SCHOOL OF ELECTRONICS ENGINEERING

B. Tech Electronics and Communication Engineering
Specialization in Internet of Things & Sensor
B.TECH (ECE with IoT & Sensor)

Curriculum
(2018-2019 admitted students)
VISION STATEMENT OF VELLORE INSTITUTE OF TECHNOLOGY

Transforming life through excellence in education and research.

MISSION STATEMENT OF VELLORE INSTITUTE OF TECHNOLOGY

  - **World class Education**: Excellence in education, grounded in ethics and critical thinking, for improvement of life.
  - **Cutting edge Research**: An innovation ecosystem to extend knowledge and solve critical problems.
  - **Impactful People**: Happy, accountable, caring and effective workforce and students.
  - **Rewarding Co-creations**: Active collaboration with national & international industries & universities for productivity and economic development.
  - **Service to Society**: Service to the region and world through knowledge and compassion.

VISION STATEMENT OF THE SCHOOL OF ELECTRONICS ENGINEERING

To be a leader by imparting in-depth knowledge in Electronics Engineering, nurturing engineers, technologists and researchers of highest competence, who would engage in sustainable development to cater the global needs of industry and society.

MISSION STATEMENT OF THE SCHOOL OF ELECTRONICS ENGINEERING

- Create and maintain an environment to excel in teaching, learning and applied research in the fields of electronics, communication engineering and allied disciplines which pioneer for sustainable growth.

- Equip our students with necessary knowledge and skills which enable them to be lifelong learners to solve practical problems and to improve the quality of human life.
B. Tech Electronics and Communication Engineering  
Specialization with Internet of Things & Sensor  

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)  

1. Graduates will be engineering practitioners and leaders, who would help solve industry’s technological problems  
2. Graduates will be engineering professionals, innovators or entrepreneurs engaged in technology development, technology deployment, or engineering system implementation in industry  
3. Graduates will function in their profession with social awareness and responsibility  
4. Graduates will interact with their peers in other disciplines in industry and society and contribute to the economic growth of the country  
5. Graduates will be successful in pursuing higher studies in engineering or management  
6. Graduates will pursue career paths in teaching or research
B. Tech Electronics and Communication Engineering
Specialization with Internet of Things & Sensor

PROGRAMME OUTCOMES (POs)

PO_01: Having an ability to apply mathematics and science in engineering applications.

PO_02: Having a clear understanding of the subject related concepts and of contemporary issues and apply them to identify, formulate and analyse complex engineering problems.

PO_03: Having an ability to design a component or a product applying all the relevant standards and with realistic constraints, including public health, safety, culture, society and environment.

PO_04: Having an ability to design and conduct experiments, as well as to analyse and interpret data, and synthesis of information.

PO_05: Having an ability to use techniques, skills, resources and modern engineering and IT tools necessary for engineering practice.

PO_06: Having problem solving ability- to assess social issues (societal, health, safety, legal and cultural) and engineering problems.

PO_07: Having adaptive thinking and adaptability in relation to environmental context and sustainable development.

PO_08: Having a clear understanding of professional and ethical responsibility.

PO_09: Having cross cultural competency exhibited by working as a member or in teams.

PO_10: Having a good working knowledge of communicating in English – communication with engineering community and society.

PO_11: Having a good cognitive load management skills related to project management and finance.

PO_12: Having interest and recognise the need for independent and lifelong learning.
B. Tech Electronics and Communication Engineering
Specialization with Internet of Things & Sensor

ADDITIONAL PROGRAMME OUTCOMES (APOs)

APO_01: Having an ability to be socially intelligent with good SIQ (Social Intelligence Quotient) and EQ (Emotional Quotient)

APO_02: Having Sense-Making Skills of creating unique insights in what is being seen or observed (Higher level thinking skills which cannot be codified)

APO_03: Having design thinking capability

APO_04: Having computational thinking (Ability to translate vast data in to abstract concepts and to understand database reasoning

APO_05: Having Virtual Collaborating ability

APO_06: Having an ability to use the social media effectively for productive use

APO_07: Having critical thinking and innovative skills

APO_08: Having a good digital footprint
B. Tech Electronics and Communication Engineering 
Specialization with Internet of Things & Sensor

PROGRAMME SPECIFIC OUTCOMES (PSOs)

On completion of B.Tech. ECE with Specialization in Internet of Things and Sensors program, graduates will be able to

**PSO1.** Design and develop components and systems for applications related to Electronics & Communication, Embedded systems, Sensors & Data Acquisition Systems, Cloud Computing and Information security in the context of Internet of things.

**PSO2.** Apply modern engineering tools to solve complex Electronics & Communication Engineering problems pertaining to Internet of things and sensors.

**PSO3.** Solve interdisciplinary problems in the fields such as Smart Agriculture, Telemetry, Health, Transportation, Energy and others.
B. Tech Electronics and Communication Engineering
Specialization with Internet of Things & Sensor

CREDIT STRUCTURE

Category-wise Credit distribution

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B. Tech Electronics and Communication Engineering
Specialization with Internet of Things & Sensor

DETAILED CURRICULUM

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**University Elective Baskets**

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University Core
Course Objectives:
1. To make students understand and appreciate the unity of life in all its forms, the implications of life style on the environment.
2. To understand the various causes for environmental degradation.
3. To understand individuals contribution in the environmental pollution.
4. To understand the impact of pollution at the global level and also in the local environment.

Expected Course Outcome: Students will be able to
1. Students will recognize the environmental issues in a problem oriented interdisciplinary perspectives
2. Students will understand the key environmental issues, the science behind those problems and potential solutions.
3. Students will demonstrate the significance of biodiversity and its preservation
4. Students will identify various environmental hazards
5. Students will design various methods for the conservation of resources
6. Students will formulate action plans for sustainable alternatives that incorporate science, humanity, and social aspects
7. Students will have foundational knowledge enabling them to make sound life decisions as well as enter a career in an environmental profession or higher education.

Student Learning Outcomes (SLO): 1,2,3,4,5,9,11,12
1. Having an ability to apply mathematics and science in engineering applications
2. Having a clear understanding of the subject related concepts and of contemporary issues
3. Having an ability to be socially intelligent with good SIQ (Social Intelligence Quotient) and EQ (Emotional Quotient)
4. Having Sense-Making Skills of creating unique insights in what is being seen or observed (Higher level thinking skills which cannot be codified)
5. Having design thinking capability
9. Having problem solving ability- solving social issues and engineering problems
11. Having interest in lifelong learning
12. Having adaptive thinking and adaptability

Module:1 Environment and Ecosystem 7 hours
Key environmental problems, their basic causes and sustainable solutions. IPAT equation. Ecosystem, earth – life support system and ecosystem components; Food chain, food web, Energy flow in ecosystem; Ecological succession- stages involved, Primary and secondary succession, Hydrarch, mesarch, xerarch; Nutrient, water, carbon, nitrogen, cycles; Effect of human activities on these cycles.

Module:2 Biodiversity 6 hours
Importance, types, mega-biodiversity; Species interaction - Extinct, endemic, endangered and rare species; Hot-spots; GM crops- Advantages and disadvantages; Terrestrial biodiversity and Aquatic biodiversity – Significance, Threats due to natural and anthropogenic activities and Conservation methods.
### Module:3  Sustaining Natural Resources and Environmental Quality  7 hours

### Module:4  Energy Resources  6 hours

### Module:5  Environmental Impact Assessment  6 hours
Introduction to environmental impact analysis. EIA guidelines, Notification of Government of India (Environmental Protection Act – Air, water, forest and wild life). Impact assessment methodologies. Public awareness. Environmental priorities in India.

### Module:6  Human Population Change and Environment  6 hours
Urban environmental problems; Consumerism and waste products; Promotion of economic development – Impact of population age structure – Women and child welfare, Women empowerment. Sustaining human societies: Economics, environment, policies and education.

### Module:7  Global Climatic Change and Mitigation  5 hours

### Module:8  Contemporary issues  2 hours
Lecture by Industry Experts

| Total Lecture hours: | 45 hours |

**Text Books**

**Reference Books**

**Mode of evaluation:** Internal Assessment (CAT, Quizzes, Digital Assignments) & FAT

**Recommended by Board of Studies:** 12.08.2017
**Approved by Academic Council:** No. 46  Date 24.08.2017
### Course Objectives:

1. To develop broad understanding of computers, programming languages and their generations
2. Introduce the essential skills for a logical thinking for problem solving
3. To gain expertise in essential skills in programming for problem solving using computer

### Expected Course Outcome:

1. Understand the working principle of a computer and identify the purpose of a computer programming language.
2. Learn various problem solving approaches and ability to identify an appropriate approach to solve the problem
3. Differentiate the programming Language constructs appropriately to solve any problem
4. Solve various engineering problems using different data structures
5. Able to modulate the given problem using structural approach of programming
6. Efficiently handle data using flat files to process and store data for the given problem

### Student Learning Outcomes (SLO):

1. Having an ability to apply mathematics and science in engineering applications
12. Having adaptive thinking and adaptability
14. Having an ability to design and conduct experiments, as well as to analyze and interpret data

### List of Challenging Experiments (Indicative)

1. Steps in Problem Solving Drawing flowchart using yEd tool/Raptor Tool 3 Hours
2. Introduction to Python, Demo on IDE, Keywords, Identifiers, I/O Statements 4 Hours
3. Simple Program to display Hello world in Python.
4. Operators and Expressions in Python 4 Hours
5. Algorithmic Approach 1: Sequential 2 Hours
6. Algorithmic Approach 2: Selection (if, elif, if.. else, nested if else 2 Hours
7. Algorithmic Approach 3: Iteration (while and for) 4 Hours
8. Strings and its Operations 2 Hours
9. Regular Expressions 2 Hours
10. List and its operations. 2 Hours
11. Dictionaries: operations 2 Hours
12. Tuples and its operations 2 Hours
13. Set and its operations 2 Hours
14. Functions, Recursions 2 Hours
15. Sorting Techniques (Bubble/Selection/Insertion) 4 Hours
16. Searching Techniques: Sequential Search and Binary Search 3 Hours
17. Files and its Operations 4 Hours

**Total Lecture hours:** 45 hours

### Text Book(s)

John V. Guttag., 2016. Introduction to computation and programming using python: with applications to understanding data. PHI Publisher.

### Reference Books

<table>
<thead>
<tr>
<th>Mode of Evaluation:</th>
<th>PAT / CAT / FAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommended by Board of Studies</td>
<td>04-04-2014</td>
</tr>
<tr>
<td>Approved by Academic Council</td>
<td>No. 38</td>
</tr>
</tbody>
</table>
### Course Objectives:
1. To emphasize the benefits of object oriented concepts.
2. To enable students to solve the real time applications using object oriented programming features.
3. To improve the skills of a logical thinking and to solve the problems using any processing elements.

### Expected Course Outcome:
1. Demonstrate the basics of procedural programming and to represent the real world entities as programming constructs.
2. Enumerate object oriented concepts and translate real-world applications into graphical representations.
3. Demonstrate the usage of classes and objects of the real world entities in applications.
4. Discriminate the reusability and multiple interfaces with same functionality based features to solve complex computing problems.
5. Illustrate possible error-handling constructs for unanticipated states/inputs and to use generic programming constructs to accommodate different datatypes.
6. Validate the program against file inputs towards solving the problem.

### Student Learning Outcomes (SLO): 1,9,17
1. Having an ability to apply mathematics and science in engineering applications.
17. Having an ability to use techniques, skills and modern engineering tools necessary for engineering practice.

### Module: 1 Structured Programming 12 hours
Structured Programming conditional and looping statements - arrays - functions - pointers - dynamic memory allocation - structure.

### Module: 2 Introduction to object oriented approach 10 ours

### Module: 3 Classes and objects 14 hours
Classes and objects: Definition of classes access specifier class versus structure constructor destructor copy constructor and its importance array of objects dynamic objects - friend function-friend class.

### Module: 4 Polymorphism and Inheritance 26 hours
### Module: 5 Exception handling and Templates

<table>
<thead>
<tr>
<th>Exception handling and Templates</th>
<th>18 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exception handling (user-defined exception) - Function template, Class template Template with inheritance, STL Container, Algorithm, Iterator - vector, list, stack, map</td>
<td></td>
</tr>
</tbody>
</table>

### Module: 6 IO Streams and Files

<table>
<thead>
<tr>
<th>IO Streams and Files</th>
<th>10 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>IOstreams and Files, Manipulators - overloading Inserters( ) and Extractors( ), Sequential and Random files writing and reading objects into/from files</td>
<td></td>
</tr>
</tbody>
</table>

### Text Book(s)


### Reference Books


### Mode of Evaluation

- CAT / Assignment / Quiz / FAT / Project / Seminar

### List of Challenging Experiments (Indicative)

<table>
<thead>
<tr>
<th>EXPERIMENT</th>
<th>DESCRIPTION</th>
<th>HOURS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Postman Problem</td>
<td>A postman needs to walk down every street in his area in order to deliver the mail. Assume that the distances between the streets along the roads are given. The postman starts at the post office and returns back to the post office after delivering all the mails. Implement an algorithm to help the post man to walk minimum distance for the purpose.</td>
<td>10 hours</td>
</tr>
<tr>
<td>2. Budget Allocation for Marketing Campaign</td>
<td>A mobile manufacturing company has got several marketing options such as Radio advertisement campaign, TV non peak hours campaign, City top paper network, Viral marketing campaign, Web advertising. From their previous experience, they have got a statistics about paybacks for each marketing option. Given the marketing budget (rupees in crores) for the current year and details of paybacks for each option, implement an algorithm to determine the amount that shall spent on each marketing option so that the company attains the maximum profit.</td>
<td>15 hours</td>
</tr>
<tr>
<td>3. Missionaries and Cannibals</td>
<td>Three missionaries and three cannibals are on one side of a river, along with a boat that can hold one or two people. Implement an algorithm to find a way to get everyone to the other side of the river, without ever leaving a group of missionaries in one place outnumbered by the cannibals in that place.</td>
<td>10 hours</td>
</tr>
<tr>
<td>4. Register Allocation Problem</td>
<td>A register is a component of a computer processor that can hold any type of data and can be accessed faster. As registers are faster to access, it is</td>
<td>15 hours</td>
</tr>
</tbody>
</table>
desirable to use them to the maximum so that the code execution is faster.

For each code submitted to the processor, a register interference graph (RIG) is constructed. In a RIG, a node represents a temporary variable and an edge is added between two nodes (variables) $t_1$ and $t_2$ if they are live simultaneously at some point in the program. During register allocation, two temporaries can be allocated to the same register if there is no edge connecting them. Given a RIG representing the dependencies between variables in a code, implement an algorithm to determine the number of registers required to store the variables and speed up the code execution.

5. **Selective Job Scheduling Problem**

A server is a machine that waits for requests from other machines and responds to them. The purpose of a server is to share hardware and software resources among clients. All the clients submit the jobs to the server for execution and the server may get multiple requests at a time. In such a situation, the server schedule the jobs submitted to it based on some criteria and logic. Each job contains two values namely time and memory required for execution. Assume that there are two servers that schedules jobs based on time and memory. The servers are named as Time Schedule Server and memory Schedule Server respectively. Design a OOP model and implement the Time Schedule Server and memory Schedule Server. The Time Schedule Server arranges jobs based on time required for execution in ascending order whereas memory Schedule Server arranges jobs based on memory required for execution in ascending order.

6. **Fragment Assembly in DNA Sequencing**

DNA, or deoxyribonucleic acid, is the hereditary material in humans and almost all other organisms. The information in DNA is stored as a code made up of four chemical bases: adenine (A), guanine (G), cytosine (C), and thymine (T). In DNA sequencing, each DNA is sheared into millions of small fragments (reads) which assemble to form a single genomic sequence (superstring). Each read is a small string. In such a fragment assembly, given a set of reads, the objective is to determine the shortest superstring that contains all the reads. For example, given a set of strings, 000, 001, 010, 011, 100, 101, 110, 111 the shortest superstring is 001110100. Given a set of reads, implement an algorithm to find the shortest superstring that contains all the given reads.

7. **House Wiring**

An electrician is wiring a house which has many rooms. Each room has many power points in different locations. Given a set of power points and the distances between them, implement an algorithm to find the minimum cable required.

<table>
<thead>
<tr>
<th>Total Laboratory Hours</th>
<th>90 hours</th>
</tr>
</thead>
</table>

Mode of assessment: Project/Activity

Recommended by Board of Studies: 29-10-2015

Approved by Academic Council: No. 39 Date 17-12-2015

B.TECH (ECE with IoT & Sensor)
<table>
<thead>
<tr>
<th>Course code</th>
<th>Technical Answers for Real World Problems (TARP)</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>J</th>
<th>C</th>
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<tbody>
<tr>
<td>ECE3999</td>
<td></td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>8</td>
<td>3</td>
</tr>
</tbody>
</table>

Pre-requisite: PHY1999 and 115 Credits Earned

Syllabus version: 1.0

**Course Objectives:**
- To help students to identify the need for developing newer technologies for industrial / societal needs
- To train students to propose and implement relevant technology for the development of the prototypes / products
- To make the students learn to use the methodologies available to assess the developed prototypes / products

**Expected Course Outcome:**
At the end of the course, the student will be able to
1. Identify real life problems related to society
2. Apply appropriate technology(ies) to address the identified problems using engineering principles and arrive at innovative solutions

**Student Learning Outcomes (SLO):** 9, 18

**Module: 1**

<table>
<thead>
<tr>
<th></th>
<th>15 hours</th>
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<tbody>
<tr>
<td>1.</td>
<td>Identification of real life problems</td>
</tr>
<tr>
<td>2.</td>
<td>Field visits can be arranged by the faculty concerned</td>
</tr>
<tr>
<td>3.</td>
<td>6 – 10 students can form a team (within the same / different discipline)</td>
</tr>
<tr>
<td>4.</td>
<td>Minimum of eight hours on self-managed team activity</td>
</tr>
<tr>
<td>5.</td>
<td>Appropriate scientific methodologies to be utilized to solve the identified issue</td>
</tr>
<tr>
<td>6.</td>
<td>Solution should be in the form of fabrication/coding/modeling/product design/process design/relevant scientific methodology(ies)</td>
</tr>
<tr>
<td>7.</td>
<td>Consolidated report to be submitted for assessment</td>
</tr>
<tr>
<td>8.</td>
<td>Participation, involvement and contribution in group discussions during the contact hours will be used as the modalities for the continuous assessment of the theory component</td>
</tr>
<tr>
<td>9.</td>
<td>Project outcome to be evaluated in terms of technical, economical, social, environmental, political and demographic feasibility</td>
</tr>
<tr>
<td>10.</td>
<td>Contribution of each group member to be assessed</td>
</tr>
<tr>
<td>11.</td>
<td>The project component to have three reviews with the weightage of 20:30:50</td>
</tr>
</tbody>
</table>

**Mode of Evaluation:** (No FAT) Continuous Assessment
- The project done – Mark weightage of 20:30:50 – project report to be submitted, presentation and project reviews

Recommended by Board of Studies: 05/03/2016

Approved by Academic Council: 40th AC Date 18/03/2016
**Course Code**: ECE4099  
**Course Title**: Capstone Project

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<tr>
<th>L</th>
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<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>20</td>
</tr>
</tbody>
</table>

**Pre-requisite**: As per the academic regulations

**Syllabus version**: 1.0

**Course Objectives:**
To provide sufficient hands-on learning experience related to the design, development and analysis of suitable product / process so as to enhance the technical skill sets in the chosen field.

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

1. Formulate specific problem statements for ill-defined real life problems with reasonable assumptions and constraints.
2. Perform literature search and / or patent search in the area of interest.
3. Conduct experiments / Design and Analysis / solution iterations and document the results.
4. Perform error analysis / benchmarking / costing
5. Synthesis the results and arrive at scientific conclusions / products / solution
6. Document the results in the form of technical report / presentation

**Student Learning Outcomes (SLO):** 5, 6, 20

**Contents**

1. Capstone Project may be a theoretical analysis, modeling & simulation, experimentation & analysis, prototype design, fabrication of new equipment, correlation and analysis of data, software development, applied research and any other related activities.
2. Project can be for one or two semesters based on the completion of required number of credits as per the academic regulations.
3. Can be individual work or a group project, with a maximum of 3 students.
4. In case of group projects, the individual project report of each student should specify the individual’s contribution to the group project.
5. Carried out inside or outside the university, in any relevant industry or research institution.
6. Publications in the peer reviewed journals / International Conferences will be an added advantage

**Mode of Evaluation:** Periodic reviews, Presentation, Final oral viva, Poster submission

<table>
<thead>
<tr>
<th>Recommended by Board of Studies</th>
<th>Approved by Academic Council</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.06.2015</td>
<td>37th AC</td>
</tr>
</tbody>
</table>

Date 16.06.2015
Course Objectives:
1. To facilitate effective language skills for academic purposes and real-life situations.
2. To enhance students’ language and communication with focus on placement skills development.
3. To aid students apply language and communication skills in professional reading and reporting.

Expected Course Outcome:
1. Apply language skills with ease in academic and real-life situations.
2. Build up a job winning digital footprint and learn to face interviews confidently.
3. Develop good interpreting and reporting skills to aid them in research.
4. Comprehend language and communication skills in academic and social contexts.
5. Acquire vocabulary and learn strategies for error-free communication.

Student Learning Outcomes (SLO): 3, 6, 18
4. Having an ability to be socially intelligent with good SIQ (Social Intelligence Quotient) and EQ (Emotional Quotient)
16. Having a good working knowledge of communicating in English
18. Having critical thinking and innovative skills

Module: 1 Listening 4 hours
Casual and Academic
Module: 2 Speaking 4 hours
Socializing Skills - Introducing Oneself- His / Her Goals & SWOT
Module: 3 Reading 2 hours
Skimming and Scanning
Module: 4 Writing 2 hours
Error-free sentences, Paragraphs
Module: 5 Listening 4 hours
News (Authentic Material): Analyzing General and Domain Specific Information
Module: 6 Speaking 4 hours
Group Discussion on factual, controversial and abstract issues
Module: 7 Reading 2 hours
Extensive Reading
Module: 8 Writing 2 hours
Email Etiquette with focus on Content and Audience
Module: 9 Listening 4 hours
Speeches : General and Domain Specific Information
Module: 10 Speaking 4 hours
Developing Persuasive Skills - Turncoat and Debate
Module: 11 Reading 2 hours
Intensive Reading
Module: 12 Writing 2 hours
Data Transcoding
Module: 13 Cross Cultural Communication 4 hours
### Understanding Inter and Cross-Cultural Communication Nuances

<table>
<thead>
<tr>
<th>Module</th>
<th>Topic</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>Speaking</td>
<td>4</td>
</tr>
<tr>
<td>15</td>
<td>Reading for research</td>
<td>2</td>
</tr>
<tr>
<td>16</td>
<td>Writing</td>
<td>2</td>
</tr>
<tr>
<td>17</td>
<td>Speaking</td>
<td>4</td>
</tr>
<tr>
<td>18</td>
<td>Writing</td>
<td>2</td>
</tr>
<tr>
<td>19</td>
<td>Speaking</td>
<td>4</td>
</tr>
<tr>
<td>20</td>
<td>Vocabulary</td>
<td>2</td>
</tr>
</tbody>
</table>

### Total Lecture hours: 60 hours

### Text Book (s)

### Reference Books

### Mode of Evaluation: Assignment and FAT- Mini Project, Flipped Class Room, Lecture, PPT’s, Role play, Assignments Class/Virtual Presentations, Report and beyond the classroom activities

### List of Challenging Experiments (Indicative)
<table>
<thead>
<tr>
<th></th>
<th>Activity Description</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Create a Digital or Online Profile or a Digital Footprint</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>Prepare a video resume</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>Analyse a documentary critically</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>Turn Coat- Speaking for and against the topic / Activities through VIT Community Radio</td>
<td>6</td>
</tr>
<tr>
<td>5</td>
<td>Present a topic using ‘Prezi’</td>
<td>6</td>
</tr>
<tr>
<td>6</td>
<td>Analyse a case on cross cultural communication critically</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>Create a list of words relating to your domain</td>
<td>4</td>
</tr>
<tr>
<td>8</td>
<td>Listen to a conversation of native speakers of English and answer the following questions</td>
<td>6</td>
</tr>
<tr>
<td>9</td>
<td>Read an article and critically analyse the text in about 150 words</td>
<td>6</td>
</tr>
<tr>
<td>10</td>
<td>Read an autobiography and role play the character in class by taking an excerpt from the book</td>
<td>8</td>
</tr>
</tbody>
</table>

**Total Practical Hours** 60 hours

Mode of evaluation: Mini Project, Flipped Class Room, Lecture, PPT’s, Role play, Assignments
Class/Virtual Presentations, Report and beyond the classroom activities

Recommended by Board of Studies 22-07-2017

Approved by Academic Council No. 47 Date 24.08.2017
Course Objectives:
1. To understand and appreciate the ethical issues faced by an individual in profession, society and polity
2. To understand the negative health impacts of certain unhealthy behaviors
3. To appreciate the need and importance of physical, emotional health and social health

Expected Course Outcome:
Students will be able to:
1. Follow sound morals and ethical values scrupulously to prove as good citizens
2. Understand various social problems and learn to act ethically
3. Understand the concept of addiction and how it will affect the physical and mental health
4. Identify ethical concerns in research and intellectual contexts, including academic integrity, use and citation of sources, the objective presentation of data, and the treatment of human subjects
5. Identify the main typologies, characteristics, activities, actors and forms of cybercrime

Student Learning Outcomes (SLO): 2,10,11,12
2. Having a clear understanding of the subject related concepts and of contemporary issues
10. Having a clear understanding of professional and ethical responsibility
11. Having interest in lifelong learning
12. Having adaptive thinking and adaptability

Module:1 Being Good and Responsible 5 hours
Gandhian values such as truth and non-violence – Comparative analysis on leaders of past and present – Society’s interests versus self-interests - Personal Social Responsibility: Helping the needy, charity and serving the society

Module:2 Social Issues 1 4 hours
Harassment – Types - Prevention of harassment, Violence and Terrorism

Module:3 Social Issues 2 4 hours
Corruption: Ethical values, causes, impact, laws, prevention – Electoral malpractices; White collar crimes - Tax evasions – Unfair trade practices

Module:4 Addiction and Health 5 hours
Peer pressure - Alcoholism: Ethical values, causes, impact, laws, prevention – Ill effects of smoking - Prevention of Suicides; Sexual Health: Prevention and impact of pre-marital pregnancy and Sexually Transmitted Diseases

Module:5 Drug Abuse 3 hours
Abuse of different types of legal and illegal drugs: Ethical values, causes, impact, laws and prevention

Module:6 Personal and Professional Ethics 4 hours
Dishonesty - Stealing - Malpractices in Examinations – Plagiarism

<table>
<thead>
<tr>
<th>Module:7</th>
<th>Abuse of Technologies</th>
<th>3 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hacking and other cyber crimes, Addiction to mobile phone usage, Video games and Social networking websites</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:8</th>
<th>Contemporary issues:</th>
<th>2 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Guest lectures by Experts</td>
<td></td>
</tr>
</tbody>
</table>

| Total Lecture hours: | 30 hours |

**Reference Books**


**Mode of Evaluation:** CAT, Assignment, Quiz, FAT and Seminar

**Recommended by Board of Studies** 26-07-2017

**Approved by Academic Council** No. 46 Date 24-08-2017
## Course Objectives:

1. To provide the requisite and relevant background necessary to understand the other important engineering mathematics courses offered for Engineers and Scientists.
2. To introduce important topics of applied mathematics, namely Single and Multivariable Calculus and Vector Calculus etc.
3. To impart the knowledge of Laplace transform, an important transform technique for Engineers which requires knowledge of integration

## Expected Course Outcomes:

At the end of this course the students should be able to:

1. apply single variable differentiation and integration to solve applied problems in engineering and find the maxima and minima of functions
2. understand basic concepts of Laplace Transforms and solve problems with periodic functions, step functions, impulse functions and convolution
3. evaluate partial derivatives, limits, total differentials, Jacobians, Taylor series and optimization problems involving several variables with or without constraints
4. evaluate multiple integrals in Cartesian, Polar, Cylindrical and Spherical coordinates.
5. understand gradient, directional derivatives, divergence, curl and Greens’, Stokes, Gauss theorems
6. demonstrate MATLAB code for challenging problems in engineering

### Student Learning Outcome (SLO):

1. Having an ability to apply mathematics and science in engineering applications
2. Having a clear understanding of the subject related concepts and of contemporary issues
9. Having problem solving ability – solving social issues and engineering problems

### Module: 1 Application of Single Variable Calculus

<table>
<thead>
<tr>
<th>Duration</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>9 hours</td>
<td>Differentiation- Extrema on an Interval-Rolle’s Theorem and the Mean Value Theorem- Increasing and Decreasing functions and First derivative test- Second derivative test-Maxima and Minima-Concavity. Integration-Average function value - Area between curves - Volumes of solids of revolution - Beta and Gamma functions–interrelation</td>
</tr>
</tbody>
</table>

### Module: 2 Laplace transforms

<table>
<thead>
<tr>
<th>Duration</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 hours</td>
<td>Definition of Laplace transform-Properties-Laplace transform of periodic functions-Laplace transform of unit step function, Impulse function-Inverse Laplace transform-Convolution.</td>
</tr>
</tbody>
</table>

### Module: 3 Multivariable Calculus

<table>
<thead>
<tr>
<th>Duration</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 hours</td>
<td>Functions of two variables-limits and continuity-partial derivatives –total differential-Jacobian and its properties.</td>
</tr>
</tbody>
</table>

### Module: 4 Application of Multivariable Calculus

<table>
<thead>
<tr>
<th>Duration</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 hours</td>
<td>Taylor’s expansion for two variables–maxima and minima–constrained maxima and minima- Lagrange’s multiplier method.</td>
</tr>
</tbody>
</table>

### Module: 5 Multiple integrals

<table>
<thead>
<tr>
<th>Duration</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 hours</td>
<td>Evaluation of double integrals–change of order of integration–change of variables between Cartesian and polar co-ordinates - Evaluation of triple integrals-change of variables between</td>
</tr>
</tbody>
</table>

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**MAT1011 Calculus for Engineers**

<table>
<thead>
<tr>
<th>Pre-requisite</th>
<th>Syllabus Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAT1001</td>
<td>1.0</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>L</th>
<th>T</th>
<th>P</th>
<th>J</th>
<th>C</th>
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<tbody>
<tr>
<td>3</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>4</td>
</tr>
</tbody>
</table>
Cartesian and cylindrical and spherical co-ordinates- evaluation of multiple integrals using gamma and beta functions.

