SCHOOL OF ELECTRONICS ENGINEERING

B. Tech Electronics and Communication Engineering

Curriculum
(2019-20 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

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

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

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 into 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

PROGRAMME SPECIFIC OUTCOMES (PSOs)

On the completion of B.Tech Electronics and Communication Engineering degree, Students will be able to

PSO1. Design and develop systems for applications including Signal processing, Communication, Networking, Embedded systems, VLSI and Control systems.

PSO2. Use modern tools and techniques to solve contemporary problems in the field of Electronics and Communication Engineering.

PSO3: Analyze and understand deeper aspects of the problem and provide creative design solutions through high level thinking skills to attain the desired outcomes.
B. Tech Electronics and Communication Engineering

CREDIT STRUCTURE

Category-wise Credit distribution

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# B. Tech Electronics and Communication Engineering

## DETAILED CURRICULUM

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Bridge Course (BC)
B. Tech Electronics and Communication Engineering

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# B. Tech Electronics and Communication Engineering

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<td>30</td>
<td>HUM1045</td>
<td>Introduction to Psychology</td>
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<td>31</td>
<td>HUM1706</td>
<td>Business Accounting for Engineers</td>
<td>3</td>
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</tr>
</tbody>
</table>
Course Code | Course Title | L | T | P | J | C
--- | --- | --- | --- | --- | --- | ---
CHY1701 | Engineering Chemistry (UC) | 3 | 0 | 2 | 0 | 4

Pre-requisite | Syllabus version | 1.1

**Course Objectives:**
1. To impart technological aspects of applied chemistry
2. To lay foundation for practical application of chemistry in engineering aspects

**Expected Course Outcomes (CO):** Students will be able to
1. Recall and analyze the issues related to impurities in water and their removal methods and apply recent methodologies in water treatment for domestic and industrial usage
2. Evaluate the causes of metallic corrosion and apply the methods for corrosion protection of metals
3. Evaluate the electrochemical energy storage systems such as lithium batteries, fuel cells and solar cells, and design for usage in electrical and electronic applications
4. Assess the quality of different fossil fuels and create an awareness to develop the alternative fuels
5. Analyze the properties of different polymers and distinguish the polymers which can be degraded and demonstrate their usefulness
6. Apply the theoretical aspects: (a) in assessing the water quality; (b) understanding the construction and working of electrochemical cells; (c) analyzing metals, alloys and soil using instrumental methods; (d) evaluating the viscosity and water absorbing properties of polymeric materials

**Student Learning Outcomes involved: 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 | Water Technology | 5 hours**

**Module:2 | Water Treatment | 8 hours**
Water softening methods: - Lime-soda, Zeolite and ion exchange processes and their applications. Specifications of water for domestic use (ICMR and WHO); Unit processes involved in water treatment for municipal supply - Sedimentation with coagulant- Sand Filtration - chlorination; Domestic water purification – Candle filtration- activated carbon filtration; Disinfection methods- Ultrafiltration, UV treatment, Ozonolysis, Reverse Osmosis; Electro dialysis.

**Module:3 | Corrosion | 6 hours**
Dry and wet corrosion - detrimental effects to buildings, machines, devices & decorative art forms, emphasizing Differential aeration, Pitting, Galvanic and Stress corrosion cracking; Factors that enhance corrosion and choice of parameters to mitigate corrosion.

Module:4  Corrosion Control  4 hours
Corrosion protection - cathodic protection – sacrificial anodic and impressed current protection methods; Advanced protective coatings: electroplating and electroless plating, PVD and CVD.

Alloying for corrosion protection – Basic concepts of Eutectic composition and Eutectic mixtures - Selected examples – Ferrous and non-ferrous alloys.

Module:5  Electrochemical Energy Systems  6 hours
Brief introduction to conventional primary and secondary batteries; High energy electrochemical energy systems: Lithium batteries – Primary and secondary, its Chemistry, advantages and applications.
Fuel cells – Polymer membrane fuel cells, Solid-oxide fuel cells- working principles, advantages, applications.
Solar cells – Types – Importance of silicon single crystal, polycrystalline and amorphous silicon solar cells, dye sensitized solar cells - working principles, characteristics and applications.

Module:6  Fuels and Combustion  8 hours
Calorific value - Definition of LCV, HCV. Measurement of calorific value using bomb calorimeter and Boy’s calorimeter including numerical problems.
Controlled combustion of fuels - Air fuel ratio – minimum quantity of air by volume and by weight-
Numerical problems-three way catalytic converter- selective catalytic reduction of NOX; Knocking in IC engines-Octane and Cetane number - Antiknocking agents.

Module:7  Polymers  6 hours
Difference between thermoplastics and thermosetting plastics; Engineering application of plastics - ABS, PVC, PTFE and Bakelite; Compounding of plastics: moulding of plastics for Car parts, bottle caps (Injection moulding), Pipes, Hoses (Extrusion moulding), Mobile Phone Cases, Battery Trays, (Compression moulding), Fibre reinforced polymers, Composites (Transfer moulding), PET bottles (blow moulding);

Conducting polymers- Polyacetylene- Mechanism of conduction – applications (polymers in sensors, self-cleaning windows)

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

Total Lecture hours:  45 hours

Text Book(s)

Reference Books

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

### List of Experiments

<table>
<thead>
<tr>
<th>Experiment title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Water Purification: Estimation of water hardness by EDTA method and its removal by ion-exchange resin</td>
<td>1 h 30 min</td>
</tr>
<tr>
<td>2. Water Quality Monitoring: Assessment of total dissolved oxygen in different water samples by Winkler’s method</td>
<td>3 h</td>
</tr>
<tr>
<td>3. Estimation of sulphate/chloride in drinking water by conductivity method</td>
<td></td>
</tr>
<tr>
<td>4/5 Material Analysis: Quantitative colorimetric determination of divalent metal ions of Ni/Fe/Cu using conventional and smart phone digital-imaging methods</td>
<td>3h</td>
</tr>
<tr>
<td>6. Analysis of Iron in carbon steel by potentiometry</td>
<td>1 h 30 min</td>
</tr>
<tr>
<td>7. Construction and working of an Zn-Cu electrochemical cell</td>
<td>1 h 30 min</td>
</tr>
<tr>
<td>8. Determination of viscosity-average molecular weight of different natural/synthetic polymers</td>
<td>1 h 30 min</td>
</tr>
<tr>
<td>9. Arduino microcontroller based sensor for monitoring pH/temperature/conductivity in samples.</td>
<td>1 h 30 min</td>
</tr>
</tbody>
</table>

Total Laboratory Hours 17 hours

Mode of Evaluation: Viva-voce and Lab performance & FAT

Recommended by Board of Studies 31-05-2019

Approved by Academic Council 54th ACM Date 13-06-2019
Course Code: CHY1002  
Course Title: Environmental Sciences  
Pre-requisite:  
Syllabus version: V:1.1  

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
6. Having problem solving ability- solving social issues and engineering problems
7. Having interest in lifelong learning
8. 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
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>CSE1001</td>
<td>Problem Solving And Programming</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>0</td>
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</tbody>
</table>

Pre-requisite: Nil

Syllabus version: 1.0

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, 12, 14
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., Introduction to computation and programming using python: with applications to understanding data, 2016, PHI Publisher.

Reference Books

Mode of Evaluation: **PAT/CAT/FAT**

<p>| Recommended by Board of Studies | 04-04-2014 |
| Approved by Academic Council    | No. 38     | Date   | 23-10-2015 |</p>
<table>
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<tr>
<th>Course Code</th>
<th>Course Title</th>
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<th>T</th>
<th>P</th>
<th>J</th>
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<tbody>
<tr>
<td>CSE1002</td>
<td>Problem Solving and Object Oriented Programming</td>
<td>0</td>
<td>0</td>
<td>6</td>
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<tr>
<td>Pre-requisite</td>
<td>Nil</td>
<td></td>
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</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
- Polymorphism and Inheritance: Polymorphism - compile time polymorphism function over- loading operator overloading. Inheritance - types of inheritance - constructors and destructors in inheritance constraints of multiple inheritance - virtual base class - run time polymorphism-function overriding
<table>
<thead>
<tr>
<th>Module:5</th>
<th>Exception handling and Templates</th>
<th>18 hours</th>
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</thead>
<tbody>
<tr>
<td>Exception handling and Templates</td>
<td>Exception handling(user-defined exception) - Function template, Class template</td>
<td>Template with inheritance , STL Container, Algorithm, Iterator - vector, list, stack, map</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:6</th>
<th>IO Streams and Files</th>
<th>10 hours</th>
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</thead>
<tbody>
<tr>
<td>IO streams and Files</td>
<td>IOstreams, Manipulators - overloading Inserters( ) and Extractors( ), Sequential and Random files writing and reading objects into/from files</td>
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<table>
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<tr>
<th>Text Book(s)</th>
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<table>
<thead>
<tr>
<th>Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar</th>
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<table>
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<tr>
<th>List of Challenging Experiments (Indicative)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. <strong>Postman Problem</strong>&lt;br&gt;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>
</tr>
<tr>
<td>2. <strong>Budget Allocation for Marketing Campaign</strong>&lt;br&gt;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>
</tr>
<tr>
<td>3. <strong>Missionaries and Cannibals</strong>&lt;br&gt;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>
</tr>
<tr>
<td>4. <strong>Register Allocation Problem</strong>&lt;br&gt;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 desirable to use them to the maximum so that the code execution is faster.</td>
</tr>
</tbody>
</table>
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) t1 and t2 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 0001110100. 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.

| Total Laboratory Hours | 90 hours |

Mode of assessment: Project/Activity

Recommended by Board of Studies | 29-10-2015

Approved by Academic Council | No. 39 | Date | 17-12-2015
Course Code | Course Title | L | T | P | J | C
--- | --- | --- | --- | --- | --- | ---
ECE1901 | Technical Answers for Real World Problems (TARP) | 1 | 0 | 0 | 4 | 2
Pre-requisite | PHY1999 and 115 Credits Earned | | | | | Syllabus version 1.0

Course Objectives:
1. To help students to identify the need for developing newer technologies for industrial / societal needs
2. To train students to propose and implement relevant technology for the development of the prototypes / products
3. 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
9. Having problem solving ability - solving social issues and engineering problems
18. Having critical thinking and innovative skills

Module: 1

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

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  |  Course Title          | L | T | P | J | C  
---|------------------------|---|---|---|---|---
ECE1902 | Industrial Internship  | 0 | 0 | 0 | 0 | 1  

Pre-requisite  
Completion of minimum of Two semesters

**Course Objectives:**
The course is designed to expose the students to industry environment and to take up on-site assignment as trainees or interns.

**Expected Course Outcome:**
At the end of this internship the student should be able to:
1. Have an exposure to industrial practices and to work in teams
2. Communicate effectively
3. Understand the impact of engineering solutions in a global, economic, environmental and societal context
4. Develop the ability to engage in research and to involve in life-long learning
5. Comprehend contemporary issues
6. Engage in establishing his/her digital footprint

**Student Learning Outcomes (SLO):**  
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  
11. Having interest in lifelong learning  
13. Having cross cultural competency exhibited by working in teams  
16. Having a good working knowledge of communicating in English

**Contents**  
Four weeks of work at industry site.  
Supervised by an expert at the industry.

**Mode of Evaluation:** Internship Report, Presentation and Project Review

Recommended by Board of Studies  
05/03/2016

Approved by Academic Council  
40th AC  
18/03/2016
Course Code | Course Title | L | T | P | J | C
---|---|---|---|---|---|---
ECE1903 | Comprehensive Examination | 0 | 0 | 0 | 0 | 1

Prerequisite: Minimum of 6th Semester Courses

**Course Objectives:**

1. Designed to test the students on the electronics and communication engineering concepts, and tools, and the process of identifying and solving engineering problems.

**Expected Course Outcome:**

The students will be able to

1. Apply knowledge of mathematics, science, and engineering
2. Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health care and safety, manufacturability, and sustainability.

**Student Learning Outcomes (SLO):** 1, 2, 8, 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
8. Having Virtual Collaborating ability
14. Having an ability to design and conduct experiments, as well as to analyze and interpret data

**Module: 1 ** Networks, Signals and Systems

Network solution methods: nodal and mesh analysis; Network theorems: superposition, Thevenin and Norton’s, maximum power transfer; Wye-Delta transformation; Steady state sinusoidal analysis using phasors; Time domain analysis of simple linear circuits; Solution of network equations using Laplace transform; Frequency domain analysis of RLC circuits; Linear 2-port network parameters: driving point and transfer functions; State equations for networks and Network Synthesis (RL, RC, LC and RLC Synthesis): Positive real functions, hurwitz polynomial, foster and cauer forms.

Continuous-time signals: LTI System & Properties, Fourier series and Fourier transform representations, sampling and aliasing concepts and applications; Discrete-time signals: discrete-time Fourier transform (DTFT), DFT, FFT, Z-transform. Interconnection of systems; Filter design concepts, phase and group delay concepts.

**Module: 2 ** Electronic Devices and Analog Circuits

Energy bands in intrinsic and extrinsic silicon; Carrier transport: diffusion current, drift current, mobility and resistivity; Generation and recombination of carriers; Poisson and continuity equations; P-N junction, Zener diode, BJT, LED, photo diode and solar cell; MOS Transistor Theory: nMOS, pMOS Enhancement Transistor, ideal I-V characteristics, MOS capacitor, C-V characteristics, DC transfer Characteristics of CMOS inverter.

Small signal equivalent circuits of diodes, BJTs and MOSFETs; Simple diode circuits: clipping, clamping and rectifiers; Special diodes, Single-stage BJT and MOSFET amplifiers: biasing, bias stability, mid-frequency small signal analysis and frequency response; BJT and MOSFET amplifiers: multi-stage, differential, feedback, tuned amplifiers, power and operational; Simple op-amp circuits; Active filters; Sinusoidal oscillators: criterion for oscillation, single-transistor and op-amp configurations; Function generators, 555 timers, open and closed loop applications of
Comparators, Voltage Regulators, regulator protection methods, noise analysis of electronic circuits, PLLs and Data converters.

### Module:3 | Digital Circuits

Number systems; Combinatorial circuits: Boolean algebra, minimization of functions using Boolean identities and Karnaugh map, logic gates and their static CMOS implementations, arithmetic circuits, code converters, multiplexers, decoders and PLAs; Sequential circuits: latches and flip-flops, counters, shift-registers and finite state machines; Data converters: sample and hold circuits, ADCs and DACs; Semiconductor memories: ROM, SRAM, DRAM; 8-bit microcontroller (8051): architecture, programming, memory and I/O interfacing.

### Module:4 | Electromagnetics

Electrostatics; Maxwell’s equations: differential and integral forms and their interpretation, boundary conditions, wave equation, Poynting vector; Plane waves and properties: reflection and refraction, polarization, phase and group velocity, propagation through various media, skin depth; Transmission lines: equations, characteristic impedance, impedance matching, S-parameters, Smith chart; Waveguides: modes, boundary conditions, cut-off frequencies, Rader range equation, Friss formula; Antennas: antenna types, radiation pattern, gain and directivity, return loss, antenna arrays; Wave Propagation. **Antenna design considerations - Microstrip and Horn antennas.** Basics of radar; Properties and characteristics of light sources (Laser and LED) and detectors; Light propagation in optical fibers.

### Module:5 | Control Systems

Basic control system components; Feedback principle; Transfer function; Block diagram representation; Signal flow graph; Transient and steady-state analysis of LTI systems; Frequency response; Routh-Hurwitz and Nyquist stability criteria; Bode and root-locus plots; Closed loop control system design by Nichols plot, PID controller design, Lag, lead and lag-lead compensation, States space models, states space equations and solutions, states space methods for controller designs and non-linear control systems and its applications.

### Module:6 | Communications

Random processes: autocorrelation and power spectral density, properties of white noise, filtering of random signals through LTI systems; Analog communications: amplitude modulation and demodulation, angle modulation and demodulation, spectra of AM and FM, superheterodyne receivers, circuits for analog communications; Information theory: entropy, mutual information and channel capacity theorem. Digital communications: PCM, DPCM, digital modulation schemes, amplitude, phase and frequency shift keying (ASK, PSK, FSK), QAM, MAP and ML decoding, matched filter receiver, calculation of bandwidth, SNR and BER for digital modulation; Fundamentals of error correction, Hamming codes; inter-symbol interference and its mitigation; Wireless Communication: Structure of a Wireless Communication Link, Modulation Techniques: QPSK, MSK, GMSK. Basics of TDMA, FDMA and CDMA.

Mode of Evaluation: Computerized Multiple Choice Questions FAT Examination – 100%
Course Code: ECE1904  
Course Title: Capstone Project  
L | T | P | J | C  
0 | 0 | 0 | 0 | 12  
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
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
20. Having a good digital footprint

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
Recommended by Board of Studies: 10.06.2015
Approved by Academic Council: 37th AC | Date: 16.06.2015
<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>
<th>Syllabus Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENG1000</td>
<td>Foundation English - I</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

**Course Objectives:**

1. To equip learners with English grammar and its application.
2. To enable learners to comprehend simple text and train them to speak and write flawlessly.
3. To familiarize learners with MTI and ways to overcome them.

**Expected Course Outcome:**

1. Develop the skills to communicate clearly through effective grammar, pronunciation and writing.
2. Understand everyday conversations in English
3. Communicate and respond to simple questions about oneself.
4. Improve vocabulary and expressions.
5. Prevent MTI (Mother Tongue Influence) during usual conversation.

**Student Learning Outcomes (SLO):**

3. 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 Essentials of grammar**

<table>
<thead>
<tr>
<th>3 Hours</th>
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</table>

Understand basic grammar-Parts of Speech
Activity: Grammar worksheets on parts of speech

**Module:2 Vocabulary Building**

<table>
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<tr>
<th>3 Hours</th>
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</table>

Vocabulary development; One word substitution
Activity: Elementary vocabulary exercises

**Module:3 Applied grammar and usage**

<table>
<thead>
<tr>
<th>4 Hours</th>
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</table>

Types of sentences; Tenses
Activity: Grammar worksheets on types of sentences; tenses

**Module:4 Rectifying common errors in everyday conversation**

<table>
<thead>
<tr>
<th>4 Hours</th>
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</table>

Detect and rectify common mistakes in everyday conversation
Activity: Common errors in prepositions, tenses, punctuation, spelling and other parts of speech; Colloquialism

**Module :5 Jumbled sentences**

<table>
<thead>
<tr>
<th>2 Hours</th>
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</table>

Sentence structure; Jumbled words to form sentences; Jumbled sentences to form paragraph/short story
Activity: Unscramble a paragraph / short story

**Module:6 Text-based Analysis**

<table>
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<tr>
<th>4 Hours</th>
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</table>

*Wings of Fire* - Autobiography of APJ Abdul Kalam (Excerpts)
Activity: Enrich vocabulary by reading and analyzing the text

**Module:7 Correspondence**

<table>
<thead>
<tr>
<th>3 Hours</th>
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<tbody>
<tr>
<td>Module:8</td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td>Activity: Compose letters; Emails, Leave applications</td>
</tr>
<tr>
<td>Listening to simple conversations &amp; gap fill exercises</td>
</tr>
<tr>
<td>Activity: Simple conversations in Received Pronunciation using audio-visual materials.</td>
</tr>
<tr>
<td>Module:9</td>
</tr>
<tr>
<td>Self-introduction; role-plays; Everyday conversations</td>
</tr>
<tr>
<td>Activity: Identify and communicate characteristic attitudes, values, and talents; Working and interacting within groups</td>
</tr>
<tr>
<td>Module:10</td>
</tr>
<tr>
<td>Activity: Practice pronunciation by reading aloud simple texts; Detecting syllables; Visually connecting to the words shown in relevant videos</td>
</tr>
<tr>
<td>Module:11</td>
</tr>
<tr>
<td>Activity: Reading and analyzing the author’s point of view; Identifying the central idea.</td>
</tr>
<tr>
<td>Module:12</td>
</tr>
<tr>
<td>Activity: Writing paragraphs, essays and short stories</td>
</tr>
<tr>
<td>Module:13</td>
</tr>
<tr>
<td>Activity: Interpreting and presenting simple graphical representations/charts in the form of PPTs</td>
</tr>
<tr>
<td>Module:14</td>
</tr>
<tr>
<td>Activity: Identifying and overcoming mother tongue influence.</td>
</tr>
<tr>
<td><strong>Total Laboratory Hours</strong></td>
</tr>
</tbody>
</table>

**Text Book / Workbook**


**Reference Books**

<table>
<thead>
<tr>
<th>List of Challenging Experiments (Indicative)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Rearranging scrambled sentences</td>
<td>8 hours</td>
</tr>
<tr>
<td>2. Identifying errors in oral and written communication</td>
<td>12 hours</td>
</tr>
<tr>
<td>3. Critically analyzing the text</td>
<td>8 hours</td>
</tr>
<tr>
<td>4. Developing passages from hint words</td>
<td>8 hours</td>
</tr>
<tr>
<td>5. Role-plays</td>
<td>12 hours</td>
</tr>
<tr>
<td>6. Listening to a short story and analyzing it</td>
<td>12 hours</td>
</tr>
<tr>
<td>Total Laboratory Hours</td>
<td>60 hours</td>
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**Mode of Evaluation:** Quizzes, Presentation, Discussion, Role Play, Assignments

**Recommended by Board of Studies:** 08-06-2019

**Approved by Academic Council:** 55 Date 13-06-2019
<table>
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<tr>
<th>Course code</th>
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<tr>
<td>Pre-requisite</td>
<td>51% - 70% EPT Score / Foundation English I</td>
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</tbody>
</table>

**Course Objectives:**

1. To practice grammar and vocabulary effectively
2. To acquire proficiency levels in LSRW skills in diverse social situations.
3. To analyze information and converse effectively in technical communication.

**Expected Course Outcome:**

1. Accomplish a deliberate reading and writing process with proper grammar and vocabulary.
2. Comprehend sentence structures while Listening and Reading.
3. Communicate effectively and share ideas in formal and informal situations.
4. Understand specialized articles and technical instructions and write clear technical correspondence.
5. Critically think and analyze with verbal ability.

**Student Learning Outcomes (SLO):**

3. 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**  
Grammatical Aspects  
4 hours
Sentence Pattern, Modal Verbs, Concord (SVA), Conditionals, Connectives  
Activity : Worksheets, Exercises

**Module:2**  
Vocabulary Enrichment  
4 hours
Active & Passive Vocabulary, Prefix and Suffix, High Frequency Words  
Activity : Worksheets, Exercises

**Module:3**  
Phonics in English  
4 Hours
Speech Sounds – Vowels and Consonants – Minimal Pairs- Consonant Clusters- Past Tense Marker and Plural Marker  
Activity : Worksheets, Exercises

**Module:4**  
Syntactic and Semantic Errors  
2 Hours
Tenses /SVA/Articles/ Prepositions/ Punctuation & Right Choice of Vocabulary  
Activity : Worksheets, Exercises

**Module:5**  
Stylistic errors  
2 Hours
Dangling Modifiers, Parallelism, Standard English, Ambiguity, Redundancy, Brevity  
Activity : Worksheets, Exercises

**Module:6**  
Listening and Note making  
6 Hours
Intensive and Extensive Listening - Scenes from plays of Shakespeare (Eg: Court scene in *The Merchant of Venice*, Disguise Scene in *The Twelfth Night*, Death of Desdemona in *Othello*, Death scene in *Julius Caesar* and Balcony scene from *Romeo and Juliet*)

Activity: Summarizing; Note-making and drawing inferences from Short videos

<table>
<thead>
<tr>
<th>Module: 7</th>
<th>Art of Public Speaking</th>
<th>6 Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impromptu, Importance of Non-verbal Communication, Technical Talks, Dynamics of Professional Presentations – Individual &amp; Group</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Activity: Ice Breaking; Extempore speech; Structured technical talk and Group presentation</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Module: 8</th>
<th>Reading Comprehension Skills</th>
<th>4 Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skimming, scanning, comprehensive reading, guessing words from context, understanding text organization, recognizing argument and counter-argument; distinguishing between main information and supporting detail, fact and opinion, hypothesis versus evidence; summarizing and note-taking, Critical Reasoning Questions – Reading and Discussion</td>
<td></td>
<td></td>
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<tr>
<td>Activity: Reading of Newspapers Articles and Worksheets on Critical Reasoning from web resources</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module: 9</th>
<th>Creative Writing</th>
<th>4 Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structure of an essay, Developing ideas on analytical/ abstract topics</td>
<td></td>
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<tr>
<td>Activity: Movie Review, Essay Writing on suggested Topics, Picture Descriptions</td>
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</table>

<table>
<thead>
<tr>
<th>Module: 10</th>
<th>Verbal Aptitude</th>
<th>6 hours</th>
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</thead>
<tbody>
<tr>
<td>Word Analogy, Sentence Completion using Appropriate words, Sentence Correction</td>
<td></td>
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<tr>
<td>Activity: Practicing the use of appropriate words and sentences through web tools.</td>
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</table>

<table>
<thead>
<tr>
<th>Module: 11</th>
<th>Business Correspondence</th>
<th>4 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formal Letters- Format and purpose: Business Letters - Sales and complaint letter</td>
<td></td>
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<tr>
<td>Activity: Letter writing - request for Internship, Industrial Visit and Recommendation</td>
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<thead>
<tr>
<th>Module: 12</th>
<th>Career Development</th>
<th>6 hours</th>
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</thead>
<tbody>
<tr>
<td>Telephone Etiquette, Resume Preparation, Video Profile</td>
<td></td>
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<tr>
<td>Activity: Preparation of Video Profile</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Module: 13</th>
<th>Art of Technical Writing - I</th>
<th>4 hours</th>
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</thead>
<tbody>
<tr>
<td>Technical Instructions, Process and Functional Description</td>
<td></td>
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<tr>
<td>Activity: Writing Technical Instructions</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Module: 14</th>
<th>Art of Technical Writing – II</th>
<th>4 hours</th>
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</thead>
<tbody>
<tr>
<td>Format of a Report and Proposal</td>
<td></td>
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</tr>
</tbody>
</table>

Total Lecture hours: 60 hours

**Text Book / Workbook**


**Reference Books**
1. Peter Watkins, *Teaching and Developing Reading Skills*: Cambridge Handbooks for Language Teachers, Cambridge, 2018

**Web Resources**

1. [https://www.hitbullseye.com/Sentence-Correction-Practice.php](https://www.hitbullseye.com/Sentence-Correction-Practice.php)

**Mode of Evaluation:** Presentation, Discussion, Role Play, Assignments, FAT

**List of Challenging Experiments (Indicative)**

<table>
<thead>
<tr>
<th>Experiment Description</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading and Analyzing Critical Reasoning questions</td>
<td>8</td>
</tr>
<tr>
<td>Listening and Interpretation of Videos</td>
<td>12</td>
</tr>
<tr>
<td>Letter to the Editor</td>
<td>6</td>
</tr>
<tr>
<td>Developing structured Technical Talk</td>
<td>12</td>
</tr>
<tr>
<td>Drafting SOP (Statement of Purpose)</td>
<td>10</td>
</tr>
<tr>
<td>Video Profile</td>
<td>12</td>
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<tr>
<td><strong>Total Laboratory Hours</strong></td>
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**Mode of Evaluation:** Presentation, Discussion, Role Play, Assignments, FAT

**Recommended by Board of Studies** 08.06.2019

**Approved by Academic Council** 55

**Date** 13-06-2019
Course Code | Course Title            | L | T | P | J | C |
------------|------------------------|---|---|---|---|---|
ENG1901     | Technical English - I  | 0 | 0 | 4 | 0 | 2 |
Pre-requisite | Foundation English-II |   |   |   |   |   |
Syllabus Version |                 |   |   |   |   | 1 |

Course Objectives:
1. To enhance students’ knowledge of grammar and vocabulary to read and write error-free language in real life situations.
2. To make the students’ practice the most common areas of written and spoken communications skills.
3. To improve students’ communicative competency through listening and speaking activities in the classroom.

