 50 |
| Teaching Hours/Week (L:P:SDA) | 3:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |

**Course Learning objectives:**

- To know the state-of-the-art methodologies in Cyber Physical system.
- To impart knowledge on Model threats and countermeasures.
- To explore the Privacy Preservation and Trust Models in Internet of Things (IoT).
- To apply the concept of Internet of Things Security in the real world scenarios

**Module-1**

**Introduction to IoT –Cyber Physical Systems:**IoT and cyber-physical systems, IoT security (vulnerabilities, attacks, and countermeasures), security engineering for IoT development, IoT security lifecycle.

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |

**Module-2**

**IoT as Interconnection of Threats :**Network Robustness of Internet of Things- Sybil Attack Detection in Vehicular Networks- Malware Propagation and Control in Internet of Things- Solution-Based Analysis of Attack Vectors on Smart Home Systems.

| | |
|---|---|
| **Teaching-Learning Process** | .<br>Chalk and talk/PPT/case study/web content |

**Module-3**

**Cryptographic Fundamentals**: Encryption and Decryption, Hashes, Digital Signature, Cryptographic module principles, key management fundamentals, IoT communication protocols like blutooth, zigbee, Near field Communication(NFC), IoT Messaging protocols like MQTT, CoAP, DDS, REST.

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |

**Module-4**

**Block Chains :** Block chain basics, blockchain nodes, blockchain P2P network, alticoins, Ethereum wallets and smart contracts, hyperledger.

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |

**Module-5**

**Privacy Preservation for IoT :** Privacy Preservation Data Dissemination- Privacy Preservation Data Dissemination- Social Features for Location Privacy Enhancement in Internet of Vehicles- Lightweight and Robust Schemes for Privacy Protection in Key Personal IoT Applications: Mobile WBSN and Participatory Sensing.

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |

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**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Text Books**


1. Hu Fei. (2016) ; **Security and privacy in Internet of things (IoTs): Models, Algorithms, and Implementations**, 1st edition, CRC Press.
2. Russell, Brian, Van Duren Drew (2016 ) : **Practical Internet of Things Security**, 1st edition, Packt Publishing Ltd.
3. The Blockchain Developer, Elad Elrom, ISBN:13(pbk):978-1-4842-4846-1.


**Reference Books**


1. Whitehouse O. (2014): **Security of things: An implementers' guide to cyber-security for internet of things devices and beyond**, 1st edition, NCC Group.
2. DaCosta, Francis, Henderson Byron (2013): **Rethinking the Internet of Things: a scalable approach to connecting everything**, 1st edition, Springer Nature.


**Web links and Video Lectures (e-Resources):**

- https://youtu.be/4C4P_tzjthc

**Skill Development Activities Suggested**

- The students with the help of the course teacher can take up relevant technical – activities which will enhance their skill.

**Course outcome (Course Skill Set)**

At the end of the course the student will be able to :

| Sl. No. | Description |
|---|---|
| CO1 | Understand the cryptographic fundamentals for IoT |
| CO2 | Demonstrate the Security requirements in IoT. |
| CO3 | Apply the authentication credentials and access control |
| CO4 | Relate the Block Chains for IoT. |
| CO5 | Analyze the security principles and methodologies for Internet of Things |

**Program Outcome of this course**

| Sl. No. | Description | POs |
|---|---|---|
| 1 | Adequate knowledge of fundamentals on sensors, signal conditioning and IoT | PO1 |
| 2 | Ability to design, implement, analyse, interpret data and synthesis of information | PO2 |
| 3 | Ability to analyse a problem critically using scientific approach, relevant IT tools and techniques | PO3 |
| 4 | Appropriate research skills for solving new problem and present a substantial technical report | PO4 |
| 5 | Ability to work ethically and carry out the work with social responsibility | PO5 |
| 6 | Professional skills to carry out work independently or collaboratively in a multidisciplinary environment | PO6 |

**Mapping of COS and POs**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | **x** | **x** | | | | **x** |
| **CO2** | **x** | **x** | | | | **x** |
| **CO3** | **x** | **x** | | | | **x** |
| **CO4** | **x** | **x** | | | | **x** |
| **CO5** | **x** | **x** | | | | **x** |

@#15042024

| DEEP LEARNING-AN APPROACH TO ARTIFICIAL INTELLIGENCE | | | |
|---|---|---|---|
| Course Code | **22ISS322** | CIE Marks | 50 |
| Teaching Hours/Week (L:P:SDA) | 3:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 3 | Exam Hours | 3 |

**Course Learning objectives:** This Course will enable students to

- To introduce the fundamental theory and concepts of machine learning and artificial intelligence
- To provide a comprehensive foundation to artificial neural networks, neuro-modeling, and their applications to pattern recognition.
- To explore the learning paradigms of supervised and unsupervised shallow/deep neural networks.
- To provide exposure to the recent advances in the field of and facilitate in depth discussions on chosen topic
- To impart adequate knowledge on deep learning frameworks and their applications to solving engineering problems

**Module-1**

**Foundations of Machine Learning-I:**Supervised and unsupervised learning, parametric vs non-parametric models, parametric models for classification and regression- Linear Regression, Logistic Regression, Naïve Bayes classifier, simple non-parametric classifier-K-nearest neighbour,support vector machines.

**Foundations of Machine Learning-II:** Clustering- distance based- K-means, density based, association rule mining, validation techniques- cross validations, feature selection and dimensionality reduction, principal component analysis-Eigen values, Eigen vectors, Orthogonality- challenges motivating deep learning

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

**Module-2**

**Neural Networks for Classification and Regression:** ANN as a technique for regression and classification, structure of an artificial neuron, activation functions- linear activation, sigmoid andsoftmax. Feedforward neural networks- shallow model- single layer perceptron,multi-layer perceptron as complex decision classifier-learning XOR-Gradient based learning, Backpropagation algorithm, risk minimization, loss function, regularization, heuristics

for faster training and avoiding local minima..