<table>
<thead>
<tr>
<th>Module:6</th>
<th>Vector Differentiation</th>
<th>5 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scalar and vector valued functions – gradient, tangent plane–directional derivative-divergence and curl–scalar and vector potentials–Statement of vector identities-Simple problems</td>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:7</th>
<th>Vector Integration</th>
<th>5 hours</th>
</tr>
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<tbody>
<tr>
<td>line, surface and volume integrals - Statement of Green’s, Stoke’s and Gauss divergence theorems -verification and evaluation of vector integrals using them.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:8</th>
<th>Contemporary Issues:</th>
<th>2 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industry Expert Lecture</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

|  | Total Lecture hours:  | 45 hours |
|  |  |  |

**Text Book(s)**


**Reference Books**


**Mode of Evaluation**

Digital Assignments, Quiz, Continuous Assessments, Final Assessment Test

**List of Challenging Experiments (Indicative)**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Introduction to MATLAB through matrices, and general Syntax</td>
<td>2 hours</td>
</tr>
<tr>
<td>2. Plotting and visualizing curves and surfaces in MATLAB – Symbolic computations using MATLAB</td>
<td>2 hours</td>
</tr>
<tr>
<td>3. Evaluating Extremum of a single variable function</td>
<td>2 hours</td>
</tr>
<tr>
<td>4. Understanding integration as Area under the curve</td>
<td>2 hours</td>
</tr>
<tr>
<td>5. Evaluation of Volume by Integrals (Solids of Revolution )</td>
<td>2 hours</td>
</tr>
<tr>
<td>6. Evaluating maxima and minima of functions of several variables</td>
<td>2 hours</td>
</tr>
<tr>
<td>7. Applying Lagrange multiplier optimization method</td>
<td>2 hours</td>
</tr>
<tr>
<td>8. Evaluating Volume under surfaces</td>
<td>2 hours</td>
</tr>
<tr>
<td>9. Evaluating triple integrals</td>
<td>2 hours</td>
</tr>
<tr>
<td>10. Evaluating gradient, curl and divergence</td>
<td>2 hours</td>
</tr>
<tr>
<td>11. Evaluating line integrals in vectors</td>
<td>2 hours</td>
</tr>
<tr>
<td>12. Applying Green's theorem to real world problems</td>
<td>2 hours</td>
</tr>
</tbody>
</table>

| Total Laboratory Hours | 24 hours |

**Mode of Assessment:**

Weekly assessment, Final Assessment Test

Recommended by Board of Studies | 12-06-2015
Approved by Academic Council | No. 37 | Date | 16-06-2015
Course Code | Course Title | L | T | P | J | C
---|---|---|---|---|---|---
MAT2001 | Statistics for Engineers | 3 | 0 | 2 | 0 | 4
Prerequisites | MAT1011 – Calculus for Engineers | Syllabus Version | 1.0

Course Objectives:
1. To provide students with a framework that will help them choose the appropriate descriptive methods in various data analysis situations.
2. To analyse distributions and relationship of real-time data.
3. To apply estimation and testing methods to make inference and modelling techniques for decision making.

Expected Course Outcome:
At the end of the course the student should be able to:
1. Compute and interpret descriptive statistics using numerical and graphical techniques.
2. Understand the basic concepts of random variables and find an appropriate distribution for analysing data specific to an experiment.
3. Apply statistical methods like correlation, regression analysis in analysing, interpreting experimental data.
4. Make appropriate decisions using statistical inference that is the central to experimental research.
5. Use statistical methodology and tools in reliability engineering problems.
6. demonstrate R programming for statistical data

Student Learning Outcome (SLO): 1, 2, 7, 9, 14

Module: 1 | Introduction to Statistics | 6 hours
---|---|---
Introduction to statistics and data analysis-Measures of central tendency – Measures of variability-[Moments-Skewness-Kurtosis (Concepts only)].

Module: 2 | Random variables | 8 hours
---|---|---

Module: 3 | Correlation and regression | 4 hours
---|---|---
Correlation and Regression – Rank Correlation- Partial and Multiple correlation- Multiple regression.

Module: 4 | Probability Distributions | 7 hours
---|---|---

Module: 5 | Hypothesis Testing I | 4 hours
---|---|---
Testing of hypothesis – Introduction-Types of errors, critical region, procedure of testing hypothesis-Large sample tests- Z test for Single Proportion, Difference of Proportion, mean
and difference of means.

Module: 6  Hypothesis Testing II  9 hours
Small sample tests- Student’s t-test, F-test- chi-square test- goodness of fit - independence of attributes- Design of Experiments - Analysis of variance – one and two way classifications - CRD-RBD- LSD.

Module: 7  Reliability  5 hours
Basic concepts- Hazard function-Reliabilities of series and parallel systems- System Reliability - Maintainability-Preventive and repair maintenance- Availability.

Module: 8  Contemporary Issues  2 hours
Industry Expert Lecture

Total Lecture hours  45 hours

Text book(s)

Reference books

Mode of Evaluation
Digital Assignments, Continuous Assessment Tests, Quiz, Final Assessment Test.

List of Experiments (Indicative)

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Description</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Introduction: Understanding Data types; importing/exporting data.</td>
<td>2</td>
</tr>
<tr>
<td>2.</td>
<td>Computing Summmary Statistics /plotting and visualizing data using Tabulation and Graphical Representations.</td>
<td>2</td>
</tr>
<tr>
<td>3.</td>
<td>Applying correlation and simple linear regression model to real dataset; computing and interpreting the coefficient of determination.</td>
<td>2</td>
</tr>
<tr>
<td>4.</td>
<td>Applying multiple linear regression model to real dataset; computing and interpreting the multiple coefficient of determination.</td>
<td>2</td>
</tr>
<tr>
<td>5.</td>
<td>Fitting the following probability distributions: Binomial distribution</td>
<td>2</td>
</tr>
<tr>
<td>6.</td>
<td>Normal distribution, Poisson distribution</td>
<td>2</td>
</tr>
<tr>
<td>7.</td>
<td>Testing of hypothesis for One sample mean and proportion from real-time problems.</td>
<td>2</td>
</tr>
<tr>
<td>8.</td>
<td>Testing of hypothesis for Two sample means and proportion from real-time problems</td>
<td>2</td>
</tr>
<tr>
<td>9.</td>
<td>Applying the t test for independent and dependent samples</td>
<td>2</td>
</tr>
<tr>
<td>10.</td>
<td>Applying Chi-square test for goodness of fit test and Contingency test to real dataset</td>
<td>2</td>
</tr>
<tr>
<td>11.</td>
<td>Performing ANOVA for real dataset for Completely</td>
<td>2</td>
</tr>
<tr>
<td>Design</td>
<td>Total laboratory hours</td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>------------------------</td>
<td></td>
</tr>
<tr>
<td>randomized design, Randomized Block design , Latin square</td>
<td>22 hours</td>
<td></td>
</tr>
</tbody>
</table>

**Mode of Evaluation**

<table>
<thead>
<tr>
<th>Weekly Assessment, Final Assessment Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommended by Board of Studies</td>
</tr>
<tr>
<td>Approved by Academic Council</td>
</tr>
<tr>
<td>Course Code</td>
</tr>
<tr>
<td>-------------</td>
</tr>
<tr>
<td>MGT1022</td>
</tr>
</tbody>
</table>

**Pre-requisite:** Nil

**Syllabus version:** v.1.0

**Course Objectives:** To develop the ability to

1. Learn methods of company formation and management.
2. Gain practical skills in and experience of stating of business using pre-set collection of business ideas.
3. Learn basics of entrepreneurial skills.

**Expected Course Outcome:** On the completion of this course the student will be able to

1. Understand developing business models and growth drivers
2. Use the business model canvas to map out key components of enterprise
3. Analyze market size, cost structure, revenue streams, and value chain
4. Understand build-measure-learn principles
   - Foreseeing and quantifying business and financial risks

**Student Learning Outcomes (SLO):** 1,2,3,4,5

**Module:1**

- Creative and Design Thinking (identify the vertical for business opportunity, understand your customers, accurately assess market opportunity)

- 2 Hours

**Module:2**

- Minimum Viable Product (Value Proposition, Customer Segments, Build-measure-learn process)

- 3 Hours

**Module:3**

- Business Model Development (Channels and Partners, Revenue Model and streams, Key Resources, Activities and Costs, Customer Relationships and Customer Development Processes, Business model canvas –the lean model- templates)

- 3 Hours

**Module:4**

- Business Plan and Access to Funding (visioning your venture, taking the product/service to market, Market plan including Digital & Viral Marketing, start-up finance - Costs/Profits & Losses/cash flow, Angel/VC/Bank Loans and Key elements of raising money)

- 3 Hours

**Module:5**

- Legal, Regulatory, CSR, Standards, Taxes

- 3 Hours

**Module:6**

- Lectures by Entrepreneurs

- 2 Hours

**Total Lecture:** 15 hours

**Text Book(s):**

<table>
<thead>
<tr>
<th>2</th>
<th>The Four Steps to the Epiphany, Steve Blank, K&amp;S Ranch; 2nd edition (July 17, 2013)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses, Eric Ries, Crown Business; (13 September 2011)</td>
</tr>
</tbody>
</table>

**Reference Books**

1. Holding a Cat by the Tail, Steve Blank, K&S Ranch Publishing LLC (August 14, 2014)
4. Lean Analytics: Use Data to Build a Better Startup Faster (Lean Series), Alistair Croll & Benjamin Yoskovitz, O'Reilly Media; 1st Edition (March 21, 2013)

6. **Website References:**
   5. https://www.youtube.com/watch?v=fEvKo90qBns
   10. chventures.blogspot.in/platformsandnetworks.blogspot.in/p/saas-model.html

**Mode of Evaluation:** Assignments; Field Trips, Case Studies; e-learning; Learning through research, TED Talks

<table>
<thead>
<tr>
<th>Project</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Project</td>
<td>60 hours</td>
</tr>
<tr>
<td><strong>Total Project</strong></td>
<td><strong>60 hours</strong></td>
</tr>
</tbody>
</table>

Recommended by Board of Studies: 08-06-2015

Approved by Academic Council: 37 Date 16-06-2015
Course Code: PHY1701
Course Title: Engineering Physics
Pre-requisite: None
Syllabus version: V.2.1

Course Objectives:
To enable the students to understand the basics of the latest advancements in Physics viz., Quantum Mechanics, Nanotechnology, Lasers, Electro Magnetic Theory and Fiber Optics.

Expected Course Outcome: Students will be able to
1. Comprehend the dual nature of radiation and matter.
2. Compute Schrodinger’s equations to solve finite and infinite potential problems.
3. Analyze quantum ideas at the nanoscale.
4. Apply quantum ideas for understanding the operation and working principle of optoelectronic devices.
5. Recall the Maxwell’s equations in differential and integral form.
6. Design the various types of optical fibers for different Engineering applications.
7. Explain concept of Lorentz Transformation for Engineering applications.
8. Demonstrate the quantum mechanical ideas

Student Learning Outcomes (SLO): 2, 4, 5, 9
2. Having a clear understanding of the subject related concepts and of contemporary issues
4. Having Sense-Making Skills of creating unique insights in what is being seen or observed (Higher level thinking skills which cannot be codified)
5. Having design thinking capability
9. Having problem solving ability- solving social issues and engineering problems

Module: 1 Introduction to Modern Physics 6 hours
Planck’s concept (hypothesis), Compton Effect, Particle properties of wave: Matter Waves, Davisson Germer Experiment, Heisenberg Uncertainty Principle, Wave function, and Schrodinger equation (time dependent & independent).

Module: 2 Applications of Quantum Physics 5 hours
Particle in a 1-D box (Eigen Value and Eigen Function), 3-D Analysis (Qualitative), Tunneling Effect (Qualitative) (AB 205), Scanning Tunneling Microscope (STM).

Module: 3 Nanophysics 5 hours
Introduction to Nano-materials, Moore’s law, Properties of Nano-materials, Quantum confinement, Quantum well, wire & dot, Carbon Nano-tubes (CNT), Applications of nanotechnology in industry.

Module: 4 Laser Principles and Engineering Application 6 hours
Laser Characteristics, Spatial and Temporal Coherence, Einstein Coefficient & its significance, Population inversion, Two, three & four level systems, Pumping schemes, Threshold gain coefficient, Components of laser, Nd-YAG, He-Ne, CO2 and Dye laser and their engineering applications.

Module: 5 Electromagnetic Theory and its application 6 hours
Physics of Divergence, Gradient and Curl, Qualitative understanding of surface and volume
Module: 6 | Propagation of EM waves in Optoelectronic Devices | 10 hours


Module: 7 | Special Theory of Relativity | 5 hours

Frame of reference, Galilean relativity, Postulate of special theory of relativity, Simultaneity, length contraction and time dilation.

Module: 8 | Contemporary issues: | 2 hours

Lecture by Industry Experts

Total Lecture hours: 45 hours

Text Book(s)


Reference Books


Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Experiments

1. Determination of Planck’s constant using electroluminescence process 2 hrs
2. Electron diffraction 2 hrs
3. Determination of wavelength of laser source (He -Ne laser and diode lasers of different wavelengths) using diffraction technique 2 hrs
4. Determination of size of fine particle using laser diffraction 2 hrs
5. Determination of the track width (periodicity) in a written CD 2 hrs
6. Optical Fiber communication (source + optical fiber + detector) 2 hrs
7. Analysis of crystallite size and strain in a nano-crystalline film using X-ray 2 hrs
<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
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<th></th>
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</thead>
<tbody>
<tr>
<td>8.</td>
<td>Numerical solutions of Schrödinger equation (e.g. particle in a box problem) (can be given as an assignment)</td>
<td>2 hrs</td>
</tr>
<tr>
<td>9.</td>
<td>Laser coherence length measurement</td>
<td>2 hrs</td>
</tr>
<tr>
<td>10.</td>
<td>Proof for transverse nature of E.M. waves</td>
<td>2 hrs</td>
</tr>
<tr>
<td>11.</td>
<td>Quantum confinement and Heisenberg's uncertainty principle</td>
<td>2 hrs</td>
</tr>
<tr>
<td>12.</td>
<td>Determination of angle of prism and refractive index for various colour – Spectrometer</td>
<td>2 hrs</td>
</tr>
<tr>
<td>13.</td>
<td>Determination of divergence of a laser beam</td>
<td>2 hrs</td>
</tr>
<tr>
<td>14.</td>
<td>Determination of crystalline size for nanomaterial (Computer simulation)</td>
<td>2 hrs</td>
</tr>
<tr>
<td>15.</td>
<td>Demonstration of phase velocity and group velocity (Computer simulation)</td>
<td>2 hrs</td>
</tr>
<tr>
<td></td>
<td><strong>Total Laboratory Hours</strong></td>
<td><strong>30 hrs</strong></td>
</tr>
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</table>

Mode of evaluation: CAT / FAT

Recommended by Board of Studies 04-06-2019

Approved by Academic Council No. 55 Date 13-06-2019
Course Objectives:
This course is offered to the students in the 1st Year of B.Tech. in order to orient them towards independent, systemic thinking and be innovative.
1. To make students confident enough to handle the day to day issues.
2. To develop the “Thinking Skill” of the students, especially Creative Thinking Skills.
3. To train the students to be innovative in all their activities.
4. To prepare a project report on a socially relevant theme as a solution to the existing issues.

Expected Course Outcome: Students will be able to
1. Comprehend the various types of thinking skills.
2. Explain the innovative and creative ideas.
3. Analyze a suitable solution for socially relevant issues.

Student Learning Outcomes (SLO): 2,3,9,17,18
2. Having a clear understanding of the subject related concepts and of contemporary issues
3. Having an ability to be socially intelligent with good SIQ (Social Intelligence Quotient) and EQ (Emotional Quotient)
9. Having problem solving ability- solving social issues and engineering problems
17. Having an ability to use techniques, skills and modern engineering tools necessary for engineering practice
18. Having critical thinking and innovative skills

Module: 1 A  |  Self Confidence  |  1 hour
Understanding self – Johari Window – SWOT Analysis – Self Esteem – Being a contributor – Case Study
Project: Exploring self, understanding surrounding, thinking about how s/he can be a contributor for the society, Creating a big picture of being an innovator – writing a 1000 words imaginary autobiography of self – Topic “Mr X – the great innovator of 2015” and upload. (4 non-contact hours)

Module: 1 B  |  Thinking Skill  |  1 hour
Thinking and Behaviour – Types of thinking– Concrete – Abstract, Convergent, Divergent, Creative, Analytical, Sequential and Holistic thinking – Chunking Triangle – Context Grid – Examples – Case Study.
Project: Meeting at least 50 people belonging to various strata of life and talk to them / make field visits to identify a min of 100 society related issues, problems for which they need solutions and categories them and upload along with details of people met and lessons learnt. (4 non-contact hours)

Module: 1 C  |  Lateral Thinking Skill  |  1 hour
Blooms Taxonomy – HOTS – Out of the box thinking – deBono lateral thinking model – Examples
Project: Last weeks - incomplete portion to be done and uploaded

Module: 2 A  |  Creativity  |  1 hour
<table>
<thead>
<tr>
<th>Module</th>
<th>Title</th>
<th>Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 B</td>
<td>Brainstorming</td>
<td>1 hour</td>
</tr>
<tr>
<td>3</td>
<td>Mind Mapping</td>
<td>1 hour</td>
</tr>
<tr>
<td>4 A</td>
<td>Systems thinking</td>
<td>1 hour</td>
</tr>
<tr>
<td>4 B</td>
<td>Design Thinking</td>
<td>1 hour</td>
</tr>
<tr>
<td>5 A</td>
<td>Innovation</td>
<td>1 hour</td>
</tr>
<tr>
<td>5 B</td>
<td>Blocks for Innovation</td>
<td>1 hour</td>
</tr>
<tr>
<td>5 C</td>
<td>Innovation Process</td>
<td>1 hour</td>
</tr>
<tr>
<td>6 A</td>
<td>Innovation in India</td>
<td>1 hour</td>
</tr>
<tr>
<td>6 B</td>
<td>JUGAAD Innovation</td>
<td>1 hour</td>
</tr>
<tr>
<td>7 A</td>
<td>Innovation Project Proposal Presentation</td>
<td>1 hour</td>
</tr>
<tr>
<td>8 A</td>
<td>Contemporary issue in Innovation</td>
<td>1 hour</td>
</tr>
</tbody>
</table>

**Total Lecture hours:** 15 hours
Text Book(s)

1. How to have Creative Ideas, Edward debone, Vermilon publication, UK, 2007

Reference Books

1. Creating Confidence, Meribeth Bonct, Kogan Page India Ltd, New Delhi, 2000
2. Lateral Thinking Skills, Paul Sloane, Keogan Page India Ltd, New Delhi, 2008

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar
Three reviews with weightage of 25 : 25 : 50 along with reports

Recommended by Board of Studies 15-12-2015
Approved by Academic Council No. 39 Date 17-12-2015
# STS1001 Introduction to Soft skills

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>J</th>
<th>C</th>
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<tbody>
<tr>
<td>STS1001</td>
<td>Introduction to Soft skills</td>
<td>3</td>
<td>0</td>
<td>0</td>
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</table>

**Pre-requisite:** None

**Syllabus version:** 1

## Course Objectives:
1. To enhance the ability to plan better and work as a team effectively
2. To boost the learning ability and to acquire analytical and research skills
3. To educate the habits required to achieve success

## Expected Course Outcome:
- Enabling students to know themselves and interact better with self and environment

## Student Learning Outcomes (SLO):
10. Having a clear understanding of professional and ethical responsibility
12. Having adaptive thinking and adaptability

### Module: 1 Lessons on excellence 10 hours

#### Ethics and integrity
- Importance of ethics in life, Intuitionism vs Consequentialism, Non-consequentialism, Virtue ethics vs situation ethics, Integrity - listen to conscience, Stand up for what is right

#### Change management
- Who moved my cheese?, Tolerance of change and uncertainty, Joining the bandwagon, Adapting change for growth - overcoming inhibition

#### How to pick up skills faster?
- Knowledge vs skill, Skill introspection, Skill acquisition, "10,000 hours rule" and the converse

#### Habit formation
- Know your habits, How habits work? - The scientific approach, How habits work? - The psychological approach, Habits and professional success, "The Habit Loop", Domino effect, Unlearning a bad habit

#### Analytic and research skills.
- Focused and targeted information seeking, How to make Google work for you, Data assimilation

### Module: 2 Team skills 11 hours

#### Goal setting
- SMART goals, Action plans, Obstacles - Failure management

#### Motivation
- Rewards and other motivational factors, Maslow's hierarchy of needs, Internal and external motivation

#### Facilitation
- Planning and sequencing, Challenge by choice, Full Value Contract (FVC), Experiential learning cycle, Facilitating the Debrief

#### Introspection
- Identify your USP, Recognize your strengths and weakness, Nurture strengths, Fixing weakness, Overcoming your complex, Confidence building

#### Trust and collaboration
- Virtual Team building, Flexibility, Delegating, Shouldering responsibilities

### Module: 3 Emotional Intelligence 12 hours

#### Transactional Analysis
Introduction, Contracting, Ego states, Life positions

**Brain storming**
Individual Brainstorming, Group Brainstorming, Stepladder Technique, Brain writing, Crawford's Slip writing approach, Reverse brainstorming, Star bursting, Charlette procedure, Round robin brainstorming

**Psychometric Analysis**
Skill Test, Personality Test

**Rebus Puzzles/Problem Solving**
More than one answer, Unique ways

<table>
<thead>
<tr>
<th>Module:4</th>
<th>Adaptability</th>
<th>12 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Theatrix</strong></td>
<td>Motion Picture, Drama, Role Play, Different kinds of expressions</td>
<td></td>
</tr>
<tr>
<td><strong>Creative expression</strong></td>
<td>Writing, Graphic Arts, Music, Art and Dance</td>
<td></td>
</tr>
<tr>
<td><strong>Flexibility of thought</strong></td>
<td>The 5'P' framework (Profiling, prioritizing, problem analysis, problem solving, planning)</td>
<td></td>
</tr>
<tr>
<td><strong>Adapt to changes(tolerance of change and uncertainty)</strong></td>
<td>Adaptability Curve, Survivor syndrome</td>
<td></td>
</tr>
</tbody>
</table>

**Total Lecture hours:** 45 hours

**Text Book(s)**


**Reference Books**

2. **Phil Lapworth**, *An Introduction to Transactional Analysis*, 2011, Sage Publications (CA)

**Mode of Evaluation**: FAT, Assignments, Projects, Case studies, Role plays, 3 Assessments with Term End FAT (Computer Based Test)

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**Recommended by Board of Studies** 09/06/2017

**Approved by Academic Council** No. 45th AC 15/06/2017
<table>
<thead>
<tr>
<th>STS1002</th>
<th>Introduction to Business Communication</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>J</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-requisite</td>
<td>None</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

| Syllabus version | 2 |

**Course Objectives:**
1. To provide an overview of Prerequisites to Business Communication
2. To enhance the problem solving skills and improve the basic mathematical skills
3. To organize the thoughts and develop effective writing skills

**Expected Course Outcome:**
- Enabling students enhance knowledge of relevant topics and evaluate the information

**Student Learning Outcomes (SLO):**
9. Having problem solving ability- solving social issues and engineering problems
11. Having interest in lifelong learning

**Module:1 Study skills**

<table>
<thead>
<tr>
<th>10 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory techniques</td>
</tr>
<tr>
<td>Relation between memory and brain, Story line technique, Learning by mistake, Image-name association, Sharing knowledge, Visualization</td>
</tr>
<tr>
<td>Concept map</td>
</tr>
<tr>
<td>Mind Map, Algorithm Mapping, Top down and Bottom Up Approach</td>
</tr>
<tr>
<td>Time management skills</td>
</tr>
<tr>
<td>Prioritization - Time Busters, Procrastination, Scheduling, Multitasking, Monitoring</td>
</tr>
<tr>
<td>6. Working under pressure and adhering to deadlines</td>
</tr>
</tbody>
</table>

**Module:2 Emotional Intelligence (Self Esteem )**

<table>
<thead>
<tr>
<th>6 hours</th>
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</thead>
<tbody>
<tr>
<td>Empathy</td>
</tr>
<tr>
<td>Affective Empathy and Cognitive Empathy</td>
</tr>
<tr>
<td>Sympathy</td>
</tr>
<tr>
<td>Level of sympathy (Spatial proximity, Social Proximity, Compassion fatigue)</td>
</tr>
</tbody>
</table>

**Module:3 Business Etiquette**

<table>
<thead>
<tr>
<th>9 hours</th>
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</thead>
<tbody>
<tr>
<td>Social and Cultural Etiquette</td>
</tr>
<tr>
<td>Value, Manners, Customs, Language, Tradition</td>
</tr>
<tr>
<td>Writing Company Blogs</td>
</tr>
<tr>
<td>Building a blog, Developing brand message, FAQs', Assessing Competition</td>
</tr>
<tr>
<td>Internal Communications</td>
</tr>
<tr>
<td>Open and objective Communication, Two way dialogue, Understanding the audience</td>
</tr>
<tr>
<td>Planning</td>
</tr>
<tr>
<td>Identifying, Gathering Information, Analysis, Determining, Selecting plan, Progress check, Types of planning</td>
</tr>
<tr>
<td>Writing press release and meeting notes</td>
</tr>
<tr>
<td>Write a short, catchy headline, Get to the Point –summarize your subject in the first paragraph, Body – Make it relevant to your audience</td>
</tr>
</tbody>
</table>

**Module:4 Quantitative Ability**

<table>
<thead>
<tr>
<th>4 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Numeracy concepts</td>
</tr>
</tbody>
</table>
Fractions, Decimals, Bodmas, Simplifications, HCF, LCM, Tests of divisibility

**Beginning to Think without Ink**
Problems solving using techniques such as: Percentage, Proportionality, Support of answer choices, Substitution of convenient values, Bottom-up approach etc.

**Math Magic**
Puzzles and brain teasers involving mathematical concepts

**Speed Calculations**
Square roots, Cube roots, Squaring numbers, Vedic maths techniques

---

<table>
<thead>
<tr>
<th>Module:5</th>
<th>Reasoning Ability</th>
<th>3 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Interpreting Diagramming and sequencing information</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Picture analogy, Odd picture, Picture sequence, Picture formation, Mirror image and water image</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:6</th>
<th>Verbal Ability</th>
<th>3 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Strengthening Grammar Fundamentals</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parts of speech, Tenses, Verbs( Gerunds and infinitives)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Reinforcements of Grammar concepts</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subject Verb Agreement, Active and Passive Voice, Reported Speech</td>
<td></td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Module:7</th>
<th>Communication and Attitude</th>
<th>10 hours</th>
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<tbody>
<tr>
<td><strong>Writing</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Writing formal &amp; informal letters, How to write a blog &amp; knowing the format, Effective ways of writing a blog, How to write an articles &amp; knowing the format, Effective ways of writing an articles, Designing a brochures</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Speaking skills</strong></td>
<td></td>
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</tr>
<tr>
<td>How to present a JAM, Public speaking</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Self managing</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concepts of self management and self motivation, Greet and Know, Choice of words, Giving feedback, Taking criticism</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Total Lecture hours:** | 45 hours |

**Text Book(s)**

**Reference Books**

**Mode of Evaluation:** FAT, Assignments, Projects, Case studies, Role plays,
3 Assessments with Term End FAT (Computer Based Test)

Recommended by Board of Studies | 09/06/2017
Approved by Academic Council | No. 45th AC | Date | 15/06/2017
<table>
<thead>
<tr>
<th>STS2001</th>
<th>Reasoning Skill Enhancement</th>
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<tr>
<td></td>
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<td>3</td>
<td>0</td>
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<td>0</td>
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</table>

Pre-requisite

Course Objectives:
1. To strengthen the social network by the effective use of social media and social interactions.
2. To identify own true potential and build a very good personal branding
3. To enhance the Analytical and reasoning skills.

Expected Course Outcome:
- Understanding the various strategies of conflict resolution among peers and supervisors and respond appropriately.

Student Learning Outcomes (SLO): 9,12
9. Having problem solving ability- solving social issues and engineering problems [SLO 9]
12. Having adaptive thinking and adaptability [SLO 12]

Module: 1 Social Interaction and Social Media 6 hours

Effective use of social media
Types of social media, Moderating personal information, Social media for job/profession, Communicating diplomatically

Networking on social media
Maximizing network with social media, How to advertise on social media

Event management
Event management methods, Effective techniques for better event management

Influencing
How to win friends and influence people, Building relationships, Persistence and resilience, Tools for talking when stakes are high

Conflict resolution
Definition and strategies, Styles of conflict resolution

Module: 2 Non Verbal Communication 6 hours

Proximecs
Types of proximecs, Rapport building

Reports and Data Transcoding
Types of reports

Negotiation Skill
Effective negotiation strategies

Conflict Resolution
Types of conflicts

Module: 3 Interpersonal Skill 8 hours

Social Interaction
Interpersonal Communication, Peer Communication, Bonding, Types of social interaction

Responsibility
Types of responsibilities, Moral and personal responsibilities
Networking
Competition, Collaboration, Content sharing

Personal Branding
Image Building, Grooming, Using social media for branding

Delegation and compliance
Assignment and responsibility, Grant of authority, Creation of accountability

<table>
<thead>
<tr>
<th>Module</th>
<th>Course Description</th>
<th>Hours</th>
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<tbody>
<tr>
<td>Module:4</td>
<td>Quantitative Ability</td>
<td>10</td>
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<tr>
<td></td>
<td>Number properties</td>
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<tr>
<td></td>
<td>Number of factors, Factorials, Remainder Theorem, Unit digit position, Tens digit position</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Averages</td>
<td></td>
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<tr>
<td></td>
<td>Averages, Weighted Average</td>
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<tr>
<td></td>
<td>Progressions</td>
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<tr>
<td></td>
<td>Arithmetic Progression, Geometric Progression, Harmonic Progression</td>
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</tr>
<tr>
<td></td>
<td>Percentages</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Increase &amp; Decrease or successive increase</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ratios</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Types of ratios and proportions</td>
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</tr>
</tbody>
</table>

| Module:5 | Reasoning Ability                                      | 8     |
|          | Analytical Reasoning                                   |       |
|          | Data Arrangement(Linear and circular & Cross Variable Relationship), Blood Relations, Ordering/ranking/grouping, Puzzletest, Selection Decision table |       |

| Module:6 | Verbal Ability                                         | 7     |
|          | Vocabulary Building                                    |       |
|          | Synonyms & Antonyms, One word substitutes, Word Pairs, Spellings, Idioms, Sentence completion, Analogies |       |

**Text Book(s)**

**Reference Books**

**Mode of evaluation:** FAT, Assignments, Projects, Case studies, Role plays, 3 Assessments with Term End FAT (Computer Based Test)

Recommended by Board of Studies  09/06/2017
Approved by Academic Council  No. 45th AC  15/06/2017
<table>
<thead>
<tr>
<th>STS2002</th>
<th>Course Title</th>
<th>L</th>
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<th>P</th>
<th>J</th>
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<tr>
<td>STS2002</td>
<td>Introduction to Etiquette</td>
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</table>

<table>
<thead>
<tr>
<th>Pre-requisite</th>
<th>None</th>
</tr>
</thead>
</table>

| Syllabus version | 2 |

**Course Objectives:**
1. To analyze social psychological phenomena in terms of impression management.
2. To control or influence other people's perceptions.
3. To enhance the problem solving skills

**Expected Course Outcome:**
Creating in the students an understanding of decision making models and generating alternatives using appropriate expressions.

**Student Learning Outcomes (SLO):**
13. Having cross cultural competency exhibited by working in teams.
18. Having critical thinking and innovative skills.

<table>
<thead>
<tr>
<th>Module:1</th>
<th>Impression Management</th>
<th>8 hours</th>
</tr>
</thead>
</table>

**Types and techniques**
Importance of impression management, Types of impression management, Techniques and case studies, Making a good first impression in an interview (TEDOS technique), How to recover from a bad impressions/experience, Making a good first impression online

**Non-verbal communication and body language**
Dressing, Appearance and Grooming, Facial expression and Gestures, Body language (Kinesics), Keywords to be used, Voice elements (tone, pitch and pace)

<table>
<thead>
<tr>
<th>Module:2</th>
<th>Thinking Skills</th>
<th>4 hours</th>
</tr>
</thead>
</table>

**Introduction to problem solving process**
Steps to solve the problem, Simplex process

**Introduction to decision making and decision making process**
Steps involved from identification to implementation, Decision making model

<table>
<thead>
<tr>
<th>Module:3</th>
<th>Beyond Structure</th>
<th>4 hours</th>
</tr>
</thead>
</table>

**Art of questioning**
How to frame questions, Blooms questioning pyramid, Purpose of questions

**Etiquette**
Business, Telephone etiquette, Cafeteria etiquette, Elevator etiquette, Email etiquette, Social media etiquette

<table>
<thead>
<tr>
<th>Module:4</th>
<th>Quantitative Ability</th>
<th>9 hours</th>
</tr>
</thead>
</table>

**Profit and Loss**
Cost Price & Selling Price, Margins & Markup

**Interest Calculations**
Simple Interest, Compound Interest, Recurring

**Mixtures and solutions**
Ratio & Averages, Proportions
Time and Work
Pipes & Cisterns, Man Day concept, Division Wages

Time Speed and Distance
Average speed, Relative speed, Boats and streams.