Expected Course Outcome:
1. Develop a better understanding of advanced grammar rules and write grammatically correct sentences.
2. Acquire wide vocabulary and learn strategies for error-free communication.
3. Comprehend language and improve speaking skills in academic and social contexts.
4. Improve listening skills so as to understand complex business communication in a variety of global English accents through proper pronunciation.
5. Interpret texts, diagrams and improve both reading and writing skills which would help them in their academic as well as professional career.

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

Module:1 Advanced Grammar 4 hours
Articles, Tenses, Voice and Prepositions
Activity: Worksheets on Impersonal Passive Voice, Exercises from the prescribed text

Module:2 Vocabulary Building I 4 hours
Idioms and Phrases, Homonyms, Homophones and Homographs
Activity: Jigsaw Puzzles; Vocabulary Activities through Web tools

Module:3 Listening for Specific Purposes 4 hours
Gist, monologues, short conversations, announcements, briefings and discussions
Activity: Gap filling; Interpretations

Module:4 Speaking for Expression 6 hours
Introducing oneself and others, Making Requests & responses, Inviting and Accepting/Declining Invitations
Activity: Brief introductions; Role-Play; Skit.

Module:5 Reading for Information 4 hours
Reading Short Passages, News Articles, Technical Papers and Short Stories
Activity: Reading specific news paper articles; blogs
<table>
<thead>
<tr>
<th>Module:6</th>
<th>Writing Strategies</th>
<th>4 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joining the sentences, word order, sequencing the ideas, introduction and conclusion</td>
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<tr>
<td>Activity: Short Paragraphs; Describing familiar events; story writing</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:7</th>
<th>Vocabulary Building II</th>
<th>4 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enrich the domain specific vocabulary by describing Objects, Charts, Food, Sports and Employment.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Activity: Describing Objects, Charts, Food, Sports and Employment</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:8</th>
<th>Listening for Daily Life</th>
<th>4 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Listening for statistical information, Short extracts, Radio broadcasts and TV interviews</td>
<td></td>
<td></td>
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<tr>
<td>Activity: Taking notes and Summarizing</td>
<td></td>
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<table>
<thead>
<tr>
<th>Module:9</th>
<th>Expressing Ideas and Opinions</th>
<th>6 hours</th>
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</thead>
<tbody>
<tr>
<td>Telephonic conversations, Interpretation of Visuals and describing products and processes.</td>
<td></td>
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<tr>
<td>Activity: Role-Play (Telephonic); Describing Products and Processes</td>
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<table>
<thead>
<tr>
<th>Module:10</th>
<th>Comprehensive Reading</th>
<th>4 hours</th>
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</thead>
<tbody>
<tr>
<td>Reading Comprehension, Making inferences, Reading Graphics, Note-making, and Critical Reading.</td>
<td></td>
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<tr>
<td>Activity: Sentence Completion; Cloze Tests</td>
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<thead>
<tr>
<th>Module:11</th>
<th>Narration</th>
<th>4 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Writing narrative short story, Personal milestones, official letters and E-mails.</td>
<td></td>
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<tr>
<td>Activity: Writing an E-mail; Improving vocabulary and writing skills.</td>
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<thead>
<tr>
<th>Module:12</th>
<th>Pronunciation</th>
<th>4 hours</th>
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</thead>
<tbody>
<tr>
<td>Speech Sounds, Word Stress, Intonation, Various accents</td>
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</tr>
<tr>
<td>Activity: Practicing Pronunciation through web tools; Listening to various accents of English</td>
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<table>
<thead>
<tr>
<th>Module:13</th>
<th>Editing</th>
<th>4 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple, Complex &amp; Compound Sentences, Direct &amp; Indirect Speech, Correction of Errors, Punctuations.</td>
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</tr>
<tr>
<td>Activity: Practicing Grammar</td>
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<thead>
<tr>
<th>Module:14</th>
<th>Short Story Analysis</th>
<th>4 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>“The Boundary” by Jhumpa Lahiri</td>
<td></td>
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<tr>
<td>Activity: Reading and analyzing the theme of the short story.</td>
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</table>

| Total Lecture hours | 60 hours |

<table>
<thead>
<tr>
<th>Text Book / Workbook</th>
</tr>
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</table>
### Reference Books


### Mode of evaluation:
Quizzes, Presentation, Discussion, Role play, Assignments and FAT

<table>
<thead>
<tr>
<th>List of Challenging Experiments (Indicative)</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Self-Introduction</td>
<td>12</td>
</tr>
<tr>
<td>2. Sequencing Ideas and Writing a Paragraph</td>
<td>12</td>
</tr>
<tr>
<td>3. Reading and Analyzing Technical Articles</td>
<td>8</td>
</tr>
<tr>
<td>4. Identifying Errors in a Sentence or Paragraph</td>
<td>8</td>
</tr>
<tr>
<td>5. Writing an E-mail by narrating life events</td>
<td>8</td>
</tr>
<tr>
<td>Total Laboratory Hours</td>
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### Mode of evaluation:
Quizzes, Presentation, Discussion, Role play, Assignments and FAT

#### Recommended by Board of Studies
08.06.2019

#### Approved by Academic Council
55 Date: 13-06-2019
Course Code: ENG1902  
Course Title: Technical English - II  
L T P J C: 0 0 4 0 2  
Pre-requisite: 71% to 90% EPT score  
Syllabus Version: 1

Course Objectives:
1. To acquire proficiency levels in LSRW skills on par with the requirements for placement interviews of high-end companies / competitive exams.
2. To evaluate complex arguments and to articulate their own positions on a range of technical and general topics.
3. To speak in grammatical and acceptable English with minimal MTI, as well as develop a vast and active vocabulary.

Expected Course Outcome:
1. Communicate proficiently in high-end interviews and exam situations and all social situations
2. Comprehend academic articles and draw inferences
3. Evaluate different perspectives on a topic
4. Write clearly and convincingly in academic as well as general contexts
5. Synthesize complex concepts and present them in speech and writing

Student Learning Outcomes (SLO): 3, 16, 18
3. 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 for Clear Pronunciation  4 hours
Ice-breaking, Introduction to vowels, consonants, diphthongs.
Listening to formal conversations in British and American accents (BBC and CNN) as well as other ‘native’ accents
Activity: Factual and interpretive exercises; note-making in a variety of global English accents

Module: 2  
Introducing Oneself  4 hours
Speaking: Individual Presentations
Activity: Self-Introductions, Extempore speech

Module: 3  
Effective Writing  6 hours
Writing: Business letters and Emails, Minutes and Memos
Structure/ template of common business letters and emails: inquiry/ complaint/ placing an order;
Formats of Minutes and Memos
Activity: Students write a business letter and Minutes/ Memo

Module: 4  
Comprehensive Reading  4 hours
Reading: Reading Comprehension Passages, Sentence Completion (Technical and General Interest), Vocabulary and Word Analogy
Activities: Cloze tests, Logical reasoning, Advanced grammar exercises

Module: 5  
Listening to Narratives  4 hours
Activity: Note-making and Interpretive exercises

Module: 6  
Academic Writing and Editing  6 hours
Writing: Editing/ Proofreading symbols
Citation Formats
Structure of an Abstract and Research Paper
Activity: Writing Abstracts and research paper; Work with Editing/ Proofreading exercise

<table>
<thead>
<tr>
<th>Module:7</th>
<th>Team Communication</th>
<th>4 hours</th>
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</table>
| Speaking: Group Discussions and Debates on complex/ contemporary topics
| Discussion evaluation parameters, using logic in debates
| Activity: Group Discussions on general topics

<table>
<thead>
<tr>
<th>Module:8</th>
<th>Career-oriented Writing</th>
<th>4 hours</th>
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</thead>
</table>
| Writing: Resumes and Job Application Letters, SOP
| Activity: Writing resumes and SOPs

<table>
<thead>
<tr>
<th>Module:9</th>
<th>Reading for Pleasure</th>
<th>4 hours</th>
</tr>
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</table>
| Reading: Reading short stories
| Activity: Classroom discussion and note-making, critical appreciation of the short story

<table>
<thead>
<tr>
<th>Module: 10</th>
<th>Creative Writing</th>
<th>4 hours</th>
</tr>
</thead>
</table>
| Writing: Imaginative, narrative and descriptive prose
| Activity: Writing about personal experiences, unforgettable incidents, travelogues

<table>
<thead>
<tr>
<th>Module: 11</th>
<th>Academic Listening</th>
<th>4 hours</th>
</tr>
</thead>
</table>
| Listening: Listening in academic contexts
| Activity: Listening to lectures, Academic Discussions, Debates, Review Presentations, Research Talks, Project Review Meetings

<table>
<thead>
<tr>
<th>Module:12</th>
<th>Reading Nature-based Narratives</th>
<th>4 hours</th>
</tr>
</thead>
</table>
| Narratives on Climate Change, Nature and Environment
| Activity: Classroom discussions, student presentations

<table>
<thead>
<tr>
<th>Module:13</th>
<th>Technical Proposals</th>
<th>4 hours</th>
</tr>
</thead>
</table>
| Writing: Technical Proposals
| Activities: Writing a technical proposal

<table>
<thead>
<tr>
<th>Module:14</th>
<th>Presentation Skills</th>
<th>4 hours</th>
</tr>
</thead>
</table>
| Persuasive and Content-Specific Presentations
| Activity: Technical Presentations

**Total Lecture hours:** 60 hours

**Text Book / Workbook**


**Reference Books**


### Books, 2016.


### Online Sources:
- [http://www.eco-ction.org/dt/thinking.html](http://www.eco-ction.org/dt/thinking.html) (Leopold, Aldo.“Thinking like a Mountain”)
- [https://www.esl-lab.com/](https://www.esl-lab.com/)
- [http://www.bbc.co.uk/learningenglish/](http://www.bbc.co.uk/learningenglish/)

### Mode of evaluation: Quizzes, Presentation, Discussion, Role play, Assignments and FAT

### List of Challenging Experiments (Indicative)

<table>
<thead>
<tr>
<th>Experiment Description</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Self-Introduction using SWOT</td>
<td>12</td>
</tr>
<tr>
<td>2. Writing minutes of meetings</td>
<td>10</td>
</tr>
<tr>
<td>3. Writing an abstract</td>
<td>10</td>
</tr>
<tr>
<td>4. Listening to motivational speeches and interpretation</td>
<td>10</td>
</tr>
<tr>
<td>5. Cloze Test</td>
<td>6</td>
</tr>
<tr>
<td>6. Writing a proposal</td>
<td>12</td>
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</tbody>
</table>

**Total Laboratory Hours** 60 hours

### Mode of evaluation: Quizzes, Presentation, Discussion, Role play, Assignments and FAT

**Recommended by Board of Studies** 08.06.2019

**Approved by Academic Council** 55 Date: 13-06-2019
<table>
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<th>Course Code</th>
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<th>T</th>
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<td>ENG1903</td>
<td>Advanced Technical English</td>
<td>0</td>
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</table>

Pre-requisite: Greater than 90 % EPT score

Syllabus Version: 1

**Course Objectives:**

1. To review literature in any form or any technical article
2. To infer content in social media and respond accordingly
3. To communicate with people across the globe overcoming trans-cultural barriers and negotiate successfully

**Expected Course Outcome:**

1. Analyze critically and write good reviews
2. Articulate research papers, project proposals and reports
3. Communicate effectively in a trans-cultural environment
4. Negotiate and lead teams towards success
5. Present ideas in an effective manner using web tools

**Student Learning Outcomes (SLO):** 3, 16, 18

3. 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** Negotiation and Decision Making Skills through Literary Analysis 5 hours

Concepts of Negotiation and Decision Making Skills
Activity: Analysis of excerpts from Shakespeare’s “The Merchant of Venice” (court scene) and discussion on negotiation skills.
Critical evaluation of excerpts from Shakespeare’s “Hamlet” (Monologue by Hamlet) and discussion on decision making skills

**Module:2** Writing reviews and abstracts through movie interpretations 5 hours

Review writing and abstract writing with competency
Activity: Watching Charles Dickens “Great Expectations” and writing a movie review
Watching William F. Nolan’s “Logan’s Run” and analyzing it in tune with the present scenario of depletion of resources and writing an abstract

**Module:3** Technical Writing 4 hours

Stimulate effective linguistics for writing: content and style
Activity: Proofreading
Statement of Purpose

**Module:4** Trans-Cultural Communication 4 hours

Nuances of Trans-cultural communication
Activity:
Group discussion and case studies on trans-cultural communication.
Debate on trans-cultural communication.

**Module:5** Report Writing and Content Writing 4 hours

Enhancing reportage on relevant audio-visuals
Activity:
Watch a documentary on social issues and draft a report
Identify a video on any social issue and interpret

<table>
<thead>
<tr>
<th>Module: 6</th>
<th>Drafting project proposals and article writing</th>
<th>4 hours</th>
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<tbody>
<tr>
<td>Dynamics of drafting project proposals and research articles</td>
<td>Writing a project proposal. Writing a research article.</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Module: 7</th>
<th>Technical Presentations</th>
<th>4 hours</th>
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</thead>
<tbody>
<tr>
<td>Build smart presentation skills and strategies</td>
<td>Activity: Technical presentations using PPT and Web tools</td>
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</table>

<table>
<thead>
<tr>
<th>Text Book / Workbook</th>
</tr>
</thead>
</table>

**Reference Books**


**Mode of Evaluation:** Quizzes, Presentation, Discussion, Role Play, Assignments

**List of Challenging Experiments (Indicative)**

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Enacting a court scene - Speaking</td>
<td>6 hours</td>
</tr>
<tr>
<td>2. Watching a movie and writing a review</td>
<td>4 hours</td>
</tr>
<tr>
<td>3. Trans-cultural – case studies</td>
<td>2 hours</td>
</tr>
<tr>
<td>4. Drafting a report on any social issue</td>
<td>6 hours</td>
</tr>
<tr>
<td>5. Technical Presentation using web tools</td>
<td>6 hours</td>
</tr>
<tr>
<td>6. Writing a research paper</td>
<td>6 hours</td>
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</table>

**J-Component Sample Projects**

<table>
<thead>
<tr>
<th>Project</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>1. Short Films</td>
<td></td>
</tr>
<tr>
<td>2. Field Visits and Reporting</td>
<td></td>
</tr>
<tr>
<td>3. Case studies</td>
<td></td>
</tr>
<tr>
<td>4. Writing blogs</td>
<td></td>
</tr>
<tr>
<td>5. Vlogging</td>
<td></td>
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</tbody>
</table>

<p>| Total Hours (J-Component) | 60 hours |</p>
<table>
<thead>
<tr>
<th><strong>Mode of evaluation:</strong> Quizzes, Presentation, Discussion, Role play, Assignments and FAT</th>
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<tbody>
<tr>
<td><strong>Recommended by Board of Studies</strong></td>
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<tr>
<td><strong>Approved by Academic Council</strong></td>
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<tr>
<td>Course Code</td>
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<td>-------------</td>
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<tr>
<td>HUM1021</td>
</tr>
<tr>
<td>Pre-requisite</td>
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</table>

**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
<table>
<thead>
<tr>
<th>Module:6</th>
<th>Personal and Professional Ethics</th>
<th>4 hours</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Dishonesty - Stealing - Malpractices in Examinations – Plagiarism</td>
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</table>

<table>
<thead>
<tr>
<th>Module:7</th>
<th>Abuse of Technologies</th>
<th>3 hours</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Hacking and other cyber crimes, Addiction to mobile phone usage, Video games and Social networking websites</td>
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<table>
<thead>
<tr>
<th>Module:8</th>
<th>Contemporary issues:</th>
<th>2 hours</th>
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<tbody>
<tr>
<td></td>
<td>Guest lectures by Experts</td>
<td></td>
</tr>
</tbody>
</table>

**Total Lecture hours:** 30 hours

**Reference Books**

1. Dhaliwal, K.K, Gandhian Philosophy of Ethics: A Study of Relationship between his Presupposition and Precepts, 2016, Writers Choice, New Delhi, India.

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

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

**Approved by Academic Council**

<table>
<thead>
<tr>
<th>No.</th>
<th>Date</th>
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<tbody>
<tr>
<td>46</td>
<td>24-08-2017</td>
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</table>
Course Code: MAT1011  
Course Title: Calculus for Engineers  
Pre-requisite: NIL  
Syllabus Version: 1.0

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 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
9. Having problem solving ability- solving social issues and engineering problems

Module:1  Application of Single Variable Calculus  9 hours
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

Module:2  Laplace transforms  7 hours
Definition of Laplace transform-Properties-Laplace transform of periodic functions-Laplace transform of unit step function, Impulse function-Inverse Laplace transform-Convolution.

Module:3  Multivariable Calculus  4 hours

Module:4  Application of Multivariable Calculus  5 hours
Taylor’s expansion for two variables–maxima and minima–constrained maxima and minima-Lagrange’s multiplier method.
### Module: 5 | Multiple Integrals | 8 hours
---
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 Cartesian and cylindrical and spherical co-ordinates- evaluation of multiple integrals using gamma and beta functions.

### Module: 6 | Vector Differentiation | 5 hours
---
Scalar and vector valued functions – gradient, tangent plane–directional derivative-divergence and curl–scalar and vector potentials–Statement of vector identities-Simple problems

### Module: 7 | Vector Integration | 5 hours
---
line, surface and volume integrals - Statement of Green's, Stoke’s and Gauss divergence theorems -verification and evaluation of vector integrals using them.

### Module: 8 | Contemporary Issues: | 2 hours
---
Industry Expert Lecture

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

---
**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**: MAT2001  
**Course Title**: Statistics for Engineers  
**L T P J C**: 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
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).
14. Having an ability to design and conduct experiments, as well as to analyse and interpret data.

**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

Text book(s)

Reference books

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

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

**Total laboratory hours** 22 hours

**Mode of Evaluation**

Weekly Assessment, Final Assessment Test

Recommended by Board of Studies 25-02-2017

Approved by Academic Council 47 Date: 05-10-2017
Course Code: MGT1022
Course Title: Lean Start up Management
L 0 0 4 2
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
1. Ability to apply mathematics and science in engineering applications.
2. Clear understanding of the subject related concepts and of contemporary issues.
3. Ability to be socially intelligent with good SIQ (Social Intelligence Quotient) and EQ (Emotional Quotient).
4. Sense-Making Skills of creating unique insights in what is being seen or observed (Higher level thinking skills which cannot be codified).
5. Design thinking capability.

Module:1
Creativity 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
### Text Book(s)

<table>
<thead>
<tr>
<th></th>
<th>Total Lecture</th>
<th>15 hours</th>
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### Reference Books

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Steve Blank, Holding a Cat by the Tail, August 14, 2014, K&amp;S Ranch Publishing LLC.</td>
</tr>
<tr>
<td>3</td>
<td>Peter Thiel, Zero to One: Notes on Startups, or How to Build the Future, 2014, Crown Business</td>
</tr>
<tr>
<td>4</td>
<td>Alistair Croll &amp; Benjamin Yoskovitz, O'Reilly Media, Lean Analytics: Use Data to Build a Better Startup Faster (Lean Series), March 21, 2013, 1st Edition.</td>
</tr>
</tbody>
</table>

### Website References:

2. [https://www.kickstarter.com/projects/881308232/only-on-kickstarter-the-leaders-guide-by-eric-ries](https://www.kickstarter.com/projects/881308232/only-on-kickstarter-the-leaders-guide-by-eric-ries)
4. [https://www.leanstartupmachine.com/](https://www.leanstartupmachine.com/)
5. [https://www.youtube.com/watch?v=fEvKo90qBns](https://www.youtube.com/watch?v=fEvKo90qBns)
9. [https://hbr.org/2013/05/why-the-lean-start-up-changes-everything](https://hbr.org/2013/05/why-the-lean-start-up-changes-everything)
10. [chventures.blogspot.in/ platformsandnetworks.blogspot.in/p/saas-model.html](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

### Project

<p>| | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Project</td>
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Recommended by Board of Studies 08-06-2015

Approved by Academic Council 37 Date 16-06-2015
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<table>
<thead>
<tr>
<th>Pre-requisite</th>
<th>Syllabus version</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>V.2.1</td>
</tr>
</tbody>
</table>

**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]


**Module: 5** Electromagnetic Theory and its application [6 hours]

- Physics of Divergence, Gradient and Curl, Qualitative understanding of surface and volume integral, Maxwell Equations (Qualitative), Wave Equation (Derivation), EM Waves, Phase velocity, Group velocity, Group index. Wave guide (Qualitative)
<table>
<thead>
<tr>
<th>Module:6</th>
<th>Propagation of EM waves in Optical fibers and Optoelectronic Devices</th>
<th>10 hours</th>
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<table>
<thead>
<tr>
<th>Module:7</th>
<th>Special Theory of Relativity</th>
<th>5 hours</th>
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<tbody>
<tr>
<td>Frame of reference, Galilean relativity, Postulate of special theory of relativity, Simultaneity, length contraction and time dilation.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:8</th>
<th>Contemporary issues:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture by Industry Experts</td>
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</table>

<table>
<thead>
<tr>
<th>Total Lecture hours:</th>
<th>45 hours</th>
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</table>

**Text Book(s)**


**Reference Books**

<table>
<thead>
<tr>
<th>Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar</th>
</tr>
</thead>
</table>

**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 diffraction | 2 hrs |
8. Numerical solutions of Schrödinger equation (e.g. particle in a box problem) | 2 hrs |
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>9.</td>
<td>Laser coherence length measurement</td>
</tr>
<tr>
<td>10.</td>
<td>Proof for transverse nature of E.M. waves</td>
</tr>
<tr>
<td>11.</td>
<td>Quantum confinement and Heisenberg's uncertainty principle</td>
</tr>
<tr>
<td>12.</td>
<td>Determination of angle of prism and refractive index for various colour – Spectrometer</td>
</tr>
<tr>
<td>13.</td>
<td>Determination of divergence of a laser beam</td>
</tr>
<tr>
<td>14.</td>
<td>Determination of crystalline size for nanomaterial (Computer simulation)</td>
</tr>
<tr>
<td>15.</td>
<td>Demonstration of phase velocity and group velocity (Computer simulation)</td>
</tr>
<tr>
<td>Total Laboratory Hours</td>
<td>30 hrs</td>
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</tbody>
</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

<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>
<th>Syllabus version</th>
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<tbody>
<tr>
<td>PHY1901</td>
<td>Introduction to Innovative Projects</td>
<td>1</td>
<td>0</td>
<td>0</td>
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<td>1.0</td>
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</tbody>
</table>

#### 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 of100 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 – Outof the box thinking – deBono lateral thinking model – Examples

**Project**: Last weeks - incomplete portion to be done and uploaded
<table>
<thead>
<tr>
<th>Module:2 A</th>
<th>Creativity</th>
<th>1 hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creativity Models – Walla – Barrons – Koberg &amp; Begnall – Examples</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Project</strong>: Selecting 5 out of 100 issues identified for future work. Criteria based approach for prioritisation, use of statistical tools &amp; upload. (4 non-contact hours)</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:2 B</th>
<th>Brainstorming</th>
<th>1 hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 brainstorming techniques and examples</td>
<td></td>
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</tr>
<tr>
<td><strong>Project</strong>: Brainstorm and come out with as many solutions as possible for the top 5 issues identified &amp; upload. (4 non-contact hours)</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:3</th>
<th>Mind Mapping</th>
<th>1 hour</th>
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<tbody>
<tr>
<td>Mind Mapping techniques and guidelines. Drawing a mind map</td>
<td></td>
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<tr>
<td><strong>Project</strong>: Using Mind Maps get another set of solutions for the next 5 issues (issue 6 – 10). (4 non-contact hours)</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:4 A</th>
<th>Systems thinking</th>
<th>1 hour</th>
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</thead>
<tbody>
<tr>
<td>Systems Thinking essentials – examples – Counter Intuitive condemn</td>
<td></td>
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</tr>
<tr>
<td><strong>Project</strong>: Select 1 issue / problem for which the possible solutions are available with you. Apply Systems Thinking process and pick up one solution [explanation should be given why the other possible solutions have been left out]. Go back to the customer and assess the acceptability and upload. (4 non-contact hours)</td>
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<table>
<thead>
<tr>
<th>Module:4 B</th>
<th>Design Thinking</th>
<th>1 hour</th>
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</thead>
<tbody>
<tr>
<td>Design thinking process – Human element of design thinking – case study</td>
<td></td>
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<tr>
<td><strong>Project</strong>: Apply design thinking to the selected solution, apply the engineering &amp; scientific tinge to it. Participate in “design week” celebrations upload the weeks learning out come.</td>
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</table>

<table>
<thead>
<tr>
<th>Module:5 A</th>
<th>Innovation</th>
<th>1 hour</th>
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<tbody>
<tr>
<td>Difference between Creativity and Innovation – Examples of innovation – Being innovative.</td>
<td></td>
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</tr>
<tr>
<td><strong>Project</strong>: A literature searches on prototyping of your solution finalized. Prepare a prototype model or process and upload. (4 non-contact hours)</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:5 B</th>
<th>Blocks for Innovation</th>
<th>1 hour</th>
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</thead>
<tbody>
<tr>
<td>Identify Blocks for creativity and innovation – overcoming obstacles – Case Study</td>
<td></td>
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</tr>
<tr>
<td><strong>Project</strong>: Project presentation on problem identification, solution, innovations-expected results – Interim review with PPT presentation. (4 non-contact hours)</td>
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<table>
<thead>
<tr>
<th>Module:5 C</th>
<th>Innovation Process</th>
<th>1 hour</th>
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<tbody>
<tr>
<td>Steps for Innovation – right climate for innovation</td>
<td></td>
<td></td>
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<tr>
<td><strong>Project</strong>: Refining the project, based on the review report and uploading the text. (4 non-contact hours)</td>
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</table>

<table>
<thead>
<tr>
<th>Module:6 A</th>
<th>Innovation in India</th>
<th>1 hour</th>
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<tbody>
<tr>
<td>Stories of 10 Indian innovations</td>
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<tr>
<td><strong>Project</strong>: Making the project better with add ons. (4 non-contact hours)</td>
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</table>

<table>
<thead>
<tr>
<th>Module:6 B</th>
<th>JUGAAD Innovation</th>
<th>1 hour</th>
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</thead>
<tbody>
<tr>
<td>Frugal and flexible approach to innovation - doing more with less Indian Examples</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Project</strong>: Fine tuning the innovation project with JUGAAD principles and uploading (Credit for JUGAAD implementation) (4 non-contact hours)</td>
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<table>
<thead>
<tr>
<th>Module:7 A</th>
<th>Innovation Project Proposal Presentation</th>
<th>1 hour</th>
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</thead>
<tbody>
<tr>
<td>Project proposal contents, economic input, ROI – Template</td>
<td></td>
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<tr>
<td><strong>Project</strong>: Presentation of the innovative project proposal and upload. (4 non-contact hours)</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:8 A</th>
<th>Contemporary issue in Innovation</th>
<th>1 hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contemporary issue in Innovation</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Project</strong>: Final project Presentation, Viva voce Exam (4 non-contact hours)</td>
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</table>
### Total Lecture hours: 15 hours