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content. |

**Module-3**

**Deep Feed Forward Neural Networks:** Feed forward neural networks- deep model- output units and hidden units, training deep models- hyper parameters and validation sets-cross validation, capacity, overfitting and under fitting, bias vs variance trade off, cross validation - vanishing gradient problem, new optimization methods (adagrad, adadelta, rmsprop, adam), regularization methods (dropout, batch normalization, dataset augmentation), early stopping

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

**Module-4**

**XML vs JSON vs YAM:** Introduction and Features, Use of XML, XML document, Creating XML, DTD, Reading XML, Introduction to JSON, JSON Structure, Object Representation, YAML, YAML structure, USE Case

PHP, MYSQL Connection, CRUD Operations, Handling JSON, XML data

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| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

**Module-5**

**BOOTSTRAP, ANGULAR JS, REACT JS, NODEJS.**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs
3. The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.

**Suggested Learning Resources:**

**Text Books:**


1. Thomas A. Powell, Fritz Schneider," JavaScript: The Complete Reference", McGraw-Hill Osborne, Second Edition, 2004.
2. Jamsa Krishna, "Introduction to web development using HTML5", 2014.
3. Danny Goodman, "JavaScript bible", Wiley, Seventh Edition, 2010.
4. Azat Mardan, " Practical Node.js: Building Real-World Scalable Web Apps", Apress Publications, 2014.
5. Krasimir Tsonev, "Node.js by Example", Packt Publications, 2015. .
6. Luke Welling, Laura Thomson, "PHP and MySQL Web Development (Developer's Library)", Addison Wesley Publications, 2008.
7. Ben Laurie, Peter Laurie, "Apache: The Definitive Guide", 3rd Edition, O'Reilly Media,2009


**Web links and Video Lectures (e-Resources):**

**Skill Development Activities Suggested**

- The students with the help of the course teacher can take up relevant technical – activities which will enhance their skill.

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**Course outcome (Course Skill Set)**

At the end of the course the student will be able to :

| Sl. No. | Description |
|---|---|
| CO1 | Prepare a dynamic webpage by the use of java script. |
| CO2 | Summarize a well formed / valid XML document. |
| CO3 | Schedule web application connect to a DBMS to perform insert, update and delete operations |
| CO4 | Practice converting the string and parse using JSON objects. |
| CO5 | Apply Bootstrap, Angular JS, React JS, Node JS to construct modern website. |

**Program Outcome of this course**

| Sl. No. | Description | POs |
|---|---|---|
| 1 | Adequate knowledge of fundamentals on sensors, signal conditioning and IoT | PO1 |
| 2 | Ability to design, implement, analyse, interpret data and synthesis of information | PO2 |
| 3 | Ability to analyse a problem critically using scientific approach, relevant IT tools and techniques | PO3 |
| 4 | Appropriate research skills for solving new problem and present a substantial technical report | PO4 |
| 5 | Ability to work ethically and carry out the work with social responsibility | PO5 |
| 6 | Professional skills to carry out work independently or collaboratively in a multidisciplinary environment | PO6 |

**Mapping of COS and POs**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | x | | | | | x |
| **CO2** | x | | | | | x |
| **CO3** | x | | x | | | x |
| **CO4** | | x | x | | | x |
| **CO5** | | x | x | | | x |

@#15042024

| IOT APPLICATION DEVELOPMENT | | | |
|---|---|---|---|
| Course Code | 22ISS323 | CIE Marks | 50 |
| Teaching Hours/Week (L:P:SDA) | 3:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 3 | Exam Hours | 3 |

**Course Learning objectives:** This Course will enable students to

- Define the developmental aspects of the application in IoT.
- Explain the usage of Linux Operating system for desktop and embedded environment
- Understand the programming skills in scripting languages like shell and python.
- Understand the fundamental concepts in Client Server architecture and database.

**Module-1**

**IoT Application:** Development Cycle of IoT, Software & Hardware, Application Types, IoT Platforms, Cloud Platforms for IoT

**Booting:** Introduction to Linux, Functions of an OS, OS Structure, Linux Structure, Booting of Process, GRUB, GRUB2, UEFI, Booting with Embedded boards, Embedded Boot Loaders, Toolchain, Cross Compilation of the Kernel .

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

**Module-2**

**Embedded Linux:** Introduction to Embedded Linux, Boot Loaders: U-Boot, Compiling U-Boot, U-boot Source Code, Kernel Compilation, Types of Linux Kernel, Monolithic vs Microkernel, Makefile Concepts

**Linux Commands - File Commands:** Viewing & Creating, Properties, Location, Manipulation, Compression, Disk & File Systems, Process -Scheduling, Networking

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content. |

**Module-3**

. **Shell Scripting:** Introduction, Constructs, File and Directory Reading, Scripting for real time applications, Document Here – Make Concepts, sed, grep, awk, Regular Expressions

**Python Scripting:** Introduction to Python, Python Datatypes, Constructs, Sockets, Python Socket Programming, Python Database Connectivity, MQTT Application

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

**Module-4**

**Sockets:** Introduction to Sockets, Client Server Architecture, Unix Sockets, PORTS, Python APIs of Sockets, TCP socket programming using Python, UDP – RAW packets python programming

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

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| Module-5 | |
|---|---|
| **Databases & Web Programming:** Introduction to Databases, File System vs RDBMS, ER Diagram, Python Database connectivity (CRUD), Web Server Concepts, Python Web Programming, IoT Framework .<br><br>**IoT Applications with Cloud:** Case Study | |
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs
3. The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module.

**Suggested Learning Resources:**

**Text Books:**


1. Arshdeep Bhaga, Vijay Madishetti, "**Internet of things: A hands on Approach**", Universities Press, ISBN:978172719547, 2015.
2. "**Beginning Linux Programming**", Wrox, 3rd edition, 2004.
3. Yaswant Kannetkar, "**Unix Shell Scripting**", BPB Publications, 2003.
4. Brandon Rhodes and John Goerzen, "**Foundations of Python Network Programming**", 2nd Edition, Apress, 2010.
5. Pankaj Tanwar, "**Socket Programming Article Series**", 2011.


**Skill Development Activities Suggested**

- The students with the help of the course teacher can take up relevant technical – activities which will enhance their skill.

