FACULTY OF ENGINEERING

Scheme of Instruction & Examination
(AICTE Model Curriculum for the Academic Year 2019-2020)

and

Syllabus

M.E. I to IV Semester

of

Two Year Post Graduate Degree Programme

in

Electronics and Communication Engineering
Specialization in Embedded Systems
(With effect from the academic year 2019– 2020)
(As approved in the faculty meeting held on 25-06-2019)

Issued by
Dean, Faculty of Engineering
Osmania University, Hyderabad – 500 007
2019
# SCHEME OF INSTRUCTION & EXAMINATION
M.E. (Electronics and Communication Engineering) I – Semester
Specialization in Embedded Systems

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Course Type/Code</th>
<th>Course Name</th>
<th>Scheme of Instruction</th>
<th>Scheme of Examination</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P/D</td>
</tr>
<tr>
<td>1</td>
<td>Core</td>
<td>Program Core – I</td>
<td>3</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>Core</td>
<td>Program Core – II</td>
<td>3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>Elective</td>
<td>Professional Elective – I</td>
<td>3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>Elective</td>
<td>Professional Elective – II</td>
<td>3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>MC or OE</td>
<td>Mandatory Course/Open Elective*</td>
<td>3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>Audit</td>
<td>Audit Course – I</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

### Practical/ Laboratory Courses

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Course Type/Code</th>
<th>Course Name</th>
<th>Scheme of Instruction</th>
<th>Scheme of Examination</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P/D</td>
</tr>
<tr>
<td>7</td>
<td>Lab-I</td>
<td>Laboratory – I</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>PC 3254 ES</td>
<td>Seminar</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Total</td>
<td>17</td>
<td>01</td>
</tr>
</tbody>
</table>

PC: Program Core      PE: Professional Elective      OE: Open Elective      AD: Audit Course
MC: Mandatory Course  HS: Humanities and social science
L: Lecture            T: Tutorial                    P: Practical           D: Drawing
CIE: Continuous Internal Evaluation  SEE: Semester End Examination (Univ. Exam)

**Note:**
1. Each contact hour is a Clock Hour.
2. The practical class can be of two and half hour (clock hours) duration as per the requirement of a particular laboratory.
3. * If the Mandatory Course is offered in I-Semester, the Open Elective course should be offered in II-semester. If Open Elective course is offered in I-Semester, then the Mandatory Course should be offered in II-semester.
4. ** Open Elective Subject is not offered to the students of ECE Department.
# SCHEME OF INSTRUCTION & EXAMINATION

M.E. (Electronics and Communication Engineering) II – Semester
Specialization in Embedded Systems

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Course Type/Code</th>
<th>Course Name</th>
<th>Scheme of Instruction</th>
<th>Scheme of Examination</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>L T P/D Contact Hrs/Wk</td>
<td>CIE SEE Duration in Hrs</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Core</td>
<td>Program Core – III</td>
<td>3 1 - -</td>
<td>4 30 70</td>
<td>3 4</td>
</tr>
<tr>
<td>2</td>
<td>Core</td>
<td>Program Core – IV</td>
<td>3 1 - -</td>
<td>3 30 70</td>
<td>3 4</td>
</tr>
<tr>
<td>3</td>
<td>Elective</td>
<td>Professional Elective – III</td>
<td>3 - - -</td>
<td>3 30 70</td>
<td>3 3</td>
</tr>
<tr>
<td>4</td>
<td>MC or OE</td>
<td>Mandatory Course/Open Elective*</td>
<td>3 - - -</td>
<td>3 30 70</td>
<td>3 3</td>
</tr>
<tr>
<td>5</td>
<td>Audit</td>
<td>Audit Course – II</td>
<td>2 - - -</td>
<td>2 30 70</td>
<td>3 0</td>
</tr>
</tbody>
</table>

### Practical/ Laboratory Courses

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th>L T P/D Contact Hrs/Wk</th>
<th>CIE SEE Duration in Hrs</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Lab-II</td>
<td>Laboratory – II</td>
<td>- - 2 2</td>
<td>25 50</td>
<td>3 1</td>
</tr>
<tr>
<td>7</td>
<td>Lab-III</td>
<td>Laboratory – III</td>
<td>- - 2 2</td>
<td>25 50</td>
<td>3 1</td>
</tr>
<tr>
<td>8</td>
<td>PC 3255 ES</td>
<td>Mini Project with Seminar</td>
<td>- - 4 4</td>
<td>25 50</td>
<td>3 2</td>
</tr>
</tbody>
</table>

Total: 14 02 08 24 300 450 18

**Note:**

1. Each contact hour is a Clock Hour.
2. The practical class can be of two and half hour (clock hours) duration as per the requirement of a particular laboratory.
3. ** Open Elective Subject is not offered to the students of ECE Department.
### SCHEME OF INSTRUCTION & EXAMINATION

**M.E. (Electronics and Communication Engineering) III – Semester**
**Specialization in Embedded Systems**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Course Type/Code</th>
<th>Course Name</th>
<th>Scheme of Instruction</th>
<th>Scheme of Examination</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P/D</td>
</tr>
<tr>
<td>1</td>
<td>Elective</td>
<td>Professional Elective – IV</td>
<td>3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>Elective</td>
<td>Professional Elective – V</td>
<td>3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>PC 3256 ES</td>
<td>Major Project Phase – I</td>
<td>-</td>
<td>-</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Total</strong></td>
<td></td>
<td><strong>06</strong></td>
</tr>
</tbody>
</table>

**M.E. (Electronics and Communication Engineering) IV – Semester**
**Specialization in Embedded Systems**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Course Type/Code</th>
<th>Course Name</th>
<th>Scheme of Instruction</th>
<th>Scheme of Examination</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P/D</td>
</tr>
<tr>
<td>1</td>
<td>PC 3257 ES</td>
<td>Major Project Phase – II</td>
<td>-</td>
<td>-</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Dissertation)</td>
<td></td>
<td></td>
<td><strong>Total</strong></td>
</tr>
</tbody>
</table>

**Note:**
1. Each contact hour is a Clock Hour
2. The practical class can be of two and half hour (clock hours) duration as per the requirement of a particular laboratory.
3. **Open Elective Subject is not offered to the students of ECE Department.**
4. The students who are willing to register for MOOCs in the M.E. (SE) III – semester instead of Professional Electives – IV & V, should register for those of the courses, approved by the CBoS, OU and respective college MOOCs Coordinator. Those students are strictly not permitted to appear for either CIE or SEE of Professional Electives – IV & V if they abstain from attending the semester class work. Further, for students willing to appear for both MOOCS and Professional Electives, they should fulfill the minimum attendance criteria.

PC: Program Core  PE: Professional Elective  OE: Open Elective  AD: Audit Course
MC: Mandatory Course  HS: Humanities and social science
L: Lecture  T: Tutorial  P: Practical  D: Drawing
CIE: Continuous Internal Evaluation  SEE: Semester End Examination (Univ. Exam)
### List of subjects of Professional Core

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PC 3301 EV</td>
<td>Micro Controllers for Embedded System Design</td>
</tr>
<tr>
<td>2</td>
<td>PC 3202 ES</td>
<td>Smart Sensors and Internet of Things</td>
</tr>
<tr>
<td>3</td>
<td>PC 3203 ES</td>
<td>Programming and Interfacing with Microcontroller</td>
</tr>
<tr>
<td>4</td>
<td>PC 3204 ES</td>
<td>IoT Applications and Communication Protocols</td>
</tr>
</tbody>
</table>

### List of subjects of Professional Electives I to V

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PE 3216 ES</td>
<td>Wireless Sensor Protocols and Programming</td>
</tr>
<tr>
<td>2</td>
<td>PE 3217 ES</td>
<td>Advance Wireless and Mobile Networks</td>
</tr>
<tr>
<td>3</td>
<td>PE 3218 ES</td>
<td>Wireless Access Technologies</td>
</tr>
<tr>
<td>4</td>
<td>PE 3219 ES</td>
<td>Embedded Linux and Basics of Device Drivers</td>
</tr>
<tr>
<td>5</td>
<td>PE 3220 ES</td>
<td>Neural Networks and Fuzzy Logic</td>
</tr>
<tr>
<td>6</td>
<td>PE 3221 ES</td>
<td>Privacy and Security in IoT</td>
</tr>
<tr>
<td>7</td>
<td>PE 3222 ES</td>
<td>IoT: Sensing and Actuator Devices</td>
</tr>
<tr>
<td>8</td>
<td>PE 3223 ES</td>
<td>Energy Harvesting Technology and Power Management for IoT Devices</td>
</tr>
<tr>
<td>9</td>
<td>PE 3224 ES</td>
<td>Scripting Languages</td>
</tr>
<tr>
<td>10</td>
<td>PE 3225 ES</td>
<td>Image and Video Processing</td>
</tr>
<tr>
<td>11</td>
<td>PE 3226 ES</td>
<td>Kernel and Driver Programming</td>
</tr>
<tr>
<td>12</td>
<td>PE 3227 ES</td>
<td>Cloud Computing</td>
</tr>
<tr>
<td>13</td>
<td>PE 3228 ES</td>
<td>Mobile Computing</td>
</tr>
<tr>
<td>14</td>
<td>PE 3319 EV</td>
<td>SoC Design</td>
</tr>
<tr>
<td>15</td>
<td>PC 3303 EV</td>
<td>Real Time Operating Systems (Elective)</td>
</tr>
</tbody>
</table>

### List of Mandatory Courses

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MC 5161 ME</td>
<td>Research Methodology &amp; IPR</td>
</tr>
</tbody>
</table>

### List of Open Electives

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>OE 9101 CE</td>
<td>Cost Management of Engineering Projects</td>
</tr>
<tr>
<td>2</td>
<td>OE 9102 CS</td>
<td>Business Analytics</td>
</tr>
<tr>
<td>3</td>
<td>OE 9103 EC**</td>
<td>Embedded System Design</td>
</tr>
<tr>
<td>4</td>
<td>OE 9104 EE</td>
<td>Waste to Energy</td>
</tr>
<tr>
<td>5</td>
<td>OE 9105 ME</td>
<td>Industrial Safety</td>
</tr>
</tbody>
</table>

Note: ** Open Elective Subject is not offered to the students of ECE Department.