Proportions & Variations

<table>
<thead>
<tr>
<th>Module:5</th>
<th>Reasoning Ability</th>
<th>11 hours</th>
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</thead>
<tbody>
<tr>
<td>Logical Reasoning</td>
<td>Sequence and series, Coding and decoding, Directions</td>
<td></td>
</tr>
<tr>
<td>Visual Reasoning</td>
<td>Abstract Reasoning, Input Type Diagrammatic Reasoning, Spatial reasoning, Cubes</td>
<td></td>
</tr>
<tr>
<td>Data Analysis And Interpretation</td>
<td>DI-Tables/Charts/Text</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:6</th>
<th>Verbal Ability</th>
<th>9 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grammar</td>
<td>Spot the Errors, Sentence Correction, Gap Filling Exercise, Sentence Improvisations, Misc. Grammar Exercise</td>
<td></td>
</tr>
</tbody>
</table>

Total Lecture hours: 45 hours

Text Book(s)

Reference Books

Mode of Evaluation: FAT, Assignments, Projects, Case studies, Role plays, 3 Assessments with Term End FAT (Computer Based Test)
Recommended by Board of Studies 09/06/2017
Approved by Academic Council No. 45th AC Date 15/06/2017
Course Objectives:
1. To effectively tackle the interview process, and leave a positive impression with your prospective employer by reinforcing your strength, experience and appropriateness for the job.
2. To check if candidates have the adequate writing skills that are needed in an organization.
3. To enhance the problem solving skills.

Expected Course Outcome:
- Enabling students acquire skills for preparing for interviews, presentations and higher education

Student Learning Outcomes (SLO): 9, 18
- 9. Having problem solving ability- solving social issues and engineering problems
- 18. Having critical thinking and innovative skills

Module:1 Interview Skills 3 hours
- Types of interview
  - Structured and unstructured interview orientation, Closed questions and hypothetical questions, Interviewers' perspective, Questions to ask/not ask during an interview
- Techniques to face remote interviews
  - Video interview, Recorded feedback, Phone interview preparation
- Mock Interview
  - Tips to customize preparation for personal interview, Practice rounds

Module:2 Resume Skills 2 hours
- Resume Template
  - Structure of a standard resume, Content, color, font
- Use of power verbs
  - Introduction to Power verbs and Write up
- Types of resume
  - Quiz on types of resume
- Customizing resume
  - Frequent mistakes in customizing resume, Layout - Understanding different company's requirement, Digitizing career portfolio

Module:3 Presentation Skills 6 hours
- Preparing presentation
  - 10 tips to prepare PowerPoint presentation, Outlining the content, Passing the Elevator Test
- Organizing materials
  - Blue sky thinking, Introduction, body and conclusion, Use of Font, Use of Color, Strategic presentation
- Maintaining and preparing visual aids
  - Importance and types of visual aids, Animation to captivate your audience, Design of posters
- Dealing with questions
  - Setting out the ground rules, Dealing with interruptions, Staying in control of the questions, Handling difficult questions
### Module: 4 | Quantitative Ability
- **14 hours**
- **Permutation-Combinations**
  - Counting, Grouping, Linear Arrangement, Circular Arrangements
- **Probability**
  - Conditional Probability, Independent and Dependent Events
- **Geometry and Mensuration**
  - Properties of Polygon, 2D & 3D Figures, Area & Volumes
- **Trigonometry**
  - Heights and distances, Simple trigonometric functions
- **Logarithms**
  - Introduction, Basic rules
- **Functions**
  - Introduction, Basic rules
- **Quadratic Equations**
  - Understanding Quadratic Equations, Rules & probabilities of Quadratic Equations
- **Set Theory**
  - Basic concepts of Venn Diagram

### Module: 5 | Reasoning Ability
- **7 hours**
- **Logical reasoning**
  - Syllogisms, Binary logic, Sequential output tracing, Crypto arithmetic
- **Data Analysis and Interpretation**
  - Data Sufficiency
  - Data interpretation-Advanced Interpretation tables, pie charts & bar chats

### Module: 6 | Verbal Ability
- **8 hours**
- **Comprehension and Logic**
  - Reading comprehension
  - Para Jumbles
  - Critical Reasoning:
    - Premise and Conclusion, Assumption & Inference, Strengthening & Weakening an Argument

### Module: 7 | Writing Skills
- **5 hours**
- **Note making**
  - What is note making, Different ways of note making
- **Report writing**
  - What is report writing, How to write a report, Writing a report & work sheet
- **Product description**
  - Designing a product, Understanding it's features, Writing a product description
- **Research paper**
  - Research and its importance, Writing sample research paper

**Total Lecture hours:** **45 hours**

**Text Book(s)**
### Reference Books


### Mode of Evaluation

<table>
<thead>
<tr>
<th>Mode of Evaluation: FAT, Assignments, Projects, Case studies, Role plays, 3 Assessments with Term End FAT (Computer Based Test)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommended by Board of Studies</td>
</tr>
<tr>
<td>Approved by Academic Council</td>
</tr>
</tbody>
</table>
Course Objectives:
1. To develop logics which will help them to create programs, applications in C.
2. To learn how to design a graphical user interface (GUI) with Java Swing.
3. To present an introduction to database management systems, with an emphasis on how to organize, maintain and retrieve - efficiently, and effectively.

Expected Course Outcome:

- Enabling students to write coding in C,C++,Java and DBMS concepts

Student Learning Outcomes (SLO): 7, 17

7. Having Computational thinking (Ability to translate vast data into abstract concepts and to understand database reasoning)
17. Having an ability to use techniques, skills and modern engineering tools necessary for engineering practice

Module 1: C Programming
- Introduction to C, Execution and Structure of a C Program, Data Types and Operators, Control Statements, Looping, Arrays, Structure, Pointers, Memory Management in C, Functions.
- 15 hours

Module 2: C++ Programming
- Introduction to C++, Need for OOP, Class & Objects, Create C++ & Java class and show the similarity Encapsulation, Access Specifiers, Relationship, Polymorphism, Exception Handling, Abstract Classes, Interfaces.
- 15 hours

Module 3: JAVA
- Introduction to Java, Data Types and Operators, Control Statements, Looping, Arrays, Need for OOP, Class & Objects, Create C++ & Java class and show the similarity Encapsulation, Access Specifiers, Relationship, Polymorphism, Exception Handling, Abstract Classes, Interfaces.
- 10 hours

Module 4: Database
- Introduction to database, DDL, Data Manipulation, SELECT, Joins.
- 5 hours

Total Lecture hours: 45 hours

Reference Books
1. Data Structures and Algorithms: https://ece.uwaterloo.ca/~dwharder/aads/Lecture_materials/
4. Websites: www.eguru.ooo

Mode of Evaluation: FAT, Assignments, Projects 3 Assessments with Term End FAT (Computer Based Test)

Recommended by Board of Studies 09/06/2017
Approved by Academic Council No.45th AC Date 15/06/2017
Programme Core
CSE2003 Data Structures and Algorithms

<table>
<thead>
<tr>
<th>Course</th>
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<th>P</th>
<th>J</th>
<th>C</th>
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<tr>
<td>Pre-requisite</td>
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<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Syllabus version</td>
<td>1.0</td>
<td></td>
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</tbody>
</table>

Course Objectives:
1. To impart the basic concepts of data structures and algorithms.
2. To assess how the choice of data structures and algorithm design methods impacts the performance of programs.
3. To provide an insight into the intrinsic nature of the problem and to develop software systems of varying complexity.

Course Outcomes:
1. Evaluating and providing suitable techniques for solving a problem using basic properties of Data Structures.
2. Analyse the performance of algorithms using asymptotic notations.
3. Demonstrate knowledge of basic data structures and legal operations on them.
4. Illustrate different types of algorithmic approaches to problem solving and assess the trade-offs involved.
5. Analyse basic graph algorithms, operations and applications through a structured (well-defined) algorithmic approach.
6. Categorize the feasibility and limitations of solutions to real-world problems.
7. Provide efficient algorithmic solution to real-world problems.

Student Learning Outcomes (SLO): 1, 6, 9
1. Having an ability to apply mathematics and science in engineering applications.
6. Having an ability to design a component or a product applying all the relevant standards and with realistic constraints
9. Having problem solving ability- solving social issues and engineering problems

Module: 1 | Introduction to Data structures and Algorithms | 1 hour
Overview and importance of algorithms and data structures, Stages of algorithm development for solving a problem: Describing the problem, Identifying a suitable technique, Design of an Algorithm, Proof of Correctness of the Algorithm, Computing the time complexity of the Algorithm.

Module: 2 | Analysis of Algorithms | 3 hours

Module: 3 | Data Structures | 7 hours
Importance of data structures, Arrays, Stacks, Queues, Linked list, Trees, Hashing table, Binary Search Tree, Heaps.

Module: 4 | Algorithm Design Paradigms | 8 hours
Divide and Conquer, Brute force, Greedy, Recursive Backtracking and Dynamic programming.
<table>
<thead>
<tr>
<th>Module:5</th>
<th>Graph Algorithms</th>
<th>4 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breadth First Search (BFS), Depth First Search (DFS), Minimum Spanning Tree (MST), Single Source Shortest Paths.</td>
<td></td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:6</th>
<th>Computational Complexity classes</th>
<th>5 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tractable and Intractable Problems, Decidable and Undecidable problems, Computational complexity Classes: P, NP and NP complete - Cook's Theorem (without proof), 3-CNF-SAT Problem, Reduction of 3-CNF-SAT to Clique Problem, Reduction of 3-CNF-SAT to Subset sum problem.</td>
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<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:7</th>
<th>Recent Trends</th>
<th>2 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algorithms related to Search Engines</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Total lecture hours:** 30 hours

**Text Book(s)**


**Reference Books**


**Mode of evaluation**: Internal Assessment (CAT, Quizzes, Digital Assignments) & Final Assessment Test (FAT)

**List of Challenging Experiments (Indicative)**

1. Extract the features based on various color models and apply on image and video retrieval  2 hours
2. Arrays, loops and Lists  2 hours
3. Stacks and Queues  2 hours
4. Searching and Sorting  3 hours
5. Linked List and operations  4 hours
6. Brute force technique  2 hours
7. Greedy Technique  2 hours
8. Backtracking  2 hours
9. Dynamic Programming  2 hours
10. Trees and Tree Operations  3 hours
11. BFS and DFS  4 hours
12. Minimum Spanning Tree  4 hours

**Total laboratory hours** 30 hours

**Mode of evaluation**: Continuous Assessment & Final Assessment Test (FAT)

Recommended by Board of Studies 04-04-2014
Approved by Academic Council No. 37 Date 16-06-2015
<table>
<thead>
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<td>CSE4033</td>
<td>Cloud Computing and Security</td>
<td>2</td>
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**Pre-requisite**

<table>
<thead>
<tr>
<th>Course Title</th>
<th>Version</th>
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<tbody>
<tr>
<td>ECE 3026 IoT System Architecture</td>
<td>01</td>
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</table>

**Course Objectives:**

The course is aimed at making the students to

1. Evaluate industry-leading systems and technologies for public and private cloud infrastructure.
2. Understand cloud orchestration to support elasticity and availability.
3. Implement cloud features to secure and harden the cloud infrastructure.

**Course Outcomes (CO):**

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

1. Study the basics of cloud computing, cloud models and its applications.
2. Understand cloud technologies, its services and platforms.
3. Learn how to use Public Cloud Services and to build applications.
4. Design cloud applications and analyse the design considerations and methodologies.
5. Familiar with the division of responsibility in Cloud environment and managing risks in the Cloud architecture.
6. Know about the security concepts and ability to design a resilient cloud architecture.
8. Analyse platform-specific tools and management consoles to configure and manage cloud infrastructure.

**Student Learning Outcomes (SLO)**

2, 7, 9

2. Having a clear understanding of the subject related concepts and of contemporary issues.

7. Having computational thinking.


**Module:1 Introduction to cloud computing 4 Hours**

- Characteristics of Cloud computing – Cloud Models – Cloud Services – IaaS, PaaS, SaaS, DaaS – Cloud based services and applications,

**Module:2 Technologies, Services and Platforms 4 Hours**

- Virtualization, Load Balancing, Scalability, Elasticity, Deployment, Replication, Monitoring,
Software defined Networking, Network function Virtualization, Mapreduce, Access management and Service level agreements

<table>
<thead>
<tr>
<th>Module:3</th>
<th>Cloud Services and Platforms</th>
<th>4 Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Compute Services, Storage Services, Database services, Application Services, Content Delivery Services, Analytics Services, Deployment and Management Services, identity and Access management services: Amazon Web Services, Google Cloud Platform, Windows Azure</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Module:4</th>
<th>Cloud Application Design</th>
<th>4 Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Design considerations – Reference Architectures – Design Methodologies – Storage Approaches</td>
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<th>Module:5</th>
<th>Risk Analysis and Division of Responsibility</th>
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<table>
<thead>
<tr>
<th>Module:6</th>
<th>Securing the Cloud Infrastructure.</th>
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<table>
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<tr>
<th>Module:7</th>
<th>Operating System and Network Security</th>
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<table>
<thead>
<tr>
<th>Module:3</th>
<th>Contemporary Issues</th>
<th>2 Hours</th>
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**Total Lecture Hours:** 30

**Text Book(s):**

## Reference Books:


## List of Challenging Experiments:

<table>
<thead>
<tr>
<th>No.</th>
<th>Experiment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Case study: Google Cloud</td>
</tr>
<tr>
<td>2.</td>
<td>Virtualization Tools – KVM, Virtual Box, Xen</td>
</tr>
<tr>
<td>3.</td>
<td>Case study: Windows Azure</td>
</tr>
<tr>
<td>4.</td>
<td>Case study: Amazon Web services</td>
</tr>
<tr>
<td>5.</td>
<td>Case Study: IBM Bluemix</td>
</tr>
<tr>
<td>6.</td>
<td>Cuckoo Sandobox – open source cloud security tool(malware analysis)</td>
</tr>
<tr>
<td>7.</td>
<td>SLA – Use Cases</td>
</tr>
<tr>
<td>8.</td>
<td>Deployment of end to end IoT Application</td>
</tr>
<tr>
<td>9.</td>
<td>Build a mobile messaging Application</td>
</tr>
<tr>
<td>10.</td>
<td>Interfacing to Raspberry Pi or Intel Galileo</td>
</tr>
</tbody>
</table>

Recommended by Board of Studies : 31/08/2018  
Approved by Academic Council : 53rd  
Date : 13/12/2018
Course Code | Course Title | L | T | P | J | C
---|---|---|---|---|---|---
ECE1013 | ELECTRONIC CIRCUITS | 2 | 0 | 2 | 4 | 4

Pre-requisite: EEE1001 – Basic Electrical and Electronics Engineering

Version: 1

Course Objectives:
The course is aimed at

[1] Imparting knowledge about basic electronic devices such as BJT, FET, operational amplifier and circuits such as Timer.

[2] Teaching about the different classes of power amplifiers, their operations and power conversion efficiency.


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

[1] Design amplifier circuits using suitable biasing method and analyze small signal amplifiers using hybrid equivalent models.

[2] Analyze the RC Coupled amplifiers and determine the frequency response of different Multistage Amplifiers.


[4] Design different closed loop amplifier circuits and determine the DC Imperfections in the Amplifier circuits.


[6] Discuss about operations of Power Amplifiers and determine the conversion efficiencies of different classes of Amplifiers.

[7] Understand different modes of Multivibrator circuits and operation of Phase Locked Loop.


Student Learning Outcomes (SLO):

1, 2, 14

Module: 1

| Transistor Biasing and Small Signal Amplifiers | 6 hours |
---|---|

B.TECH (ECE with IoT & Sensor)
Q-point, Self Bias-CE and CS. Compensation techniques, h-model of BJT and MOSFET, small signal analysis of amplifiers: voltage and current gain, input and output impedance, trans-resistance & trans-conductance; Emitter follower and source follower circuits, High frequency model of transistors.

<table>
<thead>
<tr>
<th>Module:2</th>
<th>Multistage Amplifiers</th>
<th>2 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency response of an amplifier, bandwidth of cascaded amplifiers, RC coupled amplifier (BJT and MOSFET), voltage gain, current gain, input impedance and output impedance, lower and upper half frequencies, bandwidth, and concept of wide band amplifier</td>
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</table>

<table>
<thead>
<tr>
<th>Module:3</th>
<th>Feedback Amplifiers &amp; Oscillators</th>
<th>5 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feedback concept, negative &amp; positive feedback, voltage/ current, series/shunt feedback, Barkhausen criterion, Colpitts, Hartley’s, Phase shift, Wein bridge and crystal oscillators</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:4</th>
<th>Operational Amplifier</th>
<th>5 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ideal OPAMP, Differential Amplifier, Constant current source (current mirror etc.), CMRR, Open &amp; Closed loop circuits, inverting &amp; non inverting amplifiers, voltage follower/buffer circuit. DC imperfections, Transient and frequency dependent performance.</td>
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</table>

<table>
<thead>
<tr>
<th>Module:5</th>
<th>Applications of Operational Amplifiers</th>
<th>6 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adder, integrator &amp; differentiator, comparator, Schmitt Trigger. instrumentation Amplifier, Log &amp; Anti-log amplifiers, Trans-conductance multiplier, Precision Rectifier, voltage to current and current to voltage converter, free running oscillator.</td>
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</table>

<table>
<thead>
<tr>
<th>Module:6</th>
<th>Power amplifiers</th>
<th>2 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classification of large signal amplifiers, Class A, B, AB, C, Conversion efficiency, Tuned amplifier.</td>
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</table>

<table>
<thead>
<tr>
<th>Module:7</th>
<th>Multivibrators and Special Functional Circuits</th>
<th>2 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monostable, Bistable, Astable multi vibrators using 555 timer, Mixer Circuits, VCO and PLL.</td>
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<table>
<thead>
<tr>
<th>Module:8</th>
<th>Contemporary issues:</th>
<th>2 hours</th>
</tr>
</thead>
</table>

**Total Lecture hours: : 30 hours**

**Text Book(s)**


**Reference Books**

List of Challenging Experiments (Indicative)

1. Design of small signal BJT and MOSFET amplifiers using self bias technique and analyzing the effect of capacitors on voltage gain and frequency response of the amplifiers.  
   6 hours

2. Design of Multistage amplifiers to improve the frequency response, input impedance and enhance the voltage gain using two stage RC coupled amplifier, Cascode amplifier and Darlington pair.  
   6 hours

3. Design of Power amplifiers using BJT/MOSFET for high power applications and analyzing the non – linear distortions occurring in those amplifiers. Suggesting suitable technique to eliminate the distortions and also to improve the power conversion efficiency.  
   6 hours

4. Design of linear and non-linear circuits using operational amplifiers for real time applications.  
   6 hours

5. Design of application circuits such as modulators, waveform generators etc., using timer. Design of radar synchronizing circuits using PLL and VCO.  
   6 hours

Total Laboratory Hours : 30 hours

Mode of Evaluation: Challenging Tasks, Continuous Assessment Test, Final Assessment Test

Typical Projects

1. Design of a regulated DC power supply system of various ranges using discrete devices like diodes, capacitors and resistors.
2. Design a system that will automatically sense the rain and in turn enables the wiper system in automobiles.
3. Design of smart Home automation system using basic sensors, relays and controller units.
4. Design of an Electronic code lock circuit using 555 timer and basic discrete components that provides high level security.
5. Design of a public addressing system employing small signal and large signal BJT/MOSFET amplifiers.
6. Design an automatic temperature sensing and controlling system for a boiler unit using thermocouple and signal conditioning circuit.

Mode of Evaluation: Reviews, Project Competition / Make –a- thon

Recommended by Board of Studies : 20/11/2016

Approved by Academic Council : 43rd Date:12/12/2016
## Course Code: ECE1017
### Course Title: ELECTROMAGNETIC FIELD THEORY AND TRANSMISSION LINES

**L T P J C**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>J</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECE1017</td>
<td>ELECTROMAGNETIC FIELD THEORY AND TRANSMISSION LINES</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
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</table>

**Pre-requisite:** PHY 1001-Engineering Physics

**Version:** 1

### Course objectives (CoB):

The course is aimed to:

1. Acquaint the students with basic concepts and properties of Electrostatics & Magnetostatics.
2. Make the students understand the propagation of EM wave through time varying conducting and dielectric media.
3. Make the students comprehend the concept of transmission and reflection in various transmission lines and to design different transmission lines and matching circuits using Smith chart.

### Course Outcomes (CO):

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

1. Evaluate and analyse Electric Fields & Electric Potential due to different Charge distributions.
2. Compute and analyze magnetic fields in different material media.
3. Understand the propagation of EM wave through time varying Maxwell’s equations.
4. Comprehend the EM wave propagation in conducting as well as in dielectric materials.
5. Calculate power of an EM wave while propagating through different materials.
6. Illustrate the wave mechanism in different transmission lines at high frequencies using transmission line parameters.
7. Design Impedance matching circuits using Smith chart.

### Student Learning Outcomes (SLO):

1, 6, 9

**Student Learning Outcomes involved:**

1. Having an ability to apply mathematics and science in engineering applications.
6. Having an ability to design a component or a product applying all the relevant standards and with realistic constraints.

### Module: 1

**Electrostatics** - 6 hours

Coulomb’s Law, Electric Fields due to Different Charge Distributions, Gauss Law and Applications, Electrostatic Potential and Equipotential surfaces, Energy Density, Poisson’s and Laplace’s Equations; Capacitance – Parallel Plate, Coaxial, Spherical Capacitors, Method of...
Images. Convection and Conduction currents, Continuity Equation, Relaxation Time, Joules Law, Analogy between D and J.

<table>
<thead>
<tr>
<th>Module:2</th>
<th>Magnetostatics</th>
<th>6 hours</th>
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<table>
<thead>
<tr>
<th>Module:3</th>
<th>Maxwell’s Equations (Time Varying Fields)</th>
<th>6 hours</th>
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<tr>
<th>Module:4</th>
<th>EM Wave Characteristics - I</th>
<th>7 hours</th>
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<tr>
<th>Module:5</th>
<th>EM Wave Characteristics – II</th>
<th>7 hours</th>
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<tr>
<th>Module:6</th>
<th>Transmission Lines - I</th>
<th>6 hours</th>
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<table>
<thead>
<tr>
<th>Module:7</th>
<th>Transmission Lines – II</th>
<th>5 hours</th>
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<table>
<thead>
<tr>
<th>Module:8</th>
<th>Contemporary issues:</th>
<th>2 hours</th>
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<tr>
<th>Text Book(s)</th>
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<table>
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<tr>
<th>Total Lecture Hours: 45 hours</th>
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<tbody>
<tr>
<td>Reference Books</td>
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<tr>
<td>-----------------</td>
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</tbody>
</table>

Mode of Evaluation: Continuous Assessment Test, Digital Assignment, QUIZ, FAT

Recommended by Board of Studies: 26-11-2016

Approved by Academic Council: 43rd Date: 12/12/2016
Course Code | Course Title | L | T | P | J | C
---|---|---|---|---|---|---
ECE1018 | SIGNAL ANALYSIS AND PROCESSING | 2 | 0 | 2 | 4 | 4

Pre-requisite: MAT1011 Calculus for Engineers

**Course Objectives**

The course is aimed at making the students to

1. Understanding the fundamental characteristics of signals and systems.
2. Characterizing the signals and systems both in time and transform domains to gain further insights into their analysis.
3. Acquire mathematical skills to solve problems involving convolution and sampling.

**Expected Course Outcome:**

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

1. Understand the various types of signals and systems, and study their properties.
2. Determine the system response of a Linear Time Invariant system.
3. Analyse system properties based on Impulse response and Fourier analysis.
4. Understand and use the concepts of correlation and convolution.
5. Apply Laplace Transform for analysis of CT signals and systems.
6. Apply Z-transform for analysis of DT signals and systems.
7. Apply the learnt mathematical tools in solving problems in a variety of signal processing applications with the aid of simulation software.

**Student Learning Outcomes (SLO):** 1, 2, 14

1. Having an ability to apply mathematics and science in engineering applications
2. Having a clear understanding of the subject related concepts and of contemporary issues
14. Having an ability to design and conduct experiments, as well as to analyze and interpret data

**Module: 1 Introduction to Signals and systems** 3 hours

Continuous-time and Discrete-time Signals, Transformation of independent variables- Shifting, Scaling. Exponential and sinusoidal signals, Unit impulse and Unit step functions. Basics of continuous and discrete time systems. Basic system properties. Sampling.

**Module: 2 Linear Time-Invariant (LTI) Systems** 3 hours


**Module: 3 Fourier Analysis of Continuous-time Signals:** 4 hours

Orthogonal Function, Approximation using Orthogonal Function, Fourier series, Evaluation of Fourier coefficients, Gibbs Phenomenon, Continuous-time Fourier transform (CTFT), Properties, Parseval's theorem, Inverse Fourier transform

**Module: 4 Frequency Domain Analysis of Discrete Time Signals** 4 hours

Fourier series representation of discrete time periodic signals, Properties of discrete time Fourier series (DTFS), Representation of discrete time Fourier transform (DTFT), Properties of DTFT.

**Module: 5 Concept of Convolution and Correlation** 4 hours

Introduction to correlation, Relation between convolution and correlation. Correlation of energy signals, Properties of cross-correlation and auto correlation, Correlation of discrete-time periodic signals.

**Module: 6 Laplace transform** 5 hours

The Philosophy of Transform Methods, Differences between Laplace and Fourier transform, The Laplace Transform, Properties of Laplace Transform, Inverse Laplace transform, Uses of Laplace Transforms, Partial-Fraction Expansions, Region of convergence (ROC).
### Module: 7  System Analysis using z-Transform  5 hours
Relation between DTFT and z-transform, z-transforms of unit impulse sequence, unit step sequence, unit ramp, sinusoidal and exponential sequence. ROC of finite duration sequences, Properties of z-transform, Inverse z-transform, Stability analysis.

### Module: 8  Contemporary issues:  2 hours

<table>
<thead>
<tr>
<th>Text Book(s)</th>
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<table>
<thead>
<tr>
<th>Reference Books</th>
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</thead>
</table>

**Mode of Evaluation:** Continuous Assessment Test, Quiz, Digital Assignment, Final Assessment Test

**List of Challenging Experiments (Indicative)**

<table>
<thead>
<tr>
<th>1. Time domain representation of continuous time (CT) and Discrete time (DT) signals:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study the concept of basic signals and apply to generate the complex signals. For example: Asin(2<em>pi</em>t)+Bcos(4<em>pi/2</em>t), x1[n]=u[n]-u[n-4], x2[n]=δ[n]+2δ[n-1]+4 δ[n-2]-6 δ[n-3], x3[n]=r[n-2], x4[n]=square wave with frequency 4Hz, duty cycle 50%, x5[n]=Sawtooth wave with frequency 3Hz and peak is halfway through the period</td>
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</tbody>
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<table>
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<tr>
<th>2. Operation on CT and DT Signals:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generate arbitrary signals x1[n] &amp; x2[n] and perform all the basic signal operations. For example: Addition/Subtraction, Time shifting, Time scaling, Amplitude Scaling, Odd/Even part of the signal etc.,</td>
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</tbody>
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<tr>
<th>3. LTI System Analysis in time –domain:</th>
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<tbody>
<tr>
<td>Detect the signal similarities and Find a signal of interest hidden in a long data record, measure delays between signals to synchronize them. Compute the response of to any input signal.</td>
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<tr>
<th>4. Frequency domain analysis of the signal:</th>
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<tbody>
<tr>
<td>Analyze how the signal's energy is distributed over a range of frequencies. Magnitude/Phase spectrum, Apply FFT to filtering applications.</td>
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<tr>
<th>5. Frequency domain analysis of the system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analysis of LTI system through Pole-zero mapping and Z-transform, convolution/deconvolution, Transfer function and impulse response analysis</td>
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<tr>
<th>6. Signal processing in hardware to do projects with audio/speech signals</th>
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</thead>
</table>

Total Laboratory Hours 30 hours

**Mode of Evaluation:** Challenging Tasks, Continuous Assessment Test, Final Assessment Test

**Typical Projects**

1. Consider an audio song with instrumental music and design a filter circuit to separate the voice signal and the instrumental
2. Design and implement an encryption and decryption algorithm for audio signals which can be used for secured communication.

3. Design a Hardware system to control a DC motor speed by using voice signal as an input and apply this concept for Robotics applications.

4. Develop a Voice controlled Home automation system for controlling the Home appliances in terms of switch on, switch off and etc.

5. Develop a Speaker Verification system for biometric Security Applications. This project should be designed like fingerprint or Face recognition.

6. Design the following modules for Analog to Digital conversion
   a. Sampling; b. Quantization; c. Encoding

7. Develop a system for noise cancellation. This system has to separate/filter the noise and the original signal.

8. Analyze an ECG signal for medical diagnosis applications.

9. Design and implement a DTMF signaling scheme for various controlling applications.

10. Design a motion detector circuit for intruder alarm, home automation system and etc.

11. Develop an algorithm for audio watermarking and implement the same in MATLAB


Mode of Evaluation: Reviews, Project Competition / Make-a-thon

Recommended by Board of Studies : 20/11/2016

Approved by Academic Council : 43 Date: 12/12/2016
Course Objectives:
1. To understand the use of transfer function models for the analysis of physical systems and to introduce the components of control system.
2. To provide adequate knowledge in the time response of systems and steady state error analysis along with the understanding of closed loop and open loop in frequency domain.
3. To introduce the design of compensators and controllers for the stability analysis.
4. To introduce state variable representation of physical systems and study the effect of state feedback.

Course Outcomes:
1. Differentiate real-time applications as open loop or closed loop systems.
2. Analyze the system from the transfer function.
3. Design of compensators and controllers and find the stability of these control systems.
4. Ability to compute steady state and transient response of the different order of the system and also to analyze its error coefficients.
5. Analyze the frequency domain response of the control systems.
6. Apply various control systems concepts to analyze and find the stability of control systems.
7. Analyze the observability of the system in state modeling.

Student Learning Outcomes (SLO):
1. Having an ability to apply mathematics and science in engineering applications
2. Having a clear understanding of the subject related concepts and of contemporary issues
14. Having an ability to design and conduct experiments, as well as to analyze and interpret data

Module: 1 Introduction to Control Systems
Basic block diagram of control system, Control schemes – Open loop and closed loop, Applications and scope.

Module: 2 Mathematical Modeling of Physical Systems
Uncertainty, self-information, average information, mutual information and their properties - Entropy and information rate of Markov sources - Information measures of continuous random variables.

Module: 3 Controller and Compensator Design
Controllers – P, PI, PID controllers, Realization of basic compensators, Cascade compensation in time domain and frequency domain, Feedback compensation, Design of lag, lead, lag-lead series compensator, Introduction to control system components: DC and AC Servo motors, Stepper motor and Synchros.

Module: 4 Time Domain Response
Steady state and transient response, Time domain specifications, Types of test inputs, Response of first order and second order systems, Steady state error, error constants, generalized error coefficient.