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**Course outcome (Course Skill Set)**

At the end of the course the student will be able to :

| Sl. No. | Description |
|---|---|
| CO1 | Describe the developmental aspects of the application in IoT. |
| CO2 | Demonstrate the usage of Linux Operating system for desktop and embedded environment. |
| CO3 | Demonstrate the programming skills in scripting languages like shell and python. |
| CO4 | Demonstrate the fundamental concepts in Client Server architecture and database. |

**Program Outcome of this course**

| Sl. No. | Description | POs |
|---|---|---|
| 1 | Adequate knowledge of fundamentals on sensors, signal conditioning and IoT | PO1 |
| 2 | Ability to design, implement, analyse, interpret data and synthesis of information | PO2 |
| 3 | Ability to analyse a problem critically using scientific approach, relevant IT tools and techniques | PO3 |
| 4 | Appropriate research skills for solving new problem and present a substantial technical report | PO4 |
| 5 | Ability to work ethically and carry out the work with social responsibility | PO5 |
| 6 | Professional skills to carry out work independently or collaboratively in a multidisciplinary environment | PO6 |

**Mapping of COS and POs**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | **x** | | | | | |
| **CO2** | | x | | | | x |
| **CO3** | | | x | | | |
| **CO4** | | | x | | | x |

@#15042024

| DEVICE DRIVERS | | | |
|---|---|---|---|
| Course Code | **22ISS324** | CIE Marks | 50 |
| Teaching Hours/Week (L:P:SDA) | 3:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 3 | Exam Hours | 3 |

**Course Learning objectives:** This Course will enable students to

- Understand device drivers and its building blocks
- Know driver character and various debugging techniques
- Understand to fully featured character device drivers operation
- Describe how timing issues and other tasks are addressed
- Describe how different drivers communicates with the specific devices

| **MODULE-1** | |
|---|---|
| Introduction to Device Drivers, Building & Running Modules. | |
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

| **MODULE-2** | |
|---|---|
| Character Driver, Debugging Techniques | |
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content. |

| **MODULE-3** | |
|---|---|
| Concurrency and Race Condition , Advanced Character Driver Operations | |
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

| **MODULE-4** | |
|---|---|
| Time, Delay and Deferred Work , Allocating Memory | |
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

| **MODULE-5** | |
|---|---|
| Communicating with Hardware , Interrupt Handling , PCI Drivers, USB Drivers | |
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

@#15042024

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs
3. The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.

**Suggested Learning Resources:**

**Text Books:**


1. Alessandro Rubini, "Linux Device Drivers", (Nutshell Handbook), O'Reilly Publishers, 2009.
2. John Madieu, "Linux Device Drivers Development: Develop customized drivers for embedded Linux", Packt Publishing, 2017.
3. Robert Love, "Linux Kernel Development", Addison Wesley, Third Edition, 2010.
4. Daniel P. Bovet, Marco Cesati, "Understanding the Linux Kernel", O'Reilly Media, Third Edition, 2008.
5. Wolfgang Mauerer, "Professional Linux Kernel Architecture", Wrox, 2008.
6. Sreekrishnan Venkateswaran, "Essential Linux Device Drivers", Prentice Hall, 2008.
7. W. Richard Stevens, Stephen A. Rago, "Advanced Programming in the UNIX Environment", Addison Wesley, Third Edition, 2013.


**Skill Development Activities Suggested**

- The students with the help of the course teacher can take up relevant technical – activities which will enhance their skill.

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**Course outcome (Course Skill Set)**

**At the end of the course the student will be able to :**

| Sl. No. | Description |
|---|---|
| CO1 | Explain the broad concept of device drivers and build character drivers |
| CO2 | Describe design of kernel modules and debugging these modules |
| CO3 | Handle concurrency, race condition and understand the importance of time while designing a device driver |
| CO4 | Allocate dynamic memory and communicating with devices though I/O ports |
| CO5 | Demonstrate and design USB drivers on a kit |

**Program Outcome of this course**

| Sl. No. | Description | POs |
|---|---|---|
| 1 | Adequate knowledge of fundamentals on sensors, signal conditioning and IoT | PO1 |
| 2 | Ability to design, implement, analyse, interpret data and synthesis of information | PO2 |
| 3 | Ability to analyse a problem critically using scientific approach, relevant IT tools and techniques | PO3 |
| 4 | Appropriate research skills for solving new problem and present a substantial technical report | PO4 |
| 5 | Ability to work ethically and carry out the work with social responsibility | PO5 |
| 6 | Professional skills to carry out work independently or collaboratively in a multidisciplinary environment | PO6 |

**Mapping of COS and POs**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | **x** | **x** | | | | **x** |
| **CO2** | **x** | **x** | | | | **x** |
| **CO3** | **x** | **x** | | | | **x** |
| **CO4** | **x** | | | | | **x** |
| **CO5** | **x** | | | | | **x** |

@#15042024

| MICROCONTROLLERS FOR IOT PROTOTYPING | | | |
|---|---|---|---|
| Course Code | **22ISS325** | CIE Marks | 50 |
| Teaching Hours/Week (L:P:SDA) | 3:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 3 | Exam Hours | 3 |

**Course Learning objectives:** This Course will enable students to

- Introduce low power microcontrollers and to develop the skill set of programming low power sensing applications.
- Impart the knowledge of various peripheral related to sensing and communication using wired or wireless means.
- Upgrade the students by introducing them Advanced ARM Cortex microcontrollers
- Develop the skill set of students to build IoT systems and sensor interfacing.

**Module-1**

**MSP430 microcontrollers**: Architecture of the MSP430, Memory, Addressing modes, Reflections on the CPU instruction set. Clock system, Exceptions: Interrupts and resets. Functions and subroutines, Mixing C and assembly language, Interrupts, Interrupt service routines, Issues associated with interrupts, Low- power modes of operation.

| | |
|---|---|
| power modes of operation. | Chalk and talk/PPT/NPTEL Videos/ web content |

**Module-2**

**ARM Cortex MX microcontroller:** ARM Cortex M4: Assembly language basics, Thumb-2 Technology, ARM Instruction set, Cortex M4 architecture, advantages, peripherals, instruction set, floating point operations, Advanced Cortex MX Microcontroller, core, architecture, on-chip wi-fi.

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content. |

**Module-3**

**Display and Communication modules:** GPIO, LCD display, graphical display, relays, Peripheral programming SPI, I2C, UART, Zigbee controller.