### List of subjects of Audit Course-I

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>AD 9001 HS</td>
<td>English for Research Paper Writing</td>
</tr>
<tr>
<td>2</td>
<td>AD 9002 CE</td>
<td>Disaster Management</td>
</tr>
<tr>
<td>3</td>
<td>AD 9003 HS</td>
<td>Sanskrit for Technical Knowledge</td>
</tr>
<tr>
<td>4</td>
<td>AD 9004 HS</td>
<td>Value Education</td>
</tr>
</tbody>
</table>
List of subjects of Audit Course-II

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>AD 9011 HS</td>
<td>Constitution of India and Fundamental Rights</td>
</tr>
<tr>
<td>2</td>
<td>AD 9012 HS</td>
<td>Pedagogy Studies</td>
</tr>
<tr>
<td>3</td>
<td>AD 9013 HS</td>
<td>Stress Management by Yoga</td>
</tr>
<tr>
<td>4</td>
<td>AD 9014 HS</td>
<td>Personality Development through life Enlightenment Skills</td>
</tr>
</tbody>
</table>

List of Laboratory Courses

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Lab No.</th>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I</td>
<td>PC 3151 ES</td>
<td>Embedded Systems Lab – I</td>
</tr>
<tr>
<td>2</td>
<td>II</td>
<td>PC 3152 ES</td>
<td>IoT Lab</td>
</tr>
<tr>
<td>3</td>
<td>III</td>
<td>PC 3153 ES</td>
<td>Embedded Systems Lab – II</td>
</tr>
</tbody>
</table>
Course Code | Course Title | Core/Elective
--- | --- | ---
PC 3301 EV | Microcontrollers for Embedded System Design | Core

<table>
<thead>
<tr>
<th>Prerequisite</th>
<th>Contact Hours per Week</th>
<th>CIE</th>
<th>SEE</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>L</td>
<td>T</td>
<td>D</td>
<td>P</td>
</tr>
</tbody>
</table>

Course Objectives
- Detailed overview of important concepts of Embedded system
- Analyse PIC microcontroller, its features and programming
- Describe ARM Microcontroller architectural details and instruction set
- Understand ARM Memory management
- Learn the techniques to develop an embedded system and case studies

Course Outcomes
After completing this course, the student will be able to:
1. Define an embedded system with an overview of important concepts and trends in the design process along with the challenges faced in the embedded systems design.
2. Understand the architecture of PIC 18 Microcontroller, its features and programming.
3. Understand ARM Design Philosophy, architectural details, instruction set and ARM Memory Management.
4. Analyse and compare the utility and effectiveness of various debugging tools and techniques.
5. Design a real time based embedded system in the area of communication, automotive, etc.

UNIT I

UNIT II
PIC 18: Family Overview, Architecture, Instruction Set, Addressing modes. Timers, interrupts of PIC 18, Capture/Compare and PWM modules of PIC 18

UNIT III
ARM Architecture: ARM Design Philosophy, Registers, Program Status Register, Instruction Pipeline, Interrupts and Vector Table, Architecture Revision, ARM Processor Families. Instruction Set: Data Processing Instructions, Addressing Modes, Branch, Load, Store Instructions, PSR Instructions, Conditional Instructions.

UNIT IV
ARM Thumb Instruction Set: Register Usage, Other Branch Instructions, Data Processing Instruction Single-Register and Multi Register Load-Store Instructions, Stack, Software Interrupt Instructions. Exception and interrupt handling.
ARM Memory Management: Cache Architecture, Polices, Flushing and Caches, MMU, Page Tables, Translation Access Permissions, Context Switch.

UNIT V
Faculty of Engineering, O.U. AICTE Model Curriculum with effect from Academic Year 2019-20

Case Studies: Design of Embedded Systems using Microcontrollers – for applications in the area of communication and automotive. (GSM/GPRS, CAN, ZigBee)

Suggested Reading:
Course Code | Course Title | Core/Elective
--- | --- | ---
PC 3202 ES | Smart Sensors for Internet of Things | Core

<table>
<thead>
<tr>
<th>Prerequisite</th>
<th>Contact Hours per Week</th>
<th>CIE</th>
<th>SEE</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>3</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**Course Objectives**

- Able to understand the application areas of IoT
- Able to realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks
- Able to understand building blocks of Internet of Things and characteristics
- Able to understand smart sensors principles
- Able to interface smart sensors

**Course Outcomes**

After completing this course, the student will be able to:

1. Understand the vision of IoT from a global context
2. Use of Devices, Gateways and Data Management in IoT.
4. Understand different sensor architectures
5. Develop different types of applications by using sensors

**UNIT I**

Environmental Parameters Measurement and Monitoring: Why measurement and monitoring are important, effects of adverse parameters for the living being for IoT

**UNIT II**

Sensors: Working Principles: Different types; Selection of Sensors for Practical Applications, Introduction of Different Types of Sensors such as Capacitive, Resistive, Surface Acoustic Wave for Temperature, Pressure, Humidity, Toxic Gas etc.

**UNIT III**

Important Characteristics of Sensors: Determination of the Characteristics Fractional order element: Constant Phase Impedance for sensing applications such as humidity, water quality, milk quality Impedance Spectroscopy: Equivalent circuit of Sensors and Modelling of Sensors Importance and Adoption of Smart Sensors

**UNIT IV**

Architecture of Smart Sensors: Important components, their features Fabrication of Sensor and Smart Sensor: Electrode fabrication: Screen printing, Photolithography, Electroplating Sensing film deposition: Physical and chemical Vapour, Anodization, Sol-gel

**UNIT V**

Interface Electronic Circuit for Smart Sensors and Challenges for Interfacing the Smart Sensor, Usefulness of Silicon Technology in Smart Sensor and Future scope of research in smart sensor

**Suggested Reading:**

1. Yasuura, H., Kyung, C.-M., Liu, Y., Lin, Y.-L., Smart Sensors at the IoT Frontier, Springer International Publishing
PC 3203 ES  | Programming and Interfacing with Microcontroller  | Core
---|---|---
Prerequisite | Contact Hours per Week | CIE | SEE | Credits
| L | T | D | P |
- | 3 | 1 | - | - | 30 | 70 | 4

**Course Objectives**
- Understand advanced and emerging networking technologies
- Obtain skills to do advanced networking research and programming
- Learn how to use software programs to perform varying and complex networking tasks
- Expand upon the knowledge learned and apply it to solve real world problems
- Learn IoT protocols

**Course Outcomes**
After completing this course, the student will be able to:
1. Summarise different open source platforms and open frameworks
2. Study different communication protocols
3. Design a specific application by using sensors and actuators
4. Learn different messaging standards for communication over the internet
5. Learn basic communication techniques to send data to cloud

**UNIT I**

**UNIT II**
Software: open Frameworks as our IDE (C/C++) - “Arduino” Language (C/C++) - Hardware: Desktop / Laptop / Raspberry Pi - How to approach a programming problem? Representing “reality” with computers. Digital vs. Analog circuits, audio, communication, etc. Analog to Digital Conversion (ADC) - Digital to Analog Conversion (DAC) – Microcontrollers

**UNIT III**

**UNIT IV**
Advanced I/O – open Frameworks: Live Network feeds (push and pull) - Data persistence (saving data and preferences) - Database interface (MySQL, SQLite, XML, PHP/Web) - Arduino: Wired/Wireless Networking

**UNIT V**
Talking to the cloud: Baby steps to Internet of Things, TCP/IP and UDP - Building peer to peer communication system using Bluetooth & WiFi - Experiments
Suggested Reading:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Core/Elective</th>
</tr>
</thead>
<tbody>
<tr>
<td>PC 3204 ES</td>
<td>IoT Applications and Communication Protocols</td>
<td>Core</td>
</tr>
<tr>
<td>L</td>
<td>T</td>
<td>D</td>
</tr>
<tr>
<td>-</td>
<td>3</td>
<td>-</td>
</tr>
</tbody>
</table>

**Course Objectives**

- Basic introduction of all the elements of IoT-Mechanical, Electronics/sensor platform, Wireless and wireline protocols
- Mobile to Electronics integration, Mobile to enterprise integration
- Open source/commercial electronics platform for IoT-Raspberry Pi, Arduino, ArmMbedLPC
- Open source /commercial enterprise cloud platform for IoT-Ayla, iO Bridge, Libellium, Axeda, Cisco fog cloud
- Learn different M2M platforms

**Course Outcomes**

After completing this course, the student will be able to:

1. To understand merging technological options, platforms and case studies of IoT implementation in home & city automation
2. Understand database implementation for IoT
3. Determine the Market perspective of IoT
4. Experience with working of cloud computing service
5. Design a specific application by using IoT

**UNIT I**

Basic function and architecture of a sensor — sensor body, sensor mechanism, sensor calibration, sensor maintenance, cost and pricing structure, legacy and modern sensor network.

Development of sensor electronics — IoT vs legacy, and open source vs traditional PCB design style

Development of sensor communication protocols, Protocols: Modbus, relay, ZigBee, Zwave, X10, Bluetooth, ANT, etc. Business driver for sensor deployment — FDA/EPA regulation, fraud/tempering detection, supervision, quality control and process management

Different kind of calibration Techniques: manual, automation, infield, primary and secondary calibration — and their implication in IoT Powering options for sensors: battery, solar, Witricity, Mobile and PoE

**UNIT II**

ZigBee and Zwave — advantage of low power mesh networking. Long distance ZigBee. Introduction to different ZigBee chips. Bluetooth/BLE: Low power vs high power, speed of detection, class of BLE. Introduction of Bluetooth vendors & their review. Wireless protocols such as Piconet and packet structure for BLE and ZigBee Other long distance RF communication link. LOS vs NLOS links, Capacity and throughput calculation Application issues in wireless protocols: power consumption, reliability, PER, QoS, LOS

**UNIT III**

PCB vs FPGA vs ASIC design Prototyping electronics vs Production electronics QA certificate for IoT-CE/CSA/UL/IEC/RoHS/IP65 Basic introduction of multi-layer PCB design and its workflow Electronics reliability-basic concept of FIT and early mortality rate Environmental and reliability testing-basic concepts

Basic Open source platforms: Arduino, Raspberry Pi, Beaglebone
UNIT IV
Introduction to Mobile app platform for IoT: Protocol stack of Mobile app for IoT, Mobile to server integration, iBeacon in iOS, Window Azure, Linkafy Mobile platform for IoT, Axeda, Xively

UNIT V
Database implementation for IoT: Cloud based IoT platforms, SQL vs NoSQL, Open sourced vs. Licensed Database, Available M2M cloud platform, AxedaXively, Omega NovoTech, Ayla Libellium, CISCO M2M platform, AT &T M2M platform, Google M2M platform, Recent trends in home automation, IoT-locks, Energy optimization in home

Suggested Reading:
Course Code | Course Title | Core/Elective
--- | --- | ---
PE 3216 ES | Wireless Sensor Protocols and Programming | Elective

<table>
<thead>
<tr>
<th>Prerequisite</th>
<th>Contact Hours per Week</th>
<th>CIE</th>
<th>SEE</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3</td>
<td>30</td>
<td>70</td>
<td>3</td>
</tr>
</tbody>
</table>

**Course Objectives**
- Understand basic sensor network concepts
- Know physical layer issues, understand and analyse Medium Access Control Protocols
- Comprehend network and transport layer characteristics and protocols and implement conventional protocols
- Understand the network management and Middleware services
- Understand the protocols for network security.