Module: 5 Characterization of Systems
Stability – Concept and definition, Poles, Zeros, Order and Type of systems; R-H criteria, Root locus analysis.
### Module: 6 Frequency Domain Response

| Frequency response – Performance specifications in the frequency domain, Phase margin and gain margin, Bode plot, Polar plot and Nyquist plot, Stability analysis in frequency domain. |

### Module: 7 State Space Analysis

| Concept of state and state variable, Modeling of systems using state variables, Coordinate transformations and canonical realizations, Solution of state variables, Controllability and observability. |

### Module: 8 Contemporary Issues

| 2 hours |

| Total lecture hours: 45 hours |

| Text Book(s) |


| Mode of Evaluation: Internal Assessment (CAT, Quizzes, Digital Assignments) & Final Assessment Test (FAT) |

| Recommended by Board of Studies | 13-12-2015 |

| Approved by Academic Council | No. 40 | Date | 18-03-2016 |
Course Code | Course Title | L | T | P | J | C
--- | --- | --- | --- | --- | --- | ---
ECE2023 | PRINCIPLES OF SENSORS AND DATA ACQUISITION | 3 | 0 | 2 | 0 | 4

Pre-requisite | ECE1013 - Electronic Circuits | Version :1.1

### Course Objectives:

The course is aimed at making the students

1. To provide basic understanding of physical principles of sensing, data conversion and computer-based data acquisition methods.
2. To investigate the various signal conditioning systems which need to be used to process the signals coming in from the sensors.
3. To gain experience in applying the appropriate sensors and data acquisition systems for the measurement of specific environmental change.
4. To have an hands on experience in integrating various sensors with LabVIEW based data acquisition systems.

### Expected Course Outcomes:

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

1. Determine the principles and concepts of measurement.
2. Recognize the physical principles of commonly used sensors.
3. Demonstrate a critical understanding of elements of a data acquisition system.
4. Prescribe a sensor type to measure a specific environmental change.
5. Design signal conditioning necessary for a number of sensors and transducers.
6. Evaluate and select appropriate techniques and devices for realizing data acquisition system.
7. Identify the type of interface used to get a digital signal into a PC and use software to view the data on PC.
8. Study the role of different sensors and their usage in various applications with the help of experiments.

### Student Learning Outcomes (SLO): 1,2,5

1. Having an ability to apply mathematics and science in engineering applications
2. Having a clear understanding of the subject related concepts and of contemporary issues
5. Having design thinking capability

### Module:1 Principles of Measurement 3 hours

General concepts and terminology of measurement systems, units and standards, static and dynamic characteristics.

### Module:2 Physical Principles of Sensors 8 hours

Physical effects involved in signal transduction- piezo-resistive effect (strain gages), inductive sensors-LVDT, Hall effect, capacitive sensors, piezoelectric effect, pyroelectric effect, photo electric effect, magneto-mechanical effect (magnetostriction), magneto-resistive effect, thermolectric effect, thermo-resistive effect (RTD, thermistor).

### Module:3 Signal Conditioning 8 hours

Earthling and grounding, errors due to common mode interference, Wheatstone bridge, common mode rejection ratio, signal level and bias changes, Instrumentation amplifiers, isolation amplifiers, charge amplifiers, filters, phase sensitive detectors. Cold junction compensation

### Module:4 Sample/Hold Circuits and Multiplexers 6 hours

Sampling and aliasing, S/H practical circuit, Slew rate and aperture error, reed relays, FET/CMOS switches, errors in multiplexers.

### Module:5 Analog/Digital converters 6 hours

Digital quantities, data converters and parameters, DACs-weighted resistor, ladder network, characteristics, sources of error, ADCs-integrating type-dual ramp, charge balance, non-integrating type, successive approximation, flash type.
Module: 6 Digital and Pulse Train Conditioning 6 hours
Digital I/O interfacing - high current/voltage digital I/O, Timers and counters- Digital pulse counting, frequency measurement, timing applications.

Module: 7 I/O Techniques and Buses 6 hours
Data acquisition interface devices, data transfer techniques, buffered I/O, Bus architecture, general bus types: processor-memory bus, back-plane bus, I/O bus, Bus characteristics, Bus standards and communications: expansion bus: PCI-e, PCI express, HT, disk interface- SATA, Ethernet, external buses: RS232, USB.

Module: 8 Contemporary issues: 2 hours

Text Book(s)

Reference Books
3. John Park and Steve Mackay, Practical Data acquisition for Instrumentation and Control, 2005, Newness publishers, USA.

Mode of Evaluation: Continues Assessment Test, Quiz, Digital Assignment, Challenging Experiments, Final Assessment Test

List of Challenging Experiments (Indicative):

Task 1: Using an RTD with $\alpha =0.0034/^\circ C$ and $R=100\Omega$ at $20^\circ C$, design a bridge and op amp system to provide a 0 to 10V output for a $20^\circ C$ to $100^\circ C$ temperature variation. The RTD dissipation constant is $28mW/^\circ C$. Maximum self-heating should be $0.05^\circ C$.

Task 2: A type K thermocouple with a $20^\circ C$ reference will be used to measure temperature between $200^\circ C$ and $350^\circ C$. Devise a system that will convert this temperature range into an 8-bit digital word with conversion from $00H$ to $01H$ at $200^\circ C$ and the change from $FEH$ to $FFH$ occurring at $350^\circ C$. An ADC is available with a $2.500-V$ internal reference.

Task 3: Design a thermistor-based digital temperature measurement system. The ADC has a $5V$ reference and is 8 bits. The thermistor specifications are $R=5k\Omega$ at $90^\circ F$, power dissipation of sensor is $5mW/^\circ C$, and a slope between $90^\circ F$ and $110^\circ F$ of $-8\Omega/^\circ C$. The design should be made so that $90^\circ F$ gives an ADC output of $5AH$ and $110^\circ F$ gives $6EH$.

Task 4: Design a stress measurement system using strain gage. The output of the system should be 8 bits digital output. The sensitivity should be such that there is change in the LSB for a stress of $2Pa$. The strain gage is to be attached to the steel bar. Young’s Modulus of steel is $210Gpa$ and Poisson’s ratio is $0.3$. The designed system must eliminate the strain gage temperature sensitivity.

Task 5: A shock sensor is a capacitive piezoelectric element which generates a charge under physical acceleration. Build a circuit that can convert the charge into a voltage and filtered using high valued resistors and a high input impedance CMOS amplifier such as the LTC6081. This circuit should have a gain of 100 and output $109mV/g$ of acceleration.
**Task 6:** Build an analog circuit using bridge circuit and op amps to measure the voltage output of the strain gage mounted on a cantilever beam to measure its deflection. Connect the amplified voltage output from the circuit to the DAQ card. Develop a LabVIEW program to read the voltage signal and to plot on the chart.  

4 hours

**Task 7:**

- **a)** The analog input channel of a typical frequency input data acquisition requires a low pass filter with a selectable cut off frequency of 100kHz, 300Hz, and 30Hz. Design, implement and test the low pass filter circuit. It should measure the frequencies from 1Hz to 100kHz for signals ranging from 50 mV to 5V.
- **b)** Data acquisition systems measure frequency by integrating a continuous wave ac signal or pulse trains to produce a dc voltage with a magnitude proportional to the frequency. Devise a method using LabVIEW to acquire the input pulse train and produce an output voltage proportional to the pulse train frequency.
- **c)** Devise a method using LabVIEW that can measure ±15Vdc signals from 10 Hz to 10 kHz using digital pulse counting method.

6 hours

<table>
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<tr>
<th>Total Laboratory Hours</th>
<th>30 hours</th>
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Mode of Evaluation: Challenging Experiments, Final Assessment Test

Recommended by board of studies: 20/11/2016

Approved by Academic Council : 43rd Date : 12/12/2016
Course Code: ECE2024  
Course Title: PRINCIPLES OF COMMUNICATION ENGINEERING  
L | T | P | J | C  
---|---|---|---|---  
2 | 0 | 0 | 0 | 2  
Pre-requisite: ECE1013 - Electronic Circuits  
Version: 1.1

Course Objectives:
The course is aimed at making the students to

1. Study about the elements and the types of communication systems.
2. Know about the concepts of synchronization schemes in communication system
3. Familiarize with the concepts of spread spectrum technique

Expected Course Outcome:
At the end of the course, the Students will be able to

1. Acquionte the spectrum of amplitude modulated signals and design systems for generation and demodulation of amplitude modulated signals.
2. Understand the importance of power efficient amplitude modulation schemes and use them for analog data transmission
3. Familiarize with fundamental concepts and design issues in modulation and demodulation process of angle modulation
4. Know about digital modulation techniques and apply them for digital data transmission.
5. Identity the significance of synchronization technique in communication.
6. Study the concepts behind spread spectrum communication systems.

Student Learning Outcomes (SLO): 1,2,12

1. Having an ability to apply mathematics and science in engineering applications
2. Having a clear understanding of the subject related concepts and of contemporary issues
12. Having adaptive thinking and adaptability

Module: 1  
Amplitude Modulation  
4 hours

- Need for modulation- Elements of Communication system-Types of modulation -Amplitude Modulation (AM) – frequency spectrum of AM– Power in AM wave – Generation of AM signal - Square law modulator, switching modulator, AM demodulation - Envelope and square law demodulation.

Module: 2  
Power Efficient in AM system  
3 hours

- DSB-SC - SSB-SC and VSB modulation- generation and demodulation. Power and bandwidth calculation of linear modulation systems.

Module: 3  
Angle Modulation and Demodulation  
5 hours

- Principle of Frequency Modulation (FM) and Phase Modulation (PM) – Relation between FM and PM – Frequency deviation, Bandwidth of FM – Narrow band and wide band FM, FM transmitter, FM detectors – slope detectors – Phase discriminators – Ratio detectors - Phase Locked Loop (PLL)- Pre-emphasis and de-emphasis.

Module: 4  
Digital Transmission  
3 hours


Module: 5  
Digital Modulation Scheme  
5 hours


Module: 6  
Synchronization Techniques  
4 hours

- Receiver Synchronization- Time and Frequency synchronization techniques- PLL- Network and Frame synchronization- Early Late Gate synchronization- Costas Loop.

Module: 7  
Spread Spectrum Communication  
4 hours

- PN Sequences – properties- Design principles- Direct sequence (DS) and Frequency Hopping (FH) spread spectrum -Code Division Multiple Access (CDMA) - RAKE receiver structures-
<table>
<thead>
<tr>
<th>Module:8</th>
<th>Contemporary issues:</th>
<th>2 hours</th>
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<tbody>
<tr>
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<td><strong>Total Lecture hours:</strong> 30 hours</td>
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</table>

**Text Book(s)**

**Reference Books**

**Mode of Evaluation**: Continuous assessment test, Digital Assignment, Quiz and Final Assessment Test

Recommended by Board of Studies: 20/11/2016
Approved by Academic Council: 43rd Date: 12/12/2016
**Course Code** | **Course Title** | **L** | **T** | **P** | **J** | **C**  
--- | --- | --- | --- | --- | --- | ---  
ECE2026 | DIGITAL CIRCUIT DESIGN | 2 | 0 | 2 | 4 | 4  

**Pre-requisite:** ECE1013 - Electronic Circuits  

**Course Objectives:**  
The course is aimed at  
[1] Introducing the concepts of digital and binary systems.  
[3] Learning basic software tools for the design and implementation of digital circuits and systems.  

**Expected Course Outcome:**  
The students will be able to  
[1] Understand the number systems and concepts of digital logic families to delve into its hardware aspects.  
[3] Design and analyze combinational logic and sequential logic digital circuits  
[4] Understand the basic software tools for the design and implementation of digital circuits and systems.  
[6] Use Hardware Description Language in the design and implementation of digital circuits, both combinational and sequential.  
[7] Reinforce theory and techniques related to digital circuits and systems through experiments and work on rudimentary projects.  

**Student Learning Outcomes (SLO):**  
[1] Having an ability to apply mathematics and science in engineering applications  
[2] Having a clear understanding of the subject related concepts and of contemporary issues  
[17] Having an ability to use techniques, skills and modern engineering tools necessary for engineering practice  

**Module: 1 Logic Families & Programmable Logics**  
3 hours  
Brief review of Number Systems, Digital Logic Gates and its electrical characteristics, Review of RTL, DTL, TTL, ECL, CMOS families, PAL, PLD, CPLD and FPGA Generic Architecture.  

**Module: 2 Boolean algebra & Gate-Level Minimization**  
3 hours  
Basic Definitions, Axiomatic Definition of Boolean Algebra, Basic Theorems and Properties of Boolean Algebra, Boolean Functions, Canonical and Standard Forms. The Map Method - K-map, Product of Sums and Sum of Products Simplification, NAND and NOR Implementation  

**Module: 3 Design of Combinational Logic Circuits**  
4 hours  
Design Procedure, Binary Adder-Subtractor, Parallel Adder, Binary Multiplier, MagnitudeComparator-4 bit, Decoders, Encoders, Multiplexers, De-multiplexer, Parity generator and checker. Application of Mux and Demux.  

**Module: 4 Hardware description Language (HDL)**  
6 hours  
Lexical Conventions, Ports and Modules, Gate Level Modeling, Operators, Data Flow Modeling, Behavioral level Modeling, Testbench.  

**Module: 5 Design of Sequential Logic Circuits:**  
6 hours  

**Module: 6 Modeling of Combinational Logic Circuits using HDL**  
3 hours  
Design of Comparators, 8-bit Carry Look Ahead adders and Array multiplier.  

**Module: 7 Modeling of Sequential Logic Circuits using HDL**  
3 hours
Sequence detector and vending machine design using FSM.

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<tr>
<th>Module:8</th>
<th>Contemporary issues:</th>
<th>2 hours</th>
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<tr>
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<td>Total Lecture hours:</td>
<td>30 hours</td>
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</tbody>
</table>

Text Book(s)

Reference Books

Mode of Evaluation: Continuous assessment test, Digital Assignment, Quiz and Final Assessment Test

List of Challenging Experiments (Indicative)

1. Implementation of Full adder, Full subtractor using MUX/Decoder ICs (Hardware)  
   4 hours

2. Design of Universal shift register, based on the control input it should function as anyone of the following shift registers, Serial in Serial out, Serial in serial out, Parallel in Parallel out and Parallel in Serial out.  
   6 hours

3. Design 4 bit adder and 4 bit array Multiplier using basic logic gates and implement the design in Altera FPGA  
   6 hours

4. Design a FSM that has an input $w$ and output $z$. The machine is a sequence detector that produces $z = 1$ when the previous two values of $w$ were 00 or 11 otherwise $z = 0$  
   6 hours

5. Design of a circuit that controls the traffic lights at the intersection of two roads. The circuit generates the outputs G1, Y1, R1 and G2, Y2, R2. These outputs represent the states of the green, yellow, and red lights, respectively, on each road.  
   (a) Give an ASM chart that describes the traffic-light controller. Assume that two down counters exist, one that is used to measure the t1 delay and another that is used to measure t2. Each counter has parallel-load and enable inputs. These inputs are used to load an appropriate value representing either the t1 or t2 delay and then allow the counter to count down to 0. (b) Give an ASM chart for the control circuit for the traffic-light controller. (c)Write complete Verilog code for the traffic-light controller, including the control circuit from part (a) and counters to represent t1 and t2. Use any convenient clock frequency to clock the circuit and assume convenient count values to represent t1 and t2. Give simulation results that illustrate the operation of your circuit.  
   8 hours

Total Laboratory Hours 30 hours

Mode of Evaluation: Continuous assessment test and Final Assessment Test

Typical Projects
1. Design a Voting Machine using verilog HDL and implement the system on FPGA. The system should support to add up to ten candidates and should take the number of voters and display the result after providing a passcode.

2. Design and implement a 7 segment LED matrix based display system, which is developed to display information regularly or the message in scrolling form. The system takes input directly from the keyboard and the typed message is displayed.
3. Design a 24 hour Digital Clock that has a format of HH:MM:SS using Verilog HDL Code using counters.

4. Design a calculator using verilog HDL which will be able to perform unsigned and signed addition/subtraction, multiplication of unsigned and signed numbers with 8 bit inputs.

<table>
<thead>
<tr>
<th>Mode of Evaluation : Continuous Assessment Reviews</th>
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<td>Recommended by Board of Studies : 20/11/2016</td>
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<td>Approved by Academic Council : 43rd</td>
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<td>Date : 12/12/2016</td>
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</table>
Course code | Course title | L | T | P | J | C
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ECE3026 | IoT System Architecture | 2 | 0 | 0 | 4 | 3

Pre-requisite: ECE3031 - Microcontroller and Embedded Systems

Syllabus version: 1

Course Objectives:
The course is aimed at making the students

1. To acquaint with the basic concepts of embedded system product development cycle and modelling.
2. To introduce IoT architecture reference model.
3. To introduce IoT architecture standards for different use case under discussion.
4. To acquaint with the various security concepts in IoT architecture.

Expected Course Outcome:
At the end of the course, the students will be able to

1. Comprehend and analyze various embedded product development life cycle.
2. Ability to model the embedded product modules.
3. Comprehend and analyze IoT architecture reference model.
4. Comprehend the characteristics of various IoT Communication Architecture, topologies and Hierarchy.
5. Comprehend the concepts of ETSI IoT architecture standards for different use cases under discussion.
6. Comprehend and analyze the security model for IoT architecture.
7. Architect an IoT system for real life applications.

Student Learning Outcomes (SLO): 6, 9, 10

6. Having an ability to design a component or a product applying all the relevant standards and with realistic constraints.
10. Having a clear understanding of professional and ethical responsibility

Module:1 | Embedded system product development cycle | 4 hours
--- | --- | ---
Challenges in embedded system design, Processor – general purpose, customized, application specific-Embedded product life cycle-waterfall, successive refinement, spiral models.

Module:2 | Formalisms in System modelling | 4 hours
--- | --- | ---
Requirement analysis, Architectures, Data flow graph, state models, sequence diagram UML/sysml.

Module:3 | IoT Architecture Reference Model (ARM) | 4 hours
--- | --- | ---

Module:4 | IoT Communication Architecture | 4 hours
--- | --- | ---
IoT nodes, IoT Edge, 6LOWPAN, ipv4/ipv6, MQTT, CoAP, Application aware communication, Network and channel aware communication – Topologies and Hierarchy

Module:5 | IoT Architecture standards | 4 hours
--- | --- | ---
ETSI standard for IoT Architecture : Standards for IoT for Home, Energy, People, motion, City

Module:6 | Secure IoT Architecture | 4 hours
--- | --- | ---
IoT- A Trust Model, Thrust analysis.

Module:7 | IoT system Architecture Use cases | 3 hours
--- | --- | ---
IoT in Retail, logistics and Health care, Legacy IoT platforms (IBM Bluemix /Microsoft assure) Open source IoT platforms.

Module:8 | Contemporary issues | 2 hours
--- | --- | ---
## Total Lecture hours: 30 hours

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<thead>
<tr>
<th>Text Book(s)</th>
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<tr>
<th>Reference Books</th>
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## Mode of Evaluation:
Continuous Assessment Tests, Quiz, Digital Assignment, Final Assessment Test

<table>
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<tr>
<td>1. General purpose home automation using IOT</td>
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<tr>
<td>2. Modeling rural development using IOT</td>
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<tr>
<td>3. Modeling retail management</td>
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<tr>
<td>4. Modeling secured IOT</td>
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<tr>
<td>5. Health care IOT models</td>
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**Mode of evaluation:** Continuous Assessment Reviews

<p>| Recommended by Board of Studies | 20/11/2016 |
| Approved by Academic Council | 43rd Date 12/12/2016 |</p>
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<tr>
<td>ECE3029</td>
<td>Graphical System Design for Communication Engineers</td>
<td>0</td>
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<td>2</td>
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</table>

**Prerequisite:** ECE 2024 Principles of Communication Engineering

**Course Objectives:**

The course is aimed at

1. Training students in virtual instrumentation tools like Lab View
2. Imparting hands – on training in developing various analog communication systems
3. Imparting the fundamental concepts of Communication in Virtual Instrumentation

**Course Outcome:**

At the end of the course the student should be able to

1. Code a labview program for Amplitude modulation.
2. Demonstrate simulation of Single Sideband Transmission and its characteristics
3. Code a labview program for Frequency modulation.
4. Analyse the Harmonics of modulated waveforms.
5. Design, simulate and analyse Super heterodyne receiver.
6. Construct PPM and PWM signals.
7. Simulate and carry out a study on TDM and FDM systems.

**Student Learning Outcomes (SLO):**

2, 9

[2] Having a clear understanding of the subject related concepts and of contemporary issues

[9] Having problem solving ability- solving social issues and engineering problems

**Task:1**

Amplitude Modulation and demodulation

a) Design and analyze the performance of Amplitude Modulation (AM)
   (i) Time domain
   (ii) Frequency domain

b) Analyze and study the significance of modulation index (m) of AM
   (i) m<1
   (ii) m= 1
   (iii) m>1

**Task:2**

Single sideband Transmission

a) Design and analyze the performance of Single Side Band (SSB) Transmission.
   (i) Time domain
   (ii) Frequency domain

b) Compare and analyze the performance of AM, AM-SSB and VSB.

**Task:3**

Frequency Modulation and demodulation

a) Design and analyze the performance of FM receiver

b) Compare and analyze the performance of AM and FM.

**Task:4**

8 hours
Pulse Modulation Scheme
a) Design and analyze the performance of Pulse Amplitude Modulation (PAM) and demodulation (To detect the original message signal)
  b) Using PAM design Pulse Position Modulation (PPM) and detect the original signal.

**Task:5** 8 hours

Sampling and Quantization
a) Analyze the performance of Sampling, Quantization and Encoding using
   (i) Sinusoidal Signal
   (ii) Random signal (Preferably Voice signal)

**Task:6** 8 hours

Pulse Code Modulation
a) Design a system which converts analog signal into digital and vice versa.
   (i) Sinusoidal signal
   (ii) Voice signal

**Task:7** 4 hours

a) Multiplexing Scheme
   (i) Design and analyze the performance of
   (ii) Time Division Multiplexing (TDM)
   (iii) Frequency Division Multiplexing (FDM)

**Task:8** 8 hours

Spread Spectrum Communication
a) Design the Pseudo Noise (PN) sequence generator (minimum 4 stage shift register) and verify its properties.
Design and analyze the performance of Direct Sequence-Spread Spectrum (DS-SS).

**Total Practical Hours:** 60 hours

**Text Book(s)**


**Reference Books**


Mode of Evaluation: Continuous assessment and Final Assessment Test

Recommended by Board of Studies : 26/02/17

Approved by Academic Council : 44th Date: 16/03/2017
Course Code | Course Title | L | T | P | J | C
--- | --- | --- | --- | --- | --- | ---
ECE 3030 | PRINCIPLES OF COMPUTER COMMUNICATION | 3 | 0 | 2 | 0 | 4

Pre-requisite: ECE2024 - Principles of communication Engineering

Version : 1.1

Course Objectives:
The course is aimed at

1. Teaching the students the basic terminologies and concepts of OSI, TCP/IP reference model and functions of various layers.
2. Making the students to understand the protocols, design and performance issues associated with the functioning of LANs and WLANs.
3. Introducing the students to queuing models and basic concepts of network security.

Expected Outcomes:
At the end of the course, the student will be able to

1. Explain the functions of the OSI, TCP/IP reference models and differentiate between various switching techniques and internetworking devices.
2. Analyze the performance of data link layer protocols, LAN and WLAN standards.
3. Design subnets using routing techniques.
4. Demonstrate the functioning of TCP and UDP.
5. Deduce the performance of queuing models.
6. Tackle the issues related to network security.
7. Carry out the analysis the performance of internetworking devices, various LAN, WLAN and routing protocols using simulation tools.

Student Learning Outcomes (SLO): 1, 5, 9

1. Having an ability to apply mathematics and science in engineering applications.
5. Having design thinking capability.

Module: 1 Introduction to Data Communication and Networking Devices
---

7 hours


Module: 2 Data Link Layer

6 hours

Logical Link Control – Error Detection Techniques (only CRC and checksum) – ARQ protocols– Framing – HDLC. Medium Access Control – Random access Protocols – Scheduling approaches to MAC.

Module: 3 Local Area Networks

6 hours

Ethernet – Virtual LAN – Wireless LAN-Zigbee

Module: 4 Network layer

6 hours


Module: 5 Transport Layer

6 hours


Module: 6 Queueing models

6 hours

Markov chain theory - Queueing model basics and Little’s law - M/M/1 and its variants - M/G/1, G/M/1, FIFO, WFQ and priority queues.

Module: 7 Network Security

6 hours

Basic concepts: confidentiality, integrity, availability, security policies, security mechanisms, assurance: Transposition/Substitution, Caesar Cipher, Introduction to Symmetric crypto.
primitives, Asymmetric crypto primitives, and Hash functions: Data Encryption Standard (DES).

<table>
<thead>
<tr>
<th>Module:8</th>
<th>Contemporary issues:</th>
<th>2 hours</th>
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</table>

Text Book(s)

Reference Books

Mode of Evaluation: Continuous assessment test, Digital Assignment, Quiz, Final Assessment Test

List of Challenging Experiments (Indicative)

| 1. Analyze the Performance of a Local Area Network interconnected by switches and Hubs | 6 hours |
| 2. Analyze and evaluate the performance of the data packet using CSMA-CA and CSMA-CD | 6 hours |
| 3. Estimate the shortest path from source to destination using Routing Information Protocol | 6 hours |
| 4. Design and analyze the performance of Queuing Disciplines (M/M/1 and M/G/1) | 6 hours |
| 5. Analyze the performance of 802.11g with different nodes | 6 hours |

Total Laboratory Hours: 30 hours

Mode of Evaluation: Continuous assessment task, Final Assessment Test

Recommended by Board of Studies: 26/02/2017

Approved by Academic Council: 44th Date: 16/03/2017
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<td>MICROCONTROLLER AND EMBEDDED SYSTEMS</td>
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**Pre-requisite**  
ECE2026 - Digital Circuit Design  
Version :1.1

**Course Objectives:**

The course is aimed at

[1] Acquainting students with the basic concepts of architecture 8085, 8086 and ARM processors and 8051 microcontroller – with its organization and architecture and also the RAM-ROM organization.

[2] Enabling the students to work with 8051 microcontroller and its instruction set as well programming to accomplish simple tasks about? explain


[4] Knowing about the peripherals interfaced with 8051 microcontroller and, various embedded system design for simple applications using 8051 and others. Statement is improper

**Course Outcome:**

At the end of the course, the student should be able to

[1] Know about the various microprocessor and microcontroller architectures

[2] Understand techniques for accessing data from RAM/ROM of 8051 microcontrollers

[3] Know about various 8051 instructions and addressing modes for suitably programming the microcontroller for a task.

[4] Comprehend the operation of timer and ports, peripherals in 8051 with various modes of operation and at different baud rates

[5] Study about the various 8051 interrupts and their uses.

[6] Know the methodology to handle data conversion: Analog to Digital (A/D) and vice-versa.

[7] Acquire the overview of various embedded system design using 8051 and other microcontrollers targeting simple applications

[8] Write efficient codes and be able to interface the hardware with 8051 microcontrollers. Should be able to design a real time project prototypes which includes 8051 as one of the hardware component.

**Student Learning Outcomes (SLO):**

| 2, 5 & 9 |

[2] Having a clear understanding of the subject related concepts and of contemporary issues

[5] Having design thinking capability

[9] Problem solving ability- solving social issues and engineering problems

**Module:1**  
Introduction to Processors  
2 hours

Introduction to Microprocessors and Microcontrollers, 8-bit/16-bit/32-bit Microprocessor Architectures [8085, 8086, ARM]

**Module:2**  
8051 Architecture  
4 hours

8051 -organization and architecture. RAM-ROM organization, Machine cycle

**Module:3**  
8051 Instruction set  
8 hours
### Module: 4
**8051 Peripherals: Timer and Ports**

- Peripherals: I/O Ports, Timers-Counters
- Duration: 3 hours

### Module: 5
**8051 Peripherals: Serial and Interrupt**

- Peripherals: Serial Communication, Interrupts
- Duration: 3 hours

### Module: 6
**Peripheral Interfacing**

- Interfaces: LCD, LED, Keypad, ADC, DAC, SENSOR with Signal Conditioning Interface
- Duration: 6 hours

### Module: 7
**Embedded System Design**

- Embedded system design using 8051 and other microcontrollers
- Duration: 2 hours

### Module: 8
**Contemporary Issues**

- Duration: 2 hours

**Total Lecture hours:** 30 hours

### Text Book(s)


### Reference Books

1. Swapnil Mahtre, Microprocessors and Interfacing Techniques, 2012, Navigator Series, Mumbai University, India
2. Douglas V. Hall, Microprocessors and interfacing: Programming and hardware, 2011, Tata McGraw Hill, India

### Mode of Evaluation:

- Continuous assessment test,
- Digital Assignment,
- Quiz,
- Final Assessment Test

### List of Challenging Experiments (Indicative)

1. **Write an 8051 ALP to transfer a string of data from code space starting at address 200H to RAM locations starting at 40H. The data is as shown below:**
   
   ```
   0200H:DB VIT UNIVERSITY using the simulator, single-step through the program and examine the data transfer and registers. Add the following subroutine to the program, single-step through the subroutine and examine the RAM locations. After data has been transferred from ROM space into RAM, the subroutine should copy the data from RAM locations starting at 40H to RAM locations starting at 60H.
   ```
   - Duration: 6 hours

2. **Write an 8051 ALP to add two multi-byte BCD numbers together and store the result in RAM locations 40H - 44H. The two multi-byte items are stored in the ROM space starting at 120H and 150H. See the following example data:**
   
   ```
   ORG 120H
   ```
   - Duration: 4 hours
<table>
<thead>
<tr>
<th>DATA_1:</th>
<th>DB 54H,76H,65H,98H ;number 98657654H</th>
</tr>
</thead>
<tbody>
<tr>
<td>DATA_2:</td>
<td>DB 93H,56H,77H,38H ;number 38775693H</td>
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</tbody>
</table>

Pick your own data for your program. Notice that you must first bring the data from ROM space into the CPU’s RAM and then add them together. Use a simulator to single-step the program and examine the data.

3. Write an 8051 ALP using interrupts to do the following:
   (a) Receive data serially and send it to P0,
   (b) Have port P1 read and transmit serially, and a copy is given to P2,
   (c) Make timer 0 generate a square wave of 5kHz frequency on P3.1.
   Assume that XTAL-11.0592MHZ. Set the baud rate at 4800.

4. Write and assemble a program to toggle all the bits of P0, P1, and P2 continuously by sending 55H and AAH to these ports. Put a time delay between the on and off states. Then, using the simulator, single-step through the program and examine the ports. Do not single-step through the time delay call. Get the Data From Port P1 and Send it to Port P2, Note: P1 as input Port and P2 as Output Port

5. Write a program to send the message ‘India is our Country’ to a serial port.
   Assume a SW is connected to pin P1.2. Monitor its status and set the baud rate as follows:
   SW = 0, 4800 baud rate
   SW = 1, 9600 baud rate
   Assume XTAL = 11.0592 MHz, 8-bit data, and 1 stop bit.

6. Write an 8051 ALP using interrupts to do the following:
   (a) Receive data serially and send it to P0,
   (b) Have P2 port read and transmitted serially, and a copy given to P1,
   (c) Make timer 1 generate a square wave of 3kHZ frequency on P3.5.
   Assume that XTAL-11.0592MHz. Set the baud rate at 9600.

7. Assume that the 8051 serial port is connected to the COM port of
   IBM PC, P1 and P2 of the 8051 are connected to LEDs and switches, respectively.
   Write an 8051 assembly program to
   (a) send to PC the message We Are Ready,
(b) receive any data send by PC and put it on LEDs connected to P1, and
(c) get data on switches connected to P2 and send it to PC serially.

<table>
<thead>
<tr>
<th>Total Laboratory Hours : 30 hours</th>
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<tr>
<td>Mode of Evaluation: Continuous assessment task, Final Assessment Test</td>
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<tr>
<td>Recommended by Board of Studies : 20/11/2016</td>
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<td>Approved by Academic Council : 43rd Date : 12/12/2016</td>
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Course Code: ECE3032
Course Title: SENSOR TECHNOLOGY

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Pre-requisite: ECE2023 - Principles of Sensors and Data Acquisition

Version: 1

Course Objectives:
The course is aimed at making the students to
1. Introduce various developments in sensor technology.
2. Familiarize with the basics of optimal system layout, partitioning and device scaling.
3. Know various thick film and thin film techniques used for sensor development.
4. Study the various sensor technologies for the measurement of Force, Pressure, acceleration, vibration and Torque.