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

**Module-4**

**Sensors interfacing:** Sensors interfacing techniques- Port Programming, ADC, SPI thermometer, I2C thermometer, PWM generation and demodulation, DTH11, single wire thermometer, Frequency counters.

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

**Module-5**

**Microcontrollers for IoT:** ESP8266,NodeMCU,TI-CC3200, Access point and station point mode, HTTP, MQTT, transmission and receiving, Intel-Gallileo boards.

**Low power wireless transmission using Zigbee :**

Sub Task 1: Interfacing Zigbee controller with MSP 430 microcontroller using SPI/UART.

Sub Task 2: Programming sleep and wake up mode of MSP 430.

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

@#15042024

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

4. Three Unit Tests each of **20 Marks**
5. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs
6. The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module.

**Suggested Learning Resources:**

**Text Books:**


1. John H. Davies, "MSP430 Microcontroller Basics", 2011, 2nd ed., Newnes publishing, New York.
2. Jacob Fraden, "Hand Book of Modern Sensors: physics, Designs and Applications", 2014, 4th ed., Springer, New York.
3. Jonathan W Valvano, "Introduction to ARM Cortex –M3 Microcontrollers", 2012, 5th ed., Create Space publishing, New York.
4. Muhammad Ali Mazidi, Shujen Chen, SarmadNaimi, SepehrNaimi, "TI ARM Peripherals Programming and Interfacing: Using C Language", 2015, 2nd ed., Mazidi and Naimi publishing, New York.


**Web links and Video Lectures (e-Resources):**

**Skill Development Activities Suggested**

- The students with the help of the course teacher can take up relevant technical – activities which will enhance their skill.

**Course outcome (Course Skill Set)**

At the end of the course the student will be able to :

| Sl. No. | Description |
|---|---|
| CO1 | Design and develop embedded programs for low power microcontrollers for sensor applications. |
| CO2 | Develop ARM basic and advanced programs |
| CO3 | Interface and deploy analog and digital sensors |
| CO4 | Develop communication system with sensor units |
| CO5 | Program the single board computers to read sensor data and posting in cloud. |

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**Program Outcome of this course**

| Sl. No. | Description | POs |
|---|---|---|
| 1 | Adequate knowledge of fundamentals on sensors, signal conditioning and IoT | PO1 |
| 2 | Ability to design, implement, analyse, interpret data and synthesis of information | PO2 |
| 3 | Ability to analyse a problem critically using scientific approach, relevant IT tools and techniques | PO3 |
| 4 | Appropriate research skills for solving new problem and present a substantial technical report | PO4 |
| 5 | Ability to work ethically and carry out the work with social responsibility | PO5 |
| 6 | Professional skills to carry out work independently or collaboratively in a multidisciplinary environment | PO6 |

**Mapping of COS and POs**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | | | | | | |
| **CO2** | | | | | | |
| **CO3** | | | | | | |
| **CO4** | | | | | | |
| **CO5** | | | | | | |

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| WEARABLE COMPUTING | | | |
|---|---|---|---|
| Course Code | **22ISS331** | CIE Marks | 50 |
| Teaching Hours/Week (L:P:SDA) | 3:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |

**Course Learning objectives:** This Course will enable students tox

- Understand advanced and emerging technologies in wearable computing
- Obtain skills to do advanced research and programming.
- Learn how to use software programs to perform varying and complex tasks.
- Expand upon the knowledge learned and apply it to solve real world problems.

**Module-1**

**Body Sensor Networks-**Introduction, Typical m-Health System Architecture, Hardware Architecture of a Sensor Node, Communication Medium, Power Consumption Considerations, Communication Standards, Network Topologies, Commercial Sensor Node Platforms, Biophysiological Signals and Sensors, BSN Application Domains

**BSN Programming Frameworks-**Introduction, Developing BSN Applications, Programming Abstractions, Requirements for BSN Frameworks, BSN Programming Frameworks, Signal Processing In-Node Environment-Introduction, Background, Motivations and Challenges, The SPINE Framework.

(Text Book: 1) (RBT Levels: **L1 & L2)**.

| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |
|---|---|

**Module-2**

**Task-Oriented Programming in BSDs-**Introduction, Motivations and Challenges, SPINE2 Overview, Task-Oriented Programming in SPINE2, SPINE2 Node-Side Middleware, SPINE2 Coordinator, SPINE2 Communication Protocol, Developing Application in SPINE

**Autonomic Body Sensor Networks-**Introduction, Motivations and Challenges, State-of-the-Art, SPINE: Task-Based Autonomic Architecture, Autonomic Physical Activity Recognition

**Agent-Oriented Body Sensor Networks-**Introduction, Agent-Oriented Computing and Wireless Sensor Networks, Mobile Agent Platform for Sun SPOT (MAPS), Motivations and Challenges, State-of-the-Art: Description and Comparison, Agent-Based Modellingand Implementation of BSNs, Engineering Agent-Based BSN Applications: A Case Study.

(Text Book: 1) (RBT Levels: **L1 & L2)**.

| **Teaching-Learning Process** | .<br>Chalk and talk/PPT/case study/web content |
|---|---|

**Module-3**

**Collaborative Body Sensor Networks-**Introduction, Motivations and Challenges, State-of-the-Art, Reference Architecture for Collaborative BSNs, C-SPINE: CBSN Architecture

**Integration of Body Sensor Networks and Building Networks-**Introduction, Building Sensor Networks and Systems, Building Management Framework, Motivations and Challenges, Integration Layers. State-of-the-Art: Description and Comparison, An Agent-Oriented Integration Gateway, Application Scenarios

**Integration of Wearable and Cloud Computing-**Introduction, Cloud Computing, Architectures for Sensor Stream Management, Motivations and Challenges, Reference Architecture for Cloud-Assisted BSNs, State-of-the-Art: Description and Comparison, Body Cloud: A Cloud-based Platform for Community BSN Applications, Engineering Body Cloud Applications

(Text Book: 1) (RBT Levels: **L1 & L2)**.

| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |
|---|---|

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| Module-4 | |
|---|---|
| **Development Methodology for BSN Systems-**Introduction, Motivations and Challenges, SPINE-Based Design Methodology<br>**SPINE-Based Body Sensor Network Applications-**Introduction, Physical Activity Recognition, Step Counter, Emotion Recognition, Handshake Detection, Physical Rehabilitation .<br>(Text Book: 1) (RBT Levels: **L1 & L2)**. | |
| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |
| **Module-5** | |
| **Signal Processing In-Node Environment-**Introduction, Background, Motivations and Challenges, SPINE Framework- Architecture, Programming Perspective, Optional SPINE Modules, High-Level Data Processing, Multiplatform Support.<br>**SPINE at Work-**Introduction, SPINE 1.x- How to Install SPINE 1.x, How to Use SPINE, How to Run a Simple Desktop Application using SPINE 1.3, SPINE Logging Capabilities, SPINE2- How to Install SPINE2, How to Use SPINE2, how to run a Simple Application using SPINE2.<br>(Text Book: 1) (RBT Levels: **L1 & L2)**. | |
| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs
3. The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.