**Text Book(s)**

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

**Reference Books**


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

Three reviews with weightage of 25 : 25 : 50 along with reports

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<tr>
<th>Recommended by Board of Studies</th>
<th>15-12-2015</th>
</tr>
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<tbody>
<tr>
<td>Approved by Academic Council</td>
<td>No. 39</td>
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</table>
# Course Code: STS1001  
# Course Title: Introduction to Soft skills  
# L T P J C: 3 0 0 0 1  

| 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):  
1. Having a clear understanding of professional and ethical responsibility  
2. Having adaptive thinking and adaptability

### Module: 1 Lessons on excellence  

#### 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  

#### 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

Module:4 | Adaptability | 12 hours

**Theatrix**
Motion Picture, Drama, Role Play, Different kinds of expressions

**Creative expression**
Writing, Graphic Arts, Music, Art and Dance

**Flexibility of thought**
The 5P framework (Profiling, prioritizing, problem analysis, problem solving, planning)

Adapt to changes (tolerance of change and uncertainty)
Adaptability Curve, Survivor syndrome

**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 Code | Course Title | L | T | P | J | C
--- | --- | --- | --- | --- | --- | ---
STS1002 | Introduction to Business Communication | 3 | 0 | 0 | 0 | 1

Pre-requisite | None | 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, 11
9. Having problem solving ability- solving social issues and engineering problems
11. Having interest in lifelong learning

Module:1 Study skills 10 hours

Memory techniques
Relation between memory and brain, Story line technique, Learning by mistake, Image-name association, Sharing knowledge, Visualization

Concept map
Mind Map, Algorithm Mapping, Top down and Bottom Up Approach

Time management skills
Prioritization - Time Busters, Procrastination, Scheduling, Multitasking, Monitoring
6. Working under pressure and adhering to deadlines

Module:2 Emotional Intelligence (Self Esteem ) 6 hours

Empathy
Affective Empathy and Cognitive Empathy

Sympathy
Level of sympathy (Spatial proximity, Social Proximity, Compassion fatigue)

Module:3 Business Etiquette 9 hours

Social and Cultural Etiquette
Value, Manners, Customs, Language, Tradition

Writing Company Blogs
Building a blog, Developing brand message, FAQs’, Assessing Competition

Internal Communications
Open and objective Communication, Two way dialogue, Understanding the audience

Planning
Identifying, Gathering Information, Analysis, Determining, Selecting plan, Progress check, Types of planning

Writing press release and meeting notes
Write a short, catchy headline, Get to the Point – summarize your subject in the first paragraph, Body – Make it relevant to your audience

<table>
<thead>
<tr>
<th>Module: 4</th>
<th>Quantitative Ability</th>
<th>4 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Numeracy concepts</td>
<td></td>
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</tr>
<tr>
<td>Fractions, Decimals, Bodmas, Simplifications, HCF, LCM, Tests of divisibility</td>
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<tr>
<td><strong>Beginning to Think without Ink</strong></td>
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<tr>
<td>Problems solving using techniques such as: Percentage, Proportionality, Support of answer choices, Substitution of convenient values, Bottom-up approach etc.</td>
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<td></td>
</tr>
<tr>
<td><strong>Math Magic</strong></td>
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<td></td>
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<tr>
<td>Puzzles and brain teasers involving mathematical concepts</td>
<td></td>
<td></td>
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<tr>
<td><strong>Speed Calculations</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Square roots, Cube roots, Squaring numbers, Vedic maths techniques</td>
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<table>
<thead>
<tr>
<th>Module: 5</th>
<th>Reasoning Ability</th>
<th>3 hours</th>
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</thead>
<tbody>
<tr>
<td><strong>Interpreting Diagramming and sequencing information</strong></td>
<td></td>
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</tr>
<tr>
<td>Picture analogy, Odd picture, Picture sequence, Picture formation, Mirror image and water image</td>
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<tr>
<td><strong>Logical Links</strong></td>
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<tr>
<td>Logic based questions-based on numbers and alphabets</td>
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<thead>
<tr>
<th>Module: 6</th>
<th>Verbal Ability</th>
<th>3 hours</th>
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<tbody>
<tr>
<td><strong>Strengthening Grammar Fundamentals</strong></td>
<td></td>
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</tr>
<tr>
<td>Parts of speech, Tenses, Verbs( Gerunds and infinitives)</td>
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</tr>
<tr>
<td><strong>Reinforcements of Grammar concepts</strong></td>
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</tr>
<tr>
<td>Subject Verb Agreement, Active and Passive Voice, Reported Speech</td>
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<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>
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<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>
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<tr>
<td><strong>Speaking skills</strong></td>
<td></td>
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<tr>
<td>How to present a JAM, Public speaking</td>
<td></td>
<td></td>
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<tr>
<td><strong>Self managing</strong></td>
<td></td>
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<tr>
<td>Concepts of self management and self motivation, Greet and Know, Choice of words, Giving feedback, Taking criticism</td>
<td></td>
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</table>

**Total Lecture hours:** 45 hours

**Text Book(s)**

**Reference Books**

**Mode of Evaluation:** FAT, Assignments, Projects, Case studies, Role plays,
<table>
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<th>3 Assessments with Term End FAT (Computer Based Test)</th>
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</table>
Course Code | Course Title | L | T | P | J | C | Pre-requisite | Syllabus version
--- | --- | --- | --- | --- | --- | --- | --- | ---
STS2001 | Reasoning Skill Enhancement | 3 | 0 | 0 | 0 | 1 | None | 2

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:4</th>
<th>Quantitative Ability</th>
<th>10 hours</th>
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</thead>
<tbody>
<tr>
<td><strong>Number properties</strong></td>
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<td></td>
</tr>
<tr>
<td>Number of factors, Factorials, Remainder Theorem, Unit digit position, Tens digit position</td>
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<tr>
<td><strong>Averages</strong></td>
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<tr>
<td>Averages, Weighted Average</td>
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<tr>
<td><strong>Progressions</strong></td>
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<td></td>
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<tr>
<td>Arithmetic Progression, Geometric Progression, Harmonic Progression</td>
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<tr>
<td><strong>Percentages</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increase &amp; Decrease or successive increase</td>
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<tr>
<td><strong>Ratios</strong></td>
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<tr>
<td>Types of ratios and proportions</td>
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<table>
<thead>
<tr>
<th>Module:5</th>
<th>Reasoning Ability</th>
<th>8 hours</th>
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</thead>
<tbody>
<tr>
<td><strong>Analytical Reasoning</strong></td>
<td></td>
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<tr>
<td>Data Arrangement(Linear and circular &amp; Cross Variable Relationship), Blood Relations, Ordering/ranking/grouping, Puzzletest, Selection Decision table</td>
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<thead>
<tr>
<th>Module:6</th>
<th>Verbal Ability</th>
<th>7 hours</th>
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<tbody>
<tr>
<td><strong>Vocabulary Building</strong></td>
<td></td>
<td></td>
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<tr>
<td>Synonyms &amp; Antonyms, One word substitutes, Word Pairs, Spellings, Idioms, Sentence completion, Analogies</td>
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**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 Code: STS2002
Course Title: Introduction to Etiquette
Pre-requisite: None
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.

Module: 1 Impression Management
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)

Module: 2 Thinking Skills
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

Module: 3 Beyond Structure
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

Module: 4 Quantitative Ability
Profit and Loss
Cost Price & Selling Price, Margins & Markup
Interest Calculations
Simple Interest, Compound Interest, Recurring
### Mixtures and solutions
- Ratio & Averages, Proportions
- Pipes & Cisterns, Man Day concept, Division Wages

### Time and Work
- Time Speed and Distance
  - Average speed, Relative speed, Boats and streams.

### Proportions & Variations
- Module:5  **Reasoning Ability**  11 hours
  - **Logical Reasoning**
    - Sequence and series, Coding and decoding, Directions
  - **Visual Reasoning**
    - Abstract Reasoning, Input Type Diagrammatic Reasoning, Spatial reasoning, Cubes
  - **Data Analysis And Interpretation**
    - DI-Tables/Charts/Text

- Module:6 **Verbal Ability**  9 hours
  - **Grammar**
    - Spot the Errors, Sentence Correction, Gap Filling Exercise, Sentence Improvisations, Misc.

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- **Reference Books**

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

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<td>No. 45th AC</td>
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<td>15/06/2017</td>
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</table>
Course Code | Course Title | L | T | P | J | C
---|---|---|---|---|---|---
STS3001 | Preparedness for external opportunities | 3 | 0 | 0 | 0 | 1

Pre-requisite: None

Syllabus version: 2

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

<table>
<thead>
<tr>
<th>Module:4</th>
<th>Quantative Ability</th>
<th>14 hours</th>
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</thead>
<tbody>
<tr>
<td>Permutation-Combinations</td>
<td>Counting, Grouping, Linear Arrangement, Circular Arrangements</td>
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<tr>
<td>Probability</td>
<td>Conditional Probability, Independent and Dependent Events</td>
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<tr>
<td>Geometry and Mensuration</td>
<td>Properties of Polygon, 2D &amp; 3D Figures, Area &amp; Volumes</td>
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<tr>
<td>Trigonometry</td>
<td>Heights and distances, Simple trigonometric functions</td>
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<tr>
<td>Logarithms</td>
<td>Introduction, Basic rules</td>
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</tr>
<tr>
<td>Functions</td>
<td>Introduction, Basic rules</td>
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<tr>
<td>Quadratic Equations</td>
<td>Understanding Quadratic Equations, Rules &amp; probabilities of Quadratic Equations</td>
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<tr>
<td>Set Theory</td>
<td>Basic concepts of Venn Diagram</td>
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<thead>
<tr>
<th>Module:5</th>
<th>Reasoning Ability</th>
<th>7 hours</th>
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<tbody>
<tr>
<td>Logical reasoning</td>
<td>Syllogisms, Binary logic, Sequential output tracing, Crypto arithmetic</td>
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<tr>
<td>Data Analysis and Interpretation</td>
<td>Data Sufficiency</td>
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<tr>
<td>Data interpretation-Advanced Interpretation tables, pie charts &amp; bar chats</td>
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<thead>
<tr>
<th>Module:6</th>
<th>Verbal Ability</th>
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<tbody>
<tr>
<td>Comprehension and Logic</td>
<td>Reading comprehension</td>
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<td>Para Jumbles</td>
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<tr>
<td>Critical Reasoning</td>
<td>Premise and Conclusion, Assumption &amp; Inference, Strengthening &amp; Weakening an Argument</td>
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<thead>
<tr>
<th>Module:7</th>
<th>Writing Skills</th>
<th>5 hours</th>
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<tbody>
<tr>
<td>Note making</td>
<td>What is note making, Different ways of note making</td>
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<tr>
<td>Report writing</td>
<td>What is report writing, How to write a report, Writing a report &amp; work sheet</td>
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<tr>
<td>Product description</td>
<td>Designing a product, Understanding it's features, Writing a product description</td>
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<tr>
<td>Research paper</td>
<td>Research and its importance, Writing sample research paper</td>
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</table>
**Total Lecture hours:** 45 hours

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<th><strong>Reference Books</strong></th>
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**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 | Date | 15/06/2017
## Course Code: STS3005
### Course Title: Code Mithra

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### Pre-requisite
None

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<th>Syllabus version</th>
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### 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. 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  15 hours
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.

## Module: 2  C++ Programming  15 hours
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.

## Module: 3  JAVA  10 hours
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.

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

### 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)

### Approved by Academic Council
No.45th AC  Date  15/06/2017
Programme Core (PC)

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<tr>
<td>ECE1001</td>
<td>Fundamentals of Electrical Circuits</td>
<td>2</td>
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Pre-requisite: None

Syllabus Version: 1.0

Course Objectives:
1. To develop an understanding of the fundamental laws, theorems, elements of electric circuits and to analyze dc and ac circuits.
2. To develop an ability to analyze magnetic circuits.
3. To understand transient response behaviour of electric circuits.
4. To simulate the circuits using software tools and compare their output with hard-wired circuitry.

Course Outcomes:
1. Comprehend and analyze dc and ac electric circuits using circuital laws.
2. Apply various network theorems to determine the response of the circuit.
3. Demonstrate a basic understanding of transient behavior of RL, RC and RLC circuits
4. Reflect the understanding of the sinusoidal steady state behavior of electric networks and determine power in these circuits.
5. Estimate complex power and understand resonance in ac circuits.
6. Compare electric and magnetic circuits and analyze the given magnetic circuit.
7. Demonstrate basic proficiency in building simple electrical circuits and operating fundamental electrical engineering equipment.

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 DC Circuit Analysis 4 hours
Terminologies, Ohms law, Kirchhoff’s laws, Series-parallel circuits, voltage & current division, star-delta conversion. Node voltage analysis, Mesh current analysis, special cases.

Module: 2 Network Theorems 5 hours
Source transformation, Superposition theorem, Thevenin’s& Norton’s theorems, Reciprocity and Maximum power transfer theorem

Module: 3 First-Order Transient Circuits 3 hours
Time response in inductance (L) and capacitance (C). Steady state response of circuits with RLC components. Response (forced & natural) of first order circuits (RL & RC): Series, parallel, source free, complex circuits with more than one resistance, power sources and switches.

Module: 4 Second-Order Transient Circuits 3 hours
Response of second order circuit (RLC): Series, parallel and complex circuits.

Module: 5 AC Circuit Analysis 5 hours

Module: 6 Complex Power and Resonance 4 hours
Concept of complex power and its calculation, Series and parallel resonance condition

Module: 7 Magnetic Circuits 4 hours
Introduction to magnetic field, analogy between electrical & magnetic circuits. Analysis of magnetic circuits: Series, parallel; Magnetic materials, B-H curve. Electromagnetic induction Self & mutual inductance. Transformers

Module: 8 Contemporary issues 2 hours

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. Design a resistive circuit to derive the specified load voltage and load current from a DC power source. 2 hours
2. Build and test the voltage across and the current through any element using appropriate circuit analysis techniques. 2 hours
3. Build and test the voltage and current through any elements driven by more than one source. 2 hours
4. Build a circuit with appropriate number of nodes with a variable load and determine the voltage and current. 2 hours
5. Design a circuit topology having star/delta connected network and determine the resistance at which the maximum brightness of the LED (Load device) occurs. 2 hours
6. For a given time constant, design a RL/RC circuit. Determine its current/voltage response and analyse the step response and the source free response of your circuit with initial conditions. 4 hours
7. Design a temporary power source using energy storage elements and determine the capacity of the power source. 2 hours
8. For various damping conditions, design and build a system having second order RLC circuit and deduce the transient responses. 2 hours
9. Design a phase shifter circuit for a given phase shift and validate its phasor diagram. 2 hours
10. For a given reactive load (Inductive/Capacitive), determine the power factor of the load. 4 hours
11. Design a radio tuner circuit which tunes to a given frequency using a toroid. 2 hours
12. Construct and validate the step-up /step-down behavior of the transformer. 4 hours

Total laboratory hours 30 hours
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<th><strong>Mode of Assessment:</strong> Continuous Assessment &amp; Final Assessment Test (FAT)</th>
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## Course Code: ECE1002

### Course Title: Semiconductor Devices and Circuits

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<td>4</td>
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**Prerequisite:** None

**Syllabus Version:** 2.1

### Course Objectives:

1. To give the students a solid background of solid-state devices.
2. To apply the inculcated knowledge for developing simple electronic circuits.
3. To use BJT and MOSFET in different configurations and study their parameters under various biasing schemes.
4. To simulate the circuits using EDA tools and verify their theoretical output with hard-wired circuitry results.

### Course Outcomes:

1. Understand the semiconductor physics of the intrinsic and extrinsic materials.
2. Comprehend the characteristics of the various P-N junction diode and special diodes.
3. Able to analyze the diode with different DC and AC models.
4. Construct electronic circuits using the PN junction diode for various applications.
5. Comprehend the impact of terminal voltages over the current using the BJT and MOSFET devices characteristics.
6. Design and analysis of BJT and MOSFET in different configurations and study their parameters with various biasing schemes for suitable applications.
7. Analyze the current–voltage characteristics of various semiconductor devices and their digital logic implementations.

### Student Learning Outcomes (SLO): 1, 6, 14

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  |  Semiconductor Fundamentals  | 8 hours

Formation of energy bands, Fermi level, energy-band models, direct and indirect band gap, electrons and holes, doping, intrinsic and extrinsic semiconductors, elemental and compound semiconductor, generation, recombination and injection of carriers, Drift and Diffusion of carriers, basic governing equations in semiconductors, Transport Equations.

### Module: 2  |  PN Junction Diodes  | 6 hours

PN Junctions, Formation of Junction, Physical operation of diode, Contact potential and Space Charge phenomena, I-V Characteristics, Zener diode, Physical operation of special diodes (Tunnel diode, LED, OLED, Varactor diode and Photo Diode).

### Module: 3  |  Diode Circuits  | 3 hours

DC Analysis – Small Signals and Large signal models of PN junction diode and AC equivalent circuit.

### Module: 4  |  Diode Applications  | 4 hours

Rectifier circuits, Clipper and Clamper circuits, Photodiode and LED circuits.

### Module: 5  |  Transistors- Device Perspective  | 8 hours

**Bipolar Junction Transistor:** Device structure and physical operation, current – voltage characteristics.

**Field Effect Transistor (FET):** MOS Capacitor: Device Structure and mode of operation, C-V
## Characteristics, Threshold Voltage.

### Module: 6 | Transistors- Circuits Perspective | 8 hours

**Bipolar Junction Transistor:** DC Analysis of BJT Circuits, CB, CE and CC Configuration, Biasing BJT Circuits, Switch.

**Field Effect Transistor (FET):** DC Analysis of MOSFET Circuits, biasing circuits.

### Module: 7 | Applications of MOSFETs | 6 hours

CMOS device structure, characteristics, gates and inverters. MOSFET CS, CG and Source Follower Circuits.

### Module: 8 | Contemporary Issues | 2 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): | Hours
--- | --- | ---
1 | Design a circuit to measure the cut-in and reverse breakdown voltages of a diode. | 2 hours
2 | Design a circuit to measure the cut-in and regulation region voltages of a Zener diode. | 2 hours
3 | Construct a circuit to convert alternating voltage into unidirectional pulsating voltage using an uncontrolled single device diode. | 2 hours
4 | Construct a circuit to convert alternating voltage into unidirectional voltage using an uncontrolled two diodes. Also apply the capacitor filter to obtain the smoothened DC voltage. | 4 hours
5 | Construct a circuit to perform controlled clipping of positive half-cycle / negative half-cycle. | 2 hours
6 | Construct a circuit to perform controlled level shifting of positive half-cycle / negative half-cycle. | 2 hours
7 | Design a circuit to measure the operating regions of LED and Photodiode. | 2 hours
8 | Construct a circuit to measure and plot the input / output characteristics of a transistor for calculating h-parameters under CB / CE / CE configurations. | 4 hours
9 | Design a circuit to measure and plot the DC and AC Load-Line Analysis of a Transistor. | 2 hours
10 | Construct a circuit to amplify the low level signal using a Transistor as an Amplifier under CE configuration. | 2 hours
11 | Design a circuit to measure and plot the drain and transfer characteristics of a FET. | 2 hours
12 | Design a circuit to realize logic Gates using CMOS devices. | 4 hours

**Total Laboratory Hours:** 30 hours

**Mode of Evaluation:** Internal Assessment & Final Assessment Test (FAT)

Recommended by Board of Studies 28-02-2016
Course Code | Course Title | L | T | P | J | C
---|---|---|---|---|---|---
ECE1003 | Electromagnetic Field Theory | 3 | 0 | 0 | 0 | 3

Pre-requisite: PHY1701 – Engineering Physics

Syllabus Version: 2.1

Course Objectives:
1. To provide insight on vector and scalar analysis.
2. To analyze the electric field intensity and develop the boundary conditions between two different mediums in the electric field.
3. To analyze the magnetic field intensity and current, and develop the boundary conditions between two different mediums in the magnetic field.
4. To understand the Maxwell equations and uniform plane wave propagation for the time-varying electric and magnetic fields.

Course Outcomes:
1. Derive and convert the coordinate system in space.
2. Derive the electric flux density from the Gauss’s law and define potential and potential gradient.
3. Describe the current and current density from Ohm’s law.
4. Solve the capacitance problem using Poisson’s equations and Laplace’s equations and the boundary conditions between two different media of different dielectrics.
5. Solve different problems on forces and torques on a closed circuit.
6. Understand the time-varying electric and magnetic fields and plane wave propagation.

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 | Vector Analysis | 5 hours
Cartesian, cylindrical, and spherical coordinate systems. Divergence, gradient, curl, Laplacian – Stokes’ theorems.

Module:2 | Electrostatics | 8 hours
Coulomb’s Law, Electric field intensity – Field due to the continuous line, surface, and volume charges - Electric flux density – Gauss Law – Energy expended in moving a charge in an electric field, Potential & potential gradient, Electric Dipole.

Module:3 | Electrostatic boundary conditions | 6 hours

Module:4 | Electrostatic boundary value problems | 4 hours

Module:5 | Magnetostatics | 8 hours
Biot-Savart’s law, Magnetic field intensity, Ampere’s circuital law, Magnetic flux and flux density. Magnetic scalar and vector potentials.

Module:6 | Magnetostatic Force and boundary conditions | 6 hours
Force on a moving charge (Lorentz force), force on a differential current element, and force between differential current elements. Boundary conditions - Inductance and mutual inductance.

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<tr>
<th>Module:7</th>
<th>Time-varying Electromagnetic field</th>
<th>6 hours</th>
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<tbody>
<tr>
<td></td>
<td>Faraday’s law, Lenz’s law, Displacement current, Maxwell’s equations in point and integral forms. Plane waves in free space, dielectrics, and conductors, Power and Poynting vector, Wave polarization: linear, elliptic, and circular polarizations</td>
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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 Books**


**Reference Books**


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

<p>| Recommended by Board of Studies | 28-02-2016 |
| Approved by Academic Council    | No. 47     |
| Date                            | 05-10-2017 |</p>
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<tbody>
<tr>
<td>ECE1004</td>
<td>Signals and Systems</td>
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Pre-requisite: MAT1011 - Calculus for Engineers

Syllabus version: 2.0

Course Objectives:

1. To introduce fundamental signals like unit impulse, unit step, ramp and exponentials and various operations on the signals.
2. To acquaint with static, linear, time invariant, causal and stable systems.
3. To introduce processing of signals through systems using convolution, correlation operations.
4. To analyze systems using Laplace and Z Transform.

Course Outcomes:

1. Differentiate between various types of signals and understand the implication of operations of signals.
2. Understand and classify systems based on the impulse response behavior of both continuous-time and discrete-time systems.
3. Perform domain transformation from time to frequency and understand the energy distribution as a function of frequency.
4. Apply Fourier transform for discrete-time signals and understand the difference between CTFT and DTFT.
5. Usefulness of convolution for analysing the LTI systems and understand the concepts of power spectral density through correlation.
7. Design a system based on the concepts of system properties.

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

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.
8. Having Virtual Collaborating ability
17. Having an ability to use techniques, skills and modern engineering tools necessary for engineering practice.

Module: 1 | Introduction to Continuous-time and Discrete-time Signals | 3 hours |
---|---|---|
Representation of signals, Signal classification, Types of signals, Operations on signals - Scaling, Shifting, Transformation of independent variables, Sampling.

Module: 2 | Introduction to Continuous-time and Discrete-time Systems | 3 hours |
---|---|---|
Classification of systems - Static and dynamic, Linear and non-linear, Time-variant and time-invariant, Causal and non-causal, Stable and unstable, Impulse response and step response of systems.

Module: 3 | Fourier Analysis of Continuous-time Signals | 4 hours |
---|---|---|
Introduction to Fourier series, Gibbs Phenomenon, Continuous-time Fourier transform (CTFT), Existence, Properties, Magnitude and phase response, Parseval’s theorem, Inverse Fourier transform.

Module: 4 | Fourier Analysis of Discrete-time Signals | 4 hours |
---|---|---|
Discrete-time Fourier transform (DTFT), Properties, Inverse discrete-time Fourier transform, Comparison between CTFT and DTFT.

**Module:5** | **Convolution and Correlation** | 4 hours
---|---|---
Continuous-time convolution, Convolution sum, Correlation between signals, Cross correlation, Autocorrelation, Energy spectral density, Power spectral density

**Module:6** | **System Analysis using Laplace transform** | 5 hours
---|---|---
Relation between Laplace and Fourier transforms, Properties, Inverse Laplace transform, Solution to differential equations using Laplace transform, Region of convergence, Stability analysis.

**Module:7** | **System Analysis using z-Transform** | 5 hours
---|---|---
z-transform, Properties, s-plane to z-plane mapping, Inverse z-transform, Solution to difference equations using z-transform, Region of convergence, Stability analysis.

**Module:8** | **Contemporary Issues** | 2 hours
---|---|---

**Total lecture hours:** | 30 hours
---|---|---

**Text Book**

**Reference Books**

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

**Typical Projects**
1. a) Prove any five Fourier series properties for continuous time signals.
    b) Write a Matlab script to generate and plot the following discrete time signals for $-10 \leq n \leq 10$. Also compute their energies and display them on command prompt.
    a) i) $\delta(n)$ ii) $\delta(n-2)$ iii) $\delta(n+3)$
    b) i) $u(n)$ ii) $u(n-3)$ iii) $u(n+4)$
    c) i) $r(n)$ ii) $r(n-3)$ iii) $r(n+2)$

2. a) Analysis of Power spectral density for deterministic signals and random signal.
    b) Let $x(n) = \{1, 4, 3, 5, 7, 6, 5, 4\}$. Write a Matlab script to determine and plot the following sequences. (select suitable time scale)
    i) $y(n) = 3x(n+2) - x(n-2)$
    ii) $y(n) = x(n)x(n-2)$
    iii) $y(n) = x(4-n) + x(n)x(n+2)$

3. a) Write a Matlab script to generate and plot the following discrete time signals for $-10 \leq n \leq 10$. Also compute their energies and display them on command prompt.
    i) $x(n) = (0.8)^{n+1}$
    ii) $x(n) = \exp((1 + j)^n)$ (plot the magnitude, phase, real and imaginary parts on four different subplots)
    iii) $x(n) = 2\delta(n-2) - \delta(n+4)$
iv) \( x(n) = \frac{5 \sin \left( \frac{\pi}{2} n \right)}{\pi n} \)

b) Prove any five Fourier series properties for discrete time signals.

4. a) Perceval’s theorem for both Continuous and discrete time signals in Fourier transform.
   b) Let \( x(n) = u(n) - u(n-10) \). Write a Matlab script to decompose \( x(n) \) into even and odd components and plot them on two separate subplots.

5. a) Convolution for both Continuous and discrete time signals.
   b) Generate and plot the signal: \( x(t) = \sin(2\pi t) \), for \( 0 \leq t \leq 2 \) with an increment of 0.01. Find the scaled versions of \( y_1(t) = x\left(\frac{t}{2}\right) \) & \( y_2(t) = x\left(\frac{t}{16}\right) \) and plot them.