Course Outcomes (CO):
At the end of the course the student should be able to
1. Study the basics of sensor technology and the various sensors.
2. Understand the basics of optimal system layout, partitioning and device scaling.
3. Acquaint with various thick and thin film techniques used in sensor development.
4. Know about various sensor technologies for flow and level measurement.
5. Recognize various sensor technologies for Force, Pressure and Torque measurement.
6. Identify the sensor for acceleration, vibration and shock measurement.
7. Familiarize with the fabrication techniques for packaging of sensors.
8. Apply an integrated knowledge on the sensors, work with and interpret the data obtained from various sensor applications.

Student Learning Outcomes (SLO):
2, 5, 6

Student Learning Outcomes involved:
2. Having a clear understanding of the subject related concepts and of contemporary issues
5. Having design thinking capability.
6. Having an ability to design a component or a product applying all the relevant standards and with realistic constraints

Module: 1 Developments in Sensor Technology 4 hours
Semiconductor sensors, smart sensors, micro sensors, fiber optic sensors, chemical sensors, bio sensors, TEDs.

Module: 2 Sensor Design and Packaging 4 hours
Partitioning, Layout, technology constraints, scaling, compatibility study.

Module: 3 Thick film Technology 4 hours
Thick-film processing-screen printing, Lasering of substrates, curing, low temperature co-fired ceramic processing, wire bonding. Micro machining, IOC (Integrated Optical circuit) fabrication process.

Module: 4 Thin Film Technology 4 hours
Thin film formation and characterization-sol-gel method, chemical vapour deposition, physical vapour deposition, sputtering, plasma/Ion beam deposition, structural and physical properties, Applications-Thin films for microelectronics, MEMS, optical coatings, photodetectors, smart sensors.

Module: 5 Sensor Technologies for Flow and Level Measurement 4 hours
Differential pressure- primary element options, mechanical and electronic flowmeters-design.
installation and maintenance, selection and sizing, recent developments. Level probe design, materials, characteristics, installation considerations, applications and manufacturers.

**Module: 6**
**Sensor Technologies for Force, Pressure and Torque Measurement**

4 hours

Load cell- bending beam, column and shear-web, elastic diaphragm, torsion bar- materials, characteristics, design considerations and mounting procedures, applications and manufacturers.

**Module: 7**
**Sensor Technologies for Acceleration, Vibration and Shock Measurement**

4 hours

Mass-Spring system, sensing technologies, selecting and specifying accelerometers, applicable standards, interfacing and design, applications and manufacturers.

**Module: 8**
**Contemporary issues:**

2 hours

**Text Book(s)**


**Reference Books**


**Mode of Evaluation**: Continues Assessment Test, Quiz, Digital Assignment, Challenging Experiments, Final Assessment Test

**List of Challenging Experiments (Indicative)**

1. Design a force measurement system using a cantilever beam with full bridge strain gage configuration. Deform the beam by placing known weights on the free end, thus deflecting the beam and creating strain. The force exerted by the weights is proportional to the strain along the beam. Measure this strain using strain gauges in a Wheatstone bridge configuration. Use a strain gage having nominal resistance 350Ω with the cantilever beam sensitivity 400με/kg. Calibrate the output of the strain gages as a function of the applied force. Use the least squares method (also known as linear regression) to obtain the best first-order relationship between the Force/Voltage Data.

   8 hours

2. In the transfer of mechanical power from one point to another, the twisting moment transmitted by a shaft without damage to the material is of primary importance. Given the hollow aluminium shaft measure its dimensions and fix it in the set up for measuring twisting moment. Apply a load of 100g in the weighing pan. Due to loading the shaft is twisted. Figure out how pure torsion is applied to the shaft. Using mirror and telescope arrangement note down the scale readings. Figure out how to find the angle of twist from these readings. Evaluate

   8 hours
the shear modulus of the shaft material. Devise a method for measuring the shear strain of the shaft using 350Ω strain gages bonded to the shaft material in full bridge configuration.

3. Study the process involved in screen printing technology (thick film) and construct a miniaturized Interdigitated comb type electrodes (1 mm line width & 1 mm inter electrode gap) which can be used for sensing applications. After developing the electrodes, measure the actual electrode conductivity. The overall printing surface of the electrodes on the substrate can be restricted to one square inch. 7 hours

4. Understand the dip coating / spin coating methods (thin film technology) how are being used for developing thin films for sensing applications. After the study, deposit a thin film layer of Tin oxide on the screen printed IDT electrodes. Measure the conductivity of the coated thin film using suitable electronic circuit. Based on the observation, propose how it can be used for a chemical sensing applications. 7 hours

Total Laboratory hours : 30 hours

Mode of Evaluation: Continuous Assessment and Final Assessment Test

Recommended by Board of Studies : 26/02/2017

Approved by Academic Council: 44th Date : 16/03/2017
<table>
<thead>
<tr>
<th>EEE1001</th>
<th>Basic Electrical and Electronics Engineering</th>
<th>L</th>
<th>T</th>
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<tbody>
<tr>
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<td>2</td>
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<td>2</td>
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<tr>
<td>Pre-requisite</td>
<td>NIL</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Syllabus version</td>
<td>v. 1.0</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

**Course Objectives:**
1. To understand the various laws and theorems applied to solve electric circuits and networks
2. To provide the students with an overview of the most important concepts in Electrical and Electronics Engineering which is the basic need for every engineer

**Expected Course Outcome:**
1. Solve basic electrical circuit problems using various laws and theorems
2. Analyze AC power circuits and networks, its measurement and safety concerns
3. Classify and compare various types of electrical machines
4. Design and implement various digital circuits
5. Analyze the characteristics of semiconductor devices and comprehend the various modulation techniques in communication engineering
6. Design and conduct experiments to analyze and interpret data

**Student Learning Outcomes (SLO):**  1,2,9  
1. Having an ability to apply mathematics and science in engineering applications
2. Having a clear understanding of the subject related concepts and of contemporary issues
9. Having problem solving ability- solving social issues and engineering problems

**Module:1  DC circuits**  5 hours
- Basic circuit elements and sources, Ohms law, Kirchhoff’s laws, series and parallel connection of circuit elements, Node voltage analysis, Mesh current analysis, Thevenin's and Maximum power transfer theorem

**Module:2  AC circuits**  6 hours

**Module:3  Electrical Machines**  7 hours
- Construction, Working Principle and applications of DC Machines, Transformers, Single phase and Three-phase Induction motors, Special Machines-Stepper motor, Servo Motor and BLDC motor

**Module:4  Digital Systems**  5 hours
- Basic logic circuit concepts, Representation of Numerical Data in Binary Form- Combinational logic circuits, Synthesis of logic circuits

**Module:5  Semiconductor devices and Circuits**  7 hours
- Conduction in Semiconductor materials, PN junction diodes, Zener diodes, BJTs, MOSFETs, Rectifiers, Feedback Amplifiers using transistors. Communication Engineering: Modulation and Demodulation - Amplitude and Frequency Modulation

**Total Lecture hours:**  30 hours
# Text Book(s)


# Reference Books


# Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

# List of Challenging Experiments (Indicative)

<table>
<thead>
<tr>
<th>Experiment Description</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thevenin’s and Maximum Power Transfer Theorems – Impedance matching of source and load</td>
<td>2</td>
</tr>
<tr>
<td>Sinusoidal steady state Response of RLC circuits</td>
<td>2</td>
</tr>
<tr>
<td>Three phase power measurement for ac loads</td>
<td>2</td>
</tr>
<tr>
<td>Staircase wiring circuit layout for multi storey building</td>
<td>2</td>
</tr>
<tr>
<td>Fabricate and test a PCB layout for a rectifier circuit</td>
<td>2</td>
</tr>
<tr>
<td>Half and full adder circuits.</td>
<td>2</td>
</tr>
<tr>
<td>Full wave Rectifier circuits used in DC power supplies. Study the characteristics of the semiconductor device used</td>
<td>2</td>
</tr>
<tr>
<td>Regulated power supply using zener diode. Study the characteristics of the Zener diode used</td>
<td>2</td>
</tr>
<tr>
<td>Lamp dimmer circuit (Darlington pair circuit using transistors) used in cars. Study the characteristics of the transistor used</td>
<td>2</td>
</tr>
<tr>
<td>Characteristics of MOSFET</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total Laboratory Hours</strong></td>
<td>20</td>
</tr>
</tbody>
</table>

# Mode of assessment: CAT / Assignment / Quiz / FAT / Project / Seminar

Recommended by Board of Studies: 29/05/2015
Approved by Academic Council: 37th AC 16/06/2015
<table>
<thead>
<tr>
<th>Course code</th>
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<th>T</th>
<th>P</th>
<th>J</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAT2002</td>
<td>Applications of Differential and Difference Equations</td>
<td>3</td>
<td>0</td>
<td>2</td>
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<td>4</td>
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</table>

<table>
<thead>
<tr>
<th>Pre-requisite</th>
<th>Syllabus Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAT1011 - Calculus for Engineers</td>
<td>1.0</td>
</tr>
</tbody>
</table>

**Course Objectives (CoB): 1, 2, 3, 4**

The course is aimed at
- Presenting the elementary notions of Fourier series, which is vital in practical harmonic analysis
- Imparting the knowledge of eigenvalues and eigen vectors of matrices and the transform techniques to solve linear systems, that arise in sciences and engineering
- Enriching the skills in solving initial and boundary value problems
- Impart the knowledge and application of difference equations and the Z-transform in discrete systems, that are inherent in natural and physical processes

**Course Outcome (CO): 1,2,3,4,5**

At the end of the course the student should be able to
1) Employ the tools of Fourier series to find harmonics of periodic functions from the tabulated values
2) Apply the concepts of eigenvalues, eigen vectors and diagonalisation in linear systems
3) Know the techniques of solving differential equations
4) understand the series solution of differential equations and finding eigen values, eigen functions of Strum-Liouville’s problem
5) Know the Z-transform and its application in population dynamics and digital signal processing
6) demonstrate MATLAB programming for engineering problems

**Student Learning Outcomes (SLO): 1, 2, 9**
1] Having an ability to apply mathematics and science in engineering applications
2] Having a clear understanding of the subject related concepts and of contemporary issues
[9] Having problem solving ability - solving social issues and engineering problems

**Module:1 Fourier series: 6 hours**
Fourier series - Euler’s formulae - Dirichlet’s conditions - Change of interval - Half range series – RMS value – Parseval’s identity – Computation of harmonics

**Module:2 Matrices: 6 hours**
Eigenvalues and Eigen vectors - Properties of eigenvalues and eigen vectors – Cayley-Hamilton theorem - Similarity of transformation - Orthogonal transformation and nature of quadratic form

**Module:3 Solution of ordinary differential equations: 6 hours**

**Module:4 Solution of differential equations through Laplace transform and matrix method 8 hours**
Solution of ODE’s - Nonhomogeneous terms involving Heaviside function, Impulse function - Solving nonhomogeneous system using Laplace transform – Reduction of \( n \)th order differential equation to first order system - Solving nonhomogeneous system of first order differential equations \( (X' = AX + G) \) and \( X'' = AX \)

<table>
<thead>
<tr>
<th>Module:5</th>
<th>Strum Liouville’s problems and power series Solutions:</th>
<th>6 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The Strum-Liouville’s Problem - Orthogonality of Eigen functions - Series solutions of differential equations about ordinary and regular singular points - Legendre differential equation - Bessel’s differential equation</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:6</th>
<th>Z-Transform:</th>
<th>6 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Z-transform -transforms of standard functions - Inverse Z-transform: by partial fractions and convolution method</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:7</th>
<th>Difference equations:</th>
<th>5 hours</th>
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<tbody>
<tr>
<td></td>
<td>Difference equation - First and second order difference equations with constant coefficients - Fibonacci sequence - Solution of difference equations - Complementary function - Particular integral by the method of undetermined coefficients - Solution of simple difference equations using Z-transform</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:8</th>
<th>Contemporary Issues</th>
<th>2 hours</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Industry Expert Lecture</td>
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</table>

**Total Lecture hours:** 45 hours

**Text Book(s)**


**Reference Books**


**Mode of Evaluation**

Digital Assignments (Solutions by using soft skills), Continuous Assessment Tests, Quiz, Final Assessment Test

1. Solving Homogeneous differential equations arising in engineering problems 2 hours
2. Solving non-homogeneous differential equations and Cauchy, Legendre equations 2 hours
3. Applying the technique of Laplace transform to solve differential equations 2 hours
4. Applications of Second order differential equations to Mass spring system (damped, undamped, Forced oscillations), LCR circuits etc. 2 hours
5. Visualizing Eigen value and Eigen vectors 2 hours
6. Solving system of differential equations arising in engineering applications 2 hours
<table>
<thead>
<tr>
<th></th>
<th>Activity</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.</td>
<td>Applying the Power series method to solve differential equations arising in engineering applications</td>
<td>2</td>
</tr>
<tr>
<td>8.</td>
<td>Applying the Frobenius method to solve differential equations arising in engineering applications</td>
<td>2</td>
</tr>
<tr>
<td>9.</td>
<td>Visualising Bessel and Legendre polynomials</td>
<td>2</td>
</tr>
<tr>
<td>10.</td>
<td>Evaluating Fourier series-Harmonic series</td>
<td>2</td>
</tr>
<tr>
<td>11.</td>
<td>Applying Z-Transforms to functions encountered in engineering</td>
<td>2</td>
</tr>
<tr>
<td>12.</td>
<td>Solving Difference equations arising in engineering applications</td>
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<tr>
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<td><strong>Total Laboratory Hours</strong></td>
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**Mode of Evaluation:** Weekly Assessment, Final Assessment Test

Recommended by Board of Studies | 03-06-2019
Approved by Academic Council | No. 55 Date 13-06-2019
<table>
<thead>
<tr>
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<th>Course title</th>
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<tbody>
<tr>
<td>MAT3004</td>
<td>Applied Linear Algebra</td>
<td>3</td>
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<td>4</td>
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</tbody>
</table>

**Pre-requisite**
MAT2002 Applications of Differential and Difference Equations

**Syllabus Version**
1.0

**Course Objectives**

[1] understanding basic concepts of linear algebra to illustrate its power and utility through applications to computer science and Engineering.


[3] solve problems in cryptography, computer graphics and wavelet transforms

**Expected Course Outcome**

At the end of this course the students are expected to learn

[1] the abstract concepts of matrices and system of linear equations using decomposition methods

[2] the basic notion of vector spaces and subspaces

[3] apply the concept of vector spaces using linear transforms which is used in computer graphics and inner product spaces

[4] applications of inner product spaces in cryptography


**Student Learning Outcomes**

1, 2, 7

[1] Having an ability to apply knowledge of Mathematics in Science and Engineering

[2] Having a clear understanding of the subject related concepts and of contemporary issues

[7] Having computational thinking

**Module:1** System of Linear Equations: 6 hours


**Module:2** Vector Spaces 6 hours

The Euclidean space $\mathbb{R}^n$ and vector space- subspace –linear combination-span-linearly dependent-independent- bases - dimensions-finite dimensional vector space.

**Module:3** Subspace Properties: 6 hours

Row and column spaces -Rank and nullity – Bases for subspace – invertibility- Application in interpolation.

**Module:4** Linear Transformations and applications 7 hours

Linear transformations – Basic properties-invertible linear transformation - matrices of linear transformations - vector space of linear transformations – change of bases – similarity

**Module:5** Inner Product Spaces: 6 hours

Dot products and inner products – the lengths and angles of vectors – matrix representations of inner products- Gram-Schmidt orthogonalisation
### Module: 6  
**Applications of Inner Product Spaces:**  
6 hours  
QR factorization - Projection - orthogonal projections – relations of fundamental subspaces – Least Square solutions in Computer Codes

### Module: 7  
**Applications of Linear equations:**  
6 hours  
An Introduction to coding - Classical Cryptosystems – Plain Text, Cipher Text, Encryption, Decryption and Introduction to Wavelets (only approx. of Wavelet from Raw data)

### Module: 8  
**Contemporary Issues:**  
2 hours  
Industry Expert Lecture

<table>
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<th>Total Lecture hours:</th>
<th>45 hours</th>
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<tr>
<td><strong>Tutorial</strong></td>
<td>30 hours</td>
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</table>
| • A minimum of 10 problems to be worked out by students in every Tutorial Class  
• Another 5 problems per Tutorial Class to be given as home work. |

**Text Book(s)**

1. Linear Algebra, Jin Ho Kwak and Sungpyo Hong, Second edition Springer(2004). (Topics in the Chapters 1, 3, 4 & 5)  

**Reference Books**

3. Contemporary linear algebra, Howard Anton, Robert C Busby, Wiley 2003  

**Mode of Evaluation**

Digital Assignments, Continuous Assessments, Final Assessment Test

Recommended by Board of Studies

Approved by Academic Council

No.  
Date

B.TECH (ECE with IoT & Sensor)  
Page 98
Programme Elective
Course Code: CSE4034
Course Title: IoT Edge Nodes and its Applications
Pre-requisite: ECE3026 - IoT System Architecture

Course Objectives:
The course is aimed at

[1] Introducing the basic concepts of Physical & Logical design of IoT and analyses of Machine to Machine Concepts
[2] Exposing students to the usage of Protocol Standardization for IoT with IoT Edge and Gateway Network with Communication protocols
[3] Preparing the students to know the basics of protocol stacks for the edge devices and design challenges.
[4] Providing IoT Solutions with sensor based application through embedded system platform

Course Outcomes (CO):
At the end of the course the student should be able to

[1] Comprehend and analysis concepts of Physical design and Logical design of IoT
[4] Comprehend the operation of IoT Edge and Gateway Network with Communication protocols
[5] Understand the issues on Development challenges and Security challenges in IoT.
[6] Comprehend the ideas of Developing IoT Solutions
[7] Provide suitable solution for domain specific applications of IoT
[8] Use tools to practice IoT enabling Technologies.

Student Learning Outcomes (SLO): 2,5,18
Student Learning Outcomes involved:

[2] Having a clear understanding of the subject related concepts and of contemporary issues
[5] Having design thinking capability
[18] Having critical thinking and innovative skills

Module: 1
Introduction to IoT
Defining IoT; Characteristics of IoT; Physical design of IoT; Logical design of IoT; Functional blocks of IoT; Communication models & API’s Actuators; Controllers and Sensors.
<table>
<thead>
<tr>
<th>Module:2</th>
<th>IoT PROTOCOLS</th>
<th>4 Hours</th>
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<tbody>
<tr>
<td>Protocol Standardization for IoT; Efforts of M2M and WSN Protocols; SCADA and RFID Protocols; Unified Data Standards; Protocols – IEEE 802.15.4; Network layer; 6LowPAN;MQTT; COAP</td>
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<table>
<thead>
<tr>
<th>Module:4</th>
<th>IoT Edge and Gateway Network</th>
<th>6 Hours</th>
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<tbody>
<tr>
<td>IoT Edge basic introduction; What and where is the “edge”; Edge /Fog computing Value of keeping data local; An edge-first approach; The power of edge to cloud; IoT Edge cloud interface; Communication protocols and protocol stacks for the edge devices Overview of Edge Networks in IoT; Implementation of IoT Edge Gateway; Edge Architecture : CloudPath; A Multi-Tier Cloud Computing Framework Femto Clouds; Leveraging Mobile Devices to Provide Cloud Service at the Edge Fast; Scalable and Secure Onloading of Edge Functions Using Air Box</td>
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<table>
<thead>
<tr>
<th>Module:5</th>
<th>Challenges in IoT</th>
<th>3 Hours</th>
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<tbody>
<tr>
<td>Design challenges; Development challenges; Security challenges; Other challenges.</td>
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</table>

<table>
<thead>
<tr>
<th>Module:6</th>
<th>Developing IoT Solutions</th>
<th>4 Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to IoT tools; Developing applications through IoT tools; Developing sensor based application through embedded system platform; Edge Analytics, Edge Security and Artificial Intelligence(AI).</td>
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</table>

<table>
<thead>
<tr>
<th>Module:7</th>
<th>Domain specific applications of IoT</th>
<th>3 Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home automation; Industry applications; Surveillance applications; Other IoT applications.</td>
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</table>

<table>
<thead>
<tr>
<th>Module:8</th>
<th>Contemporary Issues</th>
<th>2 Hours</th>
</tr>
</thead>
</table>

| Total Lecture hours: 30 Hours |

Text Books:

2. Ovidiu Vermesan, Peter Friess, “Internet of Things – From research and innovation to market deployment”, 2014, River Publishers Series in Communication, USA.
Reference Books:

1. Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, Dr. Ovidiu Vermesan, Dr. Peter Friess, River Publishers 2013.


3. 6LoWPAN: The Wireless Embedded Internet, Zach Shelby, Carsten Bormann, Wiley Publications 2010


Mode of Evaluation: Continuous Assessment Test + Digital Assignment + Quiz + Final Assessment Test

List of Challenging Experiments (Indicative):

1. LoWPAN for IoT gateway functions to send Ipv6 packets over IEEE802.15.4 based networks.

2. Implementation of edge nodes & edge gateways

3. Edge Analytics with (WISE3) IoT Platform

4. Design and analyse the data transmission between zigbee nodes with no path loss and analyse the throughput based on IEEE 802.15.4

5. Implementation of clustered based wireless sensor network and analysis on Residual energy and throughput.

6. To develop a case study for IoT based systems.

6. Implement Sample Edge Gateway based IoT Solution

Mode of Evaluation: Continuous Assessment Task + Final Assessment Test

Recommended by Board of Studies :31/08/2018

Approved by Academic Council : 53rd Date : 13/12/2018
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<td>CSE4035</td>
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Pre-requisite: ECE3026 - IoT System Architecture

Course objectives (CoB):

The course is aimed at

1. Acquainting students with the basic concepts in web app creation
2. Introducing students to key concepts of multimedia in android system
3. Teaching the students optimization techniques and scheduling approaches

Course Outcomes (CO):

At the end of the course the student should be able to

1. Discuss about mobile interfaces and applications.
2. Design multimedia application in android platform.
3. Comprehend the various scheduling techniques and memory mapping techniques for embedded android system.
4. Implement the different models and optimization techniques using SQLite, data storage.
5. Achieve the Power Optimizations with Loop Scheduling.
6. Comprehend the basic concepts of Mobile Cloud Computing
7. Work with Big Data Processing techniques
8. Develop a Mobile App for IoT applications.

Student Learning Outcomes (SLO): 7,17,20

Student Learning Outcomes involved:

7. Having computational thinking (Ability to translate vast data in to abstract concepts and to understand database reasoning)
17. Having an ability to use techniques, skills and modern engineering tools necessary for engineering practice
20. Having a good digital footprint

Module:1

Overview of Mobile App and Mobile Interface 2 Hours

Mobile System – Mobile Interface and Applications – Mobile Cloud
<table>
<thead>
<tr>
<th>Module:2</th>
<th>Introduction of Key Concepts and 2D Graphics and Multimedia in Android of Android</th>
<th>5 Hours</th>
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</table>

<table>
<thead>
<tr>
<th>Module:3</th>
<th>Mobile Embedded System Architecture</th>
<th>4 Hours</th>
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<tbody>
<tr>
<td>Scheduling Algorithms – Memory Technology – Mobile Embedded Systems – Messaging and Communication Mechanisms</td>
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</table>

<table>
<thead>
<tr>
<th>Module:4</th>
<th>Data Storage and SQLite Operations and Mobile Optimization by Dynamic Programming</th>
<th>5 Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local Data – Sqlite Database – Content Provider – Fixed Time Model – Probabilistic Time Model – Nondeterministic Polynomial Time Problems</td>
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<table>
<thead>
<tr>
<th>Module:5</th>
<th>Mobile Optimizations by Loop Scheduling</th>
<th>4 Hours</th>
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</thead>
<tbody>
<tr>
<td>Introduction – Basic Graph Models and Techniques – Fundamental Timing Optimizations – Time and Power Optimizations with Loop Scheduling</td>
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</table>

<table>
<thead>
<tr>
<th>Module:6</th>
<th>Mobile Cloud Computing in Mobile Applications Deployment</th>
<th>4 Hours</th>
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<table>
<thead>
<tr>
<th>Module:7</th>
<th>Efficient Data Synchronization on Mobile Devices in Big Data</th>
<th>4 Hours</th>
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<tbody>
<tr>
<td>Overview of Big Data – Big Data Processing – Mobile Big Data Storage</td>
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<table>
<thead>
<tr>
<th>Module:8</th>
<th>Contemporary issues:</th>
<th>2 Hours</th>
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</table>

| Total Lecture hours: 30 hours |

**Text Book:**


**References:**


Mode of Evaluation: Continuous Assessment Tests, Quiz, Digital Assignment, Final Assessment Test

**Typical Projects for J component**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>Develop an application that uses GUI components, Font and Colors.</td>
</tr>
<tr>
<td>2.</td>
<td>Develop an application that uses Layout Managers and event listeners.</td>
</tr>
<tr>
<td>3.</td>
<td>Develop a native calculator application.</td>
</tr>
<tr>
<td>4.</td>
<td>Write an application that draws basic graphical primitives on the screen.</td>
</tr>
<tr>
<td>5.</td>
<td>Develop an application that makes use of database.</td>
</tr>
<tr>
<td>6.</td>
<td>Develop an application that makes use of RSS Feed.</td>
</tr>
<tr>
<td>7.</td>
<td>Implement an application that implements Multi threading.</td>
</tr>
<tr>
<td>8.</td>
<td>Develop a native application that uses GPS location information.</td>
</tr>
</tbody>
</table>

Mode of evaluation: Continuous Assessment Reviews

Recommended by Board of Studies : 31/08/2018

Approved by Academic Council : 53rd Date : 13/12/2018
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>J</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECE2025</td>
<td>PROBABILITY AND STATISTICAL THEORY OF COMMUNICATION</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>2</td>
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</tbody>
</table>

Pre-requisite: ECE1018 – Signal Analysis and Processing

**Course objectives (CoB):**
The course is aimed at
1. Acquainting students with the basic concepts of random variable and random process.
2. Introducing the basics of information theory and channel capacity.

**Course Outcomes (CO):**
At the end of the course the student should be able to
1. Comprehend the basics probability and random variables understand.
2. Understand the two-dimensional random variables.
3. Comprehend the different types of random processes like stationary, Gaussian random process etc.
4. Compute information measure and channel capacity.
5. Compute response of correlator in receiver and matched filter.
6. Use the various statistical hypothesis testing methods including LR test, Mim-Max test, Neyman Pearson test.
7. Comprehend the different estimation theory including MMSE, MAP, ML and CRB estimators.
8. Solve the problems using modern engineering tools.

**Student Learning Outcomes (SLO):**
1, 9, 17

Student Learning Outcomes involved:
1. Having an ability to apply mathematics and science in engineering applications.
17. Having an ability to use techniques, skills and modern engineering tools necessary for engineering practice.

**Module: 1** Probability and Random Variable
2 hours
Axioms of probability, Conditional probability, random variable, Probability Density Function, Moments, Standard distributions- Uniform, Normal, Exponential, Rayleigh.

**Module: 2** Two Dimensional Random Variables
2 hours
Joint distributions, Marginal and conditional distributions, Covariance, Correlation, Transformation of random variables, Central limit theorem.

**Module: 3** Random Process
2 hours

**Module: 4** Information Measure
2 hours
Self-Information, Discrete and Continuous Entropy, Entropy of a binary source, Mutual Information, Channel capacity.
Module:5 | Optimum Linear Systems | 2 hours
---|---|---
Digital Communication in presence of AWGN-Correlation receiver, Matched filter receiver

Module:6 | Testing of statistical hypothesis | 2 hours
---|---|---
Likelihood ratio test, Baye’s test, Probability of error, Mini-Max test, Neyman Pearson Test

Module:7 | Estimation theory | 2 hours
---|---|---
Minimum mean square error estimator, Maximum a posteriori estimator, Maximum likelihood estimation, Cramer Rao bound (CRB) for parameter estimation

Module:8 | Contemporary issues: | 1 hour
---|---|---

Total Lecture: 15 hours

Text Book(s)

Reference Books:

Mode of Evaluation: Continues Assessment Test, Quiz, Digital Assignment, Challenging Experiments, Final Assessment Test

List of Challenging Experiments (Indicative)

<table>
<thead>
<tr>
<th>Task I: Computation of Probability Mass (Density) Function (PMF or PDF)</th>
<th>3 hours</th>
</tr>
</thead>
</table>
1. Generate 1000 sample points of real numbers uniformly distributed between ‘0’ and ‘1’.
   i) Let X be random variable(RV) taking values ‘0’ &’1’. X=0 corresponds to the sample points whose values are less than 0.5. X=1 corresponds to the sample points whose values are between 0.5 and 1. Draw the probability mass function of the RV, X.
   ii) Repeat part (i) for RV ‘Y’ taking values 0, 1&2.
2: sample values between 0&1/3 1: sample values between 1/3&2/3 2: sample values between 2/3 & 1.

<table>
<thead>
<tr>
<th>Task II: Computation of PDF and cumulative distribution function (CDF)</th>
<th>4 hours</th>
</tr>
</thead>
</table>
1. Draw the graph for the binomial density function for N=6 and p=0.4. Also compute and show it by graph, the binomial cumulative distribution function (CDF).

<table>
<thead>
<tr>
<th>Task III: Generation of Histogram of Uniform RV</th>
<th>3 hours</th>
</tr>
</thead>
</table>
1. Generate 1000 sample points of real numbers uniformly
distributed between 0 & 1 using the Matlab function ‘rand’. Compute the Histogram of the above sample points (Take 10 uniform steps between 0 & 1). Redraw the histogram when the sample points are increased to 2000. Also observe it when the steps are increased from 10 to 20. Compare your results with built in Matlab function.

Task IV : Generation of Histogram of Gaussian RV

1. Redo the steps Task III with Matlab function ‘rand’ replaced by ‘randn’.
2. Write a Matlab script to compute the mean, mean square, variance and standard deviation for the RVs given and display them on the command prompt. Compare your results with the built in functions.
3. Generate 1000 samples of a uniform RV taking values between 0 & 2π. Generate the new RV, \( Y = \sin \theta \). Plot the p.d.f of \( Y \). Compare this with the theoretical result.

Task 5: Transformation of Uniform pdf to exponential and Rayleigh pdfs

2. Generate 1000 samples of a ‘Gaussian’ random variable X. Use the transformation \( Y = X^2 \). Draw the p.d.f of \( Y \) and compare it with theoretical results.

Task 6: Probability of error analysis

4 hours

Task 7: Baseband Transmission and Reception schemes

4 hours

Task 8: True parameter estimation schemes

4 hours

Total Laboratory Hours : 30 hours

Mode of Evaluation: Continuous and Final Assessment test

Recommended by Board of Studies : 26/02/2017

Approved by Academic Council :44th Date : 16/03/2017
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course title</th>
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<th>T</th>
<th>P</th>
<th>J</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECE2027</td>
<td>EMC and EMI</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Pre-requisite</td>
<td>ECE1017- Electro Magnetic Field Theory and Transmission Lines</td>
<td>Version: 1.2</td>
<td></td>
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</tbody>
</table>

**Course Objectives:**

The course is aimed at

1. Imparting knowledge on the importance of EMC and EMC compliance.
2. Providing exposure to EMI sources, mitigation, and measurement techniques/standards to
guarantee the correct working modalities.
3. Providing exposure to the guidelines for reduced EMI in PCB design.