1. The question paper will have ten full questions carrying equal marks.
2. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
3. Each full question will have a sub-question covering all the topics under a module.
4. The students will have to answer five full questions, selecting one full question from each module

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**Suggested Learning Resources:**

**Text Books**

1. Wearable Computing: From Modeling to Implementation of Wearable Systems Based on Body Sensor Networks, Giancarlo Fortino, Raffaele Gravina, Stefano Galzarano, Wiley, IEEE Press, 2018.

**Reference Books**

1. Fundamentals of Wearable Computers and Augmented Reality, Second Edition by Woodrow Barfield 2015
2. Making Sense of Sensors: End-to-End Algorithms and Infrastructure Design by OmeshTickoo, Ravi Iyer 2016.
3. Barfield, Woodrow, ed. Fundamentals of wearable computers and augmented reality, 1st edition, CRC press, 2015.

**Web links and Video Lectures (e-Resources):**

- Wearable Computing – CodeReality.net

**Skill Development Activities Suggested**

- The students with the help of the course teacher can take up relevant technical – activities which will enhance their skill.

**Course outcome (Course Skill Set)**

At the end of the course the student will be able to :

| Sl. No. | Description |
|---|---|
| CO1 | Develop Android and Wear applications for Android phone and wearable device, including handling and making device data ready for Google Fi. |
| CO2 | Explore software, hardware tools, I/O communication protocols and components required for Wearable Computing. |
| CO3 | Explore innovations with Wearable's. |
| CO4 | Learn about the requirements to design Frameworks for Wearable Computing. |
| CO5 | Explore regulatory systems—their structures, constraints, and possibilities. |

**Program Outcome of this course**

| Sl. No. | Description | POs |
|---|---|---|
| 1 | Adequate knowledge of fundamentals on sensors, signal conditioning and IoT | PO1 |
| 2 | Ability to design, implement, analyse, interpret data and synthesis of information | PO2 |
| 3 | Ability to analyse a problem critically using scientific approach, relevant IT tools and techniques | PO3 |
| 4 | Appropriate research skills for solving new problem and present a substantial technical report | PO4 |
| 5 | Ability to work ethically and carry out the work with social responsibility | PO5 |
| 6 | Professional skills to carry out work independently or collaboratively in a multidisciplinary environment | PO6 |

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**Mapping of COS and POs**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | x | x | x | x | x | x |
| **CO2** | x | x | x | x | x | x |
| **CO3** | x | x | x | x | x | x |
| **CO4** | x | x | x | x | x | x |
| **CO5** | x | x | | | | x |

@#15042024

| AUTOMOTIVE SENSOR AND IN VEHICLE NETWORKING | | | |
|---|---|---|---|
| Course Code | 22ISS332 | CIE Marks | 50 |
| Teaching Hours/Week (L:P:SDA) | 3:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 3 | Exam Hours | 3 |

**Course Learning objectives:** This Course will enable students to

- Learn basics of Electronics Systems in Automotive engineering .
- Understand the different sensors in Automotive Applications.
- Understand the different Automotive Networking protocols.
- Apply different control systems in Automotive vehicles.
- Understand the various alternate Engines and advances in Automotive Electronic Systems

**Module-1**

**Introduction to Automotive engineering:** Evolution of automotive electronics, Automobile physical configuration, Survey of major automotive systems .

**Electrical and electronic systems in the vehicle:** Overview, Electronic diesel control (EDC), Adaptive cruise control (ACC), Occupant protection system.

**Architecture of electronic systems**: Overview, Vehicle system architecture

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

**Module-2**

Automotive Sensors : Basics and overview, automotive applications, sensor classification.

Sensor types: Engine speed sensors, wheel speed sensors, Temperature sensors, Accelerator-pedal sensors, Steering-angle sensors, Axel sensors, Piezoelectric knock sensors, Piezoelectric acceleration sensors, Torque sensors, Rain/light sensors, Two step lambda oxygen sensors,LSU4 planer wide band lambda oxygen sensor.

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content. |

**Module-3**

**Automotive Networking:** Bus systems - Classification, Applications in the vehicle, coupling of networks, Examples of networked vehicles.
**Buses** - CAN Bus, UN Bus, MOST Bus, Bluetooth, FLEXRAY, Diagnostic Interfaces.

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

**Module-4**

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**Vehicle Motion Control :** Typical Cruise Control System, Digital Cruise Control System, Digital Speed Sensor, Throttle Actuator, Digital Cruise Control configuration, Cruise Control Electronics (Digital only), Antilock Brake System (ABS)

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

**Module-5**

**Automotive Diagnostics:** Timing Light, Engine Analyzer, On-board diagnostics, Off-board diagnostics, Expert Systems, Occupant Protection Systems -Accelerometer based Air Bag systems. (Text 1)

**Future Automotive Electronic Systems:** Alternative Fuel Engines, Electric and Hybrid vehicles, Fuel cell powered cars, Collision Avoidance Radar warning Systems, Low tire pressure warning system, Heads Up display, Speech Synthesis, Navigation - Navigation Sensors - Radio Navigation, Signpost navigation, dead reckoning navigation, Voice Recognition Cell Phone dialling, Advanced Cruise Control, Stability Augmentation, Automatic driving Control

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

**Assessment Details (both CIE and SEE)**

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**Continuous Internal Evaluation:**

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs
3. The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module.