6. a) Correlation for both Continuous and discrete time signals.
   b) The sinusoidal Fourier series of any periodic continuous waveform with period ‘T=1 sec’ is given by.

\[
x(t) = a_0 + \sum_{n=1}^{N} a_n \cos \left( \frac{2\pi n t}{T} \right) + \sum_{n=1}^{N} b_n \sin \left( \frac{2\pi n t}{T} \right)
\]

where

\[
a_0 = 0, a_n = 0, b_n = \begin{cases} \frac{4}{n\pi}, & \text{for } n = 1, 3, 5, 7,... \\ 0, & \text{for } n = 2, 4, 6,...
\end{cases}
\]

(for square wave)

Consider ‘t’ form -3sec to 3sec in steps of 0.01. Compute and plot \( x(t) \) for the upper limit \( n=15 \).

7. a) Prove any five Fourier transforms properties for discrete time signals.
   b) The sinusoidal Fourier series of any periodic continuous waveform with period ‘T=1 sec’ is given by.

\[
x(t) = a_0 + \sum_{n=1}^{N} a_n \cos \left( \frac{2\pi n t}{T} \right) + \sum_{n=1}^{N} b_n \sin \left( \frac{2\pi n t}{T} \right)
\]

where

\[
a_0 = 0, a_n = 0, b_n = -\frac{1}{n\pi}
\]

(for saw tooth wave)

Consider ‘t’ form -3sec to 3sec in steps of 0.01. Compute and plot \( x(t) \) for the upper limit \( n=25 \).

8. a) Analysis of system stability and causality issues in Z-Transform.
   b) The sinusoidal Fourier series of any periodic continuous waveform with period ‘T=1 sec’ is given by.

\[
x(t) = a_0 + \sum_{n=1}^{N} a_n \cos \left( \frac{2\pi n t}{T} \right) + \sum_{n=1}^{N} b_n \sin \left( \frac{2\pi n t}{T} \right)
\]

where

\[
a_0 = 0, a_n = 0, b_n = (-1)^{n-1} \frac{8}{n^2\pi^2}
\]

(for triangular wave)

Consider ‘t’ form -3sec to 3sec in steps of 0.01. Compute and plot \( x(t) \) for the upper limit \( n=35 \).

9. a) Consider the difference equation of a causal system: 
\[
y(n) - y(n-1) + 0.9y(n-2) = x(n)
\]
   I) Calculate and plot the impulse response \( h(n) \) for \( -20 \leq n \leq 100 \)
   II) Calculate and plot the unit step response \( s(n) \) for \( -20 \leq n \leq 100 \)
   III) Find out the stability of the system.
b) Let \( x(n) = u(n) - u(n-9) \) and \( h(n) = (0.9)^n \). Write a Matlab script to find out the linear convolution of \( y(n) = x(n) * h(n) \) and plot \( x(n), h(n) \) and \( y(n) \) in different subplots.

10. a) Evaluate the DTFT of \( x(n) = (0.9)^n u(n) \), at 512 equidistant points between \([-\pi, \pi]\) and plot its magnitude, phase, real and imaginary parts on four different subplots.
   Extend the computation to 1024 equidistant points between \([\pi, 5\pi]\), and observe its periodicity and conjugate symmetry properties by plotting suitable plots.

b) Study the characteristics of EEG signal.

11. a) A third order system is described by the difference equation
\[
y(n) = 0.0181x(n) + 0.0543x(n-1) + 0.0543x(n-2) + 0.0181x(n-3) + 1.76y(n-1) - 1.1829y(n-2) + 0.2781y(n-3)
\]
Plot the magnitude and phase response of this system and verify that it is a low pass filter.

b) The sinusoidal Fourier series of any periodic continuous waveform with period ‘T=1 sec’ is given by.
\[
x(t) = a_0 + \sum_{n=1}^{N} a_n \cos \left( \frac{2n\pi t}{T} \right) + \sum_{n=1}^{N} b_n \sin \left( \frac{2n\pi t}{T} \right)
\]
where
\[
a_0 = \frac{1}{\pi}, a_n = \begin{cases} \frac{2}{\pi(n^2-1)}, & \text{for } n = 2, 4, 6, \ldots \cr 0, & \text{for } n = 1, 3, 5, 7, \ldots \cr \end{cases}, \quad b_n = \begin{cases} \frac{1}{2}, & \text{for } n = 1 \cr 0, & \text{for } n > 1 \end{cases}
\]
(For wave Rectified sine wave)
Consider ‘t’ form -3sec to 3sec in steps of 0.01. Compute and plot \( x(t) \) for the upper limit \( n=35 \).

12. a) Spectrogram and magnitude response analysis for different speech signals.

b) Two different signals \( x_1(n) = \cos(0.1\pi n) \) and \( x_2(n) = \cos(0.4\pi n) \).
   Compute and plot the sequence \( x(n) = 3x_1(n) - 2x_2(n) \) and its delayed version \( x_3(n) = x(n-5) \).
<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>ECE1005</td>
<td>Sensors and Instrumentation</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>2</td>
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</tbody>
</table>

Pre-requisite: PHY1701 – Engineering Physics

Course Objectives:
1. To provide basic understanding of measurement and instrumentation systems.
2. To gain knowledge about the variety of measuring instruments, their methods of measurement and the use of different sensors.
3. To analyse the concepts associated with multiple sensors and its sensing mechanism.
4. To apply the ideas towards the realization of various sensor applications.

Course Outcomes:
1. Differentiate between the types of sensors available
2. Characterize and mathematically model a sensor
3. Analyze different resistive sensors and utilize them for suitable applications
4. Analyze various inductive and capacitive sensors, and utilize them for suitable applications
5. Select a sensor for particular application
6. Recommend appropriate instrumentations for specific application
7. Apply the knowledge about the measuring instruments to use them more effectively.

Student Learning Outcomes (SLO): 2, 6, 8, 17

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
8. Having Virtual Collaborating ability
17. Having an ability to use techniques, skills and modern engineering tools necessary for engineering practice

<table>
<thead>
<tr>
<th>Module:1</th>
<th>Measurement Concepts and Classification of Sensors</th>
<th>1 hour</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>General concepts and terminology of measurement systems, Sensors and transducers, Classification of sensors.</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:2</th>
<th>Characteristics of Sensors</th>
<th>2 hours</th>
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<tbody>
<tr>
<td></td>
<td>Static and dynamic characteristics, Mathematical model of sensor – Zero, I and II order.</td>
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</table>

<table>
<thead>
<tr>
<th>Module:3</th>
<th>Variable Resistance Sensors</th>
<th>2 hours</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Resistive potentiometric, Strain gauge, Thermistor, Light dependent resistor.</td>
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</table>

<table>
<thead>
<tr>
<th>Module:4</th>
<th>Variable Inductance and Variable Capacitance Sensors</th>
<th>2 hours</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Linear variable differential transformers (LVDT), Characteristics and applications of LVDT, Capacitive sensor.</td>
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</table>

<table>
<thead>
<tr>
<th>Module:5</th>
<th>Special Purpose Sensors</th>
<th>2 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Piezoelectric sensor, Ultrasonic sensor, Hall effect sensor.</td>
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</table>

<table>
<thead>
<tr>
<th>Module:6</th>
<th>Introduction to Instrumentation</th>
<th>2 hours</th>
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<tbody>
<tr>
<td></td>
<td>Fundamental concepts, Types of instruments, Calibration and standard.</td>
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</table>

<table>
<thead>
<tr>
<th>Module:7</th>
<th>Electrical Measurement Instruments</th>
<th>2 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Current and voltage measurement instruments – Moving coil, Moving iron, Rectifier type.</td>
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</tbody>
</table>

| Module:8   | Contemporary issues                              | 2 hours |

Total lecture hours: 15 hours
### Text Books


### Reference Books


### Mode of Evaluation:

**Typical Projects**

1. Electronic Nose for IoT
2. Monitoring Room Temperature
3. Pressure Monitoring
4. Reverse Car Parking System for IoT
5. Water Tank Level Control for IoT
6. Humidity Measurement
7. Air Quality Measurement for IoT
8. Heart Beat Measurement
9. Fall Detection System

**Recommended by Board of Studies**

<table>
<thead>
<tr>
<th>Date</th>
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<tr>
<td>13-12-2015</td>
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**Approved by Academic Council**

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<tbody>
<tr>
<td>05-10-2017</td>
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<tr>
<td>Course Code</td>
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<tr>
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<tr>
<td>ECE2001</td>
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</tbody>
</table>

Pre-requisite: ECE1001 Fundamentals of Electrical Circuits

Syllabus Version: 2.1

Course Objectives:
1. To analyze the given electrical network using phasors and graph theory.
2. To introduce the basic knowledge of Laplace transform, Fourier Transform and Fourier series and to analyze the network using suitable technique.
3. To analyze the two-port networks, passive filters, and attenuators.

Course Outcomes:
1. Apply the knowledge of various circuit analysis techniques such as mesh analysis, nodal analysis, and network theorems to investigate the given network.
2. Able to solve the networks using graphical approach.
3. Able to analyze the given network by transforming from time domain to S domain.
4. Express the periodic sources using Fourier series and simplify the analysis using phasor approach.
5. Analyze the given network by transforming from time domain to frequency domain.

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.

Module: 1 | Sinusoidal Steady-State Analysis | 7 hours
Review of steady state sinusoidal analysis using phasors. Node voltage and Mesh current analysis, special cases. Network theorems: Superposition, Thevenin, Norton and maximum power transfer theorems.

Module: 2 | Network Graphs | 6 hours

Module: 3 | Circuit Analysis in the S domain | 6 hours
Introduction to Laplace transform (LT), poles, zeros and transfer functions. Analysis of circuits subjected to periodic and aperiodic excitations using Laplace transforms.

Module: 4 | Application of Fourier series in Circuit Analysis | 5 hours
Trigonometric Fourier series, Symmetry conditions, Applications in circuit solving.

Module: 5 | Application of Fourier transforms in Circuit Analysis | 5 hours
Fourier transforms. Properties, Applications in circuit solving, Comparisons of Fourier and Laplace transforms.

Module: 6 | Two-Port Networks | 7 hours
Significance and applications of one port and two port networks. Two port network analysis using Admittance (Y) parameters, Impedance (Z) parameters and Hybrid (h) parameters. Interconnection of Two port networks.

Module: 7 | Principles of Filters, Attenuators and equalizers | 7 hours
Concept of filtering. Filter types: Low pass, High pass, Band pass and Band stop and their Characteristics. Design of T-type, π-type, Lattice and Bridged-T attenuator, Equalizers.

Module: 8 | Contemporary Issues | 2 hours
<table>
<thead>
<tr>
<th>Text Book(s)</th>
<th></th>
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<tr>
<th>Reference Books</th>
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<tr>
<th>Mode of Evaluation</th>
<th>Internal Assessment(CAT, Quizzes, Digital Assignments) &amp; Final Assessment Test (FAT)</th>
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<tbody>
<tr>
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<td>28-02-2016</td>
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<td>No. 47</td>
</tr>
<tr>
<td>Date</td>
<td>05-10-2017</td>
</tr>
</tbody>
</table>
Course Code | Course Title | L | T | P | J | C
--- | --- | --- | --- | --- | --- | ---
ECE2002 | Analog Electronic Circuits | 2 | 0 | 2 | 4 | 4
Prerequisite: | ECE1002 - Semiconductor Devices and Circuits | Syllabus Version | 2.0

Course Objectives:
1. To design BJT and FET amplifiers with parasitic, coupling and bypass capacitors and understand the effect of capacitances in its frequency response.
2. To understand the operation and design of various classes of power amplifier circuits.
3. To introduce MOSFET active biasing and to design a MOSFET differential amplifier and analyze its frequency response.
4. To discuss the effects of negative feedback on amplifier circuits and study the different types of oscillator circuits.

Course Outcomes:
1. Design simple electronic circuits based on diodes.
2. Design a BJT and MOSFET amplifier for the given specifications and analyze the transient, frequency response.
3. Distinguish different classes of power amplifiers and employ it.
4. Classify the different current mirrors based on the biasing.
5. Illustrate MOSFET-based differential amplifiers with active biasing and its frequency response.
6. Construction of feedback amplifier and oscillator circuit for the given specifications.
7. Understand the contemporary issues related to analog electronic circuits.
8. Design, simulation, modeling and hardware implementation of analog circuits with discrete components.

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 | Diode Frequency Response: | 3 hours
Diode Capacitance | Low and High frequency Response of diode

Module:2 | BJT Internal Capacitances & High Frequency Model: | 4 hours
Diffusion capacitance, B-E junction capacitance, C-B junction capacitance, BJT high frequency hybrid-

Module:3 | MOSFET Internal Capacitances & High Frequency Model: | 4 hours
MOS junction capacitances, high frequency model, unity gain frequency, frequency response of a CS amplifier, the three frequency bands.

Module:4 | Power Amplifiers: | 4 hours
Preview – Power Amplifiers, Power Transistors, Classes of Amplifiers, Class A Power Amplifiers, Class B, Class AB Push-Pull Complementary Output Stages

Module:5 | MOSFET Active Biasing: | 3 hours
Introduction to Current Mirror – Basic, Wilson and Cascode Current Mirror.

Module:6 | MOS Differential Amplifiers: | 5 hours
MOSFET Basic Differential Pair, Large Signal and Small Signal Analysis of Differential Amplifier, Differential Amplifier with Active Load, Differential Amplifier Frequency Response.

<table>
<thead>
<tr>
<th>Module:7</th>
<th>MOS Feedback Amplifiers and Oscillators:</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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</thead>
</table>

**Text Books:**


**Reference Books:**


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

**List of Challenging Experiments (Indicative)**

# Simulation Tool used in Experiments : Multisim

# Hardware components used in experiments : discrete R,L,C components, BJT, MOSFET, bread board, Signal Generator, Oscilloscope etc

# Concepts studied in all the modules should have been used

<p>| | | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>1</td>
<td>Introduction to hardware workbench and multisim software simulation tool.</td>
<td>3 hours</td>
</tr>
<tr>
<td>2</td>
<td>Design of the Amplifiers for the given frequency Specifications and conduct frequency response analysis using BJT Single Stage Amplifier</td>
<td>3 hours</td>
</tr>
<tr>
<td>3</td>
<td>Design of the Amplifiers for the given frequency Specifications and conduct frequency response analysis using MOS Single Stage Amplifier</td>
<td>3 hours</td>
</tr>
<tr>
<td>4</td>
<td>Design of Power Amplifiers for the given Specifications using BJT Class B Power Amplifiers.</td>
<td>3 hours</td>
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<tr>
<td>5</td>
<td>Design of Power Amplifiers for the given Specifications using BJT Class AB Power Amplifiers.</td>
<td>3 hours</td>
</tr>
<tr>
<td>6</td>
<td>Design of the Amplifiers for the given frequency Specifications and conduct frequency response analysis using MOS Differential Amplifiers.</td>
<td>3 hours</td>
</tr>
<tr>
<td>7</td>
<td>Design of Feedback Amplifiers for the given Specifications- Shunt Series Feedback Amplifier.</td>
<td>3 hours</td>
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<tr>
<td>8</td>
<td>Design of Feedback Amplifiers for the given Specifications- Series Shunt Feedback Amplifier.</td>
<td>3 hours</td>
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<tr>
<td>9</td>
<td>Design of Oscillators for the given Specifications - RC Phase shift Oscillators.</td>
<td>3 hours</td>
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<tr>
<td>10</td>
<td>Design of Oscillators for the given Specifications - Colpitt’s and Hartley Oscillator</td>
<td>3 hours</td>
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<td><strong>Total laboratory hours</strong></td>
<td>30 hours</td>
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<tr>
<td><strong>Mode of assessment:</strong></td>
<td>Continuous Assessment &amp; Final Assessment Test (FAT)</td>
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<tr>
<td><strong>Typical Projects</strong></td>
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<tr>
<td>- Laser Based Transmitter And Receiver</td>
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<td>- FM Spy Audi Transmitter</td>
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<tr>
<td>- DTMF Based Automation System</td>
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<tr>
<td>- Cellphone Controlled Home Appliances Without Microcontroller</td>
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<tr>
<td>- Bluetooth Controlled Car</td>
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<td>- DTMF Controlled Landrover</td>
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<tr>
<td>- MOSFET Audio Equalizer Circuit</td>
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<tr>
<td>- Mini UPS System</td>
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<tr>
<td>- BJT Subwoofer Power Amplifier</td>
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<tr>
<td>- Design of Low Power Emergency Light Circuit</td>
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<tr>
<td><strong>Mode of evaluation:</strong></td>
<td>Review I, II and III.</td>
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<td>13-12-2015</td>
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<td>No. 40 Date 18-03-2016</td>
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<tr>
<td>ECE2003</td>
<td>Digital Logic Design</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Prerequisite: ECE1002 – Semiconductor Devices and Circuits</td>
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</table>

| Syllabus version | 1.01 |

**Course Objectives:**
1. To represent logical functions in canonical and standard forms
2. To design and analyse the combinational logic circuits
3. To design and analyse the sequential logic circuits
4. To implement combinational and sequential logic circuits using Verilog HDL

**Course Outcome:**
At the end of the course the student should be able to
1. Understand the number systems and IC characteristics
2. Understand the Boolean algebra and its properties
3. Optimize the logic functions using K-map
4. Design and analyse the combinational logic circuits
5. Get grip on Verilog HDL syntax
6. Design and analyse the sequential logic circuits
7. Implement and simulate the combinational logic circuits using Verilog HDL

**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. Having an ability to use techniques, skills and modern engineering tools necessary for engineering practice

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### Module:1 | Number systems and Logic Families:

<table>
<thead>
<tr>
<th></th>
<th>3 hours</th>
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<tbody>
<tr>
<td>Brief review of Number Systems, Digital Logic Gates and its electrical characteristics, Review of RTL, DTL, TTL, ECL, CMOS families.</td>
<td></td>
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### Module:2 | Boolean algebra:

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Basic Definitions, Axiomatic Definition of Boolean Algebra, Basic Theorems and Properties of Boolean Algebra, Boolean Functions, Canonical and Standard Forms.</td>
<td></td>
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### Module:3 | Gate-Level Minimization:

<table>
<thead>
<tr>
<th></th>
<th>3 hours</th>
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<tbody>
<tr>
<td>The Map Method - K-map, Product of Sums and Sum of Products Simplification, NAND and NOR Implementation</td>
<td></td>
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</table>

### Module:4 | Design of Combinational Logic Circuits:

<table>
<thead>
<tr>
<th></th>
<th>5 hours</th>
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### Module:5 | Verilog HDL Coding Style:

<table>
<thead>
<tr>
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<th>4 hours</th>
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</thead>
<tbody>
<tr>
<td>Lexical Conventions, Ports and Modules, Gate Level Modelling, Operators, Data Flow Modelling, Behavioral level Modelling, Testbench.</td>
<td></td>
</tr>
</tbody>
</table>
### Module: 6  
**Design of Sequential Logic Circuits:**  
6 hours  
Latches, Flip-Flops-SR, D, JK & T, Shift Registers-SISO, SIPO, PISO, PIPO, Design of Synchronous Sequential Circuits- State Table and State Diagrams, Design of Counters- Modulo-n, Johnson, Ring, Up/Down, Design of Mealy and Moore FSM -Sequence Detection.

### Module: 7  
**Modelling of Logic Circuits:**  
5 hours  
Modelling of Combinational and Sequential Logic Circuits using Verilog HDL.

### Module: 8  
**Contemporary Issues**  
2 hours  

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**Text Books:**


**Reference Books:**


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

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>List of Challenging Experiments (Indicative)</th>
<th>Total Laboratory Hours:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Characteristics of Digital ICs (Hardware)</td>
<td>4 hours</td>
</tr>
<tr>
<td>2</td>
<td>Implementation of Combinational Logic Design using MUX/Decoder ICs (Hardware)</td>
<td>4 hours</td>
</tr>
<tr>
<td>3</td>
<td>Design and Implementation of various data path elements Adders/Multipliers (Hardware)</td>
<td>4 hours</td>
</tr>
<tr>
<td>4</td>
<td>Design and Implementation of various data path elements like Adders/Multipliers and combinational Logic circuits like Multipliers (Mandatory: Verilog Modeling, Simulation and Synthesis. FPGA implementation (optional))</td>
<td>6 hours</td>
</tr>
<tr>
<td>5</td>
<td>Design and implementation of simple synchronous sequential circuits like Counters / Shift registers (Hardware)</td>
<td>2 hours</td>
</tr>
<tr>
<td>6</td>
<td>Complex state machine design (Simulation and Synthesis)</td>
<td>4 hours</td>
</tr>
<tr>
<td>7</td>
<td>Simple processor design (Simulation and Synthesis)</td>
<td>6 hours</td>
</tr>
</tbody>
</table>

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

Recommended by Board of Studies  
13-12-2015

Approved by Academic Council  
No. 40  
Date: 18-03-2016
Course Code: ECE2004  
Course Title: Transmission Lines And Waveguides  
Pre-requisite: ECE1003 - Electromagnetic Field Theory  
Syllabus Version: 1.0

Course objectives:
1. To introduce the basic concepts of transmission lines and analyze the different parameters, namely SWR, reflection coefficient, return loss.
2. To have the basic knowledge of Smith chart for solving the transmission line problems and analyse the matching sections using stubs and LC network.
3. To teach different types of waveguide devices and understand the distribution of electromagnetic fields within waveguides using Maxwell’s equations.

Course Outcomes:
1. Obtain solutions to transmission line equations with characteristic impedance, input impedance and propagation constant.
2. Able to solve the numerical problems of lossy, lossless and distortion less transmission line.
3. Distinguish between reflection coefficient plane and the impedance plane, location of SWR, voltage maxima and minima points and solve impedance and admittance calculations using Smith Chart.
4. Design and interpret the impedance matching transmission line sections using single stub, double stub and LC sections using Smith Chart.
5. Analyze the field components of different waveguides and planar transmission lines based on various modes of E and H field.
6. Understand the various interference techniques due to EM fields and the compatibility of the EM 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  Introduction  6 hours
Common types of transmission lines used in circuits, lumped circuit model for transmission line and formal solutions. Characteristic impedance, propagation constant, attenuation and phase constants, wavelength and phase velocity, Transmission line with mismatched load

Module:2  Lossy and Loss less Transmission line  7 hours
Reflection coefficient, standing wave ratio, return loss, transmission coefficient, insertion loss, standing wave pattern, input impedance. Low loss line, distortion less transmission lines, generator and load mismatch. Open circuited and short circuited lines. Transmission line resonator.

Module:3  Smith Chart  8 hours
Impedance and admittance chart, measurement of reflection coefficient, return loss, VSWR, impedance, admittance, insertion loss, standing wave ratio and attenuation.

Module:4  Impedance matching  5 hours
Lumped element matching, single and double stub matching, quarter wave transformer narrowband and broadband matching.

<table>
<thead>
<tr>
<th>Module:5</th>
<th>Waveguides</th>
<th>7 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>General solutions for TEM, TE and TM waves- parallel plate waveguide, rectangular waveguide, circular waveguide. Characteristics of wave guide- guide wavelength, cut off wave length, cut off frequency, wave impedance phase constant, phase velocity, group velocity, power and attenuation. Excitation of different modes in waveguides.</td>
<td></td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:6</th>
<th>Planar transmission lines</th>
<th>6 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to planar transmission lines - strip lines, microstrip lines- coupled lines, slot line, coplanar wave guide (CPW). Microstrip lines - field distribution, design equations - Losses in microstrip lines. Coaxial transmission line (distributed parameters).</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:7</th>
<th>Electromagnetic Interference (EMI)</th>
<th>4 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to EMI and EMC, Electromagnetic noise sources, Coupling between transmission lines and external EM fields, Methods to suppress EMI- Grounding and shielding.</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>
</table>

<table>
<thead>
<tr>
<th>Total lecture hours:</th>
<th>45 hours</th>
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</thead>
</table>

Text Book(s)


Reference Books:


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
<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>
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<tbody>
<tr>
<td>ECE2005</td>
<td>Probability Theory and Random Processes</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
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</tbody>
</table>

Pre-requisite: ECE1004 – Signals and Systems

| Syllabus Version | 1.0 |

**Course Objectives**

1. To familiarize the students with two and multi random variable theory
2. To enable the students to process the random signals in time and frequency domains
3. To make the students to understand the noise concepts and design a matched filter to increase the Signal to Noise Ratio (SNR)

**Course Outcomes**

The students will be able to

1. Extend the concept of single random variable to two and multi-random variables. Understand the probability density functions for multiple random variables
2. Perform transformation on multiple random variables and understand the concept of central limit theorem
3. Interpret the random processes in terms of stationarity, statistical independence and correlation
4. Compute the power spectral density of the random signals
5. Able to interpret the effect of random signals on LTI systems output both in time and frequency domain.
6. Able to design matched filter/Optimum filter for extracting signals in the presence of noise.

**Student Learning Outcomes (SLO): 1, 9, 18**

1. Having an ability to apply mathematics and science in engineering applications
9. Having problem solving ability- solving social issues and engineering problems
18. Having critical thinking and innovative skills

**Module:1 Multiple Random Variables**


**Module:2 Operations on Multiple Random Variables**


**Module:3 Random Processes – Temporal Characteristics**


**Module:4 Random Processes – Spectral Characteristics**

<table>
<thead>
<tr>
<th>Module:5</th>
<th>Linear Systems with Random Inputs</th>
<th>4 hours</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Module:6</th>
<th>Noise</th>
<th>4 hours</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Module:7</th>
<th>Modelling of Noise Sources</th>
<th>8 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistive Noise Sources – Arbitrary Noise Sources – Effective Noise Sources-Noise Temperature-Noise Figure-Incremental Modelling of Noisy Networks- Modelling of Practical Noisy Networks Signal to Noise Ratio – Mean Square Error- Optimization by Parameter Selection- Matched Filter for Colored Noise- Matched Filter for White Noise-Practical Applications</td>
<td></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>
</table>

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

<table>
<thead>
<tr>
<th>Reference Books</th>
<th></th>
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<table>
<thead>
<tr>
<th>Mode of Evaluation:</th>
<th>Continuous Assessment Test –I (CAT-I), Continuous Assessment Test –II (CAT-II), Digital Assignments/ Quiz / Completion of MOOC, Final Assessment Test (FAT).</th>
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</thead>
</table>

| 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
--- | --- | --- | --- | --- | --- | ---
ECE2006 | Digital Signal Processing | 2 | 0 | 2 | 4 | 4
Pre-requisite | ECE1004 – Signals and Systems | Syllabus Version | 1.0

Course Objectives:
1. To summarize and analyze the concepts of signals, systems in time and frequency domain with corresponding transformations.
2. To instruct the students to design the analog and digital IIR, FIR filters.
3. To introduce the students the diverse structures for realizing digital filters.
4. To teach students the usage of appropriate tools for realizing signal processing modules

Course Outcomes:
1. Comprehend, classify and analyze the signals and systems, also, transform the time domain signals to frequency domain for analyzing system response
2. Able to simplify Fourier transform computations using fast algorithms
3. Comprehend the various analog filter design techniques and their digitization.
4. Able to design digital filters.
5. Able to realize digital filters using delay elements, summer, etc.
6. Able to realize lattice filters using delay elements, ladders, summers, etc.
7. Able to analyze and exploit the real-time signal processing applications
8. Design and implement systems using the imbibed signal processing concepts

Student Learning Outcomes (SLO): 2, 5, 8, 17
2. Having a clear understanding of the subject related concepts and of contemporary issues
5. Having design thinking capability
8. Having Virtual Collaborating ability
17. Having an ability to use techniques, skills and modern engineering tools necessary for engineering practice

Module:1 Frequency Analysis of Signals and Systems-I 2 hours

Module:2 Frequency Analysis of Signals and Systems-II 5 hours
Frequency domain sampling- Sampling rate conversion - Aperiodic correlation estimation- Cepstrum processing- Band limited discrete time signals- Phase and group delay- DFT-Properties. Frequency analysis of signals using DFT-FFT Algorithm-Radix-2 FFT algorithms-Applications of FFT

Module:3 Theory and Design of Analog Filters 5 hours
Design techniques for analog low pass filter -Butterworth and Chebyshev approximations, frequency transformation, Properties -Constant group delay and zero phase filters

Module:4 Design of IIR Digital Filters 4 hours
IIR filter design: Bilinear and Impulse Invariant Techniques- Spectral transformation of Digital filters.