**Expected Course Outcome:**

At the end of the course the student should be able to

1. Understand the concepts related to EMI and EMC, and differentiate between conducted and radiated emission.
2. Differentiate the types of EMI coupling mechanisms
3. Apply a proper EMI control technique for a specific identified EMI problem.
4. Design an EMC model for PCBs
5. Describe about various Radiated EMI Measurements techniques and chambers.
6. Understand the standards for EMI and EMC

**Student Learning Outcomes (SLO):** 1, 2, 6, 17

1. Having a clear understanding of the subject related concepts and of contemporary issues
2. Having an ability to design a component or a product applying all the relevant standards and with realistic constraints
3. Having an ability to use techniques, skills and modern engineering tools necessary for engineering practice

**Module: 1 EMI/EMC Concepts**

3 hours

EMI/EMC definitions – Units: Sources of EMI: Classification, Lightning, ESD, NEMP - Conducted and radiated emission - Conducted and radiated susceptibility – Intra and inter system EMI - In band interference - Spectrum conservation - Radiation hazard - Specific Absorption Rate (SAR).

**Module: 2 EMI Coupling Principles**

3 hours

Conductive coupling: Common-mode, Differential-mode - Inductive coupling - Capacitive coupling - Radiative coupling

**Module: 3 EMI Control Techniques -I**

5 hours

Grounding: Earthing principle, system grounding - Shielding: Shielding theory and shielding effectiveness, Shielding integrity at discontinuities, Conductive coatings, Cable shielding, Bonding: Shape and material for bond strap - general guidelines for good bonds.

**Module: 4 EMI Control Techniques -II**

5 hours

EMI Filters: Characteristics of filters, Impedance mismatch effects, Lumped element filters, Power line filter design, Common mode filter, Differential mode filter - EMI suppression devices and components: EMI suppression cables, EMC connectors, EMC gaskets, Isolation transformers, Transient and surge suppression devices.

**Module: 5 EMC Design of PCBs**

5 hours

RF Sources in PCB - SMD / through hole components, Pins, Basic loops, Differential vs Common mode - Board layout: Grounds and Power, ground bounce, Power distribution for two-layer boards, Power supply decoupling, Board zoning, Signal traces, Cross talk, Trace routing - Cables and connectors.

**Module: 6 EMI Measurements**

4 hours
Radiated interference measurements: Open area test site measurement, anechoic chamber, TEM cell; Reverberating chamber - Conducted interference measurements: Characterization of conduction currents voltages, Conducted EM noise on power supply lines, Conducted EMI from equipment - Pulsed interference immunity: ESD/EFT, Electrical surge - Time domain EMI measurement

<table>
<thead>
<tr>
<th>Module:7</th>
<th>EMC Standards</th>
<th>3 hours</th>
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<thead>
<tr>
<th>Module:8</th>
<th>Contemporary issues:</th>
<th>2 hours</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Total Lecture hours:</td>
<td>30 hours</td>
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</table>

Text Book(s)

Reference Books

Mode of Evaluation: Continues Assessment Test, Quiz, Digital Assignment, Challenging Experiments, Final Assessment Test

List of Challenging Experiments (Indicative)

<table>
<thead>
<tr>
<th>Task 1: Test and Analysis of RE/RS</th>
<th>7 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Develop a test setup and study the performance of Radiated Emission, Radiation Susceptibility with respect to various standards.</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Task 2: Test and Analysis of CE/CS</th>
<th>7 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Develop a test setup and study the performance of Conducted Emission and Conducted Susceptibility with respect to various standards.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Task 3: Comprehensive study and analysis of ESD / EFT / Surge</th>
<th>8 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Develop a test setup and analyze the radiated and conducted effects of Electrostatic Discharge/EFT and Surge</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Task 4: PCB Design</th>
<th>8 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design a PCB for a circuit with a mixture of analog and digital parts, multiple power planes, and a single Ground plane split into analog and digital sections that have a common reference point using open source tool.</td>
<td></td>
</tr>
</tbody>
</table>

Total Laboratory Hours 30 hours

Mode of Evaluation: Continuous and Final Assessment test

Recommended by Board of Studies: 26/02/2017

Approved by Academic Council: 44th Date: 16/03/2017
Course Code: ECE2033
Course Title: INTRODUCTION TO DATA ANALYTICS
Pre-requisite: Signal Analysis and Processing
Version: 2

Course Objectives:
The course is aimed at
[1] Introducing the methods and approaches of analyzing data and to convert information into useful knowledge.
[2] Making the students to understand the establishment of mathematical basis of different approaches and discuss the advantages and drawbacks of different algorithms.

Expected Course Outcome:
At the end of the course, the student will be able to
[1] Understand state-of-the-art big data platforms and data analytic techniques
[3] Understand about the techniques of data pre-processing and visualization.
[4] Identify real world applications that can be tackled with techniques from machine learning and Neural Networks.
[5] Perform Time-series data analysis using recurrent model, autoregressive models
[6] Use different optimization techniques, predominantly used in data analytics.

Student Learning Outcomes (SLO): 1,2,7
[1] Having an ability to apply mathematics and science in engineering applications
[2] Having a clear understanding of the subject related concepts and of contemporary issues
[3] Having computational thinking (Ability to translate vast data in to abstract concepts and to understand database reasoning)

Module: 1 Introduction 2 hours
Wearables and big data- potential challenges, intelligent data analysis, analytic processes and tools, analysis Vs reporting;

Module: 2 Statistical concepts 4 hours
properties of an attribute: Mean, Median, Mode; Range, Variance, Standard Deviation;
Expectation and Variance, probability distributions, sampling distributions, measures of similarity and dissimilarity, multi-dimensional vector spaces

Module: 3 Data pre-processing and visualisation 4 hours
Data pre-processing: types of error and error handling, filtering, data transformation, data merging; Data Visualization: - plots and projection methods- 2D and 3D scatter diagram, principle component analysis, histogram, spectral analysis-amplitude, phase spectra, cosine and sine transform

Module: 4 Introduction to Machine Learning 5 hours
Differentiating algorithmic and model based frameworks, Regression-least squares, Ridge regression, Lasso regression, K Nearest Neighbor regression and classification Linear Discriminant Analysis, logistic regression

Module: 5 Supervised and Unsupervised Techniques 6 hours
Classification-Naïve Bayesian classifier, Back propagation neural network, decision trees, support vector machine, fuzzy decision trees; Clustering- K Nearest Neighbor, K-Means, Fuzzy C Means, Deep learning concepts
<table>
<thead>
<tr>
<th>Module:6</th>
<th>Time-series data analysis</th>
<th>4 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Autocovariance and autocorrelation, finite state machines, recurrent model, autoregressive models</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:7</th>
<th>Optimization methods</th>
<th>3 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Search by gradient descent, simulated annealing, Genetic algorithms</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:8</th>
<th>Contemporary issues:</th>
<th>2 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total Lecture hours:</td>
<td>30 hours</td>
</tr>
</tbody>
</table>

**Text Book(s)**


**Reference Books**

4. Shai Shalev-Shwartz, Shai Ben-David, Understanding Machine Learning: From Theory to Algorithms, Cambridge University Press, 2014

**Mode of Evaluation**: Continuous assessment test, Digital Assignment, Quiz and Final Assessment Test

**List of Experiments (indicative)**

1. Programming with Data analytic tools: WEKA, R Tool, python and SPSS
2. Using R for Introductory Statistics
3. Creating and customizing applications to analyse data.
4. Exploring the data and pre-processing the data using WEKA tool
5. Data Visualization
6. Apply Regression and different classification techniques for classifying the given data:
   - Linear Regression
   - Logistic Regression
   - Neural networks
   - SVM
   - Decision tree
   - Naïve Bayes
7. Apply various clustering techniques to cluster the data:
   - K Nearest Neighbour
   - K-Means
   - Fuzzy C Means
   - Self-organizing map
8. Apply various associative rule mining algorithms
9. Apply Deep learning for extracting complex patterns from big data.

Framework and application of ARIMA model- Build the model and make prediction in the future time points

**Recommended by Board of Studies**: 31/08/2018

**Approved by Academic Council**: 53rd Date: 13/12/2018
<table>
<thead>
<tr>
<th>ECE3002</th>
<th>VLSI System Design</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>J</th>
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</thead>
<tbody>
<tr>
<td>Prerequisite:</td>
<td>ECE2003 Digital Logic Design</td>
<td></td>
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<tr>
<td>Syllabus version</td>
<td>1.2</td>
<td></td>
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</tbody>
</table>

**Course Objectives:**
1. To understand MOS device characteristics and to implement simple gates using CMOS logic style with delay and power constraints
2. To understand the CMOS fabrication process styles including layout design rules
3. To design combinational and sequential circuits using different logic styles
4. To use modern EDA tools to simulate and synthesize VLSI circuits

**Course Outcomes:**
1. Clear understanding of fundamental concepts of MOS transistors
2. Able to design simple logic gates using CMOS logic style
3. Able to calculate power and delay of simple CMOS circuits
4. Understand fabrication processes and their impact on the circuit performance
5. Able to design and validate combinational and sequential circuits using different logic styles
6. Able to design VLSI circuits at sub-system abstraction level
7. Able to use modern EDA tools to design VLSI circuits

**Student Learning Outcomes (SLO):** 2,5,14
2. Having a clear understanding of the subject related concepts and of contemporary issues
5. Having design thinking capability
14. Having an ability to design and conduct experiments, as well as to analyze and interpret data

**Module: 1 MOS Transistor Theory**
5 hours
I-V Characteristics, C-V Characteristics, Non ideal I-V effects of MOS Transistors

**Module: 2 CMOS Logic**
5 hours
Basic gates, Compound Gates, Transmission Gates based combinational and sequential logic design

**Module: 3 CMOS Circuit characterization and Performance Estimation**
8 hours

**Module: 4 CMOS Fabrication and Layout**
5 hours
CMOS Process Technology N-well, P-well process, Stick diagram for Boolean functions using Euler Theorem, Layout Design Rule

**Module: 5 CMOS Combinational Circuit Design**
7 hours
Static CMOS, Ratioed Logic, Cascode voltage Switch Logic, Dynamic circuits, Pass Transistor Circuits

**Module: 6 CMOS Sequential Circuit Design**
7 hours
Conventional CMOS Latches and Flip Flops, Pulsed Latches, Resettable and Enabled Latches and
Flip Flops

<table>
<thead>
<tr>
<th>Module:7</th>
<th>Sub System Design</th>
<th>6 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single bit Adder, Carry look ahead adder, Carry propagate Adder, Magnitude Comparator, Barrel Shifter, Signed and unsigned multiplier.</td>
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</table>

<table>
<thead>
<tr>
<th>Module:8</th>
<th>Contemporary Issues</th>
<th>2 hours</th>
</tr>
</thead>
</table>

**Total Lecture Hours:** 45 hours

**Text Books:**

**Reference Books:**

**Mode of evaluation:** Internal Assessment (CAT, Quizzes, Digital Assignments) & Final Assessment Test (FAT)

**Sl.No.** | **List of Challenging Experiments (Indicative):** | **Total laboratory hours:** | 8 hours |
--- | --- | --- | --- |
1 | i. Cadence EDA Tool Demo & Hands on - Schematic  
 ii. Basic Cell structure (NMOS & PMOS) using conventional MOS  
 iii. Verification with different corners  
 iv. Design and Analysis of CMOS circuits  
 (Analysis: Power, Delay, NM, PDP)  
 (Design: Sizing) |  |
2 | i. Cadence EDA Tool Demo & Hands on – Layout & Post Layout Simulation  
 ii. Basic Cell layout (CMOS)  
 iii. Fingering and folding  
 iv. Standard cell design for different technology node | 8 hours |
3 | i. Adder Design using conventional CMOS  
 ii. Multiplier using conventional CMOS  
 iii. Memory design (SRAM / DRAM / CAM).  
 iv. Level converters (Optional) | 8 hours |
4 | i. ALU Design using conventional CMOS  
 ii. Simple Processor Design using conventional CMOS | 6 hours |

Total laboratory hours: 30 hours

**Mode of evaluation:** Continuous Assessment & Final Assessment Test (FAT).

Recommended by Board of Studies: 13-12-2015
Approved by Academic Council: No.40 Date: 18-03-2016

B.TECH (ECE with IoT & Sensor)  Page 114
Course Objectives:

1. To introduce and discuss the mechanism and models for radio-wave propagation, antenna radiating principles and fundamental characteristics and parameters of antennas.
2. To understand operating principles and design concepts of antenna arrays, HF and VHF antennas.
3. To design & analyze microwave frequency antennas and also to bring awareness of antenna applications in various types of communication.

Expected Course Outcomes:

1. Identify the type of radio-wave propagation for different communication
2. Comprehend the radiation mechanism of wired antennas and dipoles.
3. Identify basic antenna parameters and contrast radiation patterns of different antennas.
4. Design and analyze antenna arrays and wire antennas
5. Design and analyze aperture antennas and patch antennas
6. Appropriate identification of an antenna for a specific application.

Student Learning Outcomes (SLO) 2,5,9

2. Having a clear understanding of the subject related concepts and of contemporary issues
5. Having design and thinking capability
9. Having problem solving ability-solving social issues and engineering problems

Module: 1 Wave Propagation 8 hours


Module: 2 EM Radiation 6 hours

Radiation mechanism-single wire, two wire, dipole and current distribution on thin wire. Radiation integrals and auxiliary potential functions, Radiated field components - Hertzian dipole, half wave dipole, monopole antenna
### Module: 3 Antenna Parameters and Measurements 6 hours
Radiation pattern, beam width, field region, radiation power density, directivity and gain, bandwidth, polarization - co polarization and cross polarization level, input impedance, efficiency, antenna effective length and area, antenna temperature. Friis Transmission formula, Radar range equation. Measurements - radiation pattern- gain- directivity and impedance measurements.

### Module: 4 Linear and Planar Arrays 8 hours

### Module: 5 HF and VHF Antennas 5 hours
Wire Antennas - long wire, V-Antenna, rhombic antenna, loop antenna-helical antenna, Yagi-Uda antenna

### Module: 6 UHF and Microwave Antennas 7 hours
Frequency independent antennas - spiral and log periodic antenna- Aperture antennas – Horn antenna, Parabolic reflector antenna- Microstrip antenna.

### Module: 7 Antennas for Modern Wireless Communications 3 hours

### Module: 8 Contemporary issues 2 hours

| Total lecture hours | 45 hours |

**Text Book(s)**

## Reference Books


### Mode of evaluation:
Internal Assessment (CAT, Quizzes, Digital Assignments) & Final Assessment Test (FAT)

<table>
<thead>
<tr>
<th>Recommended by Board of Studies</th>
<th>13-12-2015</th>
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<td>Approved by Academic Council</td>
<td>No. 40</td>
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Recommended by Board of Studies 13-12-2015
Approved by Academic Council No. 40 Date 18-03-2016
<table>
<thead>
<tr>
<th>ECE3011</th>
<th>Microwave Engineering</th>
<th>L</th>
<th>T</th>
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<th>C</th>
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<tbody>
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<td>0</td>
<td>2</td>
<td>4</td>
<td>5</td>
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</tbody>
</table>

**Pre-requisite**: ECE2004 – Transmission Lines and Waveguides

**Syllabus version**: 1.0

**Course Objectives:**
1. To understand the importance of microwave circuits and applications.
2. To comprehend operational principles of microwave sources and to characterize microwave networks.
3. To design and analyze various passive and active microwave circuits.

**Course Outcomes:**
1. Identify various applications and measurement schemes for microwave circuits.
2. Comprehend the performance of different microwave sources and ferrite devices.
3. Analyze microwave circuits using scattering parameters.
4. Design and analyze power dividers and couplers at microwave frequencies.
5. Design and analyze low pass filters at microwave frequencies.
6. Understand the importance of high frequency transistors to design microwave amplifiers.
7. Measure the performance of microwave passive devices using test bench setup and also simulate and analyze microstrip passive and active circuits.
8. Design the microwave circuits to suit the needs of industry.

**Student Learning Outcomes (SLO)**

1. Having an ability to apply mathematics and science in engineering applications
2. Having a clear understanding of the subject related concepts and of contemporary issues
14. Having an ability to design and conduct experiments, as well as to analyze and interpret data

**Module: 1 Microwave measurements and applications**

<table>
<thead>
<tr>
<th>4 hours</th>
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<tbody>
<tr>
<td>Microwave frequencies (IEEE Standards), microwave measurements - guide wavelength VSWR, frequency and impedance, practical perspective of microwaves: Microwave oven, Radar, wireless applications.</td>
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</table>

**Module: 2 Microwave Sources**

<table>
<thead>
<tr>
<th>8 hours</th>
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**Module: 3 Microwave Network Analysis**

<table>
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<tr>
<th>6 hours</th>
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</table>

**Module: 4 Power dividers**

<table>
<thead>
<tr>
<th>9 hours</th>
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</thead>
<tbody>
<tr>
<td>S-matrix analysis of E-Plane Tee, H-Plane Tee, Magic Tee, Multi-hole directional coupler. Introduction to Microstrip lines. T junction and resistive power divider, Wilkinson power divider, branch line coupler (equal &amp; unequal), Rat Race Coupler (180° hybrid coupler).</td>
</tr>
</tbody>
</table>

**Module: 5 Microwave Ferrite devices**

<table>
<thead>
<tr>
<th>4 hours</th>
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</table>
**Module: 6  MW Filters (Microstrip line)** 6 hours
Filter design by insertion loss method. Low pass filter implementation (Butterworth and Chebyshev) - Richards transformation, Kuroda’s identity - Stepped impedance.

**Module: 7  Microwave Amplifiers** 6 hours
Microwave Transistors: BJT, FET, MESFET. Microwave amplifiers: Two port power gains, stability of the amplifier- design of single stage amplifier for maximum gain.

**Module: 8  Contemporary issues** 2 hours

| Total Lecture hours: | 45 hours |

**Text Book(s)**

**Reference Books**

**Mode of Evaluation:** Internal Assessment (CAT, Quizzes, Digital Assignments) & Final Assessment Test (FAT)

**List of Challenging Experiments (Indicative)**
1. Analysis of S-Parameters for the waveguide components using microwave test bench 6 hours
2. Perform the circuit analysis and electromagnetic simulation of equal and unequal Wilkinson power divider. 6 hours
3. Design and perform the electromagnetic simulation of branch line coupler and Rat-race coupler. 6 hours
4. Perform the circuit and electromagnetic simulation for low pass filter using stepped impedance method and Richard’s transform method. 6 hours
5. Using maximum gain and specific gain method design and perform the electromagnetic simulation for microwave filters in S and L bands. 6 hours

| Total laboratory hours | 30 hours |

**Mode of evaluation:** Continuous Assessment & Final Assessment Test.

Recommended by Board of Studies 13-12-2015
Approved by Academic Council No. 40 Date 18-03-2016
Course code | Course title | L | T | P | J | C
---|---|---|---|---|---|---
ECE3033 | IoT in Automotive Systems | 2 | 0 | 2 | 0 | 3

Pre-requisite: ECE 3026 IoT for Systems Architecture

Version:1

Course Objectives:
The course is aimed at making the students

1. To impart the required Automotive fundamentals for IoT System Design
2. To provide an exposure about the IoT applications in automotive systems.
3. To develop design skills in automotive IoT Systems

Expected Course Outcome:
At the end of the course, the student will be able to

1. Understand the required fundamentals for Automotive IoT.
2. Comprehend the applications of Networked Vehicles using IoT
3. Realize the IoT Safety Management in Automotive
4. Discuss the Efficiency management using IoT.
5. Interpret the IoT based Navigation applications
6. Associate the Automotive Cyber Security with IoT Systems.
7. Identify the need and importance of Smart Vehicles and Connected Cars
8. Design IoT based solutions for real time automotive applications

Student Learning Outcomes (SLO): 1, 6, 10

1. Having an ability to apply mathematics and science in engineering applications
6. Having an ability to design a component or a product applying all the relevant standards and with realistic constraints
10. Having a clear understanding of professional and ethical responsibility

Module:1 | Introduction to Automotive IoT (AIoT) | 5 hours
---|---|---
Introduction, Fundamentals of Automotive, Automotive IoT applications: Infotainment, Navigation and control, smart SOS, Electronic toll collection, Automated parking reservation and payment systems

Module:2 | Networked Vehicles using IoT | 3 hours
---|---|---
Vehicle collision avoidance, Lane change algorithm, Optimal traffic control using Smart applications in IoT, Green traffic management using IoT, Smart power control.

Module:3 | IoT Safety Management in Automotive | 5 hours
---|---|---
Tire pressure Monitoring using IoT, Immobilizers and Vehicle alarm systems, Remote Diagnostics using IoT, Vehicle tracking, Integrated infotainment systems, emergency calling systems using IoT.

Module:4 | Efficiency management using IoT | 3 hours
---|---|---
Start, stop and micro hybrids, mild hybrids, Self-driving and ADAS - Advanced driver assistance services, Automated fuel injection mechanisms, Advanced locomotives using IoT.

Module:5 | IoT based Navigation | 5 hours
---|---|---

Module:6 | Automotive Cyber Security | 3 hours
---|---|---
Security in Automotive systems, CMAP - CAN bus mapper, Security risks at High tech vehicles, Mandated legislation and Non mandated communication based threats, Stolen vehicle tracking and recovery, Attack vectors - remote vehicle theft, exfiltration, Virtual non-existence.
<table>
<thead>
<tr>
<th>Module:7</th>
<th>Smart Vehicles and Connected Cars</th>
<th>4 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Smart vehicles, V2V Communication, single vehicle applications, Connected cars - Opportunities, risks and turmoil. Policies and Standards</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:8</th>
<th>Contemporary issues:</th>
<th>2 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total Lecture hours:</td>
<td>30 hours</td>
</tr>
</tbody>
</table>

**Text Book(s)**

1. Tim Schule, Advanced Microsystems for Automotive Applications: Smart Systems for Green and Automated Driving, 2015, Springer Publishers, USA.

**Reference Books**

3. Daniel Minouli, Building the Internet of Things with IPv4 and IPv6, Oct 2015, John Wiley, USA
5. The Internet of Things and Connected Cars, Business White paper, 2015, HPE.

**Mode of Evaluation**

Continuous Assessment Tests, Quiz, Digital Assignment, Final Assessment Test

**List of Challenging Experiments (Indicative)**

1. Design and development of Automated parking system. 6 hours
2. Design and development of Automated toll payment system. 4 hours
3. Design and development of Infotainment in Automotive IoT 4 hours
4. Design and development of Smart brake system using IoT. 4 hours
5. Design and development of Theft vehicle tracking using Smart IoT 4 hours
6. Design and development of CMAP implementation. 4 hours
7. Design and development of Connected car prototype. 4 hours

Total Laboratory Hours 30 hours

**Mode of Evaluation**: Continuous Assessment, Final Assessment Test

Recommended by Board of Studies : 26/02/2017

Approved by Academic Council : 44th Date : 16/03/2017
Course code | Course title | L | T | P | J | C
--- | --- | --- | --- | --- | --- | ---
ECE3034 | IoT for Industrial Systems | 2 | 0 | 2 | 0 | 3

Pre-requisite: ECE 3026 IoT System Architecture | Version:1

Course Objectives:
The course is aimed at making the students
[1] To explore the IoT applications in industrial systems.
[2] To develop design skills in industrial IoT.
[3] To expose the state of art development in Industry 4.0 and its applications.

Expected Course Outcome:
At the end of the course the student should be able to
[1] Understand technologies, Catalysts and precursors of IIoT using suitable use cases.
[6] Relate the information Security in IIoT Systems
[7] Realize the development of Industry 4.0 and Smart Factories
[8] Experiment IoT based solutions for real time industrial applications.

Student Learning Outcomes (SLO): 2, 6
[2] Having a clear understanding of the subject related concepts and of contemporary issues
[6] Having an ability to design a component or a product applying all the relevant standards and with realistic constraints

Module: 1 Introduction to Industrial IoT (IIoT) 5hours
Introduction, Key IIOT technologies, Catalysts and precursors of IIoT, Innovation and the IIoT, Applications of IIoT Examples: Healthcare, Oil and Gas Industry, Logistics and the Industrial Internet, Retail applications, IoT innovations and design methodologies.

Module: 2 IIoT Reference Architecture and Design 3 hours
Industrial Internet Architecture Framework (IIAF): Control domain, operational domain and application domain, Three tier topology, Design of low power device network, legacy industrial protocols, Bluetooth, Zigbee IP, Z-wave, Wi-Fi backscatter in IIoT design.

Module: 3 Access Network Layer and Middlewares 5 hours

Module: 4 Software Design for IIoT 5 hours
Middleware Software patterns: Publish patterns, subscribe patterns, MQTT, XMPP, AMQP, DDS, Delay tolerant networks, Design of Web services for IIoT: SOAP, REST, HTTP Verb binding

Module: 5 IIoT WAN Technologies and Protocols 3 hours
Proximity network communication protocols, IIoT WAN protocols: SigFox, LoRaWAN, nWave, Dash7, Low power WiFi, LTE Category M, Weightless Protocols.

Module: 6 Security in IIoT Systems 3 hours
Security in Industrial systems, PLCs and DCS, Securing the OT, Network level potential threats, System level potential threats, Identity access management.

Module: 7 Industry 4.0 and Smart Factories 4 hours
Introduction to Industry 4.0, Characteristics of Industry 4.0, Value chain, Design principles and Building blocks, Smart manufacturing, smart factories, Real world smart factories.

Module: 8 Contemporary issues: 2 hours

Total Lecture hours: 30 hours
Text Book(s)

| 1. Alasdair Gilchrist, Industry 4.0 - Industrial Internet of Things, 2016, A Press, USA. |

Reference Books

| 2. Daniel Minouli, Building the Internet of Things with IPv4 and IPv6, Oct 2015, John Wiley, USA. |

Mode of Evaluation: Continuous Assessment Tests, Quiz, Digital Assignment, Final Assessment Test

List of Challenging Experiments (Indicative)

| 1. Design and development of Augmented reality board game player. | 6 hours |
| 2. Design and development of Battery and Motor Monitor. | 4 hours |
| 3. Design and development of Interior location sensor. | 4 hours |
| 4. Design and development of Security and privacy using Block chain. | 4 hours |
| 5. Design and development of Sensor Phile | 4 hours |
| 6. Design and development of Smart Safety glasses. | 4 hours |
| 7. Design and development of Smart Sprinkles. | 4 hours |

Total Laboratory Hours 30 hours

Mode of Evaluation: Continuous Assessment, Final Assessment Test

Recommended by Board of Studies : 26/02/2017

Approved by Academic Council: 44th Date : 16/03/2017
Course Code | Course Title | L | T | P | J | C
---|---|---|---|---|---|---
ECE3035 | RFID AND FLEXIBLE SENSORS | 3 | 0 | 0 | 0 | 3
Pre-requisite | ECE2023-Principles of Sensors and Data Acquisition | Version :1.1

**Course Objectives:**

The course is aimed at making the students to

1. Gain basic knowledge of different types of materials and methods used for fabrication of flexible electronics.

2. Understand and designing Radio frequency identification (RFID) systems, middleware architectures for real-world applications.

3. Determine road map for transformation of flexible electronics from foils to textiles

4. Understand the principle and applications of flexible sensors.

**Course Outcome:**

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

1. Have a clear understanding of the RFID related components, concepts and contemporary issues.

2. Design a RF component or a product applying all the relevant standards and with realistic constraints at a rudimentary level.

3. Possess knowledge for use of RF technology for a wide range of applications.

4. Have a lucid picture of the material related concepts and fabrication techniques for flexible electronics

5. Know about the recent trends in wearable technology.

6. Apply the knowledge of wearable technology for use in biological, chemical and mechanical processes.

7. Acquire knowledge on sensors in electronic textile domain.

**Student Learning Outcomes (SLO):**

2,5,17

2. Having a clear understanding of the subject related concepts and of contemporary issues.

5. Having design thinking capability

17. Ability to use techniques, skills and modern engineering tools necessary for engineering practice.

**Module:1**

**Overview of RFID Technology**

- 7 hours

Introduction- Core components of RFID systems- RFID Tags- RFID Interrogators- RFID Controllers- Frequency- selection criteria for RFID systems- Automatic identification and data capture systems- Smart Tags vs. Barcodes- RFID technology in supply chain management.
<table>
<thead>
<tr>
<th>Module:2</th>
<th>RFID Middleware and Information Technology Integration</th>
<th>6 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>RFID Middleware- Recent focus on middleware- Core functions of RFID middleware- Middleware as part of an RFID system-The EPC architecture- Present state of middleware development.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Module:3</td>
<td>Applications of RFID Technology</td>
<td>6 hours</td>
</tr>
<tr>
<td>Short range RFID applications: Access control-Transportation Ticketing- Personnel identification- Vehicle identification- Production line monitoring. Long range RFID applications: Supply chain management- Mail and shipping-Clothing tags-Food production control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Module:4</td>
<td>Materials and Novel patterning methods for flexible electronics</td>
<td>6 hours</td>
</tr>
<tr>
<td>Introduction, Inorganic semiconductors and dielectrics, organic semiconductors and dielectrics, conductors - Print processing options for device fabrication: Overview, control of feature sizes of jet printed liquids, jet printing for etch mask patterning, methods for minimizing feature size, printing of active materials.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Module:5</td>
<td>Wearable Haptics</td>
<td>6 hours</td>
</tr>
<tr>
<td>World of wearables - Attributes of wearables - Textiles and clothing: The meta wearable - Challenges and opportunities - Future of wearables - Need for wearable haptic devices - Categories of wearable haptic.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Module:6</td>
<td>Wearable Bio, Chemical and Inertial sensors</td>
<td>6 hours</td>
</tr>
<tr>
<td>Introduction-Systems design - Challenges in chemical and biochemical sensing - Application areas -Wearable inertial sensors - obtained parameters from inertial sensors - Applications for wearable motion sensors - Practical considerations for wearable inertial sensor - Application in clinical practice and future scope.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Module:7</td>
<td>Knitted electronic textiles</td>
<td>6 hours</td>
</tr>
<tr>
<td>From fibers to textile sensors - Interlaced network -Textile sensors for physiological state monitoring - Biomechanical sensing - Noninvasive sweat monitoring by textile sensors and other applications.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Module:8</td>
<td>Contemporary issues:</td>
<td>2 hours</td>
</tr>
<tr>
<td></td>
<td>Total Lecture hours: 45 hours</td>
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</table>

Text Book(s)


Reference Books


Mode of Evaluation: Continuous Assessment Tests, Quiz, Digital Assignment, Final Assessment Test

Recommended by Board of Studies : 26/02/2017

Approved by Academic Council : 44th Date : 16/03/2017
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course title</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>J</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECE 3036</td>
<td>SENSORS FOR STRUCTURAL HEALTH MONITORING</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>3</td>
</tr>
</tbody>
</table>

**Pre-requisite**: ECE2023 Principles of Sensors and Data Acquisition

**Version**: 1

**Course Objectives:**

The course is aimed

1. To give an overview of sensors their principles and applications in structural health monitoring.
2. To bring an awareness of a variety of challenges that structural health monitoring environment presents to the sensor designer.
3. To understand the future technologies in the structural health monitoring.

**Expected Course Outcome:**

At the end of the course, the student should be able to

1. Have a clear understanding of the subject related concepts and of contemporary issues
2. Having a clear understanding of the subject related concepts and of contemporary issues
3. Having design thinking capability
4. Having an ability to design a component or a product applying all the relevant standards and with realistic constraints
5. Having a clear understanding of the subject related concepts and of contemporary issues
6. Having an ability to design a component or a product applying all the relevant standards and with realistic constraints

**Module: 1 Introduction**

Need for structural health monitoring, technical challenges, potential applications in civil, naval, aerospace & manufacture engineering. definition of damage, structural measurands, overview of smart materials

**Module: 2 Vibration based Techniques for SHM**

Basic vibration and modal analysis- Frequency domain methods, time domain methods, mode shape methods. Limitations of vibration based damage detection techniques.

**Module: 3 SHM using Piezoelectric Sensors**

Lamb wave structure interrogation, sensor technology, localized damage with guided waves in composite materials, electro-mechanical impedance in defect detection in metallic and composite parts.

**Module: 4 SHM using Electrical Resistance**

Composite damage, electrical resistance of unloaded composite, influence of temperature, composite strain and damage monitoring-piezoresistivity and strain sensing, damage localization, Corrosion sensors.