**Course Outcomes**
After completing this course, the student will be able to:
1. Present applications of wireless sensors and communication deployment mechanisms
2. Describe MAC layer protocols
3. Carry out reliable data transfer protocols and routing algorithms in given networks and mechanisms for security
4. Understand IoT protocols
5. Handle routing management, network security and attacks in OS

**UNIT I**
**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.

**UNIT II**

**UNIT III**

**UNIT IV**
UNIT V

Suggested Reading:
## Course Code: PE 3217 ES  
## Course Title: Advanced Wireless and Mobile Networks  
## Core/Elective: Elective

### Prerequisite
-  

### Contact Hours per Week

<table>
<thead>
<tr>
<th></th>
<th>L</th>
<th>T</th>
<th>D</th>
<th>P</th>
<th>CIE</th>
<th>SEE</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>30</td>
<td>70</td>
<td>3</td>
</tr>
</tbody>
</table>

### Course Objectives
- The students should get familiar with the wireless/mobile market and the future needs and challenges.
- To get familiar with key concepts of wireless networks, standards, technologies and their basic operations.
- To learn how to design and analyse various medium access.
- To learn how to evaluate MAC and network protocols using network simulation software tools.
- The students should get familiar with the wireless/mobile market and the future needs and challenges.

### Course Outcomes
After completing this course, the student will be able to:

1. Demonstrate advanced knowledge of networking and wireless networking and understand various types of wireless networks, standards, operations and use cases.
2. Design WLAN, WPAN, WWAN, Cellular based upon underlying propagation and performance analysis.
3. Develop mobile applications to solve some of the real-world problems.
4. Work with IoT communication techniques.
5. Understand Vehicular Adhoc Networks.

### UNIT I
#### Introduction:

#### Wireless Local Area Networks:
IEEE 802.11 Wireless LANs Physical & MAC layer, 802.11 MAC Modes (DCF & PCF) IEEE 802.11 standards, Architecture & protocols, Infrastructure vs. Adhoc Modes, Hidden Node & Exposed Terminal Problem, Problems, Fading Effects in Indoor and outdoor WLANs, WLAN Deployment issues.

### UNIT II
#### Wireless Cellular Networks:

### UNIT III
WiMAX (Physical layer, Media access control, Mobility and Networking), IEEE 802.22 Wireless Regional Area Networks, IEEE 802.21 Media Independent Handover Overview

#### Wireless Sensor Networks:
Introduction, Application, Physical, MAC layer and Network Layer, Power Management, Tiny OS Overview.

### UNIT IV
#### Wireless PANs:
Bluetooth AND ZigBee, Introduction to Wireless Sensors.
UNIT V


Advanced Topics: IEEE 802.11x and IEEE 802.11i standards, Introduction to Vehicular Adhoc Networks

Suggested Reading:

1. Schiller J., Mobile Communications, Addison Wesley 2000
2. Stallings W., Wireless Communications and Networks, Pearson Education 2005
5. Pandya Raj, Mobile and Personal Communications Systems and Services, PHI 200
Course Code | Course Title | Core/Elective
---|---|---
PE 3218 ES | Wireless Access Technologies | Elective

<table>
<thead>
<tr>
<th>Prerequisite</th>
<th>Contact Hours per Week</th>
<th>CIE</th>
<th>SEE</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L</td>
<td>T</td>
<td>D</td>
<td>P</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**Course Objectives**

- Overview of wireless access technologies, Fixed wireless access networks. Terminal mobility issues regarding wireless access to Internet
- Introduction to various Network topologies, hotspot networks, Communication links: point-to-point, point-to-multipoint, multipoint-to-multipoint.
- To provide an overview of Standards for most frequently used wireless access networks: WPAN, UWB, WLAN, WMAN, WWAN. Network services. Wireless access networks planning, design and installation.
- To get and insight of Wireless networking security issues, Wireless access network exploitation and management, software requirements, link quality control.
- Study Recent trends in wireless networking and various access mechanism, new standards of wireless communication.

**Course Outcomes**

After completing this course, the student will be able to:

1. compare various wireless access technologies
2. analyze measurements of wireless access network parameter
3. assess security issues in wireless networks
4. Solve Wireless networking security issues
5. Design Wireless access networks

**UNIT I**


**UNIT II**

Fixed wireless access (FWA) networks, frequency bands for different networks. Criterions for frequency bands allocation, Network topologies, hotspot networks. Communication links: point-to-point (PTP), point-to-multipoint (PMP), multipoint-to-multipoint (MTM).

**UNIT III**

Standards for most frequently used wireless access networks: WPAN (802.15, Bluetooth, DECT, IrDA), UWB (Ultra-Wideband), WLAN (802.11, Wi-Fi, HIPERLAN, IrDA), WMAN (802.16, WiMAX, HIPERMAN, HIPERACCESS), WWAN (802.20), Other technologies for broadband wireless access, Local Multipoint Distribution Service (LMDS), Multichannel Multipoint Distribution Service (MMDS). Ad Hoc networks, Network services. Services types based on carrier frequency and bandwidth.
UNIT IV
Wireless access networks planning, design and installation. Services provision, legislative and technical aspects, Technical and economic factors for network planning: expenses, coverage, link capacity, network complexity and carrier-to-interference ratio (C/I). Base station or access point allocation. Base station and access point equipment. Terminal mobility issues regarding wireless access to Internet. Wireless networking security issues.

UNIT V
Example of laptop or handheld PC wireless connection in real environment. PC wireless interface equipment. Wireless access network exploitation and management, software requirements, link quality control. Business model, wireless network services market, market research and marketing, service providers, wireless data application service providers (WDASP) and their role on public telecommunication services market, billing systems. Recent trends in wireless networking and various access mechanism, new standards of wireless communication.

Suggested Reading:
3. R. Pandya, Introduction to WLLs: Application and Deployment for Fixed and Broadband Services, IEEE Press, Piscataway
Course Code | Course Title | Core/Elective
--- | --- | ---
PE 3219 ES | Embedded Linux and Basics of Device Drivers | Elective

<table>
<thead>
<tr>
<th>Prerequisite</th>
<th>Contact Hours per Week</th>
<th>CIE</th>
<th>SEE</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>3 - - -</td>
<td>30</td>
<td>70</td>
<td>3</td>
</tr>
</tbody>
</table>

**Course Objectives**
- Able to understand embedded Linux development environment, understand and create Linux BSP for a hardware platform
- Able to program different embedded storage devices
- Able to understand the Linux model for embedded storage, understand and write various embedded Linux drivers such as serial, I²C, and so on.
- Able to port applications to embedded Linux and write real – time applications in embedded Linux

**Course Outcomes**
After completing this course, the student will be able to:
1. Get familiar with the functions of Linux operating systems
2. Writing of device driver programming in Linux
3. Understand how to configure, build, install and boot from a kernel
4. write various embedded Linux drivers such as serial, I²C, and so on
5. Experience Hard Real-Time Linux

**UNIT – I**

**UNIT – II**
**Board Support Package:** Inserting BSP in Kernel Build Procedure, Boot Loader Interface, Memory Map, Interrupt Management, PCI Subsystem, Timers, UART, and Power Management.
**Embedded Storage:** Flash Map, MTD—Memory Technology Device, MTD Architecture, Flash Mapping Drivers, MTD Block and Character devices, Embedded File systems, Optimizing Storage Space.

**UNIT – III**
**Embedded Drivers:** Linux Serial Driver, Ethernet Driver, I²C subsystem on Linux, USB Gadgets, Watchdog Timer, and Kernel Modules.

**UNIT-IV**
**Porting Applications:** Architectural Comparison, Application Porting Road Map, Programming with Pthreads, Operating System Porting Layer (OSPL), Kernel API Driver.

**Unit-V**
**Real-Time Linux:** Linux and Real-Time, Real-Time Programming in Linux, Hard Real-Time Linux.

**Suggested Reading:**
2. Embedded Linux – Hardware, Software and Interfacing
Course Code | Course Title | Core/Elective
--- | --- | ---
PE 3220 ES | Neural Networks and Fuzzy Logic | Elective

<table>
<thead>
<tr>
<th>Prerequisite</th>
<th>Contact Hours per Week</th>
<th>CIE</th>
<th>SEE</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L</td>
<td>T</td>
<td>D</td>
<td>P</td>
</tr>
</tbody>
</table>

**Course Objectives**
- Formulate neural networks
- Understand Training of neural networks using various algorithms
- Use of neural networks for pattern recognition
- Learn fuzzy systems, application of fuzzy systems
- Describe Comparison of fuzzy systems with conventional control system.

**Course Outcomes**
After completing this course, the student will be able to:
1. Analyze the various feedback networks
2. Apply genetic algorithms to combinatorial optimization problems
3. Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems
4. Analyze the application of fuzzy logic control to real time systems.
5. Analyze the application of fuzzy logic control to real time systems.

**UNIT I**
Introduction to ANS (Artificial Neural systems) Technology, ANS simulation, Types of Neural Networks: Hopfield, perceptron and related models, Adaline and Madaline: Adaline and the Adaptive Linear Combiner, the Madaline and simulating the Adaline. Essential vector operations, Lateral Inhibition and Sensory Processing.

**UNIT II**

**UNIT III**

**UNIT IV**

**UNIT V**
AICTE Model Curriculum with effect from Academic Year 2019-20

Suggested Reading:

Course Code | Course Title | Core/Elective
---|---|---
PE 3221 ES | Privacy and Security in IoT | Elective

<table>
<thead>
<tr>
<th>Prerequisite</th>
<th>Contact Hours per Week</th>
<th>CIE</th>
<th>SEE</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>30</td>
<td>70</td>
<td>3</td>
</tr>
</tbody>
</table>

Course Objectives
- Ability to understand the Security requirements in IoT
- Understand the cryptographic fundamentals for IoT
- Ability to understand the authentication credentials and access control
- Understand the various types Trust models and Cloud Security.
- Understand New directions in cloud enabled IoT computing

Course Outcomes
After completing this course, the student will be able to:
1. Identify and analyse IoT security and privacy risks
2. Concept design for secure hardware and software
3. Analyse the social and privacy impacts of the IoT
4. Design self-organising things for security
5. Understand New directions in cloud enabled IoT computing

UNIT I

UNIT II

UNIT III

UNIT IV

UNIT V
Cloud Security for IoT: Cloud services and IoT – offerings related to IoT from cloud service providers – Cloud IoT security controls – An enterprise IoT cloud security architecture – New directions in cloud enabled IoT computing.
Suggested Reading:

1. Practical Internet of Things Security (Kindle Edition) by Brian Russell, Drew Van Duren
2. Securing the Internet of Things, Elsevier
Course Objectives

- Understanding of IoT value chain structure (device, data cloud), application areas and technologies involved
- Understand IoT sensors and technological challenges faced by IoT devices, with a focus on wireless, energy, power, RF and sensing modules
- Analyse the technologies in sensors and actuators
- Market forecast for IoT devices with a focus on sensors
- Explore and learn about Internet of Things with the help of preparing projects designed for Raspberry Pi

Course Outcomes

After completing this course, the student will be able to:

1. Develop thinking of making new generations of sensors
2. Analyse power management
3. Design an IoT project
4. Design wearable devices
5. Design Prototypes

UNIT I


UNIT II


UNIT III


UNIT IV


UNIT V

Preparing IoT Projects: Creating the sensor project - Preparing Raspberry Pi - Clayster libraries - Hardware- Interacting with the hardware - Interfacing the hardware- Internal representation of sensor values - Persisting data - External representation of sensor values - Exporting sensor data - Creating the actuator project- Hardware - Interfacing the hardware - Creating a controller - Representing sensor values - Parsing sensor data - Calculating control states - Creating a camera - Hardware -Accessing the serial port on
Raspberry Pi - Interfacing the hardware - Creating persistent default settings - Adding configurable properties - Persisting the settings - Working with the current settings Initializing the camera

**Suggested Reading:**

Course Code | Course Title | Core/Elective
---|---|---
PE 3223 ES | Energy Harvesting Technologies and Power Management for IoT Devices | Elective

Prerequisite | Contact Hours per Week | CIE | SEE | Credits
---|---|---|---|---
- | 3 | - | - | - | 30 | 70 | 3

Course Objectives
- Understand the various energy sources and energy harvesting based sensor networks
- Learn about the various Piezoelectric materials and Non-linear techniques
- Learn principles of Electromagnetic Energy Harvesting and Non-Linear Techniques
- Understand the various Power sources for WSN
- Learn about the applications of Energy harvesting systems.