Module:5 Design of FIR Digital Filters 5 hours
**Module: 6 | Realization of Digital Filters**

<p>| | |</p>
<table>
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<tbody>
<tr>
<td></td>
<td>3 hours</td>
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<tr>
<td>Direct, Cascade, Parallel, State space representations, Basic FIR and IIR digital filter structures</td>
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</table>

**Module: 7 | Realization of Lattice filter structures**

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<tbody>
<tr>
<td></td>
<td>4 hours</td>
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<tr>
<td>All pass filters, IIR tapped cascaded lattice structures, FIR cascaded lattice structures, Parallel all pass realization of IIR transfer function</td>
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</table>

**Module: 8 | Contemporary issues**

<table>
<thead>
<tr>
<th></th>
<th>2 hours</th>
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<td></td>
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<tr>
<td>Total lecture hours:</td>
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</tbody>
</table>

**Text Book(s)**


**Reference Books**


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

**List of Challenging Experiments (Indicative)**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction to MATLAB 2015A, Code Composer Studio and Digital Signal Processor.</td>
</tr>
<tr>
<td>3</td>
<td>Signal Processing Techniques for Speech Applications-simulation, optimization and implementation.</td>
</tr>
<tr>
<td>4</td>
<td>Signal processing methods for Music Signals- simulation, optimization and implementation.</td>
</tr>
<tr>
<td>5</td>
<td>Signal processing mechanisms for Bio-Signals - simulation, optimization and implementation.</td>
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<tbody>
<tr>
<td></td>
<td>Total laboratory hours: 30 hours</td>
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</tbody>
</table>

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

**Typical Projects**

1. Voice biometric speaker recognition
2. Hearing aid system
3. Identification of Musical Instruments
4. Simulation of cochlear implant in MATLAB
5. Speaker recognition system based on MFCC
6. Voice conversion
7. Disease detection based on ECG
8. Implementation of 5-Band Audio Equalizer in Matlab
9. Watermarking in audio signal
10. Musical tone generator using Matlab
11. Hearing aid system for impaired People using Matlab
13. Implementation of speech recognition system
14. Disease detection based on Speech signal
15. Disease detection based on EEG.

<table>
<thead>
<tr>
<th>Mode of evaluation: Review I, II and III.</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 impart students the need, design, analysis and applications of Linear AM modulators and demodulators.
2. To introduce Angle Modulation, demodulation and the concept of pre-emphasis and de-emphasis.
3. To elaborate the super-heterodyne receiver and the Figure of Merit in DSB-SC, SSB, AM and FM receivers.
4. To describe the sampling, pulse modulation schemes-PAM, PWM and PPM and the multiplexing techniques FDM and TDM.

Course Outcomes:
1. Able to comprehend the elements of electronic communication system
2. Ability to design AM, DSB-SC and SSB-SC modulation and demodulation, and to calculate the power of AM, DSB-SC and SSB-SC schemes.
3. Able to design DSB-SC and SSB-SC modulator and demodulator.
4. Comprehend and compare the FM and PM generation and design, distinguish Wideband and Narrowband FM signals.
5. Comprehend and compare different angle demodulators.
6. Able to design radio receivers, identify role of AGC, and compute noise voltage, signal-to-noise ratio, noise figure, noise temperature and figure of merit.
7. Determine the Nyquist sampling rate of a given signal, explain aliasing effect, Comprehend and compare the different pulse modulation techniques.

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 Introduction to Communication Systems 
4 hours
Need and Importance of Communication, Elements of a Communication System, Types of communication systems - Electromagnetic Spectrum used in communication, concept of bandwidth and power, Receiver characteristics, Need for modulation.

Module: 2 Linear Modulation 
8 hours
Amplitude modulation – 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: 3 Bandwidth and Power Efficient AM Systems 
5 hours
DSB-SC modulation, Power saving in DSB-SC, Synchronous detection, Quadrature null effect, SSB-SC, VSB generation and demodulation. Comparison of linear modulation systems with respect to power, bandwidth and receiver complexity, Low level and high level AM transmitters.

Module: 4 Angle Modulation 
7 hours
Principle of frequency and phase modulation – Relation between FM and PM waves – Frequency deviation, Bandwidth of FM – Narrow band and wide band FM, FM transmitter, Bessel functions and Carson’s rule – Generation of FM and PM wave- Comparison of AM and FM.

<table>
<thead>
<tr>
<th>Module:5</th>
<th>Demodulation of Angle Modulated Signals</th>
<th>8 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FM detectors – slope detectors – Phase discriminators – Ratio detectors. Feedback Demodulators - The Phase Locked Loop-Frequency Compressive Feedback Demodulator. Pre-emphasis and de-emphasis.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:6</th>
<th>Receivers and Noise in Communication Systems</th>
<th>7 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tuned Radio Frequency (TRF), Super-heterodyne receiver (AM and FM) - Choice of IF and Oscillator frequencies – Tracking – alignment – AGC, AFC Noise and its types. Noise voltage - Signal-to-noise ratio - Noise figure - Noise temperature - Noise figure, Figure of Merit in DSB-SC, SSB, AM and FM receivers</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:7</th>
<th>Pulse Modulation Systems</th>
<th>4 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sampling theorem, Types of Sampling. Pulse modulation schemes – PAM, PPM and PWM generation and detection-Pulse code modulation. Conversion of PWM to PPM. Multiplexing Techniques - FDM and TDM - problems related to FDM and TDM.</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>45 hours</td>
</tr>
</tbody>
</table>

**Text Books**

**Reference Books**

**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: ECE3002  
**Course Title:** VLSI System Design  
**L T P J C:** 3 0 2 0 4  
**Prerequisite:** ECE2003 Digital Logic Design  
**Syllabus version:** 1.2

#### 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. 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

#### Module: 7  
**Sub System Design**  
6 hours
Single bit Adder, Carry look ahead adder, Carry propagate Adder, Magnitude Comparator, Barrel Shifter, Signed and unsigned multiplier.

<table>
<thead>
<tr>
<th>Module</th>
<th>Contemporary Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2 hours</td>
</tr>
</tbody>
</table>

| Total Lecture Hours: | 45 hours |

**Text Books:**


**Reference Books:**


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

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>List of Challenging Experiments (Indicative):</th>
<th>Total laboratory hours:</th>
</tr>
</thead>
</table>
| 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) | 8 hours |
| 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).  
v. 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).
Course Code: ECE3003  
Course Title: Microcontroller and its Applications  
Pre-requisite: ECE2003 - Digital Logic Design  
Syllabus version: 1.01

Course Objectives:
1. To introduce the architectures of microprocessors, microcontroller and ARM processors
2. To familiarize the students with assembly language programming in 8051 microcontroller
3. To design the interfacing of peripherals interfacing with the 8051 microcontroller
4. To introduce code converters and sensors interfacing with 8051 microcontroller

Course Outcomes:
1. Comprehend and analyze architectures of microprocessors, microcontroller and ARM7 processor
2. Comprehend the evaluations of the Intel (i3, i5, i7) series processors
3. Comprehend the memory organization of 8051 microcontroller
4. Showcase the skill, knowledge and ability of programming using instruction set
5. Work with microcontroller and interfaces including general purpose input/output and timers
6. Comprehend and use peripheral serial communication and the concepts of interrupts in 8051 microcontroller
7. Interface 8051 microcontroller with the input and output devices such as LEDs, LCDs, 7-segment display and keypad
8. Design 8051 microcontroller based system with analog-to-digital converters and digital-to-analog converters within realistic constraints like user specification, availability of components etc.

Student Learning Outcomes (SLO):  2, 8, 14, 17
2. Having a clear understanding of the subject related concepts and of contemporary issues
8. Having Virtual Collaborating ability
14. Having an ability to design and conduct experiments, as well as to analyze and interpret data
17. Having an ability to use techniques, skills and modern engineering tools necessary for engineering practice

Module:1  Introduction to Processors:  4 hours
Introduction to Microprocessors and Microcontrollers, 8-bit/16-bit Microprocessor Architectures [8085, 8086], Introduction to ARM7, Intel I (i3, i5, i7) Series Processors

Module:2  8051 Architecture:  4 hours
8051 - Organization and Architecture, RAM-ROM Organization, Machine Cycle

Module:3  8051 Instruction Set:  6 hours
Data Processing - Stack, Arithmetic, Logical; Branching – Unconditional and Conditional

Module:4  8051 Peripherals: Ports and Timers  3 hours
Peripherals: I/O Ports, Timers-Counters

Module:5  8051 Peripherals: Serial Communication and Interrupt  3 hours
Peripherals: Serial Communication, Interrupts
## Module: 6  |  Peripheral Interfacing:
--- | ---
4 hours | Interfaces: LCD, LED, Keypad

## Module: 7  |  Peripheral Interfacing:
--- | ---
4 hours | Interfaces: Analog-to-Digital Convertors, Digital-to-Analog Convertors, Sensor with Signal Conditioning Interface

## Module: 8  |  Contemporary issues:
--- | ---
2 hours | 

**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)
<table>
<thead>
<tr>
<th>Experiment</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keil Simulator tool Introduction.</td>
<td>2 hours</td>
</tr>
<tr>
<td>I/O ports programming.</td>
<td>4 hours</td>
</tr>
<tr>
<td>LCD Interfacing.</td>
<td>2 hours</td>
</tr>
<tr>
<td>Keypad Interfacing.</td>
<td>2 hours</td>
</tr>
<tr>
<td>Timer programming.</td>
<td>4 hours</td>
</tr>
<tr>
<td>Interrupt Programming.</td>
<td>4 hours</td>
</tr>
<tr>
<td>Motor Interfacing.</td>
<td>2 hours</td>
</tr>
<tr>
<td>ADC/DAC Interfacing.</td>
<td>4 hours</td>
</tr>
<tr>
<td>Sensors Interfacing.</td>
<td>4 hours</td>
</tr>
<tr>
<td>Serial port programming.</td>
<td>2 hours</td>
</tr>
</tbody>
</table>

**Total laboratory hours** 30 hours

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

### Typical Projects:
1. Electronic code locker
2. Water level Indicator alarm
3. Remote Room Temperature Monitoring
4. Digital countdown timer
5. Fire detection
6. Digital voltmeter
7. Car parking system
8. Vehicle tracking system
9. TV Remote control  
10. Intelligent Traffic control  
11. Smartphone home appliance control  
12. Automated toll collection system  
13. Sun tracking system  
14. Street light intensity control  
15. Rash driving alert  
16. Flood monitoring  
17. Automatic irrigation system  
18. GSM based energy monitoring system  
19. Gas leakage detection  
20. Electronic Voting Machine  
21. Automatic College Bell  
22. Finger print based Electronic Voting Machine  
23. Line Following Robot Microcontroller based Intelligent Digital Volume Controller with Timers

**Mode of evaluation:** Review I, II and III

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Date</th>
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<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</td>
</tr>
<tr>
<td>Date</td>
<td>18-03-2016</td>
</tr>
</tbody>
</table>
Course Code: ECE4001  
Course Title: Digital Communication Systems  
L T P J C: 3 0 2 0 4  
Pre-requisite: ECE3001 – Analog Communication Systems  
Syllabus version: 1.1

Course Objectives:
1. To interpret the transmitter and receiver blocks of various waveform coding techniques.
2. To analyze various line coding techniques in time and frequency domains.
3. To identify the role of baseband and bandpass formats for effective transmission of signals, combat ISI and to increase the reliability of transmission.
4. To understand the principles and importance of spread spectrum and multiple access in the context of communication.

Course Outcomes:
1. Comprehend the sampling process of analog signal and recover the original signal without any distortion.
2. Apply the knowledge of signal theory and evaluate the performance of various waveform coding techniques.
3. Characterize various line coding techniques in time and frequency domains.
4. Design the baseband pulse for ISI free transmission over finite bandwidth channels.
5. Describe the mathematical model of a digital modulation technique, characterize the effect of AWGN channel and determine its bit error rate performance.
6. Describe and analyze the digital communication system with spread spectrum modulation.
7. Design as well as conduct experiments, analyze and interpret the results to provide valid conclusions for digital modulators and demodulators using hardware components and MATLAB tool.

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  
Sampling and Quantization  
4 hours

Module: 2  
Waveform Coding Techniques  
5 hours
Pulse Code Modulation (PCM) – Quantization noise and signal to quantization noise ratio – Companding (A law and µ law) – Differential pulse code modulation-Delta modulation.

Module: 3  
Line Codes  
6 hours
Representation of line codes – Properties and applications of line codes – Power spectral density of NRZ unipolar, NRZ polar, NRZ bipolar and Manchester.

Module: 4  
Baseband System  
7 hours

Module: 5  
Bandpass System-I  
8 hours
Gram-Schmidt orthogonalization procedure – Correlation receiver – QAM- Generation and detection of coherent system (BASK, BFSK, BPSK, QPSK, MSK) – Error performance.
<table>
<thead>
<tr>
<th>Module:6</th>
<th>Bandpass System-II</th>
<th>6 hours</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Module:7</th>
<th>Spread Spectrum Techniques and Multiple Access Techniques</th>
<th>7 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generation of PN sequence and its properties – Direct sequence spread spectrum – Processing gain – Probability of error – Anti-jam characteristics – Frequency hopped spread spectrum – Slow and fast frequency hopping – Multiple access techniques - TDMA, FDMA, CDMA</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:8</th>
<th>Contemporary issues</th>
<th>2 hours</th>
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<tr>
<th></th>
<th>Text Book(s)</th>
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<table>
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<th></th>
<th>Reference Books</th>
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<tr>
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<th>Total lecture hours:</th>
<th>45 hours</th>
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|                  | Mode of Evaluation: Internal Assessment (CAT, Quizzes, Digital Assignments) & Final Assessment Test (FAT) |

<table>
<thead>
<tr>
<th></th>
<th>List of Challenging Experiments (Indicative)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SOFTWARE BASED TASKS</td>
</tr>
<tr>
<td></td>
<td>1. Simple digital communication system</td>
</tr>
<tr>
<td></td>
<td>Simulate a simple communication system which transmits a text message from the source to the destination. Also, observe signals at different points of this communication system.</td>
</tr>
</tbody>
</table>

|                  | 2. Coding for analog sources                |
|                  | Consider the given analog audio signal. Convert the analog input signal into binary sequence using |
|                  | i. Pulse code modulation (PCM)              |
|                  | ii. Differential pulse code modulation (DPCM) |
|                  | iii. Delta Modulation (DM)                  |
|                  | iv. Adaptive delta modulation (ADM)         |
|                  | Also, construct the stair-case approximated signal from the received binary sequence using above mentioned decoding schemes. |
|                  | In DM, analyse the impact of step size and sampling period on the stair case reconstruction. | 4 hours |

|                  | 3. Line coding                             |
|                  | Write a code which uses the below mentioned line coding techniques to generate the baseband signal for the given text message. Also, transmit the generated base band signal through AWGN channel. Analyse the effect of channel noise on the reconstructed signal. |
|                  | i. Unipolar                               | 4 hours |
### 4 Band-pass Modulation

Write a code which uses below mentioned band pass modulation techniques to generate the modulated signal for the given text message. Transmit the modulated signal through AWGN channel. Detect transmitted message using the suitable rules. Plot the necessary graphs.

- **i.** BASK
- **ii.** BPSK
- **iii.** BFSK
- **iv.** DPSK

4 hours

### 5 Probability of error analysis

Consider the bit sequence of length 10,000. Modulate it with BPSK, BASK, BFSK. Transmit the signal through AWGN channel. Vary the SNR. Compare the theoretical and simulated probability of error.

Consider the bit sequence of length 10,000. Modulate it with BPSK, QPSK and 8-PSK. Transmit the signal through AWGN channel. Vary the SNR. Compare the theoretical and simulated probability of error.

2 hours

### 6 Spread spectrum

Write a code to complete the following task:

- **i.** For the given connection logic and the number of flip-flops, generate the pseudo-noise (PN) sequence. Check whether the given connection logic is primitive or not using periodicity property.
- **ii.** For the generated PN sequence, verify
  - a) Balance property
  - b) Run property
  - c) Auto-correlation property
- **iii.** Use the generated PN sequence to get direct sequence spread spectrum (DSSS) (Assume BPSK modulation). Construct a simple transceiver chain.
- **iv.** Use the generated PN sequence to get slow and fast frequency hopped signals (Assume M-FSK modulation). Construct a simple transceiver chain.

4 hours

### Multiple Access

Consider 4 users with different data. Use the following multiple access schemes to generate the composite signal. Use the orthogonality property to get back the proper data at the receiver end.

Multiple access schemes:

- **i.** TDMA (Hint: Use GSM burst format)
- **ii.** CDMA (Hint: Use Hadamard codes)
- **iii.** OFDMA (Hint: Use IEEE 802.11a specifications)

4 hours

### HARDWARE BASED TASKS

8 Generation and detection of ASK, FSK and PSK

2 hours
<table>
<thead>
<tr>
<th>Experiment</th>
<th>Description</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td><strong>Implementation of QPSK modulation</strong>&lt;br&gt;Build the transceiver chain for the QPSK scheme. Observe signals at different points of communication system.</td>
<td>2 hours</td>
</tr>
<tr>
<td>10</td>
<td><strong>Adaptive linear Equalizer</strong>&lt;br&gt;Build the transceiver chain for adaptive linear equalizer and discuss the RRC pulse generation and LMS rule.</td>
<td>2 hours</td>
</tr>
</tbody>
</table>

**Total laboratory hours**: 30 hours

**Mode of evaluation**: Continuous assessment & FAT

Recommended by Board of Studies 28-02-2016

Approved by Academic Council No. 47 Date 05-10-2017
Course Code: MAT2002  
Course Title: Applications of Differential and Difference Equations  
Pre-requisite: MAT1011 - Calculus for Engineers  
Syllabus Version: 1.0

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

Course Outcomes
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, eigenvectors and diagonalisation in linear systems
3. Know the techniques of solving differential equations
4. Understand the series solution of differential equations and finding eigenvalues, 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. 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:  
- 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:  
- Eigenvalues and Eigenvectors - Properties of eigenvalues and eigenvectors – Cayley-Hamilton theorem - Similarity of transformation - Orthogonal transformation and nature of quadratic form

Module:3  
Solution of ordinary differential equations:  
### 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 \(X' = AX\)

### Module: 5
**Strum Liouville’s problems and power series Solutions:**
6 hours

- 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

### Module: 6
**Z-Transform:**
6 hours

- Z-transform - transforms of standard functions - Inverse Z-transform: by partial fractions and convolution method

### Module: 7
**Difference equations:**
5 hours

- 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

### Module: 8
**Contemporary Issues**
2 hours

- Industry Expert Lecture

---

**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

**List of Challenging Experiments (Indicative)**

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
<table>
<thead>
<tr>
<th></th>
<th>Activity</th>
<th>Hours</th>
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<tbody>
<tr>
<td>5</td>
<td>Visualizing Eigen value and Eigen vectors</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>Solving system of differential equations arising in engineering applications</td>
<td>2</td>
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<tr>
<td>7</td>
<td>Applying the Power series method to solve differential equations arising in engineering applications</td>
<td>4</td>
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<tr>
<td>8</td>
<td>Applying the Frobenius method to solve differential equations arising in engineering applications</td>
<td>2</td>
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<tr>
<td>9</td>
<td>Visualising Bessel and Legendre polynomials</td>
<td>2</td>
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<tr>
<td>10</td>
<td>Evaluating Fourier series-Harmonic series</td>
<td>2</td>
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<tr>
<td>11</td>
<td>Applying Z-Transforms to functions encountered in engineering</td>
<td>2</td>
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<tr>
<td>12</td>
<td>Solving Difference equations arising in engineering applications</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td><strong>Total laboratory hours</strong></td>
<td><strong>30</strong></td>
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</table>

**Mode of evaluation:** Weekly Assessment, Final Assessment Test

Recommended by Board of Studies 25-02-2017

Approved by Academic Council No. 47 Date 05-10-2017
### Course Objectives
1. Understanding basic concepts of linear algebra to illustrate its power and utility through applications to computer science and Engineering.
2. Apply the concepts of vector spaces, linear transformations, matrices and inner product spaces in engineering.
3. Solve problems in cryptography, computer graphics and wavelet transforms

### Course Outcomes
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
5. Use of wavelet in image processing.

### Student Learning Outcomes (SLO)
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

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### Module: 2 Vector Spaces

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

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

### Module: 4 Linear Transformations and applications

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</table>

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

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</table>

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

### Text Book(s)

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

### Reference Books


### Mode of Evaluation: Digital Assignments, Continuous Assessments, Final Assessment Test

- Recommended by Board of Studies | 25-02-2017
- Approved by Academic Council | No. 47 | Date | 05-10-2017
Course Code | Course Title                       | L | T | P | J | C
-------------|-----------------------------------|---|---|---|---|---
CSE2003      | Data Structures And Algorithms    | 2 | 0 | 2 | 4 | 4
Pre-requisite| NIL                               |   |   |   |   |   

Syllabus version: 1.0

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>
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</thead>
<tbody>
<tr>
<td></td>
<td>Breadth First Search (BFS), Depth First Search (DFS), Minimum Spanning Tree (MST), Single Source Shortest Paths.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:6</th>
<th>Computational Complexity classes</th>
<th>5 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tractable and Intractable Problems, Decidable and Undecidable problems, Computational complexity Classes: P, NP and NP complete - Cooks 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>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:7</th>
<th>Recent Trends</th>
<th>2 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Algorithms related to Search Engines</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
Course Code | Course Title | L | T | P | J | C | Syllabus version
--- | --- | --- | --- | --- | --- | --- | ---
CSE2005 | Operating Systems | 2 | 0 | 2 | 4 | 4 | 1.0
Pre-requisite | NIL | |

Course Objectives:
1. To introduce the concept of Operating system concepts and designs and provide the skills required to implement the services.
2. To describe the trade-offs between conflicting objectives in large scale system design.
3. To develop the knowledge for application of the various design issues and services.

Course Outcomes:
1. Interpret the evolution of OS functionality, structures and layers.
2. Apply various types of system calls and to find the stages of various process states.
3. Design a model scheduling algorithm to compute various scheduling criteria.
4. Apply and analyze communication between inter process and synchronization techniques.
5. Implement page replacement algorithms, memory management problems and segmentation.
6. Differentiate the file systems for applying different allocation and access techniques.
7. Representing virtualization and Demonstrating the various Operating system tasks and the principle algorithms for enumerating those tasks.

Student Learning Outcomes (SLO): 2, 14, 17
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.
17. Having an ability to use techniques, skills and modern engineering tools necessary for engineering practice.

Module: 1 | Introduction | 2 hours
--- | --- | ---
Introduction to OS: - Functionality of OS - OS Design issues - Structuring methods (monolithic, layered, modular, micro-kernel models) - Abstractions, processes, and resources - influence of security, networking, multimedia.

Module: 2 | OS Principles | 3 hours
--- | --- | ---
System Calls System/Application Call Interface - Protection User/Kernel modes - Interrupts Processes and Threads - Structures (Process Control Block, Ready List etc).

Module: 3 | Scheduling | 5 hours
--- | --- | ---
Processes Scheduling - CPU Scheduling - Pre-emptive non-pre-emptive - Resource allocation and management - Deadlocks Deadlock Handling Mechanisms.

Module: 4 | Concurrency | 4 hours
--- | --- | ---
Inter-process communication Synchronization - Implementing Synchronization Primitives Semaphores - Monitors - Multiprocessors and Locking - Scalable Locks - Lock-free Coordination.

Module: 5 | Memory management | 5 hours
Main Memory management
Memory allocation strategies
Caching - Virtual Memory
Hardware TLB
- Virtual Memory
OS techniques
Paging
Segmentation
Page Faults
Page Replacement
Thrashing
Working Set.

### Module: 6 | Virtualization | 4 hours
---
Virtual Machines
Virtualization (Hardware/Software, Server, Service, Network)
Hypervisors
- OS - Container
Virtualization - Cost of virtualization.

### Module: 7 | File systems | 3 hours
---
File system interface - file system implementation
File system recovery
Journaling - Soft updates
LFS - Distributed file system.

### Module: 8 | Security Protection and trends | 4 hours
---
Security and Protection - Mechanism Vs Policies
Access and authentication - models of protection
Memory Protection
Disk Scheduling - OS performance,
Scaling OS - Mobile OS: Recent Trends:
- Future directions in Mobile OS / Multi-core
Optimization / Power efficient Scheduling

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

**Total lecture hours:** 30 hours

### List of Challenging Experiments (Indicative)

<table>
<thead>
<tr>
<th>Experiment Description</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Write a boot loader to load a particular OS say TinyOS/ KolibriOS image - code to access from BIOS to loading the OS - involves little assembly code may use QEMU/virtual machines for emulation of hardware.</td>
<td>4 hours</td>
</tr>
<tr>
<td>2. Allocate/free memory to processes in whole pages, find max allocatable pages, incorporate address translation into the program.</td>
<td>2 hours</td>
</tr>
<tr>
<td>3. Create an interrupt to handle a system call and continue the previously running process after servicing the interrupt.</td>
<td>4 hours</td>
</tr>
<tr>
<td>4. Write a Disk driver for the SATA interface. Take care to check readiness of the controller, locked buffer cache, accept interrupts from OS during the period, interrupting the OS again once done and clearing buffers.</td>
<td>2 hours</td>
</tr>
<tr>
<td>5. Demonstrate the use of locks in conjunction with the IDE driver.</td>
<td>4 hours</td>
</tr>
<tr>
<td>6. Run an experiment to determine the context switch time from one process to another and one kernel thread to another. Compare the findings.</td>
<td>2 hours</td>
</tr>
<tr>
<td>7. Determine the latency of individual integer access times in main memory, L1 Cache and L2 Cache. Plot the results in log of memory accessed vs average latency.</td>
<td>4 hours</td>
</tr>
<tr>
<td>8. Compare the overhead of a system call with a procedure call. What is the cost of a minimal system call?</td>
<td>2 hours</td>
</tr>
<tr>
<td>9. Compare the task creation times. Execute a process and kernel thread, determine the time taken to create and run the threads.</td>
<td>4 hours</td>
</tr>
</tbody>
</table>
10. Determine the file read time for sequential and random access based on varying sizes of the files. Take care not to read from cached data - used the raw device interface. Draw a graph log/log plot of size of file vs average per-block time.