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**Suggested Learning Resources:**

**Text Books:**

William B. Ribbens, "Understanding Automotive Electronics", 6th Edition, Elsevier Publishing.
Robert Bosch GmbH (Ed.) Bosch Automotive Electrics and Automotive Electronics Systems and Components, Networking and Hybrid Drive, 5th edition, John Wiley & Sons Inc., 2007.

**Skill Development Activities Suggested**

- The students with the help of the course teacher can take up relevant technical – activities which will enhance their skill.

**Course outcome (Course Skill Set)**

At the end of the course the student will be able to :

| Sl. No. | Description |
|---|---|
| CO1 | Understand basics of Electronics Systems in Automotive engineering. |
| CO2 | Use of the different sensors in Automotive Applications. |
| CO3 | Analyze the different Automotive Networking protocols. |
| CO4 | Understand different control systems in Automotive vehicles. |
| CO5 | Describe the various alternate Engines and advances in Automotive Electronic Systems |

**Program Outcome of this course**

| Sl. No. | Description | POs |
|---|---|---|
| 1 | Adequate knowledge of fundamentals on sensors, signal conditioning and IoT | PO1 |
| 2 | Ability to design, implement, analyse, interpret data and synthesis of information | PO2 |
| 3 | Ability to analyse a problem critically using scientific approach, relevant IT tools and techniques | PO3 |
| 4 | Appropriate research skills for solving new problem and present a substantial technical report | PO4 |
| 5 | Ability to work ethically and carry out the work with social responsibility | PO5 |
| 6 | Professional skills to carry out work independently or collaboratively in a multidisciplinary environment | PO6 |

**Mapping of COS and POs**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | x | | | | | x |
| **CO2** | x | | | | | x |
| **CO3** | x | x | | | | x |
| **CO4** | x | x | | | | x |
| **CO5** | x | | | | | x |

@#15042024

| RESPONSIVE WEB APPLICATION DEVELOPMENT | | | |
|---|---|---|---|
| Course Code | **22ISS333** | CIE Marks | 50 |
| Teaching Hours/Week (L:P:SDA) | 3:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 3 | Exam Hours | 3 |

**Course Learning objectives:** This Course will enable students to

- Understand client server model, various types of servers and HTML
- Familiarize with Cascading style sheets
- Understand JavaScript which is a scripting language that enables you to create dynamically updating content, control multimedia, animate images, and pretty much everything else.
- Acquaint with text-file formats that can be used to store structured data that can be handy for embedded and Web applications
- Recognize the tools for JavaScript web applications worldwide that are helpful in the software product development world.

**Module-1**

**Introduction to Internet and Web Technology:** Client Server Model, Tier Architecture, Types of Servers, Web Hosting, Responsive Design.

**HTML:** Basic tags of HTML, Common Tags, Formatting Tags, Images and Linking, List and Table Structure, Forms, and control: Text, Radio, Checkbox, Select, Button, Input, HTML5: HTML Graphics, HTML Media, HTML API .

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

**Module-2**

**CSS3:** Inline styles, internal style sheets, linking external style sheets, positioning elements, backgrounds, element dimensions, Box Model and text flow, Media Types, Building a CSS drop-down menu

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content. |

**Module-3**

**JavaScript:** Elements of Java Script -Variables, Data Types, Operators, Control Statements, Functions, Dialog - obtaining user input with prompt dialogs, Document Object Model(DOM) - Document, Form, Event Handling, JQUERY, AJAX

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

**Module-4**

**XML vs JSON vs YAML:** Introduction and Features, Use of XML, XML document, Creating XML, DTD, Reading XML, Introduction to JSON, JSON Structure, Object Representation, YAML, YAML structure, USE Case

PHP, MYSQL Connection, CRUD Operations, Handling JSON, XML data

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

**Module-5**

**BOOTSTRAP, ANGULAR JS, REACT JS, NODEJS.**

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| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

**Assessment Details (both CIE and SEE)**

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**Continuous Internal Evaluation:**

7. Three Unit Tests each of **20 Marks**
8. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs
9. The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

6. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
7. The question paper will have ten full questions carrying equal marks.
8. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
9. Each full question will have a sub-question covering all the topics under a module.
10. The students will have to answer five full questions, selecting one full question from each module.

**Suggested Learning Resources:**

**Text Books:**


8. Thomas A. Powell, Fritz Schneider," JavaScript: The Complete Reference", McGraw-Hill Osborne, Second Edition, 2004.
9. Jamsa Krishna, "Introduction to web development using HTML5", 2014.
10. Danny Goodman, "JavaScript bible", Wiley, Seventh Edition, 2010.
11. Azat Mardan, " Practical Node.js: Building Real-World Scalable Web Apps", Apress Publications, 2014.
12. Krasimir Tsonev, "Node.js by Example", Packt Publications, 2015. .
13. Luke Welling, Laura Thomson, "PHP and MySQL Web Development (Developer's Library)", Addison Wesley Publications, 2008.
14. Ben Laurie, Peter Laurie, "Apache: The Definitive Guide", 3rd Edition, O'Reilly Media,2009


**Skill Development Activities Suggested**

- The students with the help of the course teacher can take up relevant technical – activities which will enhance their skill.

**Course outcome (Course Skill Set)**

At the end of the course the student will be able to :

| Sl. No. | Description |
|---|---|
| CO1 | Prepare a dynamic webpage by the use of java script. |
| CO2 | Summarize a well formed / valid XML document. |
| CO3 | Schedule web application connect to a DBMS to perform insert, update and delete operations |
| CO4 | Practice converting the string and parse using JSON objects. |
| CO5 | Apply Bootstrap, Angular JS, React JS, Node JS to construct modern website. |

**Program Outcome of this course**

| Sl. No. | Description | POs |
|---|---|---|
| 1 | Adequate knowledge of fundamentals on sensors, signal conditioning and IoT | PO1 |
| 2 | Ability to design, implement, analyse, interpret data and synthesis of information | PO2 |
| 3 | Ability to analyse a problem critically using scientific approach, relevant IT tools and techniques | PO3 |
| 4 | Appropriate research skills for solving new problem and present a substantial technical report | PO4 |
| 5 | Ability to work ethically and carry out the work with social responsibility | PO5 |
| 6 | Professional skills to carry out work independently or collaboratively in a multidisciplinary environment | PO6 |

**Mapping of COS and POs**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | × | | × | | | |
| **CO2** | × | | | × | | |
| **CO3** | × | × | | | × | × |
| **CO4** | × | | | | × | |
| **CO5** | × | | | | | × |

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| AZURE IOT DEVELOPMENT | | | |
|---|---|---|---|
| Course Code | **22ISS334** | CIE Marks | 50 |
| Teaching Hours/Week (L:P:SDA) | 3:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 3 | Exam Hours | 03 |

**Course Learning objectives:**

- Understanding Azure IoT Platform, Learning different Device Management operaations, commands
- Learning Azure IoT Communication protocols, best practices to secure Azure IoT Hub and Pre-Configured solutions analytics.
- Connect and implementing Azure IotT using real devices.