Course Outcomes
After completing this course, the student will be able to:
1. Develop Novel energy harvesting hardware, devices, systems
2. Design Self-sustaining wearable devices
3. Recognise alternative power sources for embedded applications, such as novel nuclear, chemical, or biological for energy harvesting
4. Design Bio-MEMS based applications

UNIT I

UNIT II

UNIT III

UNIT IV

UNIT V

Suggested Reading:
2. Danick Briand, Eric Yeatman, Shad Roundy, “Micro Energy Harvesting”
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Core/Elective</th>
</tr>
</thead>
<tbody>
<tr>
<td>PE 3224 ES</td>
<td>Scripting Languages</td>
<td>Elective</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Prerequisite</th>
<th>Contact Hours per Week</th>
<th>CIE</th>
<th>SEE</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L</td>
<td>T</td>
<td>D</td>
<td>P</td>
</tr>
</tbody>
</table>

**Course Objectives**

- The principles of scripting languages.
- Motivation for and applications of scripting.
- Difference between scripting languages and non-scripting languages.
- Types of scripting languages.
- Scripting languages such as PERL, TCL/TK, python and BASH.

**Course Outcomes**

After completing this course, the student will be able to:

1. Demonstrate knowledge and understanding of the nature of scripting and the role of scripting languages.
2. Write simple scripts to automate system administration tasks using appropriate languages.
3. Develop simple applications using appropriate tools.
4. Creation of programs in the Linux environment.
5. Usage of scripting languages in IC design flow.

**UNIT I**

**Linux Basics:** Introduction to Linux, File System of the Linux, General usage of Linux kernel & basic commands, Linux users and group, Permissions for file, directory and users, searching a file & directory, zipping and unzipping concepts.

**UNIT II**


**UNIT III**

**Perl Scripting:** Introduction to Perl Scripting, working with simple values, Lists and Hashes, Loops and Decisions, Regular Expressions, Files and Data in Perl Scripting, References & Subroutines, Running and Debugging Perl, Modules, Object – Oriented Perl.

**UNIT IV**

**Tcl / Tk Scripting:** Tcl Fundamentals, String and Pattern Matching, Tcl Data Structures, Control Flow Commands, Procedures and Scope, Evel, Working with Unix, Reflection and Debugging, Script Libraries, Tk Fundamentals, Tk by examples, The Pack Geometry Manager, Binding Commands to X Events, Buttons and Menus, Simple Tk Widgets, Entry and List Box Widgets Focus, Grabs and Dialogs.

**UNIT V**

**Python Scripting:** Introduction to Python, using the Python Interpreter, More Control Flow Tools, Data Structures, Modules, Input and Output, Errors and Exceptions, Classes, Brief Tour of the Standard Library.
Suggested Reading:
6. Python Tutorial by Guido Van Rossum, Fred L. Drake Jr. editor, Release 2.6.4
7. Practical Programming in Tcl and Tk by Brent Welch, Updated for Tcl 7.4 and Tk 4.0.
8. Teach Yourself Perl in 21 days by David Till.
Course Code | Course Title | Core/Elective
---|---|---
PE 3225 ES | Image and Video Processing | Elective

<table>
<thead>
<tr>
<th>Prerequisite</th>
<th>Contact Hours per Week</th>
<th>CIE</th>
<th>SEE</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**Course Objectives**
- Study fundamental concepts of Image Processing and various Image Transforms.
- Familiarize with fundamentals of Image compression, Lossy & Lossless Compression methods.
- Define concepts of Video Processing, Image Formation models, and processing of Video signals.
- Understand general methodologies of 2 D Motion Estimation and Video coding methods.

**Course Outcomes**
After completing this course, the student will be able to:
1. Use different transforms for various applications like Image Enhancement, Compression etc.
2. Use Spatial and Transform techniques to Enhance the given image and to extract the features of the image.
3. Use Lossless and Lossy compression techniques for real time applications.
4. Understand the fundamental concepts of Video capturing and Three Dimensional Motion Models.
5. Understand and analyse various Motion estimation techniques.

**UNIT I**
**Fundamentals of Image Processing and Image Transforms:** Basic steps of Image Processing System, Sampling and Quantization of an image, relationship between pixels

**Image Transforms:** 2 D- Discrete Fourier Transform, Discrete Cosine Transform (DCT), Wavelet Transforms: Continuous Wavelet Transform, Discrete Wavelet Transforms.

**UNIT II**

**Image Segmentation:** Segmentation concepts, Point, Line and Edge Detection, Thresholding, Region

**UNIT III**
**Image Compression:** Image compression fundamentals - Coding Redundancy, Spatial and Temporal redundancy, Compression models: Lossy & Lossless, Huffman coding, Arithmetic coding, LZW coding, Run length coding, Bit plane coding, Transform coding, Predictive coding, Wavelet coding, JPEG Standards.

**UNIT IV**
**Basic concepts of Video Processing:** Analog Video, Digital Video. Time-Varying Image Formation models: Three-Dimensional Motion Models, Geometric Image Formation, Photometric Image Formation, Sampling of Video signals, Filtering operations.
UNIT V

Motion Estimation: Optical flow, General Methodologies, Pixel Based Motion Estimation, Block-Matching Algorithm, Mesh based Motion Estimation, Global Motion Estimation, Region based Motion Estimation, Multi resolution motion estimation, Waveform based coding, Block based transform coding, Predictive coding. Application of motion estimation in Video coding, constant dependent video coding and joint shape and texture coding .MPEG and H.26X standards.

Suggested Reading:

2. Yao Wang, Joem Ostermann, Ya-quin Zhang, Video processing and communication, 1st Edition, PH Int.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Core/Elective</th>
</tr>
</thead>
<tbody>
<tr>
<td>PE 3226 ES</td>
<td><strong>Kernel and Driver Programming</strong></td>
<td>Elective</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Prerequisite</th>
<th>Contact Hours per Week</th>
<th>CIE</th>
<th>SEE</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td></td>
<td>70</td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

Course Objectives
- To learn the fundamental of device driver and write simple device driver programs
- To learn the debugging technique and study the concurrency and Trace conditions
- To learn about the interrupt handling, PCI driver and USB driver
- To learn the block driver and network driver

Course Outcomes
After completing this course, the student will be able to:
1. write simple device driver programs
2. Handle interrupts and drivers
3. Measure the performance of your device driver.
4. write programs for devices in Linux.
5. Design and implement a kernel module.

UNIT I
**Introduction to Device Driver and Char Driver:** Introduction to device driver - The Role of the Device Driver –Splitting the Kernel - Classes of Devices and Modules - Security Issues – Building and running modules – Setting your test system – compiling and loading - Char Drivers - Design of scull - Some Important Data Structures - Char Device Registration - open and release - scull’s Memory Usage - read and write - Playing with the New Devices

UNIT II
**Debugging Technique, Concurrency and Trace Conditions:** Debugging technique -Concurrency and trace conditions – Pitfalls in scull - Concurrency and Its management - Semaphores and Mutexes - Completions – Spinlocks - Locking Traps - Alternatives to Locking - Advanced Char driver operations – ioctl 135 - Blocking I/O 147 - poll and select 163 - Asynchronous Notification - Seeking a Device - Access Control on a Device File

UNIT III
**Memory Allocation, Communicating with Hardware:** Time, delays and deferred work – Allocating memory – The Real Story of kmalloc - Lookaside Caches - get_free_page and Friends - vmalloc and Friends - Per-CPU Variables - Obtaining Large Buffers - Communicating with hardware – I/O Ports and I/O Memory - Using I/O Ports - I/O Port Example - Using I/O Memory

UNIT IV
**Interrupt Handling, Data Types, Pci Driver and Usb Driver:** Interrupt handling - Preparing the Parallel Port - Installing an Interrupt Handler - Implementing a Handler - Top and Bottom Halves - Interrupt Sharing - Interrupt-Driven I/O - Data types in kernel – Use of Standard C Types - Assigning an Explicit Size to Data Items - Interface-Specific Types - Other Portability Issues - Linked Lists - PCI drivers - PCI Interface - PC/104 and PC/104+ - Other PC Buses - USB drivers - USB and Sysfs - USB Urbs - Writing a USB Driver - USB Transfers Without Urbs
UNIT V

LINUX Device Model, Block Driver and Network Drivers: Linux device model - Kobjects, Ksets, and Subsystems - Low-Level Sysfs Operations - Hotplug Event Generation - Buses, Devices, and Drivers – Classes – Hotplug - Block Driver – Registration - Block Device Operations - Request Processing - Network Drivers

Suggested Reading:

Course Code | Course Title | Core/Elective
--- | --- | ---
PE 3227 ES | Cloud Computing | Elective

<table>
<thead>
<tr>
<th>Prerequisite</th>
<th>Contact Hours per Week</th>
<th>CIE</th>
<th>SEE</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>30</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>70</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
</tr>
</tbody>
</table>

Course Objectives

- The student will also learn how to apply trust-based security model to real-world security problems
- An overview of the concepts, processes, and best practices needed to successfully secure information within Cloud infrastructures
- Students will learn the basic Cloud types and delivery models
- Develop an understanding of the risk and compliance responsibilities and Challenges for each Cloud type and service delivery model
- Understand Security Management in the Cloud and Privacy Issues

Course Outcomes

After completing this course, the student will be able to:

1. Identify security aspects of each cloud model
2. Develop a risk-management strategy for moving to the Cloud
3. Implement a public cloud instance using a public cloud service provider
4. Apply trust-based security model to different layer
5. Apply techniques for Security Management in the Cloud and Privacy Issues

UNIT I

Introduction to Cloud Computing: Online Social Networks and Applications, Cloud introduction and overview, Different clouds, Risks, Novel applications of cloud computing

UNIT II


Cloud Deployment Models: Key Drivers to Adopting the Cloud, The Impact of Cloud Computing on Users, Governance in the Cloud, Barriers to Cloud Computing Adoption in the Enterprise

UNIT III


Identity and Access Management: Trust Boundaries and IAM, IAM Challenges, Relevant IAM Standards and Protocols for Cloud Services, IAM Practices in the Cloud, Cloud Authorization Management

UNIT IV


UNIT V

Audit and Compliance: Internal Policy Compliance, Governance, Risk, and Compliance (GRC), Regulatory/External Compliance, Cloud Security Alliance, Auditing the Cloud for Compliance, Security-as-a-Cloud

Suggested Reading:
Course Code: PE 3228 ES  
Course Title: Mobile Computing  
Core/Elective: Elective

<table>
<thead>
<tr>
<th>Prerequisite</th>
<th>Contact Hours per Week</th>
<th>CIE</th>
<th>SEE</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>3</td>
<td>30</td>
<td>70</td>
<td>3</td>
</tr>
</tbody>
</table>

Course Objectives
- Learn front end devices for information access and their operating systems.
- Familiarize with Communication between the mobile equipment and the base station transceiver
- Learn transmission and reception of data directory service
- Formulate network routing
- Estimate transaction.