<table>
<thead>
<tr>
<th>Total laboratory hours</th>
<th>30 hours</th>
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**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>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tr>
<td>ECE1006</td>
<td>Introduction to Nano Science and Nanotechnology</td>
<td>2</td>
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<td>3</td>
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<tr>
<td>Pre-requisite</td>
<td>PHY1701–Engineering Physics</td>
<td></td>
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</table>

**Course Objectives:**

1. To understand the basic concepts involved in the field of Nanoscience and Nanotechnology.
2. To introduce the fundamental concepts of statistical mechanics, to compare different distribution functions and to enable them to understand the various degrees of quantization.
3. To analyze the concepts of quantum mechanics and its applications.
4. To gain knowledge about various synthesis routes of nanostructured materials and to introduce students about the basic characterization concepts and nanometrology tools.

**Course Outcomes:**

1. Understand and appreciate the novel concepts in the field of nanoscience and nanotechnology. Also to comprehend and compare various particles based on their distribution functions and the degrees of quantization.
2. Understand the basic concepts of quantum mechanics.
3. Understand the change in properties at nanoscale.
4. Know the types of nanostructures and few important nanomaterials including carbon nanotubes.
5. Gain knowledge about bottom-up and top-down approaches for producing nanomaterials.
6. Be aware of various morphological characterization techniques and selecting the appropriate tool for their future research.
7. Be aware of various spectroscopic characterization techniques and work on futuristic applications of nanomaterials.

**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
9. Having problem solving ability-s solving social issues and engineering problems

**Module:1 Introduction**


**Module:2 Quantum Mechanics**

Basics in Quantum Mechanics, Schrödinger wave equation and its applications. Quantum confinement and density of states in 0-D, 1-D and 2-D. Quantum mechanical tunneling process.

**Module:3 Change in material properties at Nano scale**

Effects of the nanometre length scale- Change in physical, chemical, mechanical, magnetic, electronic and optical properties at Nano scale.

**Module:4 Important Nano materials**

4 hours
Engineering Nano materials, Basic Types of Nanostructures- Fundamental concepts on semiconductor hetero structure (super lattice and quantum wells), Carbon Nanotubes, Nanowires, and Quantum Dots.

<table>
<thead>
<tr>
<th>Module:5</th>
<th>Fabrication methods for nanomaterials</th>
<th>5 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top-down processes- Ball milling, Optical lithography, E-Beam lithography, Micro machining, Bottom-up processes- Physical vapour deposition, Chemical vapour deposition, Self-assembly, Molecular beam epitaxy.</td>
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<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:6</th>
<th>Characterization Technique - Microscopy</th>
<th>5 hours</th>
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</thead>
</table>

<table>
<thead>
<tr>
<th>Module:7</th>
<th>Characterization Technique – Spectroscopy</th>
<th>4 hours</th>
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</table>

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

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

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

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

| List of Challenging Projects: |
1. Chemical composition study of metallic nanomaterials using Fourier transform infrared spectroscopy (FTIR)
2. Synthesis of Anti Corrosive paints using Nanomaterials (Sol-Gel)
3. Synthesis of nano particles to make anti fading fabric (Sol-Gel)
4. Bandages impregnated with nanosilver to kill germs
5. Synthesis of nano particles to make nanosocks which keeps the feet from smelling bad (Sol-Gel)
6. Effectiveness of different kinds of sunscreen- With and without nanoparticles
7. Synthesis of nano coating materials to make Hydro phobic clothes (Sol-Gel)
8. Property optimization of multi wall carbon nano tubes (MWNT) and single wall nano tubes (SWNT)

**Mode of evaluation:** Review I, II and III.

<p>| Recommended by Board of Studies | 13-12-2015 |
| Approved by Academic Council | No. 40 | Date | 18-03-2016 |</p>
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tr>
<td>ECE1007</td>
<td>Optoelectronics</td>
<td>3</td>
<td>0</td>
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Pre-requisite

<table>
<thead>
<tr>
<th>Course Title</th>
<th>Syllabus Version</th>
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</thead>
<tbody>
<tr>
<td>PHY1701 – Engineering Physics</td>
<td>1.1</td>
</tr>
</tbody>
</table>

Course Objectives:

1. To introduce the fundamentals of the basic physics behind optoelectronic devices.
2. To impart the applied aspects of optoelectronic device physics and its usage in the design and operation of laser diodes, light-emitting diodes, photodetectors and light modulators.
3. To provide applications of optoelectronic systems in telecommunication engineering

Course Outcomes:

1. Understand the band structures of various types of semiconductors and choice of materials for optical process in semiconductors.
2. Understand the basic concepts of optical absorption and recombination process in semiconductors.
3. Understand the various types of optical sources, characteristics and their applications.
4. Apply, analyze and design circuits using optoelectronic components for various applications and analyze their performance.
5. Understand the various types of optical detectors and modulators, characteristics and their applications.
6. Exploit the way to improve the use of optoelectronic components in engineering, modern application systems and their longevity.

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  |  Elemental and Compound semiconductors  | 4 hours |
Band structure, Direct band gap and indirect semiconductors, Transmission media and choice of materials

Module: 2  |  Absorption in semiconductors  | 7 hours |
Indirect intrinsic transitions, Donor-Acceptor and Impurity band absorption, Impurity band absorption, Intra-band transition and free carrier absorption, Franz –Keldysh effect and quantum confined stark effect

Module: 3  |  Recombination in semiconductors  | 7 hours |
Relation between absorption and emission spectra, Stokes shift in optical transitions, Band to band recombination, Donor acceptor and impurity band transitions, Deep level transitions, Auger recombination

Module: 4  |  Light emitting diodes (LED) Sources  | 7 hours |
Double heterojunction LED, Surface emitter LED, Edge emitter LED, Superluminescent LED, LED power and efficiency, LED characteristics-output power, output spectrum, modulation bandwidth, reliability.

Module: 5  |  LASER Sources  | 8 hours |
Absorption and emission of radiation, Einstein relations, Population inversion, Optical feedback and oscillation, Threshold condition for laser oscillation, Stripe geometry DH injection laser, Single mode operation, Distributed feedback laser, Distributed Braggs reflector laser, VCSEL, Temperature effects.

<table>
<thead>
<tr>
<th>Module: 6</th>
<th>Optical Detectors</th>
<th>7 hours</th>
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<tbody>
<tr>
<td>PN, PIN, Avalanche and Heterojunction photodiodes, Photo transistors, Avalanche multiplication process in APDs, Quantum efficiency, Responsivity.</td>
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</table>

<table>
<thead>
<tr>
<th>Module: 7</th>
<th>Optoelectronic Modulators</th>
<th>3 hours</th>
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</thead>
<tbody>
<tr>
<td>Basic principle, Birefringence, Optical Activity, Electro –Optic modulators, Acousto-Optic modulators, Magneto-Optic modulators.</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 Book(s)**


**Reference Books**


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

*Recommended by Board of Studies* 28-02-2016

*Approved by Academic Council* No. 47 Date 05-10-2017
Course Code: ECE1008
Course Title: Electronics Hardware Troubleshooting
Prerequisite: Nil

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<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>1</td>
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</table>

Syllabus Version: 1.0

Course Objectives:
1. To understand the process of identification and testing of various electronic components and instruments.
2. To introduce the troubleshooting methods of electronic circuits.
3. To understand the process of PCB layout and implementation of various circuits on it.

Course Outcomes:
1. Perform testing and identification of various electronic components and instruments.
2. Perform trouble shooting of simple electronic circuits
3. Perform soldering, basic operations of hardware trouble shooting on a PCB.
4. Construct and Implement basic application oriented circuits on PCB.

Student Learning Outcomes (SLO): 1, 14, 18
1. Having an ability to apply mathematics and science in engineering applications
14. Having an ability to design and conduct experiments, as well as to analyze and interpret data problems
18. Having critical thinking and innovative skills

# List of possible experiments:
3. Trouble shooting of Clamper and Clipper Circuits.
4. Trouble shooting and testing of power supply.
5. Use of C.R.O to find Mid-band Voltage gain and Frequency Response of Amplifiers.
6. Trouble shooting and Testing of NMOS Inverter, NMOS NOR and NAND Logic with Pull-Up resistor
7. Trouble shooting and Testing of NMOS and Diode connected with Pull-Up resistor for A specific logic.
8. PCB layout and hardware troubleshooting of simple audio amplifier.
9. Trouble shooting and testing of power Inverter.
10. Trouble shooting and testing of multi-meter.
11. Trouble shooting and testing of equalizer circuits.
12. Trouble shooting and testing of emergency light.

1. THE STUDY OF MEASURING INSTRUMENTS, TESTING INSTRUMENTS AND POWER SUPPLY.
   Short description:- The objective of this experiment is to gain some hand on experience with the tools that is used in the electronic testing and measuring equipment’s. A breadboard has a construction base for prototyping of electronic circuits. Solderless breadboard does not required soldering, it is reusable. In general breadboard consist of power rail, DIP support and terminal strips.

2. TESTING AND TROUBLE SHOOTING OF DIODES AND TRANSISTORS. 2 Hours
### Short description:
In diodes faults are determined using multi-meter by checking forward and reverse bias resistances. In digital multi-meter diode is tested by connecting diode test function.
In Transistors upper and lower 3dB frequencies, bandwidth & gain frequency are determined by using CRO. Phase difference is determined by applying two signals on channel 1 and channel 2.

### 3. TROUBLE SHOOTING OF CLAMPER AND CLIPPER CIRCUITS.
**Short description:** - Trouble shooting the problems related to clipper and clamper circuits. Study of nonlinearities in diode and analysis of charging and discharging time of capacitors.

### 4. USE OF C.R.O TO FIND MID-BAND VOLTAGE GAIN AND FREQUENCY RESPONSE OF BASIC AMPLIFIERS.
**Short description:** Outputs and input of amplifier is connected to channel 1 and channel 2. Output amplitude of amplifier is independent of the input frequency variation which gives mid-band gain of the amplifier. By adjusting tuning knob of function generator 3-dB frequency can be determined.

### 5. TROUBLE SHOOTING AND TESTING OF POWER SUPPLY.
**Short description:** - A regulated power supply expected to have constant output voltage or current despite variation in load current or input supply. Conversely, output of an unregulated power supply changes significantly when its input voltage or load current changes. Power supply should be ripple free and concerning filter circuits are designed carefully.

### 6. TROUBLE SHOOTING AND TESTING OF NMOS INVERTER, NMOS NOR AND NAND LOGIC WITH PULL-UP RESISTOR.
**Short description:** - All logic circuit is consists of an N-channel MOSFET and pull-up resistor. Strong zeroes and strong ones are to be expected at the outputs. To elevate back-gate effects Bulk is to be biased properly. Small device lengths are preferred which reduces both static and dynamic power dissipation.

### 7. TROUBLE SHOOTING AND TESTING OF NMOS DIODE CONNECTED WITH PULL-UP RESISTOR FOR A SPECIFIC LOGIC.
**Short description:** - When input voltage is high and greater than $V_T$, NMOS is ON. The input Supply voltage is applied to the gate and output is applied to the LED. By this arrangement a unique logic is implemented other than basic logic gates.

### 8. PCB LAYOUT AND HARDWARE TROUBLESHOOTING OF SIMPLE AUDIO AMPLIFIER.
**Short description:** - study of audio amplifier is an electronics amplifier that amplify low poweraudio signal (signal composed primarily of frequencies ranges between 20 to 20KHz) to a levelsuitable for driving loudspeakers is implemented on PCB and issues related to amplifier layout on PCB are rectified.

### 9. TROUBLE SHOOTING AND TESTING OF POWER INVERTER.
**Short description:** - 3 Hours
### Short description:
Study of issues related to input-output power of the inverter and fuse of the inverter. Study of performance parameters related to the changing of DC to AC which is dependent on input voltage, output voltage, frequency and overall power handling.

### 10. TROUBLE SHOOTING AND TESTING OF ELECTRONIC COMPONENTS USING MULTI-METER.
**Short description:** - Troubleshooting the electronics devices and components to check whether they are working properly. Before testing components proper mode should be selected and pins of components should be inserted in their respective slots.

**3 Hours**

### 11. TROUBLE SHOOTING AND TESTING OF EQUALIZER.
**Short description:** - Trouble shooting the circuit for correction of frequency dependent distortion in telecommunication. Study of signal which is send to bank of filter and the signal which is passed as a portion of the signal present in its own frequency range.

**3 Hours**

### 12. TROUBLE SHOOTING AND TESTING OF EMERGENCY LIGHT.
**Short description:** - Study and controlling of charging currents in battery. Study of minimizing the switching delays. When battery is fully charged power should cut-off and leakages of battery charge should be minimized when not in use.

**3 Hours**

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

**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 |

| Total laboratory hours: | 30 hours |
Course Code: ECE2008
Course Title: Robotics and Automation
Prerequisite: ECE1005 - Sensors and Instrumentation

Course Objectives:
1. To provide basic understanding of robotics and their applications.
2. To demonstrate the need for various sensors and drives in robotics.
3. To provide knowledge about the robot kinematics, path planning and different trajectories.
4. To understand the basics of programming of robots, contemporary use and design of robots in practice and research.

Course Outcomes:
1. Understand the necessity of robots in various applications.
2. Comprehend the working of basic electric, electronic and other types of drives required in robots.
3. Identify a suitable sensor for a specific robot.
4. Derive the mathematical model of robotic systems and analyze its kinematic behavior.
5. Design robots for diverse environments encompassing all types of motions and paths.
6. Apply the ideas for performing various robotic tasks with the application of programming skills.
7. Design of different types of robots for various applications.

Student Learning Outcomes (SLO): 2, 13, 17
2. Having a clear understanding of the subject related concepts and of contemporary issues
13. Having cross cultural competency exhibited by working in teams
17. Having an ability to use techniques, skills and modern engineering tools necessary for engineering practice.

Module: 1 | Introduction to Robotics | 2 hours
Robots: Basics, Types-Application, Mobility, Terrain, components classification, performance characteristics.

Module: 2 | Drives for Robotics | 3 hours
Drives: Electric, hydraulic and pneumatic drives.

Module: 3 | Sensors for Robots | 4 hours
Tactile sensors - Proximity and range sensors - Acoustic sensors - Vision sensor systems - Image processing and analysis - Image data reduction – Segmentation – Feature extraction - Object recognition.

Module: 4 | Robot Kinematics and Dynamics | 7 hours

Module: 5 | Path Planning | 5 hours
Types of trajectories, trajectory planning and avoidance of obstacles, path planning, skew motion, joint integrated motion and straight line motion.

Module: 6 | Programming of Robots | 3 hours
Robot programming: languages and software packages-MATLAB/Simulink, OpenRDK, Adams.

Module: 7 | Application of Robots | 4 hours
Industrial robots used for welding, painting and assembly, remote controlled robots, robots for nuclear, thermal and chemical plants, industrial automation, typical examples of automated industries.

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

**Total lecture hours:** 30 hours

**Text Books:**

**Reference Books:**

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

**Typical Projects**
1. Pick and place robot
2. Ball throwing machine for cricket practice
3. Variable height vehicle
4. Wall plastering robot
5. Soil sample collecting robot
6. Object sorting robot
7. Automatic packing robot
8. Robotic goalkeeper

**Mode of evaluation:** Review I,II and III

<table>
<thead>
<tr>
<th>Recommended by Board of Studies</th>
<th>13-12-2015</th>
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<tbody>
<tr>
<td>Approved by Academic Council</td>
<td>No. 40</td>
</tr>
<tr>
<td>Date:</td>
<td>18-03-2019</td>
</tr>
</tbody>
</table>
Course Code: ECE2010
Course Title: Control Systems
Pre-requisite: ECE1004 -Signals and Systems
Syllabus version: 2.1

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 | 3 hours
Basic block diagram of control system, Control schemes – Open loop and closed loop, Applications and scope.

Module: 2 | Mathematical Modeling of Physical Systems | 8 hours
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 | 8 hours
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 | 6 hours
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 | 4 hours
Stability – Concept and definition, Poles, Zeros, Order and Type of systems; R-H criteria, Root locus analysis.

Module: 6 | Frequency Domain Response | 8 hours
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  |  6 hours
---|---|---
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
---|---|---

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
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tr>
<td>ECE3004</td>
<td>Computer Organization and Architecture</td>
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<td></td>
<td>Pre-requisite</td>
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<td></td>
<td>ECE2003 - Digital Logic Design</td>
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</tbody>
</table>

**Course Objectives:**

1. To discuss about architecture, bus interconnection, data processing units and control unit operations.
2. To elucidate memory systems, mapping techniques and various I/O interfacing methods.
3. To introduce parallelism and pipelining concepts, Flynn taxonomy and multi-processor architectures.

**Course Outcomes:**

1. Understand the functional components of a computer, different types of bus architectures and differentiate between Von-Neumann, Harvard architectures.
2. Understand how basic arithmetic operations are implemented in computer architecture and how signed multiplication and divisions are carried out using Booth multiplier and divider in processor architectures.
3. Compare the differences between CISC and RISC architectures, understand and design hardwired, micro programmed control units.
4. Gain knowledge between the levels of memory subsystems like Cache memory and Virtual memory, understand memory mapping schemes used in computer architectures.
5. Classify types of I/O schemes and their operations choose the scheme based on the requirements.
6. Comprehend the methods of performance enhancement techniques such as pipelining and their hazards, Scalar and Vector processing architectures, Multiprocessing techniques like SMP.

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

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

**Module: 1**  
Introduction to Computing Systems  
5 hours


**Module: 2**  
Processing Unit – Data Path  
6 hours

Register organization, Arithmetic and Logic Unit – signed addition/subtraction, Multiplier Architecture – signed/unsigned multiplication – Booth multiplier, array multipliers, restoring and non-restoring division

**Module: 3**  
Processing Unit – Control Path  
6 hours

Machine instructions, Operands, Addressing modes, Instruction formats, Instruction set architectures - CISC and RISC architectures. Instruction Cycle – Fetch-Decode-Execute, Control Unit- Organization of a control unit - Operations of a control unit, Hardwired control unit, Micro-programmed control unit.
<table>
<thead>
<tr>
<th>Module:4</th>
<th>Memory Subsystem</th>
<th>8 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Semiconductor memories, Memory cells - SRAM and DRAM cells, Internal Organization of a memory chip, Organization of a memory unit, Cache memory unit - Concept of cache memory, Mapping methods, Organization of a cache memory unit, Fetch and write mechanisms, Memory management unit - Concept of virtual memory, Address translation.</td>
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<thead>
<tr>
<th>Module:5</th>
<th>I/O Subsystem</th>
<th>8 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access of I/O devices, I/O ports, I/O control mechanisms - Program controlled I/O, Interrupt controlled I/O, and DMA controlled I/O, I/O interfaces - Serial port, Parallel port, PCI bus, SCSI bus.</td>
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<tr>
<th>Module:6</th>
<th>Instruction Level Parallelism</th>
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<tr>
<th>Module:7</th>
<th>Multiprocessors</th>
<th>5 hours</th>
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<tbody>
<tr>
<td>Processor level parallelism - Dependency, Flynn taxonomy, Memory organization for Multiprocessors system, Symmetric Multiprocessor, Cache Coherence and The MESI Protocol</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: | 45 hours |

**Text Book(s)**


**Reference Books**


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

Recommended by Board of Studies 28-02-2016
Approved by Academic Council No. 47 Date 05-10-2017
Course Code | Course Title | L | T | P | J | C  
---|---|---|---|---|---|---  
ECE3005 | Digital Image Processing | 3 | 0 | 2 | 0 | 4  
Pre-requisite | ECE2006 - Digital Signal Processing | Syllabus version | 1.1  

Course Objectives:

1. To introduce the fundamentals of digital image processing, the concept of two dimensional transformation on spatial images.
2. To apply various filtering methods for image enhancement.
3. To understand the concepts of color image processing and different image compression techniques.
4. To study various image segmentation algorithms and introduce descriptors for boundary representation of images.

Course Outcomes:

1. Perform histogram processing and apply spatial filter on images.
2. Apply 2D-FFT, DWT and KL transform on images.
3. Perform filtering in frequency domain for image enhancement.
4. Process the color image in three dimensions for enhancement.
5. Design various standard image compression techniques and interpret their effects in terms of data reduction.
6. Apply various image segmentation algorithms and also, represent the same using boundary, region descriptors
7. Design and implement algorithms using the imbibed image processing concepts.

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 | Basics of Digital Image Processing | 6 hours
---|---|---

Module:2 | Image Transforms | 8 hours
---|---|---

Module:3 | Image Enhancement in Frequency domain | 6 hours
---|---|---
Smoothing frequency domain filters- Sharpening frequency domain filters- Homomorphic filtering, Restoration filters

Module:4 | Color Image Processing | 5 hours
---|---|---
Color models-Pseudo color image processing- Color transformations

Module:5 | Image Compression | 6 hours
Overview of Image Compression Techniques - Quantization- Entropy Encoding-JPEG and MPEG standards

Module:6 | Image Segmentation | 7 hours
Detection of discontinuities – Edge linking and boundary detection- Thresholding -Edge based segmentation-Region based segmentation- Matching-Morphological segmentation- Watershed algorithm

Module:7 | Representation and Description | 5 hours
Boundary descriptions-Region descriptors- Use of Principal Components and Description, Texture description.

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)

<table>
<thead>
<tr>
<th>No.</th>
<th>Experiment</th>
<th>Details</th>
<th>Hours</th>
</tr>
</thead>
</table>
| 1   | Perform point to point operation on the given image and compute the following and interpret changes in image:  
  - Image Negative  
  - Power law transformation  
  - Log transform | 2 hours |
| 2   | Perform histogram equalization for the given image and analyze the enhanced quality of the image:  
  - Read the input Image of size 256 × 256 and perform up sampling and down sampling by a factor of 2. Show the effect of image shrinking and zooming.  
  - Read the input image of size 256 × 256 and show the effect of gray level variation for $L = 32, 4, 2$.  
  - Perform contrast stretching for the given poor contrast image. | 2 hours |
| 3   | Extract all 8-bit planes from given image and comment on the number of visually significant bits in each image. | 1 hour |
| 4   | To detect moving objects in an image sequence using background subtraction algorithm. | 2 hours |
5. For the given 512x512 image (lena.jpg), implement the following spatial domain filtering techniques
   - Low Pass Filtering
   - High Pass Filtering
   - Order Statistics (Median) Filtering
   2 hours

6. To perform DFT for the given image and obtain its Fourier spectrum. Verify the symmetric property of DFT and compare the result with Discrete Cosine Transform.
   2 hours

7. Removal of fine details in an image by frequency domain processing and analysis of information loss.
   2 hours

8. Identifying objects in an image based on their boundaries
   1 hour

9. Compute the Fourier Transform of the given images and add them using blend. Take the inverse Fourier Transform of the sum. Explain the result.
   2 hours

10. Perform logical operations on the given images.
    2 hours

11. Perform image enhancement, feature extraction studies and compression using DFT.
    4 hours

12. Perform image enhancement, feature extraction studies and compression using DCT.
    4 hours

13. Perform image enhancement, feature extraction studies and compression using DWT.
    4 hours

Total laboratory hours: 30 hours

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

Recommended by Board of Studies: 28-02-2016

Approved by Academic Council: No. 47

Date: 05-10-2017
Course Code | Course Title | L | T | P | J | C
--- | --- | --- | --- | --- | --- | ---
ECE3009 | Neural Networks and Fuzzy Control | 3 | 0 | 0 | 4 | 4

Pre-requisite: ECE2006 - Digital Signal Processing

Syllabus version 1.0

Course Objectives:
1. To summarize basic learning laws and architectures of neural networks.
2. To describe supervised and unsupervised learning laws of Neural Networks.
3. To introduce Fuzzy Logic, Fuzzy relations and Fuzzy mathematics for designing a Fuzzy logic controller.
4. To discuss neuro fuzzy approaches like ANFIS and CANFIS.

Course Outcomes:
1. To translate biological motivations into various characteristics of artificial neural networks
2. To comprehend and analyze basic learning laws of neural networks and activation functions
3. To interpret associative memories for storing and recalling the input patterns
4. To learn and implement supervised and unsupervised learning algorithms for various applications.
5. To learn fuzzification and de-fuzzification methods for developing Fuzzy inference systems
6. To apply and integrate various neuro-fuzzy techniques for designing intelligent systems using ANFIS and CANFIS.
7. To design a model using neural networks and fuzzy logic for various applications.

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 | Introduction to Artificial Neural Networks | 3 hours
--- | --- | ---
Artificial neural networks and their biological motivation, terminology, models of neuron, topology, characteristics of artificial neural networks, and types of activation functions.

Module 2 | Learning methods | 7 hours
--- | --- | ---

Module 3 | Supervised Learning | 9 hours
--- | --- | ---

Module 4 | Unsupervised Learning | 9 hours
--- | --- | ---
Introduction, competitive learning neural networks, max net, Mexican hat, hamming net, Kohonen self organizing feature map, counter propagation, learning vector quantization, adaptive resonance theory, performance of SOM.

Module 5 | Fuzzy Sets and Fuzzy Relations | 4 hours
--- | --- | ---
Introduction, classical sets and fuzzy sets, classical relations and fuzzy relations, membership function.
<table>
<thead>
<tr>
<th>Module:6</th>
<th><strong>Fuzzy Inference Systems</strong></th>
<th>6 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fuzzification, fuzzy arithmetic, numbers, extension principle, fuzzy inference system, defuzzification, fuzzy rule based systems, fuzzy nonlinear simulation, fuzzy decision making, fuzzy optimization.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:7</th>
<th><strong>Neuro-Fuzzy Systems</strong></th>
<th>5 hours</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Introduction, ANFIS, ANFIS as universal approximator, CANFIS.</td>
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</table>

<table>
<thead>
<tr>
<th>Module:8</th>
<th><strong>Contemporary issues</strong></th>
<th>2 hours</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Total lecture hours:  45 hours</td>
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</tr>
</tbody>
</table>

**Text Book(s)**


**Reference Books**

2. Simon Haykin, Neural Networks and Learning Machines, 2016, 3rd edition, Pearson Education Inc. India

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

**Typical Projects**

1. Adaptive filtering for Medical (ECG) signals.
2. Adaptive Neuro Fuzzy Inference System
3. Automation of Traffic signal using Raspberry Pi
4. Cardiac Image Diagnostic System
5. Cryptographic System using Neural Networks
6. Design and Development of Biometric Recognition and Matching System
7. Digital Audio Watermark Embedding System
8. Electrical load forecasting using Neural Networks
10. Face Identification System using ANN
11. Feature Extraction of EEG Signals
12. Image Decryption using Neural Networks
13. Internal Fault identification using Artificial Neural Network
14. Signature Forgery and Handwriting Detection System
15. Smart Driver Assist System using Raspberry Pi
16. Speaker Recognition using Soft Computing
17. Speech Separation Using ICA Based Neural Networks

**Mode of evaluation:** Review I, Review II and Review III

Recommended by Board of Studies: 13-12-2015

Approved by Academic Council: No. 40 Date: 18-03-2016
Course Code: ECE3010  Course Title: Antenna and Wave Propagation  L T P J C
3 0 0 0 3
Pre-requisite: ECE2004 – Transmission Lines and Waveguides  Syllabus version: 1.1

Course Objectives:
1. To introduce and discuss the mechanism, models for radio-wave propagation, antenna radiating principles and fundamental characteristics, 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. Friss Transmission formula, Radar range equation. Measurements - radiation pattern- gain- directivity and impedance measurements.