**Module: 5 Low Frequency Electromagnetic Techniques**

Maxwell’s equation, dipole radiation, surface impedance, diffraction, eddy current, polarization of dielectrics. Applications to NDE/NDT domain- Application to SHM domain: magnetic method, electric method, hybrid method.

**Module: 6 Capacitive Methods for SHM in Civil Engineering**

Principle, capacitance probe for cover concrete, applications for external post-tensioned cable.
capacitance probe for moisture monitoring in historic buildings.

<table>
<thead>
<tr>
<th>Module</th>
<th>Fiber Optic Sensors</th>
<th>4 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Intensity based, phased modulated or interferometers, wavelength based or Fiber Bragg gratings. FBG as strain and temperature sensor, FBGs as damage sensors for composites, applications in aeronautics and civil engineering.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module</th>
<th>Contemporary issues:</th>
<th>2 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total Lecture hours:</td>
<td>30 hours</td>
</tr>
</tbody>
</table>

Text Book(s)

1. Daniel Balageas, Claus-Peter Fritzen and Alfredo Güemes, Structural Health Monitoring, 2010, John Wiley & sons, USA

Reference Books


Mode of Evaluation: Continuous Assessment Tests, Quiz, Digital Assignment, Final Assessment Test

Typical Projects:

1. Design and develop a structural load measurement system using strain gages
2. Implement a Health monitoring system using fiber optic sensors in suspended structures
3. Develop a Wireless acoustic emission sensor system for bridge monitoring
4. Structural deformation detection using wireless sensor network
5. Detection of internal corrosion caused by water seepage
6. Health monitoring of submersible navy composites
7. Develop a Damage detection system in aerospace structure

Mode of Evaluation: Continuous Assessment Reviews

Recommended by Board of Studies: 26/02/2017

Approved by Academic Council: 44th Date: 16/03/2017

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<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Title</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>J</th>
<th>C</th>
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</thead>
<tbody>
<tr>
<td>ECE 3037</td>
<td>Wireless Sensor Networks and IoT</td>
<td>2</td>
<td>0</td>
<td>0</td>
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<td>3</td>
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<tr>
<td></td>
<td>Pre-requisite ECE 3026 IoT for System Architecture</td>
<td></td>
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</tbody>
</table>

**Course Objectives:**

The course is aimed at

- [1] Understanding the implementation, challenges and design constraints of WSN.
- [2] Knowing about the MAC layer and routing protocols in WSN

**Expected Course Outcome:**

At the end of the course, the student should be able to

- [1] Describe the applications, challenges, and constraints of WSN.
- [5] Integrate WSN to Cloud Services for IoT
- [6]Understand the network architecture for WSNs and understand the design strategies of sensor layer.

**Student Learning Outcomes (SLO):**  1,2,14

- [1] Having an ability to apply mathematics and science in engineering applications
- [2] Having a clear understanding of the subject related concepts and of contemporary issues
- [14] Having an ability to design and conduct experiments, as well as to analyze and interpret data

**Module:1 | Motivation for a Network of Wireless Sensor Nodes | 5 hours**


**Module:2 | Node Architecture | 3 hours**

The Sensing Subsystem, The Processor Subsystem, Communication Interfaces, Prototypes

**Module:3 | Medium Access Control | 5 hours**


**Module:4 | Network Layer | 5 hours**

Routing Metrics, Flooding and Gossiping, Data-Centric Routing, Proactive Routing, On-Demand Routing, Hierarchical Routing, Location-Based Routing, QoS-Based Routing Protocols

**Module:5 | Power Management | 3 hours**

Local Power Management Aspects, Dynamic Power Management, Conceptual Architecture

**Module:6 | Integration of WSN to IoT | 3 hours**

Integration approaches – stack based approaches, topology based approaches - SCADA network architecture - Security Challenges

**Module:7 | Integration of WSN to Cloud Services for IoT | 4 hours**

Network Architecture, Sensor Layer Design, Coordination layer design: 6LoWPAN Gateway, Supervision layer, Lightweight Secure constrained application protocol

**Module:8 | Contemporary issues: | 2 hours**

**Total Lecture hours:** 30 hours

**Text Book(s)**

<table>
<thead>
<tr>
<th>Reference Books</th>
</tr>
</thead>
</table>

Mode of Evaluation: Continuous Assessment Test, Digital Assignment, Quiz, Final Assessment Test

<table>
<thead>
<tr>
<th>Typical Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Analysis of link quality between sender and receiver (Different types of nodes)</td>
</tr>
<tr>
<td>2. Impact of dynamic channel selection by pan coordinator on the network by restarting the pan coordinator</td>
</tr>
<tr>
<td>3. Performance analysis of MAC based routing (mbr) and level based routing (lbr) in multi hop network.</td>
</tr>
<tr>
<td>4. Performance analysis of WLAN gateway based wireless interface for connectivity between WSN and IoT</td>
</tr>
<tr>
<td>5. QoS analysis in routing protocol.</td>
</tr>
</tbody>
</table>

Mode of Evaluation: Continuous Assessment Reviews

Recommended by Board of Studies : 26/02/2017

Approved by Academic Council : 44th Date : 16/03/2017
Course Code | Course Title | L | T | P | J | C  
--- | --- | --- | --- | --- | --- | ---  
ECE3038 | MEMS AND NANOSENSORS | 3 | 0 | 0 | 0 | 3  
  
Pre-requisite: ECE 2023 - Principles of Sensors and Data Acquisition  
Version : 1.1  

**Course Objectives:**

The course is aimed at
[1] Introducing and discuss the historical background of evolution of MEMS and Microsystems and their applications as miniaturized sensors and actuators
[3] Comprehending various modern Micro-Nano fabrication techniques, device integration, packaging and bonding and highlight the applications of MEMS and Nano sensors to disciplines beyond Electrical and Mechanical engineering.

**Expected Course Outcome:**

At the end of the course, the student should be able to
[1] Understand the historical background of evolution of MEMS and Microsystems to the students. (CAT1, FAT)
[2] Comprehend the various micro sensing and actuating units were provided to the students. (CAT1, FAT)
[3] Discuss about scaling effects in different Physical domains on miniaturizing devices was done with the students. (CAT2, FAT)
[4] Rudiments of silicon and various polymer materials for MEMS fabrication was discussed with students. (A1, CAT2, FAT)
[6] Acquaint the students with Basics of Nanotechnology and its approaches towards nano-device realization. (A2, FAT)

**Student Learning Outcomes (SLO): 2,5**

[2] Having a clear understanding of the subject related concepts and of contemporary issues
[5] Having design thinking capability

**Module:1 Introduction to Microsystems **  
Overview of microelectronics and Microsystems technology, Microsystems and Miniaturization, The multi disciplinary nature of MEMS, Smart materials, Structures and Systems, RF MEMS, MOEMS, BioMEMS, Applications of MEMS in various industries.

**Module:2 Micro Sensors and Actuators**  

**Module:3 Scaling Laws in Miniaturization**  
Introduction to scaling, Scaling in Mechanical Domain, Electrostatic Domain, Magnetic Domain and Thermal Domain

**Module:4 Materials for Mems and Microsystems**  
Substrates and wafers, Silicon and Silicon compounds, Gallium Arsenide, Piezoelectric materials, Polymers

**Module:5 Fabrication Process**  
Photolithography – Ion implantation – Diffusion – Oxidation – Chemical Vapour Deposition (CVD) - Physical vapor deposition - Deposition epitaxy - etching process.

**Module:6 Micro System Manufacturing**  
Etching – isotropic and anisotropic, Wet and Dry Etching of Silicon – Plasma Etching – Deep
Introduction to nanotechnology, Future requirements and opportunities of nanotechnology in
sensing, CNT based sensors, Nano electronics and nano photonics.

<table>
<thead>
<tr>
<th>Module:</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Nano Sensors</td>
<td>6 hours</td>
</tr>
<tr>
<td>8</td>
<td>Contemporary issues:</td>
<td>2 hours</td>
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</tbody>
</table>

**Total Lecture hours:** 45 hours

**Text Book(s)**


**Reference Books**


**Mode of Evaluation:** Continuous Assessment Tests, Quiz, Digital Assignment, Final Assessment Test

**Recommended by Board of Studies:** 26/02/2017

**Approved by Academic Council:** 16/03/2017
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<th>C</th>
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</thead>
<tbody>
<tr>
<td>ECE 3039</td>
<td>CHEMICAL AND BIOSENSORS</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

Pre-requisite: ECE2023 - Principles of Sensors and Data Acquisition  
Version: 1.1

**Course Objectives:**

The course is aimed at making the students to
1. Study the basic principles of chemical sensors and its applications.
2. Familiarize with the technological advancements in the field of chemical sensors.
3. Understand the working principle of biosensors.
4. Know about the variety of sensing techniques for measurement and detection of bio-chemical to be rephrased processes.

**Expected Course Outcome:**

At the end of the course, the students will be able to
1. Gain knowledge about chemical sensors and their applications.
2. Gain the basic idea of biosensor, immobilization techniques and its applications.
3. Select a suitable chemical and biosensor for a given application.
4. Understand the sensors used for measuring analytical concentration of some components of the analyte gas or solution.
5. Know about the sensors used for quantification of biochemical processes.
6. Understand the working principle of sensors conduction and their characteristics.
7. Comprehend the working principle of mechanical sensors-based mass and heat for various applications.

**Student Learning Outcomes (SLO):** 2, 5

2. Having a clear understanding of the subject related concepts and of contemporary issues
5. Having design thinking capability

**Module: 1 Overview of Chemical Technology**  

**Module: 2 Transduction Principles**  
Transduction Elements- Ion-Selective Electrodes, Nernst Equation, voltammetry, amperometry, conductivity, FET, Modified electrodes, Thin-Film Electrodes and Screen-Printed electrodes

**Module: 3 Chemical Sensing Elements**  

**Module: 4 Potentiometric Sensors**  
Potentiometric- Ion selective electrodes- pH linked, Ammonia linked, CO₂ linked, Silver sulfide linked, Iodine selective, Lambda sensor, NOx sensor.

**Module: 5 Amperometric Sensors**  
Amperometric-bio sensors (Glucose sensor) and gas sensors (C₂H₄, CH₄, O₂, NOₓ, CO₂, NH₃).

**Module: 6 Conductometric Sensors**  
Conductometric-chemiresistors-Biosensor based chemiresistors-Semiconducting oxide sensor, CHEMFETs, ISFETs, FET based Biosensors.

**Module: 7 Mass and Thermal Sensors**  
Piezoelectric effect- Gas sensor applications, Biosensor applications- Quartz crystal microbalance, surface acoustic waves, Enzymatic mass sensor, Glucose thermistor, catalytic gas sensor, pellistors, Enzymethermistor.

**Module: 8 Contemporary issues:**  
2 hours
<table>
<thead>
<tr>
<th>Total Lecture hours:</th>
<th>45 hours</th>
</tr>
</thead>
</table>

**Text Book(s)**

1. Brian R Eggins, Chemical sensors and Biosensors, 2013, 1\(^{st}\) ed., John Wiley sons Ltd, USA.

**Reference Books**


**Mode of Evaluation:** Continuous Assessment Tests, Quiz, Digital Assignment, Final Assessment Test

Recommended by Board of Studies : 26-02-2017
Approved by Academic Council : 44 Date 16-03-2017
Course Code | Course Title | L | T | P | J | C
--- | --- | --- | --- | --- | --- | ---
ECE3040 | WIRELESS TECHNOLOGIES FOR IoT | 3 | 0 | 0 | 0 | 3

Pre-requisite | ECE3026 - IoT System Architecture | Version : 1.1

**Course Objectives:**
The course is aimed at making the students to

1. Understand the different types of fading and diversity, and signal propagation mechanism.
2. Understand the different wireless standards (WLAN, WPAN and WMAN) and its security
3. Understand the basics of 6LoWPAN and Bluetooth Low Energy (BLE) technology

**Course Outcome:** At the end of the course the student should be able to

1. Study different types of fading and diversity.
2. Analyse different types of signal propagation mechanism and multiple access techniques.
3. Know the characteristics of WLAN and their security issues.
4. Know the characteristics of WPAN and their security issues.
5. Study various types of wireless MAN standards
6. Comprehend the architecture and protocol stack of 6LoWPAN.
7. Comprehend basics of Bluetooth Low Energy (BLE) technology.

**Student Learning Outcomes (SLO):** 1,6,14

Student Learning Outcomes involved:

1. Having an ability to apply mathematics and science in engineering applications
6. Having an ability to design a component or a product applying all the relevant standards and with realistic constraints
14. Having an ability to design and conduct experiments, as well as to analyse and interpret data

**Module:1** Fading Channels and Diversity Technique 6 hours

Wireless channels – overview of fading channels – Diversity techniques – Multiple antennas in wireless communication

**Module:2** Radio Communication Basics 6 hours

RF Spectrum- Wireless Multiplexing and Multiple Access Techniques-RF signal propagation and reception-Ultra Wideband Radio-MIMO.

**Module:3** Wireless LAN 7 hours

IEEE 802.11 WLAN standards- IEEE 802.11 MAC Layer –IEEE 802.11 PHY Layer-IEEE 802.11
## Enhancement – WLAN Security - Other WLAN Standards

<table>
<thead>
<tr>
<th>Module: 4</th>
<th>Wireless PAN</th>
<th>6 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction – Bluetooth-Wireless USB-ZigBee-IrDA-Wireless PAN Security</td>
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<thead>
<tr>
<th>Module: 5</th>
<th>Wireless MAN</th>
<th>6 hours</th>
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<tr>
<td>IEEE 802.16 Wireless MAN Standard-Metropolitan Area-Mesh Network-Start-up phase and operating phase</td>
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<tr>
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<tr>
<th>Module: 8</th>
<th>Contemporary issues:</th>
<th>2 hours</th>
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**Total Lecture hours: 45 hours**

### Text Book(s)


### Reference Books


### Mode of Evaluation:

Continuous Assessment Test + Digital Assignment, Quiz, Final Assessment Test

Recommended by Board of Studies: 26/02/2017

Approved by Academic Council: 44th Date: 16/03/2017
### Course Objectives:

1. To understand advanced architectures.
2. To develop programs both in C and assembly for advanced architectures.
3. To understand the advanced features like memory management unit, exception handling.
4. To build real-time system using ARM/AVR controllers.

### Course Outcomes:

1. Comprehend the architecture and instruction set of AVR controllers.
2. Develop efficient C codes for AVR architecture and program AVR peripherals like timers, interrupts and serial port.
3. Design AVR controller based system within realistic constraint like user specification, availability of components.
4. Understand the design philosophy of ARM controllers.
5. Comprehend the instruction and assembly language program.
6. Develop efficient C codes for ARM architecture and its interfaces.
7. Design application for various social relevant and real time issues.

### Student Learning Outcomes (SLO):

- 2. Having a clear understanding of the subject related concepts and of contemporary issues
- 5. Having design thinking capability
- 13. Having cross cultural competency exhibited by working in teams

### Module: 1 | AVR architecture and Assembly language Programming: | 5 hours

AVR Register File, Special Addressing registers, Addressing modes, Stack pointer, Program status register, Pipelines, Clock, Arithmetic and logical Instructions, Jump and branch Instructions, Move, Load store Instructions, Load and store Program memory, Push and pop Instruction, Bit Instructions, I/O Port.

### Module: 2 | AVR (C Programming): | 5 hours

Data types, Time delays, I/O Programming, Logic Operations, Data Conversion, Data Serialization, Memory Allocation.
<table>
<thead>
<tr>
<th>Module</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>AVR Peripherals (C programming):</td>
<td>4 hours</td>
</tr>
<tr>
<td></td>
<td>Timers, Interrupts, Serial Port</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Communication with real world (C programming):</td>
<td>8 hours</td>
</tr>
<tr>
<td></td>
<td>SPI, I2C, ADC &amp; DAC, PWM, Relay, stepper motor, LCD, keyboard</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>ARM Architecture:</td>
<td>5 hours</td>
</tr>
<tr>
<td></td>
<td>ARM Design Philosophy, Overview of ARM architecture States [ARM, Thumb, Jazelle], Registers, modes, Conditional Execution, Pipelining, Vector Tables, Exception handling.</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>ARM &amp; Thumb Instructions and Assembly language Programming:</td>
<td>8 hours</td>
</tr>
<tr>
<td></td>
<td>ARM Instruction- data processing instructions, branch instructions, load store instructions, SWI instruction, Loading instructions, conditional Execution, Assembly Programming. Thumb Instruction-Thumb Registers, ARM Thumb interworking, branch instruction, data processing instruction, single/multiple load store instruction, Stack instruction, SWI instruction.</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>ARM Microcontroller (C Programming):</td>
<td>8 hours</td>
</tr>
<tr>
<td></td>
<td>ARM Cortex M Microcontroller- Ports, Timer, UART, ADC, I2C.</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Contemporary Issues</td>
<td>2 hours</td>
</tr>
<tr>
<td></td>
<td>Total Lecture:</td>
<td>45 hours</td>
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</table>

**Text Books:**


**Reference Books:**


**Mode of evaluation:** Internal Assessment (CAT, Quizzes, Digital Assignments) & Final Assessment Test (FAT)
### Typical Projects:

<p>| | | | | | |</p>
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<thead>
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</thead>
<tbody>
<tr>
<td>11.</td>
<td>Forest Fire detection</td>
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</table>

**Mode of evaluation:** Review I, II and III

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommended by Board of Studies</td>
<td>13-12-2015</td>
</tr>
<tr>
<td>Approved by Academic Council</td>
<td>No: 40 Date 18-03-2016</td>
</tr>
</tbody>
</table>
**Course Objectives:**
1. To acquaint students with the basics of probability, information and its properties
2. To familiarize students with different channel models and their capacity
3. To teach different types of source coding techniques
4. To explain various types of channel coding techniques

**Course Outcomes:**
1. Comprehend and analyze the basics of probability, information and its properties
2. Examine different types of channels and determine their capacity
3. Understand the binary and non-binary source coding schemes
4. Analyze the dictionary-based coding schemes for image compression techniques
5. Understand the fundamentals of error control coding schemes
6. Construct, comprehend and analyze the advanced error control coding schemes
7. Evaluate the performance of source coding, channel coding techniques in image processing and wireless applications

**Student Learning Outcomes (SLO):** 1, 2, 18
1. Having an ability to apply mathematics and science in engineering applications
2. Having a clear understanding of the subject related concepts and of contemporary issues.
18. Having critical thinking and innovative skills.

**Module: 1 Introduction**
Review of Probability Theory, Introduction to information theory

**Module: 2 Entropy**
Uncertainty, self-information, average information, mutual information and their properties - Entropy and information rate of Markov sources - Information measures of continuous random variables.

**Module: 3 Channel Models and Capacity**
Importance and types of various channel models - Channel capacity calculation – Binary symmetric channel, binary erasure channel - Shannon’s channel capacity and channel coding theorem - Shannon’s limit.

**Module: 4 Source Coding I**
Source coding theorem - Huffman coding - Non binary Huffman codes - Adaptive Huffman coding - Shannon Fano Elias coding - Non binary Shannon Fano codes

**Module: 5 Source Coding II**
Arithmetic coding - Lempel-Ziv coding - Run-length encoding and rate distortion function - Overview of transform coding.

**Module: 6 Channel Coding I**
Introduction to Error control codes - Block codes, linear block codes, cyclic codes and their properties, Encoder and Decoder design- serial and parallel concatenated block code, Convolution Codes- Properties, Encoder-Tree diagram, Trellis diagram, state diagram, transfer function of convolutional codes, Viterbi Decoding, Trellis coding, Reed Solomon codes.

**Module: 7 Channel Coding II**
Serial and parallel concatenated convolutional codes, Block and convolutional interleaver, Turbo coder, Iterative Turbo decoder, Trellis coded modulation-set partitioning - LDPC Codes.

**Module: 8 Contemporary Issues**
Text Book(s)  

Reference Books  

Mode of Evaluation: Internal Assessment (CAT, Quizzes, Digital Assignments) & Final Assessment Test (FAT)

Typical Projects  
1. Efficient Image compression technique by using modified SPIHT algorithm  
2. Develop the compression algorithms by using Discrete Wavelet Transform  
3. Compress and decompress an Image using Modified Huffman coding  
4. Apply Run length coding and Huffman encoding algorithm to compress an image.  
5. Adaptive Huffman coding of 2D DCT coefficients for Image compression  
6. Compress of an image by chaotic map and Arithmetic coding  
7. Region of Interest based lossless medical image compression  
8. Write a code to build the (3, 1, 3) repetition encoder. Map the encoder output to BPSK symbols. Transmit the symbols through AWGN channel. Investigate the error correction capability of the (3, 1, 3) repetition code by comparing its BER performance to that without using error correction code.  
9. Write a code to compare the BER performance and error correction capability of (3, 1, 3) and (5, 1, 5) repetition codes. Assume BPSK modulation and AWGN channel. Also compare the simulated results with the theoretical results.  
10. Write a code to compare the performance of hard decision and soft decision Viterbi decoding algorithms. Assume BPSK modulation and AWGN channel.  
11. Write a code to build (8, 4, 3) block encoder and decoder. Compare the BER performance of (8, 4, 3) block coder with (3,1,3) repetition codes. Assume BPSK modulation and AWGN channel.  
12. Consider the following Extended vehicular A channel power delay profile. Write a code to model the given profile. Also measure the channel capacity. Compare the obtained capacity to that without fading channel.

<table>
<thead>
<tr>
<th>Delay (ns)</th>
<th>Power (dB)</th>
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<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>30</td>
<td>-1.5</td>
</tr>
<tr>
<td>150</td>
<td>-1.4</td>
</tr>
<tr>
<td>310</td>
<td>-3.6</td>
</tr>
<tr>
<td>370</td>
<td>-0.6</td>
</tr>
<tr>
<td>710</td>
<td>-9.1</td>
</tr>
<tr>
<td>1090</td>
<td>-7</td>
</tr>
<tr>
<td>1730</td>
<td>-12</td>
</tr>
<tr>
<td>2510</td>
<td>-16.9</td>
</tr>
</tbody>
</table>

13. Performance analysis of various channels (BSC, BEC, Noiseless, Lossless) under AWGN.
14. FPGA implementation of linear block coding and syndrome decoding.
15. Performance of linear block codes under single error and burst error.
17. Implementation of VITERBI decoding in FPGA.
18. Efficiency checking of different interleaver for turbo encoder.
19. Implementation of trellis code modulator in FPGA.
20. Developing the Compression algorithms for Wireless multimedia sensor networks.

<table>
<thead>
<tr>
<th><strong>Mode of evaluation:</strong></th>
<th>Review I, Review II and Review III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommended by Board of Studies</td>
<td>13-12-2015</td>
</tr>
<tr>
<td>Approved by Academic Council</td>
<td>No. 40  Date 18-03-2016</td>
</tr>
</tbody>
</table>
Course Objectives:
1. To familiarize the concepts related to cellular communication and its capacity.
2. To acquaint students with different generations of mobile networks.
3. To teach students the fundamentals of multipath fading and propagation models.
4. To describe the modulation and diversity schemes as applied in mobile communication.

Course Outcomes:
1. Understand and solve telecommunication design issues using cellular and trunking theory.
2. Interpret the functions of the building blocks of cellular network architecture.
4. Analyze the effect of multipath channels and suggest a suitable model for indoor or outdoor applications.
5. Demonstrate the implications of multipath parameters in mobile communication.
6. Differentiate the digital modulation schemes available and select appropriate method to improve the performance of wireless communication.
7. Appraise a suitable diversity technique to combat the multipath fading effects.
8. Design a wireless mobile communication system by formulating the apt techniques and selecting the supporting software/hardware components.

Student Learning Outcomes (SLO) 1, 2, 14
1. Having an ability to apply mathematics and science in engineering applications
2. Having a clear understanding of the subject related concepts and of contemporary issues.
14. Having an ability to design and conduct experiments, as well as to analyze and interpret data.

Module: 1 Cellular Concept 6 hours
Cellular concept – Frequency reuse – Channel assignment strategies – Handoff strategies – Interference & system capacity – Trunking & grade of service – Improving coverage and capacity in cellular system.

Module: 2 Cellular Networks 5 hours
GSM architecture – CDMA architecture – GPRS architecture – UMTS architecture

Module: 3 Introduction to Mobile Radio Propagation 5 hours
Free space propagation model – Three basic propagation mechanism – Reflection, diffraction and scattering – Two ray ground reflection model

Module: 4 Mobile Radio Propagation: Large Scale Path Loss 6 hours
Link budget design using path loss model – Outdoor and indoor propagation models

Module: 5 Mobile Radio Propagation: Small Scale Fading and Multipath 6 hours
Small scale multipath propagation – Parameters of mobile multipath channels – Types of small scale fading – Fading effects due to multipath time delay spread and doppler spread – Rayleigh and Rician fading.
### Module: 6 Modulation Techniques for Mobile Radio

| Overview of linear modulation techniques: QPSK, MSK, QAM – GMSK - OFDM and its principle, transceiver implementation, cyclic prefix, inter carrier interference, windowing, PAPR and its reduction techniques. |

### Module: 7 Diversity Techniques

| Diversity – Types of diversity – Diversity combining techniques: Selection, Feedback, Maximal Ratio Combining and Equal Gain Combining – Rake receiver |

### Module: 8 Contemporary issues

| Total lecture hours: 45 hours |

### Text Book(s)


### Reference Books


### Mode of evaluation

- Internal Assessment (CAT, Quizzes, Digital Assignments) & Final Assessment Test (FAT)

### List of Challenging Experiments (Indicative)

1. To study the effect of various fading channels such as Rayleigh, Ricean and various noise channel such as AWGN and Laplacian noise
2. Simulate to compute the pathloss of urban, suburban and rural environment for LTE/WiMAX/WLAN system using free space, Ericsson, COST 231, ECC, Hata and SUI model
3. Evaluate Signal to Interference Noise Ratio (SINR) distribution for the following scenarios
   a. Effect of changing transmit power
   b. Effect of common vertical tilt of antennas
   c. Effect of changing percentage of users who are indoor and outdoor
   d. Different Terrains
4. Simulate link level Bit Error Rate (BER) performance
   a. Link level BER Performance without FEC
   b. Link level BER Performance with various CQI indices
   c. Link level BER Performance with various transmission mode
5. Study of relative interference levels in homogeneous networks
6. Evaluate SINR distribution for heterogeneous scenarios with Picos

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B.TECH (ECE with IoT & Sensor)  
Page 144
7. Study of CQI variation
   a. CQI variations for different users
   b. CQI variations in different sub bands

<table>
<thead>
<tr>
<th>Effect of Pico locations and number of Picos</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effect of power levels of Picos</td>
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<tr>
<td>Effect of Pico bias</td>
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</table>

| Total laboratory hours | 30 hours |

**Mode of evaluation:** Continuous Assessment & Final Assessment Test (FAT)

**Typical Projects**

1. Energy-and cost-efficient mobile communication using multi-cell MIMO and relaying techniques
2. Inter-cell interference mitigation for mobile communication system
3. Improving capacity / resource allocation for soft handoff performance in wireless mobile communication
4. Security in mobile communication
5. Call admission and control schemes for QoS in cellular networks
6. Analysis of different traffic models in mobile communication
7. Dynamic channel assignment in wireless mobile communication
8. Performance analysis of macrocell / microcell hierarchical cellular systems
9. Performance analysis of propagation models
10. Performance analysis of modulation schemes

**Mode of evaluation:** Review I, II and III.

Recommended by Board of Studies | 13-12-2015
Approved by Academic Council No. 40 | Date | 18-03-2016
## Course Code: ECE 4025 | Course Title: EMBEDDED PROGRAMMING

<table>
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<td>2</td>
<td>0</td>
<td>3</td>
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</table>

### Pre-requisite
ECE 3031 Microcontroller and Embedded System

### Course Objectives:
The course is aimed at

1. Expressing to Embedded C and Linux and the range of applications to which they are suited.
2. Developing skills in the Embedded C, SHELL programming and Linux
3. Familiarizing the students with data structures

### Expected Course Outcome:
At the end of the course, the student should be able to

1. Understand and write simple Embedded pseudo codes.
2. Comprehend the fundamentals of C
3. Comprehend the Data structures
4. Comprehend the basics of OS Concepts and Linux
5. Showcase the skill, knowledge and ability of SHELL programming.
6. Exhibit the working knowledge of basic Embedded Linux
7. Have hands on experience in using state-of- art hardware and software tools

### Student Learning Outcomes (SLO):
2, 5, 18

2. Having a clear understanding of the subject related concepts and of contemporary issues
5. Having design thinking capability
18. Having critical thinking and innovative skills

### Module: 1 Basics of Embedded Programming
- Basic concepts of C, Embedded C Vs. C, Embedded programming aspects with respect to firmware and OS Functions, Data Types, Data Type Conversions - Operators - Conditional Controls – Loop Controls- Input / Output Operations.

### Module: 2 C Programming Concepts
- Functions, Arrays, pointers, structures and Inputs/Outputs

### Module: 3 Data Structures
- Linked list, Single linked list, Double linked list, Stack and Queues

### Module: 4 OS Concepts
- Operating system structures, Process Management, Process Synchronization, CPU Scheduling

### Module: 5 Basics of Linux
- Command prompt, X windows basics, Navigating file system, finding files, working with folders, reading files text editing in Linux, Compression and archiving tools, Basic shell commands, File Management, I/O Handling, File Locking

### Module: 6 Shell Programming
- Processes, giving more than one command at a time, prioritizing and killing processes, Scheduling Commands, pipes and redirection, regular expression, pattern matching, Scripting using for while, if and other commands

### Module: 7 Linux Programming Concepts
- File Management, I/O Handling, File Locking, Process Management, Memory Management, Message Queues, Shared Memory, Semaphores

### Module: 8 Contemporary issues

### Text Book(s)
2. Eric Foster Johnson, John C. Welch, Micah Anderson, Beginning shell scripting, 2012,
Reference Books


Mode of Evaluation: Continues Assessment Test, Quiz, Digital Assignment, Final Assessment Test

List of Challenging Experiments (Indicative)

<table>
<thead>
<tr>
<th>Task</th>
<th>Description</th>
<th>Hours</th>
</tr>
</thead>
</table>
| 1.   | Task 1: C programming  
Create a child process by calling fork system call and display the current process ID and parent process ID for the following conditions.  
(i) Process ID and parent process ID for process and child process  
(ii) Process ID and parent process ID for process and child process while sleep in the parent.  
(iii) Process ID and parent process ID for process and child process while sleep in a child. | 5 |
| 2.   | Task 2: C programming  
Create a pipe system call to communicate between the parent process and child process.  
Create a fifo system call and communicate between two different processes. | 5 |
| 3.   | Task 3: Implementation of data structure for an application  
Write a SortedMerge() function that takes two lists, each of which is sorted in increasing order, and merges the two together into one list which is in increasing order. SortedMerge() should return the new list. The new list should be made by splicing together the nodes of the first two lists. | 6 |
| 4.   | Task 4: Shell Programming  
Development of inventory management system using Shell scripting with the following features. User may add/update/delete inventory.  
- User may add/update inventory details.  
- Details include cost, quantity and description.  
- Includes forms for inventory inwards and outwards.  
- User may create sub-inventories.  
- An interactive user interface | 6 |
| 5.   | Task 5: Inter Process Communication  
Write an implementation of Message queue, shared memory and semaphore inter process communications | 6 |
|      | Total Laboratory Hours | 30 |

Mode of Evaluation: Challenging Experiments, Final Assessment Test

Recommended by Board of Studies: 26/02/2017
Approved by Academic Council: 44th Date: 16/03/2017
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<td>ECE3030 - Principles of Computer Communications</td>
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</table>

**Course objectives (CoB):**

The course is aimed at

[1] Introducing students with the basic concepts of M2M communication

[2] Acquainting with M2M architecture, protocols and its security

[3] Knowing the significance of M2M interfaces and services

**Course Outcomes (CO):**

At the end of the course the student should be able to

[1] Get acquainted with the basics of M2M Communication

[2] Understand the operation of M2M protocols and architecture

[3] Possess an ability to optimize the M2M in public mobile networks

[4] Know about IP in M2M

[5] distinguish between different types of M2M security methods

[6] Comprehend the operation and, characteristics of M2M terminals and interfaces

[7] Familiarise with the basics of M2M services

[8] Analyse the traffic models, routing protocols and different services using modern engineering tools.