Course Outcomes
After completing this course, the student will be able to:
1. Explain the principles and theories of mobile computing technologies.
2. Describe the possible future of mobile computing technologies and applications.
3. Design effective mobile interfaces using human computer interaction principles.
4. Understand different Ad hoc Network Routing protocols
5. Estimate transaction.

UNIT I
Introduction: Challenges in mobile computing, coping with uncertainties, Resource poorness, bandwidth, etc. Cellular architecture, co-channel interference, frequency reuse, capacity increase by cell splitting: Evolution of mobile system: CDMA, FDMA, TDMA and GSM.

UNIT II
Mobility Management: Cellular architecture, Co-channel interference, Mobility: handoff, types of handoffs; Location management, HLR-VLR scheme, Hierarchial scheme, Predictive location management schemes, Mobile IP, Cellular IP.

UNIT III
Publishing and Accessing Data in Air: Pull and Push based data delivery models, Data dissemination by broadcast, Broadcast disks, Directory service in air, energy efficient indexing scheme for push based data delivery.
File system support for mobility: Distributed file sharing for mobility support, Coda and other storage manager for mobility support.

UNIT IV

UNIT V
Suggested Reading:

Course Code | Course Title | Core/Elective
---|---|---
PE 3319 EV | SoC Design | Elective

<table>
<thead>
<tr>
<th>Prerequisite</th>
<th>Contact Hours per Week</th>
<th>CIE</th>
<th>SEE</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L</td>
<td>T</td>
<td>D</td>
<td>P</td>
</tr>
</tbody>
</table>
- | 3 | - | - | - | 30 | 70 | 3 |

**Course Objectives**
- Understand Integration of hardware and software on a single chip
- Describe various processors
- Design of Memory for SoC
- Familiarize with Interconnection of various devices and reconfiguration
- Explore various application of system on single chip

**Course Outcomes**
After completing this course, the student will be able to:
1. Apply fundamental knowledge of digital logic design to modelling and analysis of low power in processor design.
2. Understand the design concepts of processor, pipelining concepts, ARM Development Tools and Interfacing ARM with Co-processors.
3. Understand the concepts of Memory Hierarchy, Cache design and Memory Management.
4. Develop an understanding of various interconnect schemes for system Development.
5. Design a simple SoC for reconfigurability/low power/ASIP/NISC etc.

**UNIT I**

**UNIT II**
**Processors:** Introduction, Processor Selection for SOC, Basic concepts in Processor Architecture, Basic concepts in Processor Micro Architecture, Basic elements in Instruction handling. Buffers: minimizing Pipeline Delays, Branches, More Robust Processors, Vector Processors and Vector Instructions extensions, VLIW Processors, Superscalar Processors.

**UNIT III**
**Memory Design for SOC:** Overview of SOC external memory, Internal Memory, Size, Scratchpads and Cache memory, Cache Organization, Cache data, Write Policies, Strategies for line replacement at miss time, Types of Cache, Split – I, and D – Caches, Multilevel Caches, Virtual to real translation, SOC Memory System, Models of Simple Processor – memory interaction.

**UNIT IV**
**Interconnect Customization and Configuration:** Inter Connect Architectures, Bus: Basic Architectures, SOC Standard Buses, Analytic Bus Models, Using the Bus model, Effects of Bus transactions and contention time. SOC Customization: An overview, Customizing Instruction Processor, Reconfiguration Technologies, Mapping design onto Reconfigurable devices, Instance- Specific design, Customizable Soft Processor, Reconfiguration - overhead analysis and trade-off analysis on reconfigurable Parallelism.
UNIT V

Application Studies / Case Studies: SOC Design approach, AES algorithms, Design and evaluation, Image compression – JPEG compression.

Suggested Reading:

4. Jason Andrews, Co-Verification of Hardware and Software for ARM System on Chip Design (Embedded Technology), Newnes, BK and CDROM.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Core/Elective</th>
</tr>
</thead>
<tbody>
<tr>
<td>PC 3303 EV</td>
<td>Real Time Operating Systems</td>
<td>Elective</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Prerequisite</th>
<th>Contact Hours per Week</th>
<th>CIE</th>
<th>SEE</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L T D P</td>
<td>30</td>
<td>70</td>
<td>3</td>
</tr>
</tbody>
</table>

**Course Objectives**
- Understand concepts of OS and RTOS
- Describe UNIX OS
- Distinguish between Hard and Soft RTOS
- Analyse the concept of Embedded RTOS
- Explore VxWorks.

**Course Outcomes**
After completing this course, the student will be able to:
1. Describe the features of UNIX operating system and differentiate between UNIX and POSIX.
2. Differentiate between Hard and Soft Real time systems and familiarize with classical Uni-processor scheduling algorithms.
3. Understand the concepts of Real time operating systems and analyse the Inter process communication.
4. Explain the features of VxWorks and compare the commercially available RTOS's
5. Understand the debugging tools and cross development environment.

**UNIT I**
Portable Operating System Interface (POSIX) – IEEE Standard 1003.13 & POSIX real time profile. POSIX versus traditional Unix signals, overheads and timing predictability.

**UNIT II**

**UNIT III**
Concept of Embedded Operating Systems, Differences between Traditional OS and RTOS. Real time System Concepts, RTOS Kernel & Issues in Multitasking – Task Assignment, Task Priorities, Scheduling, Inter task Communication & Synchronization – Definition of Context Switching, Foreground ISRs and Background Tasks. Critical Section – Reentrant Functions, Inter process Communication (IPC) – IPC through Semaphores, Mutex, Mailboxes, Message Queues or Pipes and Event Flags.

**UNIT IV**
VxWorks – POSIX Real Time Extensions, timeout features, Task Creation, Semaphores (Binary, Counting), Mutex, Mailbox, Message Queues, Memory Management – Virtual to Physical Address Mapping. Comparison of RTOS – VxWorks, μC/OS-II and RT Linux for Embedded Applications.
UNIT V

Suggested Reading:
Course Code | Course Title | Core/Elective
--- | --- | ---
MC 5161 ME | Research Methodology and IPR | Mandatory Course

<table>
<thead>
<tr>
<th>Prerequisite</th>
<th>Contact Hours per Week</th>
<th>CIE</th>
<th>SEE</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3</td>
<td>30</td>
<td>70</td>
<td>3</td>
</tr>
</tbody>
</table>

**Course Objectives**
To make students to
- Motivate to choose research as career
- Formulate the research problem, prepare the research design
- Identify various sources for literature review and data collection report writing
- Equip with good methods to analyse the collected data
- Know about IPR copyrights

**Course Outcomes**
At the end of this course, students will be able to:
1. Define research problem, review and assess the quality of literature from various sources
2. Improve the style and format of writing a report for technical paper/Journal report, understand and develop various research designs
3. Collect the data by various methods: observation, interview, questionnaires
4. Analyse problem by statistical techniques: ANOVA, F-test, Chi-square
5. Understand apply for patent and copyrights

**UNIT - I**
**Research Methodology:** Objectives and Motivation of Research, Types of Research, research approaches, Significance of Research, Research Methods Verses Methodology, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India, Benefits to the society in general. Defining the Research Problem: Selection of Research Problem, Necessity of Defining the Problem

**UNIT - II**
**Literature Survey and Report writing:** Importance and purpose of Literature Survey, Sources of Information, Assessment of Quality of Journals and Articles, Need of Review, Guidelines for Review, Record of Research Review.


**UNIT - III**

**UNIT - IV**
**Data Collection and Analysis:** Methods of data collection, Data organization, Methods of data grouping, Diagrammatic representation of data, Graphic representation of data. Importance of Parametric, non-parametric test, testing of variance of two normal populations, use of Chi-square, ANOVA, F-test, z-test
UNIT - V


**Suggested Readings:**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Core/Elective</th>
</tr>
</thead>
<tbody>
<tr>
<td>OE 9101 CE</td>
<td>Cost Management of Engineering Projects</td>
<td>Open Elective</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Prerequisite</th>
<th>Contact Hours per Week</th>
<th>CIE</th>
<th>SEE</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L  T  D  P</td>
<td>30</td>
<td>70</td>
<td>3</td>
</tr>
</tbody>
</table>

**Course Objectives**

- To apply modern software packages to conduct analysis of real world data.
- To understand the technical underpinning of engineering economic analysis.
- The ability to apply the appropriate analytical techniques to a wide variety of real world problems and data sets.
- To summarize and present the analysis results in a clear and coherent manner.

**Course Outcomes**

At the end of this course, students will be able to:

1. Students should be able to learn the cost concepts in decision making
2. Student should be able to do cost planning and Marginal Costing
3. Students should be able to create a database for operational control and decision making.

**UNIT-I**

**Introduction and Overview of the Strategic Cost Management Process:** Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

**UNIT-II**

**Project:** meaning, Different types, why to manage, cost overruns centers, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non-technical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process.

**UNIT-III**

**Cost Behavior and Profit Planning Marginal Costing:** Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis.


**UNIT-IV**

**Activity-Based Cost Management:** Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

**UNIT-V**

**Quantitative techniques for cost management:** Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.
Suggested Readings:

1. Cost Accounting – A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
Course Code | Course Title | Core/Elective
--- | --- | ---
OE 9102 CS | Business Analytics | Open Elective

<table>
<thead>
<tr>
<th>Prerequisite</th>
<th>Contact Hours per Week</th>
<th>CIE</th>
<th>SEE</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>30</td>
</tr>
</tbody>
</table>

**Course Objectives**

- Understand the role of business analytics within an organization
- Analyse data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization
- To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making
- To become familiar with processes needed to develop, report, and analyse business data
- Use decision-making tools/Operations research techniques
- Manage business process using analytical and management tools
- Analyse and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.
- Student will able to understand the basic rules of research formulation and procedure for obtaining patent rights

**Course Outcomes**

At the end of this course, students will be able to:

1. Students will demonstrate knowledge of data analytics
2. Students will demonstrate the ability of think critically in making decisions based on data and deep analytics
3. Students will demonstrate the ability to use technical skills in predicative and prescriptive modelling to support business decision-making
4. Students will demonstrate the ability to translate data into clear, actionable insights

**UNIT-I**

**Business analytics**: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics.

**Statistical Tools**: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

**UNIT-II**


**UNIT-III**

UNIT-IV
**Forecasting Techniques**: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models.