Module: 4  Linear and Planar Arrays  8 hours

<table>
<thead>
<tr>
<th>Module:5</th>
<th>HF and VHF Antennas</th>
<th>5 hours</th>
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</thead>
<tbody>
<tr>
<td>Wire Antennas - long wire, V-Antenna, rhombic antenna, loop antenna-helical antenna, Yagi-Uda antenna</td>
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<tr>
<th>Module:6</th>
<th>UHF and Microwave Antennas</th>
<th>7 hours</th>
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<tbody>
<tr>
<td>Frequency independent antennas - spiral and log periodic antenna - Aperture antennas – Horn antenna, Parabolic reflector antenna - Microstrip antenna</td>
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</table>

<table>
<thead>
<tr>
<th>Module:7</th>
<th>Antennas for Modern Wireless Communications</th>
<th>3 hours</th>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Module:8</th>
<th>Contemporary issues</th>
<th>2 hours</th>
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<thead>
<tr>
<th></th>
<th>Total lecture hours</th>
<th>45 hours</th>
</tr>
</thead>
</table>

**Text Book(s)**

**Reference Books**
3. Albert Sabban, Wideband RF Technologies and Antennas in Microwave Frequencies, 2016, Wiley, New York USA.

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

<table>
<thead>
<tr>
<th><strong>Recommended by Board of Studies</strong></th>
<th>13-12-2015</th>
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<tr>
<td><strong>Approved by Academic Council</strong></td>
<td>No. 40</td>
</tr>
</tbody>
</table>
Course Code: ECE3011  
Course Title: Microwave Engineering  
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, 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  |  Microwave measurements and applications  |  4 hours
Microwave frequencies (IEEE Standards), microwave measurements - guide wavelength VSWR, frequency and impedance, practical perspective of microwaves: Microwave oven, Radar, wireless applications.

Module:2  |  Microwave Sources  |  8 hours

Module:3  |  Microwave Network Analysis  |  6 hours

Module:4  |  Power dividers  |  9 hours
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 & unequal), Rat Race Coupler (180° hybrid coupler).

Module:5  |  Microwave Ferrite devices  |  4 hours
Properties of ferromagnetic materials, principle of faraday rotation, isolator, circulator and phase Shifter.
### 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 steeped 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 |

**Typical Projects**
1. Design and development of miniaturized power dividers
   - 2 way power divider
   - 4 way power divider
2. Design and development of miniaturized power dividers
   - 90° hybrid coupler
   - Coupled line coupler
   - 180° hybrid coupler
3. Design and development of microwave filters
   - Low pass filter
   - Band pass filter
   - High pass filter
4. Design and development of microwave amplifiers
   - Low noise amplifier
   - Power amplifier
   - Maximum gain and specific gain

5. Design and development of transmission line matching network
   - Pi network
   - T-network

6. Design and development of waveguide based
   - E-plane Tee
   - H-plane Tee
   - Magic Tee

7. Design and development of compact coupled-line balun with complex impedances transformation.

8. Analysis and design of non-planar antenna for wireless communication system.

9. Design of antennas for wireless applications
   - Planar dipole
   - Planar monopole
   - RFID antenna
   - Inverted F antenna
   - Dual polarized antenna
   - MIMO antenna

10. Design and development of polarization microstrip array antenna for satellite communication system
    - Frequency polarization
    - Radiation pattern polarization

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

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>Date</th>
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<tbody>
<tr>
<td>Recommended by Board of Studies</td>
<td>13-12-2015</td>
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<tr>
<td>Approved by Academic Council</td>
<td>No. 40</td>
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<tr>
<td>Course Code</td>
<td>Course Title</td>
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<tr>
<td>ECE3013</td>
<td>Linear Integrated Circuits</td>
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<td>Pre-requisite</td>
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<tr>
<td></td>
<td>ECE2002 – Analog Electronic Circuits</td>
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</tbody>
</table>

Course Objectives:
1. To understand the characteristics of Operational Amplifier.
2. To design various linear and non-linear circuits using operational amplifiers.
3. To acquaint and demonstrate the concepts on waveform generators, filter configurations, PLL, Timer, ADC and DAC.

Course Outcomes:
1. Comprehend the ideal and practical characteristics of op-amps and design fundamental circuits based on op-amps.
2. Design the negative feedback configuration of operational amplifier for various mathematical operations.
3. Design and analyze different waveform generator circuits using operational amplifiers.
4. Design and analyze various filter circuits using operational amplifiers.
5. Realize circuits containing PLL and IC 555.
6. Comprehend various converter circuits.
7. Design and analyze the circuits for inverting and non-inverting amplifiers, differential amplifiers, simple amplifiers and comparators experimentally using IC LM741.

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 | Operational amplifier Characteristics | 4 hours
Operational amplifier-equivalent circuits, ideal Operational amplifier, DC characteristics and AC characteristics, non-ideal characteristics.

Module:2 | Linear Operational amplifier Circuits | 8 hours

Module:3 | Operational amplifier applications using Diodes | 4 hours
Logarithmic amplifiers, Rectifiers, Peak detection and Voltage regulation

Module:4 | Comparators and Waveform Generators | 7 hours
Comparator and its applications, Schmitt trigger, Free-running, One-shot Multivibrators, Barkhausen Criterion, Sinewave generators, Phase-shift, Wein-bridge oscillators, Square, Triangular and Saw-tooth wave function generator.

Module:5 | Active filters | 7 hours
Filter classifications, frequency and impedance scaling, First and second order Low-pass and High pass filter designs, Band-pass filter, Notch filter.
Module:6  |  PLL and Timers  |  7 hours  
PLL-Phase detector, comparator, VCO, Low-pass filter, PLL applications, 555 timer IC, Astable and Monostable operations and applications.

Module:7  |  A/D and D/A Converters  |  6 hours  
Sample-and-hold circuits, DAC characteristics, D/A conversion techniques, A/D characteristics, A/D conversion techniques-integrating, successive approximation, flash converters.

Module:8  |  Contemporary issues  |  2 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. Study of internal structure of operational amplifier  |  2 hours  
2. Design of Inverting, Non Inverting amplifiers and Voltage follower  |  2 hours  
3. Mathematical operations using operational amplifier  |  2 hours  
4. Design of Instrumentation amplifier  |  2 hours  
5. Design and testing of Precision Rectifier.  |  2 hours  
6. Design of Comparator and Schmitt trigger circuits  |  2 hours  
7. Design of Square wave generator for a specified frequency and duty cycle, using operational amplifier IC741  |  2 hours  
8. Design of Triangular wave generator from Square wave generator  |  2 hours  
9. Design of a Sinusoidal oscillator for specified frequency-Wien bridge and RC phase shift oscillators using IC741  |  2 hours  
10. Design of Audio Q Multiplier using IC741  |  2 hours  
11. Design and testing of Active filters -LPF and HPF for specified frequency  |  2 hours  
12. Design of Astable and Monostable Multivibrators using IC 555  |  2 hours  
13. Design of A/D and D/A convertors  |  2 hours  
14. Implementation of Analog Arithmetic Logic Unit (AALU)  |  2 hours  
15. Design of Frequency multiplier using IC 565  |  2 hours  

**Total laboratory hours**  |  30 hours  

**Mode of evaluation:** Continuous assessment & Final Assessment Test (FAT).
<table>
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<tr>
<th>Course Code</th>
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<tbody>
<tr>
<td>ECE3046</td>
<td>Computer Vision and Pattern Recognition</td>
<td>3</td>
<td>0</td>
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<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

Pre-requisite: ECE2006 – Digital signal Processing

Syllabus version: 1.0

**Course Objectives:**
1. To develop algorithms and techniques for analyzing and interpreting the real world scenarios.
2. To introduce the concepts related to multi-dimensional signal processing, feature extraction, pattern analysis.
3. To explore and contribute to research and further developments in the field of computer vision.
4. To investigate and develop object recognition algorithms supporting real-world scenarios.

**Course Outcomes:**
1. Able to understand digital image formation and low-level processing.
2. Able to perceive the diverse perspectives of digital imaging.
3. Able to interpret, analyze and apply the different feature extraction methods.
4. Able to recognize various motion patterns, analyze and classify the same.
5. Able to recognize and detect objects.
6. Able to identify and recognize human faces.
7. Able to identify and recognize instances.

**Student Learning Outcomes (SLO)**
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 | Introduction**
---
Introduction to computer vision, Image Formation – Digital Camera and optics – Light and color properties – Sampling and quantization - Enhancement Techniques – Spatial, frequency Domain.

**Module: 2 | Morphology representation and segmentation**
---
Morphological operators, Boundary descriptor, Regional descriptors, Segmentation – Thresholding techniques, Edge, Region based segmentation.

**Module: 3 | Feature detection and Matching**
---
Interest points and corners, Local image features, Model fitting, Detectors and Key point Descriptors, SIFT, RANSAC and transformations.

**Module: 4 | Multiple views and motion**
---
Stereo introduction and camera calibration, epipolar geometry and structure from motion, Stereo correspondence and optical flow, Geometric alignment.
<table>
<thead>
<tr>
<th>Module:5</th>
<th>Supervised Recognition</th>
<th>6 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patterns and pattern classes – template matching – Active appearance and 3D shape models</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Introduction to classification – Decision theoretic methods – Bayesian classifier- Support vector Machine-ANN</td>
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<thead>
<tr>
<th>Module:6</th>
<th>Unsupervised Recognition</th>
<th>8 hours</th>
</tr>
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<table>
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<tr>
<th>Module:7</th>
<th>Applications</th>
<th>5 hours</th>
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<tbody>
<tr>
<td>Data Base and Test Set, Object Detection, Pedestrian detection, Face recognition, Instance recognition, Medical diagnosis, Deep Learning concepts &amp; Transfer learning: CV applications.</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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</thead>
<tbody>
<tr>
<td></td>
<td>Total Lecture hours:</td>
<td>45 hours</td>
</tr>
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</table>

**Text Book(s)**


**Reference Books**


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

Recommended by Board of Studies 05-02-2020

Approved by Academic Council No. 58 Date 26-02-2020
<table>
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<td>ECE3047</td>
<td>Machine Learning Fundamentals</td>
<td>3</td>
<td>0</td>
<td>2</td>
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</table>

Pre-requisite | MAT3004-Applied Linear Algebra          | Syllabus version | 1.0 |

**Course Objectives:**
1. To understand the importance and significance of Machine Learning
2. To get acquainted with different types of regression
3. To understand the diverse methods of data classification
4. To preface the essentials of mathematical optimization

**Course Outcomes:**
1. To comprehend different types of learning
2. To identify data discrepancies and eliminate anomalies
3. To predict the outcome based on regression
4. To compute optimal hyperplane and support vectors for data classification
5. To solve numericals based on Baye’s classifier
6. To appreciate clustering as an unsupervised learning methods
7. To realize the usage of optimization in solving real-world engineering problems

**Student Learning Outcomes (SLO): 1, 9, 17**
1. Having an ability to apply mathematics and science in engineering applications
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

**Module: 1 | Introduction**

Common definitions – Applications – Types of Learning – Supervised, Unsupervised, Reinforcement. Performance measure

**Module: 2 | Data Preprocessing**

Basics of Vectors & Matrices – Overview: Data cleaning, Integration, Transformation & Reduction

**Module: 3 | Regression**

Linear – Multi Linear Regression (MLR) – Logistic – Model Estimation – Evaluation

**Module: 4 | Classification**

### Module: 5 | Clustering | 7 hours
Introduction - Mixture Densities - Types – Partitioning, Hierarchical – Supervised Learning after Clustering- Choosing number of Clusters- Applications.

### Module: 6 | Optimization | 7 hours
Introduction - Classification – Derivative-based, Derivative-free.

### Module: 7 | Reinforcement Learning | 5 hours
Introduction to RL, Immediate RL, Bandit Algorithm, Montecarlo methods.

### 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)**
Software: Python, Numpy, Tensorflow, Keras, Pandas, OpenCV
Appropriate datasets from the following repository (suggestive) can be utilised
2. [http://sci2s.ugr.es/keel/datasets.php#sub1](http://sci2s.ugr.es/keel/datasets.php#sub1)

**List of experiments:**
Algorithms to be practised include,
1. Linear & Multi-Linear Regression
2. Naive Bayes classifier
3. Decision trees
4. Logistic regression
5. Support Vector Machines – Linear & Non-linear
6. Single & Multilayer Perceptrons
8. Random – forest
9. Self – Organizing maps

<p>| Total laboratory hours | 30 hours |</p>
<table>
<thead>
<tr>
<th><strong>Mode of evaluation:</strong> Continuous assessment &amp; Final Assessment Test (FAT).</th>
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<tr>
<td><strong>Recommended by Board of Studies</strong></td>
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<td><strong>Approved by Academic Council</strong></td>
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</table>
### Course Details

**Course Code**: ECE3048  
**Course Title**: Deep Learning  
**L T P J C**: 3 0 0 0 3  
**Pre-requisite**: MAT3004 - Applied Linear Algebra  
**Syllabus version**: 1.0

#### Course Objectives:
1. To understand the importance of Deep Learning
2. To get familiarized with deep feedforward neural networks
3. To get acquainted with diverse regularization strategies
4. To understand the role of optimization on deep learning models

#### Course Outcomes:
1. To analyze different learning techniques using regularization parameters
2. To build a deep feedforward network
3. To focus on regularization strategies for building deep models
4. To optimize the performance of deep learning
5. To analyze the impact of Convolution on simple neural networks
6. To process sequential data using recurrent neural networks
7. To apply deep learning algorithms for solving real-world engineering problems

#### Student Learning Outcomes (SLO) 1,9,17
1. Having an ability to apply mathematics and science in engineering applications
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

#### Module: 1 Machine Learning Basics 4 hours

#### Module: 2 Deep Feedforward Networks 6 hours
Learning XOR – Gradient Based learning – Hidden Units – Architecture Design - , Back propagation and other differentiation algorithms.

#### Module: 3 Regularization 9 hours

#### Module: 4 Optimization for training deep models 7 hours
<table>
<thead>
<tr>
<th>Module:5</th>
<th>Convolutional Neural Networks</th>
<th>7 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Convolution operation – Pooling – Efficient convolution algorithms</td>
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<table>
<thead>
<tr>
<th>Module:6</th>
<th>Sequence Modelling</th>
<th>7 hours</th>
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<tbody>
<tr>
<td>Recurrent Neural Networks (RNN) – Bi-directional RNN – Long Short-term Memory (LSTM) - Gated Recurrent Unit (GRU) – Deep Recurrent Networks</td>
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<table>
<thead>
<tr>
<th>Module:7</th>
<th>Applications</th>
<th>3 hours</th>
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<td>Computer vision – Speech recognition – Natural Language Processing</td>
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<table>
<thead>
<tr>
<th>Module:8</th>
<th>Contemporary Issues</th>
<th>2 hours</th>
</tr>
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</table>

|  | Total Lecture hours: | 45 hours |

**Text Book(s)**


**Reference Books**


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

<p>| Recommended by Board of Studies | 05-02-2020 |
| Approved by Academic Council | No. 58 | Date | 26-02-2020 |</p>
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<tr>
<td>ECE4002</td>
<td>Advanced Microcontrollers</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>4</td>
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</table>

**Prerequisite:** ECE3003 – Microcontrollers and Applications

**Syllabus version:** 1.0

### 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): 2,5,13
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.

### Module:3  | AVR Peripherals (C programming): 4 hours
Timers, Interrupts, Serial Port

### Module:4  | Communication with real world (C programming): 8 hours
SPI, I2C, ADC & DAC, PWM, Relay, stepper motor, LCD, keyboard

### Module:5  | ARM Architecture: 5 hours
ARM Design Philosophy, Overview of ARM architecture States [ARM, Thumb, Jazelle], Registers, modes, Conditional Execution, Pipelining, Vector Tables, Exception handling.

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B.TECH (Electronics and Communication Engineering)  Page 156
<table>
<thead>
<tr>
<th>Module:6</th>
<th>ARM &amp; Thumb Instructions and Assembly language</th>
<th>8 hours</th>
</tr>
</thead>
<tbody>
<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>
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<table>
<thead>
<tr>
<th>Module:7</th>
<th>ARM Microcontroller (C Programming):</th>
<th>8 hours</th>
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<tbody>
<tr>
<td></td>
<td>ARM Cortex M Microcontroller- Ports, Timer, UART, ADC, I2C.</td>
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<table>
<thead>
<tr>
<th>Module:8</th>
<th>Contemporary Issues</th>
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<table>
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<table>
<thead>
<tr>
<th>Reference Books:</th>
</tr>
</thead>
</table>

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

**Typical Projects:**

1. Home Automation
2. Smart precision irrigation system
3. Building Secure Home Automation
4. Green computing
5. Gesture controlled home automation for disabled
6. Patient monitoring system
7. Health monitoring system for old aged
8. Pollution monitoring and control system
9. Waste management
10. Smart Lighting
11. Forest Fire detection

**Mode of evaluation:** Review I, II and III

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<th>13-12-2015</th>
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<tr>
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<td>No: 40</td>
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<tr>
<td>Date</td>
<td>18-03-2016</td>
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</table>
Course Code: ECE4003  
Course Title: Embedded System Design  
L | T | P | J | C  
----|----|----|----|----  
2 | 0 | 2 | 4 | 4  

Pre-requisite: ECE3003 - Microcontroller and its applications  
Syllabus version: 1.0

Course Objectives:
1. To explain the definition, characteristics, challenges and design lifecycle of Embedded Systems. Also, highlight the principles of processor technologies, IC technologies, general-purpose processors and processor selection strategies.
2. To impart the fundamental knowhow of I/O interfacing, serial communication protocols, wireless technologies, design using UML and Petri Net models.
3. To introduce the concepts and features of Real-time operating systems, task scheduling, memory management, resource synchronization and inter-task communication.
4. To introduce various programming tools, modeling and simulation packages to program, design, simulate and build Embedded Systems.

Course Outcomes:
1. Comprehend the applications, examples, characteristics, design challenges related to Embedded Systems. Able to design any application based on the given specifications by keeping in mind different design metrics.
2. Understand general-purpose processing and its principles; select a microprocessor/microcontroller for a particular application.
3. Understand the process of interfacing basic peripherals.
4. Differentiate the pros and cons of various serial communication and wireless protocols and analyze UML diagrams and petri net models for a given application.
5. Differentiate the features of RTOS and GPOS and understand the concepts such as priority inversion, pre-emption, deadlocks, race conditions, inter-process communication and real-time task scheduling.
6. Model the working of ES using FSMs and UML designs apart from programming embedded software using suitable IDEs and free RTOS.
7. Design and implement algorithms for embedded systems.
8. Develop real-time working prototypes of different small-scale and medium-scale embedded Systems.

Student Learning Outcomes (SLO):
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  Embedded system product development  4 hours
Characteristics of embedded systems, general purpose, customized, application specific processors, Embedded product development cycle.

Module:2  System design using general purpose processor  4 hours
Microcontroller architectures (RISC, CISC), Embedded Memory, Strategic selection of processor and memory.

Module:3  Programming the peripherals of microcontrollers  4 hours
Programming ADC, DAC, switches, keyboards, Timers / Counters, PWM generation, LED, LCD.
### Module:4  Emerging bus standards and communication  4 hours
USB, PCI, UART, SPI, I2C, CAN, Bluetooth, Zigbee

### Module:5  Modeling embedded systems  4 hours
Unified model language, examples, Petrinet model.

### Module:6  Embedded Operating Systems  4 hours

### Module:7  Introduction to Real-Time Concepts  4 hours
RTOS Internals & Real Time Scheduling, Performance Metrics of RTOS, Task Specifications, Schedulability Analysis, Application Programming on RTOS.

### Module:8  Contemporary issues  2 hours

| 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)**

<p>| | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>1</td>
<td>Device Control via Bluetooth</td>
</tr>
<tr>
<td></td>
<td>Sub Task 1: Interfacing devices with microcontroller via driver circuits.</td>
</tr>
<tr>
<td></td>
<td>Sub Task 2: Interfacing Bluetooth with microcontroller for data transfer.</td>
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<tr>
<td></td>
<td>Sub Task 3: Creating Android APK for controlling devices.</td>
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<td></td>
<td>6 hours</td>
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</tbody>
</table>

| 2 | Parameter Monitoring via CAN protocol |
|   | Sub Task 1: Interfacing sensors with Microcontroller. |
|   | Sub Task 2: Interfacing display unit/actuators with microcontroller. (can be implemented by I2C protocol) |
|   | Sub Task 3: CAN Bus communication between controller |
|   | 8 hours |

| 3 | RTOS Based Parameter Monitoring and Controlling System. |
|   | Sub Task 1: collecting the data from sensor interfaced with microcontroller. |
|   | 8 hours |
- Sub Task 2: interfacing display devices/actuators with microcontroller.
- Sub Task 3: inter task/process communication between task/process.

| Sub Task 1: Creating tasks for interfacing sensors with microcontroller. |
| Sub Task 2: Creating tasks for interfacing display unit/actuators with microcontroller. (can be implemented by I2C protocol) |
| Sub Task3: CAN Bus communication between controller |

| 4 | RTOS Based Data transfer between microcontrollers using Communication Protocol. |
| Sub Task 1: Creating tasks for interfacing sensors with microcontroller. |
| Sub Task 2: Creating tasks for interfacing display unit/actuators with microcontroller. (can be implemented by I2C protocol) |
| Sub Task3: CAN Bus communication between controller |

Total laboratory hours: 30 hours

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

**Typical Projects**

1. Develop a Micro controller-based precision agriculture which includes accessing real-time data about the conditions of the crops, soil and ambient air. Sensors in fields measure the moisture content and temperature of the soil and surrounding air.

2. Design a Microcontroller based automated patient monitoring system which continuously measures the patient parameters such as heart rate and rhythm, respiratory rate, blood pressure and many other parameters has become a common feature the care of critically ill patients. When accurate and immediate decision-making is crucial for effective patient care, electronic monitors frequently are used to collect and display physiological data.

3. Develop a Microcontroller based waste management system, where the sensors are placed in the common garbage bins placed at the public places. When the garbage reaches the level of the sensor, then that indication will be given to Microcontroller. The controller will give indication to the driver of garbage collection truck as to which garbage bin is completely filled and needs urgent attention. The controller will give indication by sending SMS using GSM technology.

4. Implement a Digital Clock and Alarm using microcontroller that needs a keypad to be interfaced with the following requirement. Key 1 to turn on alarm, Key 2 to enable alarm settings, Key 3 to enable time settings, Key 4 to change hour’s settings, Key 5 to change minute settings, Key 6 to increment the time, Key 7 to decrement the time. The normal time and alarm time should be displayed using 2 X 16 LCD and a buzzer should be triggered once the normal time equal to alarm time.

5. Design face recognition based Authenticated Door Opening System using FPGA. Database consisting of authorized persons faces should be created and the same should be compared with the real time camera input faces such that if face matching happens the door actuator needs to be triggered to open the door.

**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
<table>
<thead>
<tr>
<th>Course Code</th>
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<tr>
<td>ECE4004</td>
<td>Embedded C and Linux</td>
<td>3</td>
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<td>ECE3003 - Microcontroller and its applications</td>
<td>Syllabus version</td>
<td>1.0</td>
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</table>

**Course Objectives:**
1. To develop awareness about Embedded C and Linux and the range of applications to which they are suited.
2. To develop API (Application Peripheral Interface) in C for 8051
3. To develop Shell programming
4. To develop awareness about Process management

**Expected Course Outcomes:**
1. Program Embedded Systems in C language
2. Handle Interfacing issues of 8051 microcontroller
3. Do shell programming in Linux
4. Do Resource management for Embedded Systems
5. Do Inter Process Communication for Embedded Systems
6. Write simple device drivers for embedding intelligence in embedded systems.
7. Develop Microcontroller-based application
8. Know Embedded C and Linux and the range of applications to which they are suited.

**Student Learning Outcomes (SLO) :** 2,13,14
2. Having a clear understanding of the subject related concepts and of contemporary issues
13. Having cross cultural competency exhibited by working in teams
14. Having an ability to design and conduct experiments, as well as to analyze and interpret data

**Module:1 | Introduction to C programming** 7 hours
Basic concepts of C, Embedded C vs C, programming aspects with respect to firmware and OS, functions, arrays, Pointers, File I/O and bit level operations.

**Module:2 | Embedded C** 7 hours
Modular programming-Multiple file programs, Extern and static declaration (for variable and for functions)-how executable file are created-the compiler-the linker-project structure- Object libraries-Advanced use of Pointers-void pointers, pointers to functions-Pointers to structures.

**Module:3 | Interfacing issues of 8051 microcontroller** 6 hours
The external interface of the Standard 8051-Reset requirements- Clock frequency and performance-Memory issues- I/O pins-Timers-Interrupts-Serial interface-Power consumption.

**Module:4 | Programming Embedded Systems in C** 6 hours
Embedded world-Reading switches-Adding Structure to the code–object oriented programming with C-Meeting real time constraints-using the serial interface.

**Module:5 | Basics of Linux** 6 hours
Command prompt –Navigating file system –finding files – working with folders – reading files text editing in Linux – Compression and archiving tools.

**Module:6 | Linux Programming Concepts** 6 hours
Module:7  Resource management and Inter Process Communication  5 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)

List of Challenging Experiments (Indicative)

<table>
<thead>
<tr>
<th>Task</th>
<th>Description</th>
<th>Hours</th>
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</thead>
</table>
| 1    | **Task-1:** Development of API (Application Peripheral Interface) in C for 8051 to control the speed of motor.  
* Sub-task-1: use timer and generate an exact time delay for T_{ON} and T_{OFF}  
* Sub-task-2: use timer interrupt in generating the waveform  
* Sub-task-3: controlling speed of a DC motor using Timer | 6 |
| 2    | **Task-2:** Microcontroller based application  
* Sub-task-1: Interface Zigbee with 8051  
* Sub-task-2: Interface keypad with 8051  
* Sub-task-3: Interface GSM with 8051  
* Sub-task-4: based on KEY pressed in keypad, transmit the key info via Zigbee and make a motor to rotate, which is interfaced with 8051. Using GSM module send the status of motor [run/stop] to the user. | 6 |
| 3    | **Task-3:** Development of API (Application Peripheral Interface) in C for 8051 LCD (Liquid Crystal Display), Keypad, buzzer and implementation of Musical Keypad System.  
**Task Calculator Application**  
* Sub task 1: make the LCD interfaced to 8051  
* Sub task 2: get input from switch which is interfaced to 8051 and display it on LCD  
* Sub task 3: Based on switch input, perform basic operation of a calculator | 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. | 6 |
User may create sub-inventories.
- An interactive user interface.
- A flexible inventory management system

5 Task-5 : Process Management
- Sub Task 1: 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.
- Sub task 2: Create a pipe system call to communicate between the parent process and child process.
- Sub Task 3: Write an implementation of Message queue, shared memory and semaphore inter process communications

Total laboratory hours 30 hours

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

Typical Projects

1. Design a 8051 based automated patient monitoring system which continuously measures the patient parameters such as heart rate and rhythm, respiratory rate, blood pressure and many other parameters has become a common feature of the care of critically ill patients. When accurate and immediate decision-making is crucial for effective patient care, electronic monitors frequently are used to collect and display physiological data.