**Module-1**

**Azure IoT platform:**
Introduction, creating Azure IoT Hub from the portal, Command Prompt, PowerShell, Understanding the Azure IoT Suite, using Azure ioT SDK, Calculating the pricing of IoT Hub.
**Introducing Device Management:** Introduction, Device registry operations, Device twins, Device direct methods, Device jobs, IoT Hub query explorer

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |

**Module-2**

**IoT Hub Messaging and Commands:**
Introduction, Messaging device-to-cloud, Processing device-to-cloud messaging ,Messaging-commands and control, File uploads with IoT Hub, Device firmware updates.
**Azure IoT Communication Protocols:**
Introduction, HTTPs, AMQP, Using AMQP library to communicate with IoT Hub, MQTT, IoT Protocol gateway, Using MQTT .NET library to communicate with IoT Hub, Connecting IoT Hub using MQTT client tools, How to choose between protocols.

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |

**Module-3**

**Azure IoT Hub Security and Best Practices:**
Introduction, Securing a device with IoT Hub, securing a communication, IP filtering with IoT Hub,IoT Hub access rights, Security based practices.
**IoT Suite and Pre-Configured Solutions:**
Introduction, Creating a Pre-Configured solution, IoT Suite remote monitoring, IoT Suite predictive maintenance, IoT Suite connected factory, Customize an IoT Suite

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |

**Module-4**

**Azure IoT Analytics:**
Introduction, Connecting IoT Hub with Stream Analytics, Real-time dashboard reports for IoT data using Power BI, Azure Time Series Insights, IoT Edge analytics using a simulator, Real-time alerts with Azure functions.

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| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |

**Module-5**

**Using Real Devices to Connect and Implement Azure IoT Hub;**

Install windows IoT Core on Raspberry PI, Connect and configure IoT core on Raspberry PI, Demo-Smart parking, temperature and humidity, Using an online Raspberry PI simulator.

**Managing the Azure IoT Hub:** Introduction, Device explorer for the Azure IoT Hub, using the IoT Hub Command-line tool, IoT Hub operation monitoring, The diagnostic metrics of the Azure IoT Hub, Scaling your IoT Hub solution.

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/case study/web content |

**Assessment Details (both CIE and SEE)**

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**Continuous Internal Evaluation:**

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Books**

**Text Books**


1. Yatish Patil, "Azure IoT Development Cookbook Develop and manage robust IoT solutions, Packt publication
2. Kamil Mrzyglod,"Hands-On Azure for Developers: Implement rich Azure PaaS ecosystems using containers, serverless services, and storage solutions, Packt publication.


**Web links and Video Lectures (e-Resources):**

https://www.digimat.in › nptel › courses › video

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**Skill Development Activities Suggested**

- The students with the help of the course teacher can take up relevant technical – activities which will enhance their skill.

**Course outcome (Course Skill Set)**

At the end of the course the student will be able to :

| Sl. No. | Description |
|---|---|
| CO1 | Understand the usage of Azure IoT Platform and different Device Management operations |
| CO2 | Understand the different IoT Hub messaging commands and IoT Communication Protocols |
| CO3 | Understand the Azure IoT Hub Security,best practices,IoT Suite and Pre-Configured Solutions |
| CO4 | Understand the Azure Iot Analytics |
| CO5 | Able to connect and Implement Azure Iot and to managing the Azure IoT Hub |

**Program Outcome of this course**

| Sl. No. | Description | POs |
|---|---|---|
| 1 | Adequate knowledge of fundamentals on sensors, signal conditioning and IoT | PO1 |
| 2 | Ability to design, implement, analyse, interpret data and synthesis of information | PO2 |
| 3 | Ability to analyse a problem critically using scientific approach, relevant IT tools and techniques | PO3 |
| 4 | Appropriate research skills for solving new problem and present a substantial technical report | PO4 |
| 5 | Ability to work ethically and carry out the work with social responsibility | PO5 |
| 6 | Professional skills to carry out work independently or collaboratively in a multidisciplinary environment. | PO6 |

**Mapping of COS and POs**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | × | × | | | | |
| **CO2** | × | × | × | | | |
| **CO3** | × | × | × | | | |
| **CO4** | × | × | × | | | |
| **CO5** | × | × | × | | | |

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| BIG DATA AND DATA VISUALIZATION | | | |
|---|---|---|---|
| Course Code | 22ISS335 | CIE Marks | 50 |
| Teaching Hours/Week (L:P:SDA) | 3:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |

**Course Learning objectives:**

- Study the architecture of distributed systems and Statistical techniques to analyse the Big data
- Learn the different Databases and machine learning models for Big Data.
- Explain the Issues in Stream Processing and Phases in Streaming Analytics.
- Describe Security and privacy in Big Data.
- Understand Data Visualization and Characterization.

**Module-1**

**Introduction to Big Data**: Terminology – Challenges - Architectures – Distributed File Systems – Google File System – Hadoop File Systems - Hadoop Ecosystems

**Statistics**: Sampling Techniques - Data classification, Tabulation, Frequency and Graphic representation - Measures of central value - Arithmetic mean, Geometric mean, Harmonic mean, Mode, Median, Quartiles, Deciles, Percentile - Measures of variation – Range, IQR, Quartile deviation, Mean deviation, standard deviation, coefficient variance, skewness, Moments & Kurtosis.

(Text Book:1 ) (RBT Levels: **L1 & L2 )**.