UNIT-V
**Decision Analysis**: Formulating Decision Problems, Decision Strategies with the without 8 Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.
Recent Trends in Embedded and collaborative business intelligence, Visual data 4 recovery, Data Storytelling and Data journalism.

**Suggested Readings:**
2. Business Analytics by James Evans, persons Education.
Course Code | Course Title | Core/Elective
---|---|---
OE 9103 EC | Embedded System Design | Open Elective

<table>
<thead>
<tr>
<th>Prerequisite</th>
<th>Contact Hours per Week</th>
<th>CIE</th>
<th>SEE</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L</td>
<td>T</td>
<td>D</td>
<td>P</td>
</tr>
</tbody>
</table>
| - | 3 | - | - | - | 30
|  |  |  |  |  | 70
|  |  |  |  |  | 3

### Course Objectives
- Detailed overview of important concepts of Embedded system
- Analyse PIC microcontroller, its features and programming
- Describe ARM Microcontroller architectural details and instruction set
- Understand ARM Memory management
- Learn the techniques to develop an embedded system and case studies

### Course Outcomes
After completing this course, the student will be able to:
1. Understand the fundamentals of the embedded system design
2. Enumerate the instruction set of ARM Processor by studying the architecture of ARM core
3. Acquire knowledge on the serial, parallel and network communication protocols.
4. Learn the embedded system design life cycle and co-design issues.
5. List the various embedded software development tools used in the design of embedded system for various applications.

### UNIT I

### UNIT II
**PIC 18:** Family Overview, Architecture, Instruction Set, Addressing modes. Timers, interrupts of PIC 18, Capture/Compare and PWM modules of PIC 18

### UNIT III
**ARM Architecture:** ARM Design Philosophy, Registers, Program Status Register, Instruction Pipeline, Interrupts and Vector Table, Architecture Revision, ARM Processor Families. Instruction Set: Data Processing Instructions, Addressing Modes, Branch, Load, Store Instructions, PSR Instructions, Conditional Instructions.

### UNIT IV
**ARM Thumb Instruction Set:** Register Usage, Other Branch Instructions, Data Processing Instruction Single-Register and Multi Register Load-Store Instructions, Stack, Software Interrupt Instructions. Exception and interrupt handling.
**ARM Memory Management:** Cache Architecture, Policies, Flushing and Caches, MMU, Page Tables, Translation Access Permissions, Context Switch.

### UNIT V
Case Studies: Design of Embedded Systems using Microcontrollers – for applications in the area of communications and automotives. (GSM/GPRS, CAN, Zigbee)

Suggested Readings:

Course Code | Course Title | Core/Elective
---|---|---
OE 9104 EE | Waste to Energy | Open Elective

<table>
<thead>
<tr>
<th>Prerequisite</th>
<th>Contact Hours per Week</th>
<th>CIE</th>
<th>SEE</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3</td>
<td>30</td>
<td>70</td>
<td>3</td>
</tr>
</tbody>
</table>

**Course Objectives**

- To enable students to aware about the generation of energy from the waste.

**Course Outcomes**

At the end of this course, students will be able to:

1. Students should able to learn the Classification of waste as a fuel.
2. Students should able to learn the Manufacture of charcoal.
3. Students should able to carry out the designing of gasifiers and biomass stoves.
4. Student should able to learn the Biogas plant technology.

**UNIT-I**


**UNIT-II**


**UNIT-III**

**Biomass Combustion:** Biomass stoves – Improved chullahs, types, some exotic designs, fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

**UNIT-IV**

**Biogas:** Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction

**UNIT-V**

**Biochemical conversion:** Anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

**Suggested Readings:**

Faculty of Engineering, O.U.  

AICTE Model Curriculum with effect from Academic Year 2019-20

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Core/Elective</th>
</tr>
</thead>
<tbody>
<tr>
<td>OE 9105 ME</td>
<td>Industrial Safety</td>
<td>Open Elective</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Prerequisite</th>
<th>Contact Hours per Week</th>
<th>CIE</th>
<th>SEE</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>3</td>
<td>30</td>
<td>70</td>
<td>3</td>
</tr>
</tbody>
</table>

**Course Objectives**
- Causes for industrial accidents and preventive steps to be taken.
- Fundamental concepts of Maintenance Engineering.
- About wear and corrosion along with preventive steps to be taken
- The basic concepts and importance of fault tracing.
- The steps involved in carrying out periodic and preventive maintenance of various equipments used in industry

**Course Outcomes**
After completing this course, the student will be equipped with:
1. concepts of engineering systems safety
2. Identify the causes for industrial accidents and suggest preventive measures.
3. Identify the basic tools and requirements of different maintenance procedures.
4. Apply different techniques to reduce and prevent Wear and corrosion in Industry.
5. Identify different types of faults present in various equipments like machine tools, IC Engines, boilers etc.
6. Apply periodic and preventive maintenance techniques as required for industrial equipments like motors, pumps and air compressors and machine tools etc.

**UNIT-I**
**Industrial safety:** Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc., Safety colour codes. Fire prevention and firefighting, equipment and methods.

**UNIT-II**
**Fundamentals of maintenance engineering:** Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

**UNIT-III**
UNIT-IV

Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment’s like, i. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT-V


Suggested Readings:
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Core/Elective</th>
</tr>
</thead>
<tbody>
<tr>
<td>AD 9001 HS</td>
<td>English for Research Paper Writing</td>
<td>Audit I</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Prerequisite</th>
<th>Contact Hours per Week</th>
<th>CIE</th>
<th>SEE</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L</td>
<td>T</td>
<td>D</td>
<td>P</td>
</tr>
</tbody>
</table>

**Course Objectives**

- Understand that how to improve your writing skills and level of readability
- Understand the nuances of language and vocabulary in writing a Research Paper.
- Develop the content, structure and format of writing a research paper.
- Produce original research papers without plagiarism

**Course Outcomes**

After completing this course, the student will be able to:

1. Interpret the nuances of research paper writing.
2. Differentiate the research paper format and citation of sources.
3. To review the research papers and articles in a scientific manner.
4. Avoid plagiarism and be able to develop their writing skills in presenting their research work.
5. Create a research paper and acquire the knowledge of how and where to publish their original research papers.

**UNIT - I**

*Academic Writing:* Meaning & Definition of a research paper – Purpose of a research paper – Scope – Benefits, Limitations – outcomes.

**UNIT - II**

*Research Paper Format:* Title – Abstract – Introduction – Discussion – Findings, Conclusion – Style of Indentation – Font size/Font types – Indexing – Citation of sources.

**UNIT - III**


**UNIT - IV**


**UNIT - V**


*Presentation Skills:* Developing Persuasive Presentations, Structure of Presentation, Presentation Slides, Presentation Delivery, role of the audience, what to search and cite, how to establish credibility.

**Suggested Readings:**

Course Title: Disaster Management

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Core/Elective</th>
</tr>
</thead>
<tbody>
<tr>
<td>AD 9002 CE</td>
<td>Disaster Management</td>
<td>Audit I</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Prerequisite</th>
<th>Contact Hours per Week</th>
<th>CIE</th>
<th>SEE</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L T D P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 - - -</td>
<td>30</td>
<td>70</td>
<td></td>
</tr>
</tbody>
</table>

**Course Objectives**

- To impart knowledge in students about the nature, causes, consequences and mitigation measures of the various natural disasters
- To enable the students to understand risks, vulnerabilities and human errors associated with human induced disasters
- To enable the students to understand and assimilate the impacts of any disaster on the affected area depending on its position/location, environmental conditions, demographic, etc.

**Course Outcomes**

At the end of this course, students will be able to:

1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction
2. and humanitarian response.
3. Critically evaluate disaster risk reduction and humanitarian response policy and Practice from multiple perspectives.
4. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
5. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

**UNIT-I**

**Introduction:** Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

**UNIT-II**

**Repercussions of Disasters and Hazards:** Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem.

**Natural Disasters:** Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

**UNIT-III**

**Disasters Prone Areas in India:** Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics.

**UNIT-IV**

**Disaster Preparedness:** Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.
UNIT-IV


Suggested Readings:
2. Sahni, Pardeep (Eds.), “Disaster Mitigation Experiences and Reflections”, PHI, New Delhi.
Course Code | Course Title                          | Core/Elective |
-------------|--------------------------------------|---------------|
AD 9003 HS   | Sanskrit for Technical Knowledge     | Audit I       |

<table>
<thead>
<tr>
<th>Prerequisite</th>
<th>Contact Hours per Week</th>
<th>CIE</th>
<th>SEE</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L</td>
<td>T</td>
<td>D</td>
<td>P</td>
</tr>
</tbody>
</table>

Course Objectives
- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- To make the novice Learn the Sanskrit to develop the logic in mathematics, science & other subjects
- To explore the huge knowledge from ancient Indian literature

Course Outcomes
At the end of this course, students will be able to:
1. Develop passion towards Sanskrit language
2. Decipher the latent engineering principles from Sanskrit literature
3. Correlates the technological concepts with the ancient Sanskrit history.
4. Develop knowledge for the technological progress
5. Explore the avenue for research in engineering with aid of Sanskrit

UNIT-I
Introduction to Sanskrit Language: Sanskrit Alphabets-vowels-consonants- significance of Amarakosa-parts of Speech-Morphology-creation of new words-significance of synonyms-sandhi-samasa-sutras-active and passive Voice-Past/Present/Future Tense-Syntax-Simple Sentences (elementary treatment only)

UNIT-II
Role of Sanskrit in Basic Sciences: Brahmagupthas lemmas (second degree indeterminate equations), sum of squares of n-terms of AP- sulba, sutram or baudhayana theorem (origination of Pythagoras theorem)-value of pie-Madhava’s sine and cosine theory (origination of Taylor's series).

UNIT-III
Role of Sanskrit in Engineering-I (Civil, Mechanical, Electrical and Electronics Engineering):
Building construction-soil testing-mortar-town planning-Machine definition-crucible-furnace-air blower-Generation of electricity in a cell-magnetism-Solar system-Sun: The source of energy, the earth-Pingala chandasutram (origination of digital logic system)

UNIT-IV
Role of Sanskrit in Engineering-II (Computer Science Engineering & Information Technology):
Computer languages and the Sanskrit languages-computer command words and the vedic command words-anzalogy of pramana in memamsa with operators in computer language-sanskrit analogy of physical sequence and logical sequence, programming.

UNIT-V
Role of Sanskrit in Engineering-III (Bio-technology and Chemical Engineering): Classification of plants-plants, the living-plants have senses-classification of living creatures, Chemical laboratory location and layout- equipment-distillation vessel-kosthi yantram
Suggested Readings:
5. Shri Rama Verma, Vedas the source of ultimate science, Nag publishers, 2005.
Course Code: AD 9004 HS
Course Title: Value Education
Core/Elective: Audit I

<table>
<thead>
<tr>
<th>Prerequisite</th>
<th>Contact Hours per Week</th>
<th>CIE</th>
<th>SEE</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L</td>
<td>T</td>
<td>D</td>
<td>P</td>
</tr>
</tbody>
</table>

Course Objectives
- Understand the need and importance of Values for self-development and for National development.
- Imbibe good human values and Morals
- Cultivate individual and National character.