**Student Learning Outcomes (SLO):**

1,2,6

Student Learning Outcomes involved:

[1] Having an ability to apply mathematics and science in engineering applications

[2] Having a clear understanding of the subject related concepts and of contemporary issues

[6] Having an ability to design a component or a product applying all the relevant standards and with realistic constraints

**Module:1 Introduction M2M**

4 hours

<table>
<thead>
<tr>
<th>Module:2</th>
<th>M2M Architecture and Protocols</th>
<th>4 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use-Case driven approach in M2M architecture, ETSI-M2M work on use cases, Smart Metering Approach in ETSI M2M, Typical Smart Metering Deployment Scenario, Traffic models, M2M market applications</td>
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<table>
<thead>
<tr>
<th>Module:3</th>
<th>M2M Optimization in Public Mobile Networks</th>
<th>5 hours</th>
</tr>
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<tbody>
<tr>
<td>M2M over a Telecommunications Network, M2M Communication Scenarios, Data Connections for M2M Applications, 3GPP Standardization of Network Improvements for Machine Type Communications, Numbering, Identifiers, and Addressing, Triggering Optimizations, Overload and Congestion Control</td>
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<table>
<thead>
<tr>
<th>Module:4</th>
<th>IP in M2M</th>
<th>3 hours</th>
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<tr>
<th>Module:5</th>
<th>M2M Security</th>
<th>5 hours</th>
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<thead>
<tr>
<th>Module:6</th>
<th>M2M Terminals and Interfaces</th>
<th>3 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access technologies, Physical form factors, Hardware interfaces, UICC (Universal Integrated Circuit Card) Interface, GPIO (General-Purpose Input/Output Port) Interface, SPI (Serial Peripheral Interface) Interface, Analog Audio Interfaces. Durability test</td>
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</table>

<table>
<thead>
<tr>
<th>Module:7</th>
<th>M2M Services</th>
<th>4 hours</th>
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</thead>
<tbody>
<tr>
<td>Application Execution Environment, Connectivity Services, Management services, Software services, AT Commands, SDK commands, Cellular identification, MNO Identification</td>
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</table>

<table>
<thead>
<tr>
<th>Module:8</th>
<th>Contemporary issues:</th>
<th>2 hours</th>
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</table>

**Total Lecture hours: 30 hours**

**Text Book(s)**


**Reference Books**


**Mode of Evaluation:** Continuous Assessment Tests, Quiz, Digital Assignment, Final Assessment
### Typical Projects

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>Design and implement a Telemedicine application using M2M Communications.</td>
</tr>
<tr>
<td>2.</td>
<td>Design and implement Telemetry applications using M2M</td>
</tr>
<tr>
<td>3.</td>
<td>Design and implement a Building management using M2M</td>
</tr>
<tr>
<td>4.</td>
<td>Design and implement M2M Applications using GGSN</td>
</tr>
<tr>
<td>5.</td>
<td>Design and implement M2M Applications using PDSN</td>
</tr>
<tr>
<td>6.</td>
<td>Design and implement Healthcare applications using M2M</td>
</tr>
<tr>
<td>7.</td>
<td>Design and implement Power sector control using M2M</td>
</tr>
<tr>
<td>8.</td>
<td>Design and implement Transport and logistics using M2M</td>
</tr>
</tbody>
</table>

Design and implement Smart metering applications

**Mode of Evaluation:** Continuous Assessment Reviews

**Recommended by Board of Studies:** 26/02/2017

**Approved by Academic Council:** 44th Date : 16/03/2017
<table>
<thead>
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<td>3</td>
</tr>
</tbody>
</table>

**Pre-requisite:** ECE3031 Microcontroller and Embedded Systems

**Course Objectives:**

The course is aimed at

1. Introducing fundamentals of sensing and exploration of various sensors widely used for real life application.

**Expected Course Outcome:**

At the end of the course, the student should be able to

1. Understand the working principle and behavior of sensors
2. Relate and realize the importance automotive sensors and bio medical sensors
3. Differentiate and associate the architecture, instruction set, interrupts of MSP430 and ARM Cortex M4.
4. Know the ARM peripherals programming and interfacing with advanced cortex MX microcontroller
5. Design and interface sensors with embedded controllers

**Student Learning Outcomes (SLO):** 1,2,9

1. Having an ability to apply mathematics and science in engineering applications
2. Having a clear understanding of the subject related concepts and of contemporary issues
9. Having problem solving ability- solving social issues and engineering problems

**Module:1** Fundamentals of Sensors 5 hours


**Module:2** Automotive Sensors 4 hours

Pressure, Engine temperature, Airflow, Combustion, Torque, Accelerometers, Gas composition sensors – Liquid level sensors

**Module:3** Bio-medical sensors 3 hours

Electrical Potentials and Propagation of Nerve Signals, Electrodes, EMG, ECG, EEG, Blood pressure.

**Module:4** Low Power Microcontroller 4 hours

MSP430: Architecture, Memory, Addressing modes, Instruction set, Clock system, Exceptions: Interrupts and resets - Low power mode.

**Module:5** ARM Cortex MX Processor 4 hours

ARM Cortex M4: Assembly language basics, Thumb-2 Technology, ARM Instruction set, Cortex M4 architecture, advantages, peripherals, instruction set, floating point operations.

**Module:6** ARM Peripherals Programming and Interfacing 4 hours

Principle of data acquisition, ADC, DAC, Sensor interface, single channel, multichannel Digital input/output, LCD Displays, Watchdog timers, timers, SPI, I2C, UART, Zigbee controller

**Module:7** Advanced Cortex MX Microcontroller 4 hours

Core, Architecture, on chip wifi, configuring WLAN, on CHIP 6LoWPAN and configuration.

**Module:8** Contemporary issues: 2 hours

**Total Lecture hours:** 30 hours

**Text Book(s)**

<table>
<thead>
<tr>
<th>Reference Books</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Jonathan W Valvano, Embedded Systems: Introduction to ARM Cortex -M Microcontrollers, 2017, 5\textsuperscript{th} edition, University of Texas, USA</td>
</tr>
</tbody>
</table>

| Mode of Evaluation: Continuous Assessment Tests, Quiz, Digital Assignment, Final Assessment Test |

<table>
<thead>
<tr>
<th>Typical Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Remote monitoring of soil parameters - deploy sensors in a land to measure the parameters like moisture, temperature, humidity etc.</td>
</tr>
<tr>
<td>2. Power optimization in home: Using human activity defectors appropriate appliances should be activated for a home application</td>
</tr>
<tr>
<td>3. Design and development of a prototype to demonstrate the structure health monitoring using strain gauge, accelerometer, ultra sonic sensor etc.</td>
</tr>
<tr>
<td>4. Design a gesture based controller to operate appropriate motors remotely.</td>
</tr>
<tr>
<td>5. Design an intelligent wearable device like watch, cap to sense the physical condition of human and to log the data for further analysis.</td>
</tr>
<tr>
<td>6. Design and develop an embedded bed monitoring system capable of sensing patient’s temperature, pressure, pulse rate, ECG etc and decide necessary actuations</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mode of Evaluation: Continuous Assessment Reviews</th>
</tr>
</thead>
</table>

Recommended by Board of Studies :26/02/2017
Approved by Academic Council : 44\textsuperscript{th} Date : 16/03/2017
ECE4028  Smart IoT Applications  2 0 0 4 3

Course Objectives:
The course is aimed at
[1] Introducing the application areas of IoT technologies by conducting Industrial case studies
[2] Processing the knowledge on IoT Standards and IoT legal perspectives at design phase

Expected Course Outcome:
At the end of the course the student should be able to
[1] Explore Smart Water & Environment applications and IoT Use Cases
[2] Investigate Smart Metering & Smart Cities applications and IoT Use Cases
[3] Investigate Smart Health & Home Automation applications and IoT Use Cases
[4] Understand Smart Retail & Logistics applications and IoT Use Cases
[5] Comprehend the Smart Industrial control & Agricultural applications and IoT Use Cases
[6] Understand the standardization of IoT and IoT Legal perspectives
[7] Experiment IoT based solutions for real time applications, at a very basic level

Module:1  Smart Water and Environment  4 hours
Smart Environment: Forest Fire Detection, Air Pollution, Snow Level Monitoring, Landslide and Avalanche Prevention, Earthquake Early Detection. Smart Water: Potable water monitoring, Chemical leakage detection in rivers, Swimming pool remote measurement, Pollution levels in the sea, Water Leakages, River Floods

Module:2  Smart Metering and Smart Cities  4 hours
Smart Cities: Parking, Structural Health, Noise Urban maps, Smart Phone Detection, Electromagnetic Field Levels, Traffic Congestion, Smart Lighting, Waste Management, Smart Roads. Smart Metering: Smart Grid, Tank level, Photovoltaic Installations, Silos Stock Calculation

Module:3  Smart Health and Home Automation  3 hours
Home Automation: Energy and Water Use, Intrusion Detection Systems. Health: Fall Detection, Medical Fridges, Sportsmen Care, Patients Surveillance, Ultraviolet Radiation

Module:4  Smart Retail and Logistics  4 hours
Smart Retail: Supply Chain Control, NFC Payment, Intelligent Shopping Applications, Smart Product Management. Logistics: Quality of Shipment Conditions, Item Location, Storage Incompatibility Detection, Fleet Tracking

Module:5  Smart Industrial control and Agricultural  5 hours

Module:6  IoT Legal Perspectives  5 hours

Module:7  IoT Standardization  3 hours
Module: 8

<table>
<thead>
<tr>
<th>Contemporary issues:</th>
<th>2 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Lecture hours:</td>
<td>30 hours</td>
</tr>
</tbody>
</table>

**Text Book(s)**

1. Ovidiu Vermesan, Peter Friess, Internet of Things – From research and innovation to market deployment, 2014, River Publishers Series in Communication, USA.

**Reference Books**


**Mode of Evaluation:** Continuous Assessment Tests, Quiz, Digital Assignment, Final Assessment Test

**Typical Projects**

1. Design and implement a Smart Water management system
2. Design and implement a Smart Environment
3. Design and implement a Smart Industrial control
4. Design and implement a Smart Agricultural
5. Design and implement a Smart Retailing system
6. Design and implement a Smart Logistics and Fleet Management
7. Design and implement a Smart Health monitoring System
8. Design and implement a Smart Home Automation
9. Design and implement a Smart portable Water management System
10. Design and implement a Smart energy Metering for Smart Cities

**Mode of Evaluation:** Continuous Assessment Reviews

**Recommended by Board of Studies : 26/02/2017**

**Approved by Academic Council: 44th Date: 16/03/2017**
Course Code | Course Title | L | T | P | J | C
---|---|---|---|---|---|---
ECE4030 | Building Management Systems | 1 | 0 | 0 | 0 | 1

Pre-requisite | NONE | Version : 1

Course Objectives:
The Course is aimed at

[1] Acquainting the student with the basic concepts of Building Management Systems and comfort parameters.

[2] Describing the students how HVAC, security Engineering, fire Engineering, and intrusion systems works.


Course Outcome:
At the end of course, the student will be able to

[1] Describe the basic concepts of BMS
[2] Explain the working of HVAC
[3] Outline the various performance parameters of a compressor
[4] Recognize / relate various “concept parameters” in building management systems
[5] Understand the need and operation of security engineering
[6] Study the various intrusion systems (FAT)
[7] Understand the working of fire Engineering systems (FAT)

Student Learning Outcomes (SLO): 1,2

[1] Ability to apply mathematics and science in engineering applications.
[2] Having a clear understanding of the subject related concepts and of contemporary issues

Module:1 | Introduction | 2 hours
Importance of BMS and intelligent buildings, energy efficiency, architecture of BMS, introduction to OSI layers, protocols used in BMS.

Module:2 | Heating, Ventilation & Air-Conditioning (HVAC) | 2 hours
Concepts of heating, ventilation & air-conditioning, concept of air-handling system, air handling unit, types, advantages and disadvantages of AHU, different equipment’s in AHU, different control strategies.

Module:3 | Compressor | 1 Hour
Concepts of compressor, heat recovery system, humidification, de-humidification, energy conservation in AHU

<table>
<thead>
<tr>
<th>Module:4</th>
<th>Comfort Parameters Measurement in BMS System</th>
<th>2 Hours</th>
</tr>
</thead>
</table>

Introduction, temperature sensors, humidity and the Psychrometric chart moisture sensors, pressure sensors, flow sensors and meters

<table>
<thead>
<tr>
<th>Module:5</th>
<th>Security Engineering</th>
<th>2 Hours</th>
</tr>
</thead>
</table>

Introduction, different controllers used for the security, access control system

<table>
<thead>
<tr>
<th>Module:6</th>
<th>Intrusion Systems</th>
<th>2 Hours</th>
</tr>
</thead>
</table>

Components of video surveillance system, CCTV & video surveillance systems, components of intrusion alarm system.

<table>
<thead>
<tr>
<th>Module:7</th>
<th>Fire Engineering</th>
<th>2 Hours</th>
</tr>
</thead>
</table>

Concept of fire, cold fire, concept of smoke, fire detection system, fundamental of fire alarm system, smoke detection system, fire alarm control panel, smoke detector, flame or fire detectors.

<table>
<thead>
<tr>
<th>Module:8</th>
<th>Contemporary Issues</th>
<th>2 Hours</th>
</tr>
</thead>
</table>

Text Book(s)

1. “Building Management Systems-Course Material” by Johnson controls of India

Reference Books


Mode of Evaluation:

Continuous Assessment Test + Digital Assignment + Quiz + Final Assessment Test

Recommended by Board of Studies : 31/08/2018

Approved by Academic Council : 53rd Date : 13/12/2018
Course Code: ECE4031  
Course title: Artificial Intelligence with python  
Pre-requisite: NONE  
Version : 1

Course Objectives:
The course is aimed at
[1] Providing exposure to the advancements in the Artificial Intelligence (AI) and facilitate in depth discussions on chosen topics.  

Expected Course Outcome:
At the end of this course, the students will be able to
[2] Understand the mathematical and computational models of Classification, Regression using supervised learning and Predictive Analytics with Ensemble Learning  
[3] Carry out Pattern detection using Unsupervised Learning  
[5] Identify suitable applications of AI, solution of which can be rendered using Python.  
[6] Implement the learnt artificial intelligence concepts in solving the real world problems, at a basic level.

Student Learning Outcomes (SLO):  2, 5, 14
[2] Having a clear understanding of the subject related concepts and of contemporary issues  
[5] Having design thinking capability  
[14] Having an ability to design and conduct experiments, as well as to analyze and interpret data

Module:1  Primer Concepts  6 Hours
Basics of Artificial intelligence (AI) – Necessity of learning AI – Applications of AI – Branches of AI – Intelligence - Agent and Environment – python for AI – Features of python – script from the command line – IDE

Module:2  Classification and Regression using Supervised learning  7 Hours

Module:3  Predictive Analytics with Ensemble Learning  6 Hours
Ensemble Learning - Decision Trees - Random Forests and Extremely Random Forests - Dealing with class imbalance- Finding optimal training parameters using grid search - Computing relative feature importance - Predicting traffic using Extremely Random Forest regressor

Module:4  Detecting Patterns with Unsupervised Learning  6 Hours
Unsupervised learning - Clustering data with K-Means algorithm - Estimating the number of clusters with Mean Shift algorithm - Estimating the quality of clustering with silhouette scores - Gaussian Mixture Models - Building a classifier based on Gaussian Mixture Models - Finding subgroups in stock market using Affinity Propagation model- Segmenting the market based on shopping patterns

Module:5  Building Recommender  5 Hours
Creating a training pipeline - Extracting the nearest neighbors - Building a K-Nearest Neighbors
classifier - Computing similarity scores - Finding similar users using collaborative filtering - Building a movie recommendation system

<table>
<thead>
<tr>
<th>Module:6</th>
<th>Logic Programming</th>
<th>5 Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basics of logic programming - Understanding the building blocks of logic programming - Solving problems using logic programming - Installing Python packages - Matching mathematical expressions - Validating primes - Parsing a family tree - Analyzing geography - Building a puzzle solver</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:7</th>
<th>Applications of AI with python</th>
<th>8 Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heuristic Search Techniques - Genetic Algorithms - Building Games With Artificial Intelligence - Building A Speech Recognizer - Object Detection and Tracking</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:8</th>
<th>Contemporary Issues</th>
<th>2 Hours</th>
</tr>
</thead>
</table>

Total Lecture hours: 45 Hours

Text Book(s)


Mode of Evaluation: Continuous Assessment Test + Digital Assignment + Quiz + Final Assessment Test

Lab Exercise:

1. **Searching for Solutions**: To define a structure of graph. Use depth first branch and bound algorithm for identifying occurrence of element or not in the given graph.
2. **Reasoning with Constraints**: Use stochastic local search, in particular a probabilistic mix of the variable with the most conflicts, any - conflict and a random variable, to solve Constraint Satisfactions Problems. It only maintains the data structures needed for the algorithm.
3. **Propositions and Inference**: Use Horn clauses for assumable, including consistency-based diagnosis.
4. **Learning with Uncertainty**: Implementation of k- means and Expectation– maximization algorithm (EM) for unsupervised learning
5. **Multiagent Systems**: Implementation of Two player zero-sum games and mini-max with alpha-beta pruning.
6. **Reinforcement Learning**: Q- learner, Model-based reinforcement learner, Feature- based reinforcement learner and implementing simple games

Recommended by Board of Studies : 31/08/2018
Approved by Academic Council: 53rd Date : 13/12/2018
<table>
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<tr>
<th>Course Code</th>
<th>Course title</th>
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<tbody>
<tr>
<td>ECE4032</td>
<td>Neural Networks and Deep Learning</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>4</td>
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Pre-requisite: NONE  
Version: 1

Course Objectives:
The course is aimed at making the students to
[1] Expose to neural networks advances and facilitate in depth discussions on deep learning  
[2] Understand about the mathematical, statistical and computational challenges of building stable representations for high-dimensional data, such as images, text and data.  

Expected Course Outcome:
The Students will be able to
[1] Understand the types of network architectures, learning processes, and fundamental issues & challenges in deep learning.  
[3] Understand the usage of Recurrent Neural Networks and Auto Encoders  
[5] Explore Artificial Intelligence based solutions  

Student Learning Outcomes (SLO): 2, 5, 9  
[2] Having a clear understanding of the subject related concepts and of contemporary issues  
[5] Having design thinking capability  
[9] Having problem solving ability - solving social issues and engineering problems

Module 1  Introduction to Neural Networks  3 Hours
Definition - McCulloch-Pitts's Neuron - Types of activation function - Types of network architectures - Learning processes - Advantages and disadvantages

Module 2  A Brief Introduction to Deep Learning  4 Hours
Historical Trends in Deep Learning; Applied Math and Machine Learning Basics: Linear Algebra; Probability and Information Theory; Numerical Computation; Machine Learning Basics

Module 3  Deep Feed forward Networks and Convolutional Networks  10 Hours
Example Learning XOR; Hidden Units; Architecture Design; Backpropagation; Regularization for Deep Learning; Optimization for Training Deep Models; The convolution operation; Motivation; Pooling; Variants of basic Convolution Function; Efficient Convolution Algorithms; Generative Adversarial Networks

Module 4  Sequence Models:  6 Hours
Recurrent Neural Networks; Bi directional RNNs; Deep Recurrent Networks; Leaky units; Long Short Term Memory and Other Gated RNNs

Module 5  Auto Encoders:  7 Hours
Under-complete Auto-encoders; Regularized Auto-encoders; Representational Power, Layer Size and Depth; Stochastic Encoders and Decoders; De-noising Auto-encoders; Learning Manifolds with Auto-encoders; Contractive Auto-encoders; Predictive Sparse Decomposition; Applications of Auto-encoders

Module 6  Deep Generative Models:  7 Hours
Boltzmann Machines; Restricted Boltzmann Machines; Deep Belief Networks; Deep Boltzmann Machines; Boltzmann Machines for Real-Valued Data; Convolutional Boltzmann Machines;
Boltzmann Machines for Structured or Sequential Outputs Other Boltzmann Machines

Module: 7 Practical Applications and Road to Artificial Intelligence: 6 Hours

Large Scale Deep Learning; Computer Vision; Speech Recognition; Natural Language Processing; Other Applications

Module: 8 Contemporary Issues 2 Hours

Total Lecture hours: 45 Hours

Text Book:
3) Neural Network and Deep Learning, Michael Nielsen, Online Book, 2016

Mode of Evaluation: Continuous Assessment Test + Digital Assignment + Quiz + Final Assessment Test

List of Projects (J) (Indicative)
1) Sleep Prediction Using Consumer Wearable Devices
2) Unsupervised Face Recognition in Television News Media
3) Finding Sarcasm in Reddit Postings: A Deep Learning Approach
4) Fake News Detection
5) Predicting Diabetes Re-admittance
6) Deep Imitation Learning for Playing Real Time Strategy Games
7) Time Series Sales Forecasting
8) A neural network approach for predicting urban building energy consumption
9) Weather-driven predictions of solar energy
10) Real-time Image Style Transfer
11) Deep Learning Approach to Accent Recognition
12) Voice Commands Recognition with Convolution Neural Network
13) Detecting Thoracic Diseases from Chest X-Ray Images
14) Supervised Learning for Autonomous Driving
15) Real-time Emotion Recognition From Facial Expressions

Recommended by Board of Studies: 31/08/2018
Approved by Academic Council: 53rd Date: 13/12/2018
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tr>
<td>MAT3005</td>
<td>Applied Numerical Methods</td>
<td>3</td>
<td>2</td>
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**Pre-requisite:** MAT2002 – Applications of Differential and Difference Equations

**Syllabus Version:** 1.0

**Course Objectives (CoB): 1,2,3,4**

The aim of this course

1. is to cover certain basic, important computer oriented numerical methods for analyzing problems that arise in engineering and physical sciences.
2. is to use MATLAB as the primary computer language to obtain solutions to a few problems that arise in their respective engineering courses.
3. is to impart skills to analyse problems connected with data analysis,
4. is to solve ordinary and partial differential equations numerically

**Course Outcome (CO): 1,2,3,4,5**

At the end of the course the student should be able to

1. Observe the difference between exact solution and approximate solution.
2. Use the numerical techniques (algorithms) to find the solution (approximate) algebraic equations and system of equations.
3. Fit the data using interpolation technique and spline methods.
5. Apply calculus of variation techniques to extremize the functional and also find approximate series solution to ordinary differential equations

**Student Learning Outcomes (SLO):** 1, 2, 7, 9

1. Having an ability to apply mathematics and science in engineering applications
2. Having a clear understanding of the subject related concepts and of contemporary issues
7. Having computational thinking (Ability to translate vast data in to abstract concepts and to understand database reasoning)
9. Having problem solving ability- solving social issues and engineering problems

**Module:1 Algebraic and Transcendental Equations** 5 hours

General iterative method- rates of convergence- Secant method - Newton – Raphson method-
System of non-linear equations by Newton’s method.

**Module:2 System of Linear Equations and Eigen Value Problems** 6 hours


**Module:3 Interpolation** 6 hours

Finite difference operators- Newton’s forward-Newton’s Backward- Central differences-Stirling’s interpolation - Lagrange’s interpolation - Inverse Interpolation-Newton’s divided difference-Interpolation with cubic splines.

**Module:4 Numerical Differentiation and Integration** 6 hours


**Module:5 Numerical Solution of Ordinary Differential** 8 hours
### Equations


<table>
<thead>
<tr>
<th>Module:6</th>
<th>Numerical Solution of Partial Differential Equations</th>
<th>6 hours</th>
</tr>
</thead>
</table>

Classification of second order linear partial differential equations-Laplace equation —Gauss-Seidal method-One dimensional heat equation- Schmidt explicit method-Crank-Nicolson implicit method.-One dimensional wave equation—Explicit method.

<table>
<thead>
<tr>
<th>Module:7</th>
<th>Variational Methods</th>
<th>6 hours</th>
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</table>


<table>
<thead>
<tr>
<th>Module:8</th>
<th>Contemporary Issues</th>
<th>2 hours</th>
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Industry Expert Lecture

<table>
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<tr>
<th>Total Lecture hours:</th>
<th>45 hours</th>
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<table>
<thead>
<tr>
<th>Tutorial</th>
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<tbody>
<tr>
<td>A minimum of 10 problems to be worked out by students in every Tutorial Class.</td>
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<tr>
<td>Another 5 problems per Tutorial Class to be given for practise.</td>
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</table>

<table>
<thead>
<tr>
<th>Text Book(s)</th>
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</table>

<table>
<thead>
<tr>
<th>Reference Books</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Mode of Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital Assignments (Solutions by using soft skills), Continuous Assessment Tests, Final Assessment Test</td>
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<tr>
<th>Recommended by Board of Studies</th>
<th>03-06-2019</th>
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<tr>
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<th>No. 55</th>
<th>Date</th>
<th>13-06-2019</th>
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<tr>
<td>ITE1002</td>
<td>Web Technologies</td>
<td>2</td>
<td>0</td>
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</tbody>
</table>

Pre-requisite | CSE1001 | Syllabus version | 1.10 |

**Course Objectives:**
- To understand the web architecture and web languages.
- To program for web client and web server objects.
- To understand web development environment and methodology

**Expected Course Outcome:**
1. Implement interactive and responsive web pages using HTML and CSS.
2. Use JavaScript language to transfer data and add interactive components to web pages.
3. Develop a sophisticated web application that appropriately employs the MVC architecture.
4. Demonstrate a client-server application using HTTP protocol and access web services for dynamic content using AJAX.
5. Exhibit the working of server-side scripts.
6. Understand the fundamental working of data using open source databases.
7. Develop advanced web frameworks by combining multiple web technologies.
8. Implement Client-side and Server-side programming.

**Student Learning Outcomes (SLO):**
- 6, 7

1. Having an ability to design a component or a product applying all the relevant standards and with realistic constraints.
2. Having computational thinking.

**Module:1 Web Essentials**
- Evolution of Web – Web architecture – HTML –XHTML- CSS
- 4 hours

**Module:2 Client-Side Scripting**
- Javascript Basics –Arrays- Functions - Javascript objects – HTML DOM - DOM methods – Events- Regular Expressions – Form Validation-JSON-Jquery
- 5 hours

**Module:3 Web Applications**
- 5 hours

**Module:4 Client/Server Communication**
- HTTP- Request/Response Model- HTTP Methods- RESTful APIs-AJAX-AJAX with JSON
- 4 hours

**Module:5 Web Servers**
- Node.js-NPM- Callbacks -Events- Express framework-Cookies-Sessions-Scaling
- 5 hours

**Module:6 Storage**
- MongoDB-Manipulating and Accessing MongoDB Documents from Node js
- 3 hours

**Module:7 Reactive frameworks**
- Meteor JS framework – Templates – Events – Sessions – Publish & Subscribe – Accounts
- 2 hours
<table>
<thead>
<tr>
<th>Module:8</th>
<th>Contemporary issues:</th>
<th>2 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Total Lecture hours:</strong></td>
<td><strong>30 hours</strong></td>
</tr>
</tbody>
</table>

**Text Book(s)**

**Reference Books**

**List of Challenging Experiments (Indicative)**
1. Use DHTML to perform the following:
   a) Design the spotlight section of VIT home page. Use Box properties of CSS.
   b) To create a web page which includes a map and display the related information when a hot spot is clicked in the map
   c) Create a web page which displays an image “ganesha.jpg” and the text “This is image of Lord Ganesh”. Place three buttons in the web page which performs the following on clicking them
      • To right align the image.
      • To change the height, width and border of the image to 250, 350 and 3 pixels respectively
      • To change the source and alternate text of the image to “vinayaga.jpg” and “The image cannot be loaded” respectively.
   1. Design a web page with image gallery and sliding menu for movie reviews
2. Design the following using JavaScript and DOM
   a) Given an array of words, write a javascript code to count the number of vowels and number of consonants in each word. Use Regular Expressions.
   b) Include Image Slide Show Digital clock, Survey Poll to make your webpage dynamic.

   Develop a web application to implement online quiz system. The application includes only
client side script

3. Create a popup Login form using jQuery which appears at the center of screen on loading the page after a specified time interval. Include Captcha text in the login page.

4. a) Validate the Event Registration Form given below using Jquery for the following conditions.
   - All fields are mandatory
   - Zip code should be exactly five digits
   - Email validation

   ![Event Registration Form]

   b) Create a JSON file for a list of cities. Provide autocomplete option for city field using the JSON file as source.

5. Using Angular JS, add names that are entered in textbox to the list and clear the textbox once the name is added to list.

   ![Sample names added to list]

6. Design a shopping cart application using AngularJS. Your shopping webpage should have the provisions for selecting the list of items from different category. Once the items are selected on clicking the submit button the items in the cart with its price should be displayed. Sample design is given below.
7. Create a MongoDB collection of “books” with the following details: Title, ISBN(unique id), Authors, Publication Year of Publication and Price.
   Write commands for the following:
   a) Insert a new document with multiple authors.
   b) Update a document with change in price
   c) Remove documents with year of publication lesser than 1990.

8. A MongoDB collection of words has the document structure as:

   ```
   
   
   
   
   
   
   
   }
   
   word:<word>,
   first:<first_letter>,
   last:<last_letter>,
   size: <character_count>
   
   ```
   
   Perform the following operations on those documents using Node.js.
   Find the set of words which starts with letters ‘a’, ‘b’ or ‘c’.
   Find the set of words which exactly has 12 letters.
   Count the number of words that starts and ends with a vowel.
   Find the first ten words that end with the letter ‘e’ and display it in descending order.

9. Develop an Online banking Web application over MEAN stack with the following scenarios.
   Initially the login page should contain only user id field. On entering the user id, if only the user id exists, password field should be displayed.
   On successful login, display the account summary with the following details retrieved from the database: Account no, Account type and Available Balance.
   On the left side top of the page display the Current date, Last Login date and UserName and User Id.
   The session should expire on logout or if the page is idle for more than 2 minutes.

10. Create an application in node.js for employee management. The application should manage the following details of an employee: ID, name, surname, cadre and salary. Name and surname are strings, while ID, cadre and Salary are integers.
    The application should have the following functionalities:
    To search an employee using his/her ID If the employee exists, it will show his/her data in a form, otherwise an pop message should be displayed stating the employees does not exist.
    To delete an employee, by specifying his/her ID.
    To insert a new employee using a form. By default, the form is hidden, by pressing a button the form should appear. If the same button is clicked the form should disappear. Every time
the form is shown, it should be empty. The form should allow to specify all data of an employee. If the ID field is left empty, the system will assign the next available ID. If the ID is already associated to an employee, the employee data are overwritten. If the ID is not associated to any employee, the employee is created. All the other fields cannot be empty.

11. Design an online book store using ExpressJS which has the following features (use the MongoDB database created in Question.No.9):
   a) Search option based on Title, Author or ISBN
   b) On retrieving the results, display the book details in table format with the Price field in sorted order using AngularJS

12. Design a student registration form which takes student name, register number, DOB, program, email id, temporary address, permanent address, phone number. Validate the following using jQuery:
   a. Mobile number should be exactly 10 digits
   b. Register number should have alphabets and numbers only
   c. Name should not exceed 30 characters and can be only alphabets
   d. Email validation
   e. Provide a checkbox saying “Permanent address is same as temporary address”. If checked, the value of permanent address should be added automatically from temp address. And should be in disabled mode.

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