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

**Module-2**

**Databases for Big Data**: Data science process – roles, stages in data science project – working with data from files – working with relational databases – exploring data – managing data – cleaning and sampling for modeling and validation – Big Table vs HBase introduction to NoSQL - HiveQL - Querying Data - Sorting And Aggregating, MapReduce Scripts, Joins & Subqueries, HBase concepts- Advanced Usage, Schema Design, Advance Indexing

**Machine Learning in Big Data**: Choosing and evaluating models – mapping problems to machine learning, evaluating clustering models, validating models – cluster analysis – K-means algorithm, Naïve Bayes – Memorization Methods – Linear and logistic regression – supervised and unsupervised learning - Issues regarding classification and prediction, Bayesian Classification, Classification by back propagation, Classification based on concepts from association rule mining, Other Classification Methods, Classification accuracy.

(Text Book: 1) (RBT Levels: **L1 & L2 )**.

| | |
|---|---|
| **Teaching-Learning Process** | .<br>Chalk and talk/PPT/NPTEL Videos/ web content |

**Module-3**

**Stream Computing in Big Data: Introduction -** Streaming Data – Sources – Difference between Streaming Data and Static Data. Overview of Large Scale Stream Processing Engines – Issues in Stream Processing - Phases in Streaming Analytics Architecture - Vital Attributes - High Availability – Low Latency – Horizontal Scalability-Fault Tolerance - Service Configuration and Management - Apache ZooKeeper - Distributed Stream Data Processing: Coordination, Partition and Merges, Transactions. Duplication Detection using Bloom Filters - Apache Spark Streaming Examples Choosing a storage system – NoSQL Storage Systems.

(**Reference** : Web Resources ) (RBT Levels: **L1 & L2 )**.

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

**Module-4**

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| | |
|---|---|
| **Security in Big Data:** Privacy – Identification of Anonymous People – Why Big Data Privacy is self-regulating? – Ethics – Ownership – Ethical Guidelines – Big Data Security – Organizational Security - Steps to secure big data – Classifying Data – Protecting – Big Data Compliance - HADOOP SECURITY DESIGN (**Reference** : Web Resources ) (RBT Levels: **L1 & L2 ).** | |
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |
| **Module-5** | |
| **Data Visualization, Characterisation - DATA WRANGLING:** Combining and Merging DataSets – Reshaping and Pivoting – Data Transformation – String Manipulation, Regular Expressions - DATA AGGREGATION, GROUP OPERATIONS ,TIMESERIES - GoupBy Mechanics – Data Aggregation – Groupwise Operations and Transformations – Pivot Tables and Cross Tabulations – Date and Time Date Type tools – Time Series Basics – Data Ranges, Frequencies and Shifting - WEB SCRAPING - Data Acquisition by Scraping web applications –Submitting a form - Fetching web pages – Downloading web pages through form submission – CSS Selectors - Data Visualization Tools (**Reference Books**: 7 ) (RBT Levels: **L1 & L2 ).** | |
| **Teaching-Learning Process** | Chalk and talk/PPT/NPTEL Videos/ web content |

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.

**Suggested Learning Resources:**

**Text Books:**

1. Nina Zumel, John Mount, "**Practical Data Science with R**", Manning Publications, 2014.

**Reference Books:**

1. Mark Gardener, "**Beginning R - The Statistical Programming Language**", John Wiley & Sons, Inc., 2012.
2. W. N. Venables, D. M. Smith and the R Core Team, "**An Introduction to R**", 2013.
3. Nathan Yau, "**Visualize This: The Flowing Data Guide to Design, Visualization, and Statistics**", Wiley, 2011.

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4. Boris lublinsky, Kevin t. Smith, Alexey Yakubovich, "**Professional Hadoop Solutions**", Wiley, ISBN: 9788126551071, 2015.
5. Chris Eaton, Dirk deroos et al. , "**Understanding Big data** ", McGraw Hill, 2012.
6. Tom White, "**HADOOP: The definitive Guide**" , O Reilly 2012.
7. Alberto Cordoba, "**Understanding the Predictive Analytics Lifecycle**", Wiley, 2014.
8. Eric Siegel, Thomas H. Davenport, "**Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die**", Wiley, 2013.
9. White, "**Hadoop: The Definitive Guide**", Third Edition - 2012 – O'Reilly – ISBN: 9789350237564.
10. Jared Dean, "**Big Data, Data Mining, and Machine Learning: Value Creation for Business Leaders and Practitioners**", Wiley India Private Limited, 2014.
11. Joseph F Hair, William C Black etal , "**Multivariate Data Analysis**" , Pearson Education, 7th edition, 2013. 13. Shai Vaingast, "**Beginning Python Visualization Crafting Visual Transformation Scripts**", Apress, 2nd edition, 2014

**Web links and Video Lectures (e-Resources):**

2. .https://d3js.org/
3. http://bigdatauniversity.com/

**Course outcome (Course Skill Set)**

At the end of the course the student will be able to :

| Sl. No. | Description |
|---|---|
| CO1 | Describe the architecture of distributed systems and Statistical techniques to analyse the Big data. |
| CO2 | Know the different Databases and machine learning models for Big Data. |
| CO3 | Discuss the Issues in Stream Processing and Phases in Streaming Analytics |
| CO4 | Evaluate the Security and privacy in Big Data. |
| CO5 | Demonstrate Data Visualization and Characterization techniques |

| Sl. No. | Description | POs |
|---|---|---|
| 1 | Adequate knowledge of fundamentals on sensors, signal conditioning and IoT | PO1 |
| 2 | Ability to design, implement, analyse, interpret data and synthesis of information | PO2 |
| 3 | Ability to analyse a problem critically using scientific approach, relevant IT tools and techniques | PO3 |
| 4 | Appropriate research skills for solving new problem and present a substantial technical report | PO4 |
| 5 | Ability to work ethically and carry out the work with social responsibility | PO5 |
| 6 | Professional skills to carry out work independently or collaboratively in a multidisciplinary environment. | PO6 |

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**Mapping of COS and POs**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | × | | | | | |
| **CO2** | × | × | × | | | |
| **CO3** | × | × | × | | | |
| **CO4** | | | × | × | | |
| **CO5** | | | | | | × |

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