Course Outcomes
After completion of the course, students will be able to:
1. Gain necessary Knowledge for self-development
2. Learn the importance of Human values and their application in day to day professional life.
3. Appreciate the need and importance of interpersonal skills for successful career and social life
4. Emphasize the role of personal and social responsibility of an individual for all-round growth.
5. Develop a perspective based on spiritual outlook and respect women, other religious practices, equality, non-violence and universal brotherhood.

UNIT-I
Human Values, Ethics and Morals: Concept of Values, Indian concept of humanism, human values; Values for self-development, Social values, individual attitudes; Work ethics, moral and non-moral behaviour, standards and principles based on religion, culture and tradition.

UNIT-II
Value Cultivation, and Self-management: Need and Importance of cultivation of values such as Sense-of Duty, Devotion to work, Self-reliance, Confidence, Concentration, Integrity & discipline, and Truthfulness.

UNIT-III
Spiritual outlook and social values: Personality and Behavior, Scientific attitude and Spiritual (soul) outlook; Cultivation of Social Values Such as Positive Thinking, Punctuality, Love & Kindness, avoiding fault finding in others, Reduction of anger, forgiveness, Dignity of labour, True friendship, Universal brotherhood and religious tolerance.

UNIT-IV

UNIT-V
Dharma, Karma and Guna: Concept of soul; Science of Reincarnation, Character and Conduct, Concept of Dharma; Cause and Effect based Karma Theory; The qualities of Devine and Devilish; Satwic, Rajasic and Tamasic gunas.

Suggested Readings:
Course Code | Course Title | Core/Elective
--- | --- | ---
AD 9011 HS | Constitution of India and Fundamental Rights | Audit II

<table>
<thead>
<tr>
<th>Prerequisite</th>
<th>Contact Hours per Week</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Course Objectives

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective and to address the growth of Indian opinion regarding modern Indian intellectuals’ constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.

Course Outcomes

At the end of this course, students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.

UNIT-I

**History of Making of the Indian Constitution**: History, Drafting Committee, (Composition & Working)
Philosophy of the Indian Constitution: Preamble, Salient Features.

UNIT-II


UNIT-III

**Organs of Governance**: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications. Powers and Functions.

UNIT-IV

**Local Administration**: District’s Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative CEO of Municipal Corporation, Panchayat raj: Introduction, PRI: Zilla Panchayat, Elected officials and their roles, CEO Zilla Panchayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT-V

**Election Commission**: Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.
Suggested Readings:
1. The Constitution of India, 1950 (Bare Act), Government Publication.
Course Code | Course Title | Core/Elective
--- | --- | ---
AD 9012 HS | Pedagogy Studies | Audit II

<table>
<thead>
<tr>
<th>Prerequisite</th>
<th>Contact Hours per Week</th>
<th>CIE</th>
<th>SEE</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Course Objectives

- To present the basic concepts of design and policies of pedagogy studies.
- To provide understanding of the abilities and dispositions with regard to teaching techniques, curriculum design and assessment practices.
- To familiarize various theories of learning and their connection to teaching practice.
- To create awareness about the practices followed by DFID, other agencies and other researchers.
- To provide understanding of critical evidence gaps that guides the professional development

Course Outcomes

At the end of this course, students will be able to:

1. Illustrate the pedagogical practices followed by teachers in developing countries both in formal and informal classrooms.
2. Examine the effectiveness of pedagogical practices.
3. Understand the concept, characteristics and types of educational research and perspectives of research.
4. Describe the role of classroom practices, curriculum and barriers to learning.
5. Understand Research gaps and learn the future directions.

UNIT-I

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions, Overview of methodology and Searching.

UNIT-II

Thematic Overview: Pedagogical practices followed by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education

UNIT-III

Evidence on the Effectiveness of Pedagogical Practices: Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and Practicum) and the school curriculum and guidance material best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches – Teachers attitudes and beliefs and pedagogic strategies.

UNIT-IV

Professional Development: alignment with classroom practices and follow up support - Support from the head teacher and the community – Curriculum and assessment - Barriers to learning: Limited resources and large class sizes.

UNIT-V

Research Gaps and Future Directions: Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment – Dissemination and research impact.
Suggested Readings:
Course Code | Course Title | Core/Elective
--- | --- | ---
AD 9013 HS | Stress Management by Yoga | Audit II

<table>
<thead>
<tr>
<th>Prerequisite</th>
<th>Contact Hours per Week</th>
<th>CIE</th>
<th>SEE</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L</td>
<td>T</td>
<td>D</td>
<td>P</td>
</tr>
<tr>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**Course Objectives**
The Course will introduce the students to
- Creating awareness about different types of stress and the role of yoga in the management of stress.
- Promotion of positive health and overall wellbeing (Physical, mental, emotional, social and spiritual).
- Prevention of stress related health problems by yoga practice.

**Course Outcomes**
After successful completion of the course, the students will be able to:
1. Understand yoga and its benefits.
2. Enhance Physical strength and flexibility.
3. Learn to relax and focus.
4. Relieve physical and mental tension through asanas.
5. Improve work performance and efficiency.

**UNIT - I**
**Meaning and Definition of Yoga** - Historical perspective of Yoga - Principles of Astanga Yoga by Patanjali.

**UNIT - II**

**UNIT - III**
**Concept of Stress According to Yoga** - Stress assessment methods - Role of Asana, Pranayama and Meditation in the management of stress

**UNIT - IV**
**Asanas** - (5 Asanas in each posture) - Warm up - Standing Asanas - Sitting Asanas - Prone Asanas - Supine asanas - Surya Namaskar.

**UNIT - V**
**Pranayama**- Anulom and Vilom Pranayama - Nadishudhi Pranayama - Kapalabhati Pranayama - Bhramari Pranayama - Nadanusandhana Pranayama.
**Meditation Techniques:** Om Meditation - Cyclic meditation: Instant Relaxation technique (QRT), Quick Relaxation Technique (QRT), Deep Relaxation Technique (DRT)

**Suggested Readings:**
2. Swami Vivekananda, “Rajayoga or Conquering the Internal Nature”, Advaita Ashrama (Publication Department), Kolkata.
**Course Code**: AD 9014 HS  
**Course Title**: Personality Development Through Life Enlightenment Skills  
**Core/Elective**: Audit II

<table>
<thead>
<tr>
<th>Prerequisite</th>
<th>Contact Hours per Week</th>
<th>CIE</th>
<th>SEE</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L</td>
<td>T</td>
<td>D</td>
<td>P</td>
</tr>
<tr>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**Course Objectives**
- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

**Course Outcomes**
At the end of this course, students will be able to:
1. Develop their personality and achieve their highest goal of life.
2. Lead the nation and mankind to peace and prosperity.
4. Develop a positive approach to work and duties.
5. Develop a versatile personality.

**UNIT - I**
**Neetisatakam – Holistic Development of Personality** - Verses 19, 20, 21, 22 (Wisdom) - Verses 29, 31, 32 (Pride and Heroism) - Verses 26,28,63,65 (Virtue)

**UNIT - II**
**Neetisatakam – Holistic Development of Personality (cont’d)** - Verses 52, 53, 59 (don’ts) - Verses 71,73,75 & 78 (do’s) - Approach to day to day works and duties.

**UNIT - III**
**Introduction to Bhagavadgeetha for Personality Development - Shrimad Bhagavadgeetha**: Chapter 2 – Verses 41, 47, 48 - Chapter 3 – Verses 13,21,27,35 - Chapter 6 – Verses 5,13,17,23,35 - Chapter 18 –Verses 45, 46, 48 Chapter – 6: Verses 5, 13, 17, 23, 35; Chapter – 18: Verses 45, 46, 48

**UNIT - IV**
**Statements of Basic Knowledge - Shrimad Bhagavadgeetha**: Chapter 2- Verses 56, 62,68 - Chapter 12 – Verses 13, 14, 15, 16, 17, 18 - Personality of Role model from Shrimad Bhagawat Geeta.

**UNIT - V**
**Role of Bhagavadgeetha in the Present Scenario** - Chapter 2 – Verses 17 - Chapter 3 – Verses 36, 37, 42 - Chapter 4 – Verses 18, 38, 39 - Chapter 18 – Verses 37, 38, 63.

**Suggested Readings:**
1. Srimad Bhagavad Gita, Swami Swarupananda Advaita Ashram (Publication Department), Kolkata
2. Bhartrihari’s Three Satakam (Niti-sringar-vairagya), P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi

**Online Resources:** NTPEL: [http://nptel.ac.in/downloads/109104115/](http://nptel.ac.in/downloads/109104115/)
Course Code | Course Title | Core/Elective
--- | --- | ---
PC 3251 ES | Embedded Systems Lab – I | Core

<table>
<thead>
<tr>
<th>Prerequisite</th>
<th>Contact Hours per Week</th>
<th>CIE</th>
<th>SEE</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>50</td>
<td>1</td>
</tr>
</tbody>
</table>

### Course Outcomes
After completing this course, the student will be able to:

1. Write programs for interfacing applications
2. Experience with a set of tools for embedded systems programming and debugging
3. Experience with implementing several embedded systems with particular focus on the interaction between multiple devices.
4. Write programs of serial communication
5. Design prototypes using microcontrollers and various analog and digital ICs

### Cycle 1: Programming in 8051

1. Study of 8051 Evaluation Board Trainer kit and Keil IDE Software Tool.
2. Serial Data Transmission
3. Interface switches and LEDs
4. Interface LCD
5. Interface 4*4 matrix keyboard
6. Interface stepper motor
7. Interface 7 Segment Display using I2C
8. ADC, DAC Interface

### Cycle 2: Programming in LPC2148 ARM Processor

1. Configure and Control General Purpose I/O Pins
2. Interfacing LED & Switch Interface
3. 2*16 LCD Display
4. Serial Communication
5. I2C Interface & EEPROM Interface
6. Buzzer Interface
7. SD-MMC Card Interface

**Note:** all the experiments are to be carried out independently by each student with different specifications. At least 12 experiments are to be carried out.
Course Code | Course Title | Core/Elective
---|---|---
PC 3252 ES | IoT Lab | Core

<table>
<thead>
<tr>
<th>Prerequisite</th>
<th>Contact Hours per Week</th>
<th>CIE</th>
<th>SEE</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L</td>
<td>T</td>
<td>D</td>
<td>P</td>
</tr>
</tbody>
</table>

**Course Outcomes**

After completing this course, the student will be able to:

1. Experience ESP32/ESP8266
2. Experience with implementing several IoT applications
3. Work with different communication techniques
4. Send data to mobile application
5. Send data to webpage

Note: Following are some of the programs that a student should be able to write and test on an ESP32/ESP3266, but not limited to this only.

**Cycle 1:**

1. Use of ESP32/ESP8266 and Arduino IDE. Interface ESP32/ESP8266 with Arduino IDE.
2. Interface LED and Switch to ESP32/ESP8266.
3. Flash an LED at given on time and off time cycle.
4. Interface LCD and GLCD with ESP32/ESP8266 to display text data and graphical data.
5. Interface Temperature and humidity sensors to ESP32/ESP8266 using ADC.
6. Interface GSM module to ESP32/ESP8266 using UART protocol.

**Cycle 2:**

7. RTC interface with ESP32/ESP8266 to display time and date on LCD using I2C protocol.
8. External memory interfacing to ESP32/ESP8266 for storing data using SPI protocol.
9. Interface Bluetooth to send data from ESP32/ESP8266 to mobile application.
10. LoRa (SX1276/78) interface with ESP32/ESP8266 to send data from transmission node to receiver node.
11. Interface any sensor to ESP32/ESP8266 and send the sensor data to webpage using TCP/IP or HTTP protocol.
12. Control a light source using web page.
13. Case study-1

**Additional programs:**

1. GPRS interfacing with ESP32/ESP8266.
2. Control relay using ESP32/ESP8266 and webpage/mobile app.

Note: all the experiments are to be carried out independently by each student with different specifications. At least 12 experiments are to be carried out.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Core/Elective</th>
</tr>
</thead>
<tbody>
<tr>
<td>PC 3253 ES</td>
<td>Embedded Systems Lab – II</td>
<td>Core</td>
</tr>
</tbody>
</table>

**Course Outcomes**

After completing this course, the student will be able to:

1. Demonstrate Task Management and Inter-Task Communication
2. Demonstrate Message queues and priority inversion
3. Experience the PSOC
4. Design dynamic architectures using FPGA
5. Design arithmetic unit

**Cycle 1: Real Time Operating System (RTOS):**

1. Multitasking
2. Task and Button-Parallel Execution
3. Task and Multiple Interrupts – Parallel Execution
4. Message Queues
5. Priority Inversion

**Cycle 2:**

**Part-1: Understanding PSOC**

1. Study and Characterization of programmable gain amplifier (PGA)
2. On chip ADC and DAC Realization
3. LED Control and Pattern Generation

**Part-2 FPGA Programming:**

1. Design Simulation & synthesis of combinational circuits
2. Design VGA controller.
3. Designing UART interface on SOC platform.
4. Designing basic DSP designs like adder, multiplier, etc.;
5. Design and development of FIR filter.

Note: all the experiments are to be carried out independently by each student with different specifications. At least 12 experiments are to be carried out.
Course Code | Course Title | Core/Elective
---|---|---
PC 3254 ES | Seminar | Core

<table>
<thead>
<tr>
<th>Prerequisite</th>
<th>Contact Hours per Week</th>
<th>CIE</th>
<th>SEE</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>-</td>
<td>2</td>
<td>50</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>At the end of this course, students will be able to:</td>
</tr>
<tr>
<td>1. Develop the habit of referring the journals for literature review.</td>
</tr>
<tr>
<td>2. Understand the gist of the research paper.</td>
</tr>
<tr>
<td>3. Identify the potential for further scope.</td>
</tr>
<tr>
<td>4. Present the work in an efficient manner.</td>
</tr>
<tr>
<td>5. Write the documentation in standard format.</td>
</tr>
</tbody>
</table>

Seminar topics may be chosen by the students with advice from the faculty members and the student shall read further relevant articles in the domain.

The seminar must be clearly structured and the power point presentation shall include following aspects:

1. Introduction to the field
2. Literature survey
3. Consolidation of available information
4. Summary and Conclusions
5. References

Each student is required to:

1. Deliver the seminar for a maximum duration of 30 minutes, where the presentation should be for 20 minutes in PowerPoint, followed by Question and Answers session for 10 minutes.
2. Submit the detailed report of the seminar in spiral bound in a précised format as suggested by the Department.

Guidelines for awarding marks

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Description</th>
<th>Max. Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Contents and relevance</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>Presentation skills</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>Preparation of PPT slides</td>
<td>05</td>
</tr>
<tr>
<td>4</td>
<td>Questions and answers</td>
<td>05</td>
</tr>
<tr>
<td>5</td>
<td>Report in a prescribed format</td>
<td>20</td>
</tr>
</tbody>
</table>

Note:

1. The seminar presentation should be a gist of at least five research papers from Peer-reviewed or UGC recognised journals.
2. The seminar report should be in the following order: Background of work, literature review, techniques used, prospective deliverables, discussion on results, conclusions, critical appraisal and reference.
3. At least two faculty members will be associated with the seminar presentation to evaluate and award marks.
4. Attendance of all the students for weekly seminar presentations is compulsory. If the student fails to secure minimum attendance as per O.U. rules, the marks awarded in the seminar presentation shall remain void.
Faculty of Engineering, O.U.  

AICTE Model Curriculum with effect from Academic Year 2019-20

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Core/Elective</th>
</tr>
</thead>
<tbody>
<tr>
<td>PC 3255 ES</td>
<td>Mini Project with Seminar</td>
<td>Core</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Prerequisite</th>
<th>Contact Hours per Week</th>
<th>CIE</th>
<th>SEE</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L  T  D  P</td>
<td>4</td>
<td>50</td>
<td>2</td>
</tr>
</tbody>
</table>

Course Outcomes
At the end of this course, students will be able to:
1. Formulate a specific problem and give solution
2. Develop model/models either theoretical/practical/numerical form
3. Solve, interpret/correlate the results and discussions
4. Conclude the results obtained
5. Write the documentation in standard format

Guidelines:
- As part of the curriculum in the II- semester of the programme each student shall do a mini project, generally comprising about three to four weeks of prior reading, twelve weeks of active research, and finally a presentation of their work for assessment.
- Each student will be allotted to a faculty supervisor for mentoring.
- Mini projects should present students with an accessible challenge on which to demonstrate competence in research techniques, plus the opportunity to contribute something more original.
- Mini projects shall have interdisciplinary/industry relevance.
- The students can select a mathematical modeling based/Experimental investigations or Numerical modeling
- All the investigations should be clearly stated and documented with the reasons/explanations.
- The mini-project shall contain a clear statement of the research objectives, background of work, literature review, techniques used, prospective deliverables, and detailed discussion on results, conclusions and reference

Departmental committee: Supervisor and a minimum of two faculty members

| Guidelines for awarding marks in CIE (Continuous Internal Evaluation): Max. Marks: 50 |
|------------------------------------------------------------------------|---------------------------------|
| Evaluation by              | Max. Marks | Evaluation Criteria / Parameter          |
| Supervisor                 |            | Progress and Review                     |
|                           | 20         | Report                                  |
|                           | 05         |                                        |
| Departmental Committee     | 05         | Relevance of the Topic                  |
|                           | 05         | PPT Preparation                         |
|                           | 05         | Presentation                            |
|                           | 05         | Question and Answers                     |
|                           | 05         | Report Preparation                      |
Course Code | Course Title | Core/Elective
--- | --- | ---
PC 3256 ES | Major Project Phase – I | Core

<table>
<thead>
<tr>
<th>Prerequisite</th>
<th>Contact Hours per Week</th>
<th>CIE</th>
<th>SEE</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L</td>
<td>T</td>
<td>D</td>
<td>P</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>-</td>
<td>-</td>
<td>10</td>
</tr>
</tbody>
</table>

**Course Outcomes**
At the end of this course, students will be able to:
1. Exposed to self-learning various topics.
2. Learn to survey the literature such as books, journals and contact resource persons for the selected topic of research.
3. Learn to write technical reports.
4. Develop oral and written communication skills to present.
5. Defend their work in front of technically qualified audience.

**Guidelines:**
- The Project work will preferably be a problem with research potential and should involve scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution.
- Seminar should be based on the area in which the candidate has undertaken the dissertation work.
- The CIE shall include reviews and the preparation of report consisting of a detailed problem statement and a literature review.
- The preliminary results (if available) of the problem may also be discussed in the report.
- The work has to be presented in front of the committee consists of Chairperson-BoS, Osmania University and Head, Supervisor & Project coordinator from the respective Department of the Institute.
- The candidate has to be in regular contact with his supervisor and the topic of dissertation must be mutually decided by the guide and student.

**Guidelines for awarding marks in CIE (Continuous Internal Evaluation): Max. Marks: 100**

<table>
<thead>
<tr>
<th>Evaluation by</th>
<th>Max. Marks</th>
<th>Evaluation Criteria / Parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supervisor</td>
<td>30</td>
<td>Project Status / Review(s)</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>Report</td>
</tr>
<tr>
<td>Departmental Committee (Chairperson BoS, Osmania University and Head, Supervisor &amp; Project coordinator from the respective department of the institution)</td>
<td>10</td>
<td>Relevance of the Topic</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>PPT Preparation</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>Presentation</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>Question and Answers</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>Report Preparation</td>
</tr>
</tbody>
</table>

**Note:** The Supervisor has to assess the progress of the student regularly.
Course Code | Course Title | Core/Elective
--- | --- | ---
PC 3257 ES | Major Project Phase – II (Dissertation) | Core

Prerequisite | Contact Hours per Week | CIE | SEE | Credits
--- | --- | --- | --- | ---
- | - | - | 32 | - | 200 | 16

Course Outcomes
At the end of this course, students will be able to:
1. Use different experimental techniques and will be able to use different software/computational /analytical tools.
2. Design and develop an experimental set up/equipment/test rig.
3. Conduct tests on existing set ups/equipments and draw logical conclusions from the results after analysing them.
4. Either work in a research environment or in an industrial environment.
5. Conversant with technical report writing and will be able to present and convince their topic of study to the engineering community.

Guidelines:
- It is a continuation of Major Project Phase – I started in semester - III.
- The student has to submit the report in prescribed format and also present a seminar.
- The dissertation should be presented in standard format as provided by the department.
- The candidate has to prepare a detailed project report consisting of introduction of the problem, problem statement, literature review, objectives of the work, methodology (experimental set up or numerical details as the case may be) of solution and results and discussion.
- The report must bring out the conclusions of the work and future scope for the study. The work has to be presented in front of the examiners panel consisting of an approved external examiner and Chairperson BoS, & Head, Osmania University and Supervisor from the Institute.
- The candidate has to be in regular contact with his/her Supervisor / Co-Supervisor

Guidelines for awarding marks in SEE (Semester End Examination): Max. Marks: 200

<table>
<thead>
<tr>
<th>Evaluation by</th>
<th>Max. Marks</th>
<th>Evaluation Criteria / Parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supervisor</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
10 | Regularity and Punctuality |
10 | Work Progress |
30 | Quality of the work which may lead to publications |
10 | Analytical / Programming / Experimental Skills Preparation |
10 | Report preparation in a standard format |
| External Examiner and Chairperson, BoS & Head, Osmania University (All together) | 20 | Power Point Presentation |
60 | Quality of thesis and evaluation |
30 | Innovations, application to society and Scope for future study |
20 | Viva-Voce |