2. A busy highway is intersected by a little used farm road. Detectors sense the presence of cars waiting on the farm road. With no car on farm road, light remains green in highway direction. If vehicle on farm road, highway lights go from Green to Yellow to Red, allowing the farm road lights to become green. These stay green only as long as a farm road car is detected but never longer than a set interval. When these are met, farm lights transition from Green to Yellow to Red, allowing highway to return to green. Even if farm road vehicles are waiting, highway gets at least a set interval as green.

3. Assume you have an interval timer that generates a short time pulse (TS) and a long time pulse (TL) in response to a set (ST) signal. TS is to be used for timing yellow lights and TL for green lights.

4. Development of employee database management system using C Programming with the following features.
   - Company master module
   - Employee module
   - Leave module
   - Loan module
   - Salary module
   - Reports module
   - Help module
   - Exit module

5. 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.
• A flexible inventory management system

**Mode of evaluation**: Review I, II and III

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<td>No. 40</td>
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<tr>
<td>Date</td>
<td>18-03-2016</td>
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</table>
Course Code: ECE4005  
Course Title: Optical Communication and Networks  
Pre-requisite: ECE4001: Digital Communication Systems  
Syllabus version: 1.0

Course Objectives:
1. To discuss technology developments in Optical Communication system.
2. To provide an in-depth knowledge on various types of fibers and their transmission characteristics, the construction, working principle and characteristics of transmitters, receivers and various optical amplifiers used in long distance communication.
3. To describe the concepts of Wavelength Division Multiplexing technique, components used and the estimation of rise-time and power budget for digital transmission system.
4. To introduce SONET/SDH, OTN and PON Technologies.

Course Outcomes:
1. Understand the concept of optical communication.
2. Select fiber and optoelectronic components to design, analyze an optical communication system and understand the basic concepts of optical transmitters, modulators and nonlinear effects.
3. Understand the concepts of photodetectors and receivers and various optical amplifiers.
4. Establish optical communication systems for multichannel systems using multiplexing techniques.
5. Understand the concepts of WDM system and their applications.
6. Understand and classify various types of optical Networks and their applications.
7. Design, analyze and evaluate optical communication systems.

Student Learning Outcomes (SLO): 1, 2, 17
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 | Overview of optical fiber communication and Networks | 3 hours
Motivation-Spectral bands-Key elements of optical fiber system-Modeling and simulation Tools

Module:2 | Optical Fibers | 4 hours
Types - SM-SI; MM-SI, MM-GI; specialty fibers Geometrical-Optics Description, Wave Propagation, Chromatic Dispersion, Polarization Mode Dispersion, Dispersion-Induced Limitations, Fiber Losses, Nonlinear Optical Effects (SRS,SBS,SPM,CPM,FWM)

Module:3 | Optical Transmitters and Receivers | 6 hours

Module:4 | Optical Amplifiers | 3 hours
Semiconductor Optical Amplifiers, Raman Amplifiers, Erbium-Doped Fiber Amplifiers, System Applications

Module:5 | Light-wave Transmission Systems | 4 hours
Intensity Modulation - Direct Detection Systems, Homodyne and heterodyne detection, Optical time division multiplexing (bit-interleaved, packet interleaved)Wavelength-division multiplexing, Sub
carrier multiplexing, Polarization multiplexing. Digital links: Point-to-Point links-System
consideration-Link power budget-Rise time budget, System performance

<table>
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<tr>
<th>Module:6</th>
<th>Multichannel Systems</th>
<th>4 hours</th>
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</table>
| WDM Lightwave Systems and Components, Operational principles of WDM-Passive optical
coupler:2x2 Fiber coupler-Wave guide coupler-Star couplers-MZI Multiplexers , Isolators and
Circulators – Fiber Bragg Grating-FBG Applications, WDM System Performance Issues |

<table>
<thead>
<tr>
<th>Module:7</th>
<th>Optical Networks</th>
<th>4 hours</th>
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| Network concepts-Topologies SONET/SDH -The Optical Transport Network - Introduction - OTN
Network Layers - FEC in OTN - OTN Frame Structure - OPU-k - ODU-k - OTU-k-The Optical
Channel - Optical Channel Carrier and Optical Channel Group - Optical Networks Access(existing
PON Technologies; CWDM-PON, TDM-PON,Hybrid TDM-WDM –PON) and Metro Networks
Long-Haul Networks |

<table>
<thead>
<tr>
<th>Module:8</th>
<th>Contemporary Issues</th>
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<tbody>
<tr>
<td>Total lecture hours:</td>
<td>30 hours</td>
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</table>

**Text Book(s)**


**Reference Books**

4. B.Mukerjee, Optical WDM Networks (Optical Networks), 2006, Springer edition

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

**Typical Projects**

1. Design of a DWDM link(50 Ghz grid)with multiple backward pumped Raman amplification
2. Chromatic dispersion and its effects on data transmission
3. EDFA wavelength division multiplexing
4. Penalties due to fiber induced loss
5. Topology schematic for the signal channel
6. Compensation of dispersion with fiber bragg grating component and DCF
7. Single mode fiber design
8. Analysis of fiber nonlinearity.
9. Simulated assisted design of free space optical transmission system
10. Design of Optical Fiber Transmitter And Receiver

<p>| Recommended by Board of Studies | 13-12-2015 |
| Approved by Academic Council | No. 40 | Date | 18-03-2016 |</p>
<table>
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<tr>
<th>Course Code</th>
<th>Course Title</th>
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<th>P</th>
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<th>C</th>
<th>Syllabus version</th>
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<tr>
<td>ECE4007</td>
<td>Information Theory and Coding</td>
<td>3</td>
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**Pre-requisite**: ECE4001 : Digital Communication Systems

### 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. 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

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B.TECH (Electronics and Communication Engineering)
<table>
<thead>
<tr>
<th>Text Book(s)</th>
<th>Total lecture hours:</th>
<th>45 hours</th>
</tr>
</thead>
</table>

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

**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>
</tr>
</thead>
<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>Mode of evaluation:</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</td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Title</td>
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<tr>
<td>--------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>ECE4008</td>
<td>Computer Communication</td>
</tr>
<tr>
<td>Pre-requisite</td>
<td>ECE4001 - Digital Communication Systems</td>
</tr>
<tr>
<td></td>
<td>Syllabus version</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Course Objectives:

1. To familiarize with the basic terminologies and concepts of OSI, TCP/IP reference model and functions of various layers.
2. To understand the ARQ protocols, design and performance issues associated with the functioning of LANs and WLANs.
3. To introduce IP addressing and basics of transport layer protocol.

### Course Outcomes:

1. List and explain the functions of the OSI, TCP/IP reference models and differentiate between various switching techniques and internetworking devices.
2. Able to analyze the network topologies and interconnecting devices using Transparent and Source Routing bridges.
3. Able to analyze the different topologies, error detection techniques and ARQ protocol.
4. Comprehend the various types of LAN and WAN technologies.
5. Describe routing techniques and design subnets.
6. Explain and demonstrate the functioning of TCP and UDP.
7. Comprehend the basics of DNS, FTP, SMTP and HTTP.
8. Analyze the performance of internetworking devices, various LAN, WLAN and routing protocols using simulation tools.

### 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 Layered Network Architecture 5 hours


### Module: 2 Network Topologies and Internetworking devices 6 hours


### Module: 3 Data Link Layer 8 hours

Logical link control – Error detection techniques – ARQ protocols – Framing – HDLC –Point to point protocol - Medium access control – Random access protocols – Scheduling approaches to MAC.

### Module: 4 Local Area Networks& Wide Area Networks 6 hours

Ethernet- Token bus/ring - FDDI – Virtual LAN - WAN Technologies – Frame Relay - ATM - Wireless LAN

### Module: 5 Network Layer 8 hours


### Module: 6 Transport Layer 6 hours


### Module: 7 Application Layer 4 hours

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B.TECH (Electronics and Communication Engineering)  Page 170
### Module: 8

**Contemporary Issues**

<table>
<thead>
<tr>
<th>Topic</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domain Name System (DNS) – Simple Mail Transfer Protocol (SMTP) – File Transfer Protocol (FTP) – Hypertext Transfer Protocol (HTTP) - World Wide Web (WWW)</td>
<td>2</td>
</tr>
</tbody>
</table>

**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)**

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Create a simple network model with multiple scenarios, collect statistics on network performance through the use of simulation tools, analyze statistics and draw conclusions on network performance.</td>
<td>6</td>
</tr>
<tr>
<td>2. Performance analysis of layer 1 and layer 2 (physical and data link layer) devices in LAN.</td>
<td></td>
</tr>
<tr>
<td>3. Compare the throughput and delay of a Local Area Network interconnected by a switch by creating a switched LAN with 4 nodes. Assume voice traffic and use the voice codec standards G.711, G.723 and G.729. Also analyze the voice custom traffic for the throughput of 200 kbps and 64 kbps.</td>
<td></td>
</tr>
<tr>
<td>4. Analyse the spanning tree algorithm by varying the priority among the switches:</td>
<td>4</td>
</tr>
<tr>
<td>1. Observe and explain the default behavior of spanning tree protocol (STP, 802.1D)</td>
<td></td>
</tr>
<tr>
<td>2. Observe the response to a change in the spanning tree topology</td>
<td></td>
</tr>
<tr>
<td>3. Analyze IPV4 using Class A, B &amp; Class C.</td>
<td>4</td>
</tr>
<tr>
<td>4. An ISP is granted a block of addresses starting with 190.100.0.0/24 (65,536 addresses). The ISP needs to distribute these addresses to three groups of customers as follows:</td>
<td>4</td>
</tr>
<tr>
<td>1. The first group has 64 customers; each needs 256 addresses.</td>
<td></td>
</tr>
<tr>
<td>2. The second group has 128 customers; each needs 128 addresses.</td>
<td></td>
</tr>
<tr>
<td>3. The third group has 128 customers; each needs 64 addresses.</td>
<td></td>
</tr>
<tr>
<td>Design the subnetting of sub blocks and find out how many addresses are still available after these allocations.</td>
<td></td>
</tr>
<tr>
<td>5. Examine the network and</td>
<td>4</td>
</tr>
<tr>
<td>1. Identify connectivity problems- Use the ping command to test network connectivity.</td>
<td></td>
</tr>
<tr>
<td>2. Troubleshoot network connections</td>
<td></td>
</tr>
<tr>
<td>3. Begin troubleshooting at the host connected to the router.</td>
<td></td>
</tr>
<tr>
<td>4. Examine the router to find possible configuration errors.</td>
<td></td>
</tr>
</tbody>
</table>
5. Use the necessary commands to correct the router configuration.
6. Verify the logical configuration.

<p>| | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>6</td>
<td>Configure, apply real-time routing protocols (RIP/OSPF) in a simple network topology and analyze the routing tables and check the network connectivity</td>
</tr>
</tbody>
</table>
| 7 | Recommend suitable Queuing mechanism among the following  
   1. First-In-First-Out  
   2. Priority Queuing  
   3. Weighted Fair Queuing  
   for Voice, Video & Custom traffic by creating a network using nodes, switches & routers using NETSIM Tool. | 4 hours |

Total laboratory hours 30 hours

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

Recommended by Board of Studies 28-02-2016

Approved by Academic Council No. 47 Date 05-10-2017
<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>ECE4009</td>
<td>Wireless and Mobile Communications</td>
<td>3</td>
<td>0</td>
<td>2</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Pre-requisite: ECE4001 : Digital Communication Systems

| Syllabus version | 1.0 |

**Course Objectives:**

1. To familiarize the concepts related to cellular communication and its capacity.
2. To acquaint with different generations of mobile networks.
3. To teach 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**

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**

GSM architecture – CDMA architecture – GPRS architecture – UMTS architecture

**Module:3 Introduction to Mobile Radio Propagation**

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**

Link budget design using path loss model – Outdoor and indoor propagation models

**Module:5 Mobile Radio Propagation: Small Scale Fading and Multipath**

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.
<table>
<thead>
<tr>
<th>Module:6</th>
<th>Modulation Techniques for Mobile Radio</th>
<th>9 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
<td></td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:7</th>
<th>Diversity Techniques</th>
<th>6 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diversity – Types of diversity – Diversity combining techniques: Selection, Feedback, Maximal Ratio Combining and Equal Gain Combining – Rake receiver</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

**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 | 3 hours |
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 hours |
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 | 6 hours |
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 | 6 hours |
5. Study of relative interference levels in homogeneous networks | 3 hours |
6. Evaluate SINR distribution for heterogeneous scenarios with Picos | 5 hours |
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>Effect of Pico locations and number of Picos</td>
</tr>
<tr>
<td>b.</td>
<td>Effect of power levels of Picos</td>
</tr>
<tr>
<td>c.</td>
<td>Effect of Pico bias</td>
</tr>
<tr>
<td>7.</td>
<td>Study of CQI variation</td>
</tr>
<tr>
<td>a.</td>
<td>CQI variations for different users</td>
</tr>
<tr>
<td>b.</td>
<td>CQI variations in different sub bands</td>
</tr>
</tbody>
</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.

<p>| Recommended by Board of Studies | 13-12-2015 |
| Approved by Academic Council | No. 40 | Date | 18-03-2016 |</p>
<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>ECE4010</td>
<td>Satellite Communication</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
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<tr>
<td>Pre-requisite</td>
<td>ECE4001 - Digital Communication Systems</td>
<td></td>
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</tr>
</tbody>
</table>

Syllabus version: 1.0

**Course Objectives:**

1. To have a conceptual knowledge of communication through satellites.
2. To have a detailed understanding of navigation - both inertial and by navigation satellites.
3. To analyze typical challenges of satellite based systems.

**Course Outcomes:**

1. Understand the concept of orbits, launch vehicles and satellites
2. Comprehend the design of satellite subsystems
3. Imbibe the basics of digital transmission related to satellite communication
4. Have an in-depth knowledge of navigation satellite services.
5. Understand the impact of diverse parameters on satellite link design
6. Appreciate the applications of satellite systems

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

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 | Elements of Orbital Mechanics**

Overview of satellite communication - Orbital mechanics - Equations of the orbit - Kepler’s laws of planetary motion - Orbital elements - Look angle determination - Orbital perturbation and determination.

**Module: 2 | Orbital Launchers**

Launches and launch vehicles- Launch vehicle selection factors - Satellite positioning into geostationary orbit - Orbital effects in communication systems performance - Doppler shift - Range variations - Solar eclipse and sun transit outage.

**Module: 3 | Elements of Communication Satellite Design**

Satellite subsystems - Attitude and orbit control electronics - Telemetry and tracking - Power subsystems - Communication subsystems - Satellite antennas - Reliability and redundancy- Frequency modulation techniques.

**Module: 4 | Digital Transmission Basics**

Multiple access techniques – FDMA, TDMA, CDMA, SDMA, ALOHA and its types – Onboard processing- Satellite switched TDMA – Spread spectrum transmission and reception for satellite networks.

**Module: 5 | Satellite Link Design**

Basic transmission theory – System noise temperature and G/T Ratio- Noise figure and noise temperature- Calculation of system noise temperature – G/T ratio for earth stations - Link budgets - Uplink and downlink budget calculations - Error control for digital satellite links - Prediction of rain attenuation and propagation impairment counter measures.

**Module: 6 | VSAT Systems**

Overview of VSAT systems - Network architectures – One way implementation – Split IP implementation – Two way implementation – Access control protocols – Delay considerations - VSAT earth station engineering - System design procedure and calculation of link margins for VSAT network.
<table>
<thead>
<tr>
<th>Module:7</th>
<th>Direct Broadcast Satellite Television systems and GPS</th>
<th>7 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DBS TV system design - Direct broadcast satellite television transmitters and receivers - DBS TV link budget - Radio and satellite navigation –GPS position location principles – GPS navigation messages and signal levels - GPS receivers design – Role of satellites in future networks – Advanced error control codes for satellite systems.</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:</td>
<td>45 hours</td>
</tr>
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</table>

**Text Book(s)**


**Reference Books**


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

**Recommended by Board of Studies** 13-02-2016

**Approved by Academic Council** No.47 05-10-2017
Course Code | Course Title | L | T | P | J | C
--- | --- | --- | --- | --- | --- | ---
ECE4011 | Wireless Sensor Networks | 2 | 0 | 2 | 4 | 4

Pre-requisite | ECE4008: Computer Communication | Syllabus version | 1.1

**Course Objectives:**
1. To introduce the state-of-the-art in wireless sensor networks and to provide knowledge about architectures related to wireless sensor networks.
2. To study the applications of wireless sensor networks
3. To understand and analyze the basic WSN technology and supporting protocols.
4. To acquaint with various sensor network simulation tools and provide hands on training in programming.

**Course Outcomes:**
1. Understand the concepts of sensor network architecture, challenges and applications of wireless sensor networks
2. Understand and analyze the sensor node architecture, protocol design and Gateway concepts
3. Understand the design constraints and requirements of Physical Layer in Sensor Network Stack
4. Acquire an overview of the various network level protocols for MAC, routing, time synchronization and data aggregation in wireless sensor networks
5. Analyze the higher-level decision making that directs network packets from their source towards their destination through intermediate network nodes by specific packet forwarding mechanisms
6. Analyze the low power communication standards and IP addressing mechanism
7. Analyze the various hardware, software platforms that exist for sensor networks, realize them through simulation
8. Build and deploy a wireless sensor system for real world application for various use cases

**Student Learning Outcomes (SLO):** 2,14,17
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
17. Having an ability to use techniques, skills and modern engineering tools necessary for engineering practice

**Module:1 Introduction** 4 hours

**Module:2 Sensor Node and Architecture** 4 hours

**Module:3 Physical Layer** 2 hours
Design Constraints and Requirements - Physical Layer and Transceiver Design

**Module:4 Data Link Layer** 5 hours
Link layer fundamentals and requirements – Link management - MAC Protocols — S-MAC, Low Duty Cycle and Wakeup concepts – Contention Based – Schedule Based, IEEE 802.15.4 Standard – PHY/MAC Slotted - Unslotted CSMA/CA- GTS Mechanism

<table>
<thead>
<tr>
<th>Module:5</th>
<th>Network Layer</th>
<th>5 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Need for routing protocol- Energy aware routing- Location based routing : GF, GAF, GEAR, GPSR, Attribute based routing – Directed diffusion, Rumor routing, Geographic hash tables</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:6</th>
<th>Wireless Personal Area Network</th>
<th>3 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zigbee and 6LoWPAN Network Layer Design</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:7</th>
<th>WSN Tools, Platforms and Applications</th>
<th>5 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Programming Challenges; Node-Level Platforms; Node-Level Simulator; Home Control, Building Automation, Industrial Automation, Medical Applications</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>
</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. Simulation analysis of range based localization techniques 3 hours
2. Analyze the effect of variable sensing rates and data transmission rate on the power consumption of a sensor node 3 hours
3. Performance analysis of CSMA/ CA (slotted, un-slotted) MAC protocol. 3 hours
4. Analysis of various real world sensors (temperature, humidity, light intensity, rain gauge etc.) and to demonstrate data acquisition from a sensor node. 3 hours
5. Evaluate different topologies recommended for a wireless sensor network. 3 hours
6. Simulation analysis of multi-hop communication vs. direct transmission 3 hours
7. Study and analyze WSN algorithms for clustering of sensor nodes. 3 hours
<table>
<thead>
<tr>
<th>8</th>
<th>Evaluate static clustering technique with respect to WSN life time and throughput.</th>
<th>3 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>Study and demonstrate the role of gateways (forwarding nodes) in inter cluster / cluster to sink data transmissions.</td>
<td>3 hours</td>
</tr>
<tr>
<td>10</td>
<td>Design and analyze the performance of any two routing techniques prescribed for WSN architecture (Energy aware routing- Location based routing : GF, GAF, GEAR, GPSR, Attribute based routing – Directed diffusion, Rumor routing, Geographic hash tables)</td>
<td>3 hours</td>
</tr>
</tbody>
</table>

**Total laboratory hours**: 30 hours

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

**Typical Projects**

i. Investigate and research on many challenging problems in wireless sensor networks:
   - Data aggregation/collection
   - Tasking and control
   - Routing
   - Topology control

ii. Implement and build real-world wireless sensor systems:
   - Temperature sensor networks
   - RFID inventory management
   - People management
   - Monitoring Mechanisms for Wireless Sensor Network
   - Medical Applications Based on Wireless Sensor Networks
   - Wireless Sensors Based System for Home Energy Consumption
   - Zigbee Based Remote Health Monitoring

iii. Research on wireless sensor network management framework.
   - To come out with a general architecture that supports many different types of sensor network management like static, mobile wireless sensor networks

**Mode of evaluation**: Review I, II and III.

<p>| Recommended by Board of Studies | 13-12-2015 |
| Approved by Academic Council | No. 40 | Date | 18-03-2015 |</p>
<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>ECE4013</td>
<td>Cryptography and Network Security</td>
<td>3</td>
<td>0</td>
<td>0</td>
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</tr>
<tr>
<td>Pre-requisite</td>
<td>ECE2005 Probability Theory and Random Process</td>
<td>Syllabus version</td>
<td>1.2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Course Objectives:**

1. To introduce the basic concepts in security mechanism, classical and traditional Encryption techniques.
2. To understand the significance of message authentication and digital signature in cryptography.
3. To acquaint the different types of network security and its significance.

**Course Outcomes:**

2. Comprehend the various mathematical techniques in cryptography, including number theory, Finite Field, Modulo operator and Discrete Logarithm.
3. Able to analyse block ciphers, Data Encryption Standard (DES), Advanced Encryption Standard (AES) and public key cryptography.
4. Able to analyse Diffie-Hellman key exchange, ElGamal Cryptosystem in asymmetric key cryptosystem.
5. Comprehend the various types of data integrity and authentication schemes.
6. Comprehend the various network security mechanism

**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
18. Having critical thinking and innovative skills

**Module:**

<table>
<thead>
<tr>
<th>Module</th>
<th>Classical Encryption Techniques:</th>
<th>5 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module</td>
<td>Mathematical Foundations:</td>
<td>6 hours</td>
</tr>
<tr>
<td>Module</td>
<td>Symmetric Ciphers:</td>
<td>8 hours</td>
</tr>
<tr>
<td>Module</td>
<td>Asymmetric Ciphers:</td>
<td>6 hours</td>
</tr>
<tr>
<td>Module</td>
<td>Data Integrity:</td>
<td>6 hours</td>
</tr>
<tr>
<td>Module</td>
<td>Mutual Trust:</td>
<td>6 hours</td>
</tr>
<tr>
<td>Module</td>
<td>Network Security:</td>
<td>6 hours</td>
</tr>
<tr>
<td>Module</td>
<td>Contemporary Issues</td>
<td>2 hours</td>
</tr>
</tbody>
</table>

**Module:**

- **Module 1:** Classical Encryption Techniques
- **Module 2:** Mathematical Foundations
- **Module 3:** Symmetric Ciphers
- **Module 4:** Asymmetric Ciphers
- **Module 5:** Data Integrity
- **Module 6:** Mutual Trust
- **Module 7:** Network Security
- **Module 8:** Contemporary Issues
<table>
<thead>
<tr>
<th>Text Book(s)</th>
<th></th>
</tr>
</thead>
</table>

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

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

<p>| Recommended by Board of Studies | 28-02-2016 |
| Approved by Academic Council | No.47 | Date | 05-10-2017 |</p>
<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>ECE4033</td>
<td>IoT System Design and Applications</td>
<td>3</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>4</td>
</tr>
</tbody>
</table>

Pre-requisite: ECE3003 - Microcontroller and Applications

Syllabus version 1.0

Course Objectives:

1. To teach students the fundamental design concepts of Internet of Things (IoT).
2. To acquaint the students with the hardware components, various networking protocols and software platforms used to build an end-to-end IoT system.
3. To familiarize students with the data analytics, machine learning algorithms used in IoT systems.
4. Apprise the students about the choices of sensors, boards and cloud services in designing a typical IoT application.

Course Outcomes:

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

1. Identify the different components of an IoT system and their purpose.
2. Select suitable sensors and embedded board to fit into a specified IoT application.
3. Choose appropriate protocols to interpret the data from an IoT system.
4. Evaluate the various data analytics tool and machine learning algorithms and employ suitable techniques.
5. Design and develop an IoT system architecture using appropriate hardware/software components for the given use case.
6. Explore Edge and Cloud computing platforms for IoT
7. Case studies of IoT in different verticals.

Student Learning Outcomes (SLO): 5.9,18

5. Having design thinking capability

9. Having problem solving ability - solving social issues and engineering problems

18. Having critical thinking and innovative skills

Module: 1 | Hardware subsystem of IoT | 7 hours

Module: 2 | Networking Subsystem for IoT | 6 hours
Ethernet – ESP shield, Wi-Fi, IEEE 802.15.4, ZigBee, Bluetooth, LoRa, 4G & 5G networking paradigms.

Module: 3 | Programming IoT Devices- Peripheral Interfacing | 6 hours
Programming the IoT devices using C/C++/Python – Digital and Analog I/O units, SPI & I2C protocol.

Module: 4 | Programming IoT devices – Networking to cloud | 12 hours
Networking – SSH, Sockets, Network libraries and web services. Retrieving data from real world sensors. Working with cloud – Publishing data, setting up IoT analytics at cloud.

**Module:5 | IoT Edge to cloud protocols**

<table>
<thead>
<tr>
<th>7 hours</th>
</tr>
</thead>
</table>
MQTT, MQTT – SN, CoAP, HTTP, RestFul API, AMQP. Significance of gateway design, characteristics, protocol bridging, implementations. Edge analytics at devices and gateways.

**Module:6 | Data Analytics and Machine learning in the Cloud and Edge**

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

**Module:7 | Case studies for IoT**

<table>
<thead>
<tr>
<th>3 hours</th>
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</thead>
</table>
IoT for Home automation, Smart Cities, Smart Agriculture. IoT for predictive analytics and maintenance. Smart Medical data sensing and applications in Healthcare.

**Module:8 | Contemporary Issues**

<table>
<thead>
<tr>
<th>2 hours</th>
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</thead>
</table>

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**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)**

<table>
<thead>
<tr>
<th>List of experiments:</th>
</tr>
</thead>
</table>
1. Porting Yocto Linux in Intel Edison - Board Bringup
2. Porting Rasbian Linux in R Pi3 – Board Bringup
3. Controlling GPIO using MQTT
4. Controlling LED’s using RESTful API
5. Using MQTT with Mosquito and Eclipse Paho
6. Measuring ambient Temperature from sensors and publishing using MQTT/RESTful API’s
7. Setting Up Intelligent Gateway.
8. Deploying IoT analytics at cloud suing Azure/Watson/AWS for temperature prediction
9. Waste Management / Smart light in Smart City
10. Predicting tomorrow’s temperature with past and present data
11. Predicting monthly current/power consumption
12. Predictive analytics – Implementation in pacemaker
13. LoRaWAN based smart city implementation

<table>
<thead>
<tr>
<th>Total laboratory hours</th>
<th>30 hours</th>
</tr>
</thead>
</table>

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

Recommended by Board of Studies | 05-02-2020
Approved by Academic Council | No. 58 | Date | 26-02-2020
Course Code | Course Title | L | T | P | J | C
---|---|---|---|---|---|---
MAT3005 | Applied Numerical Methods | 3 | 1 | 0 | 0 | 4
Pre-requisite | MAT2002 – Applications of Differential and Difference Equations | Syllabus Version 1.0

Course Objectives

The aim of this course is to
1. Cover certain basic, important computer oriented numerical methods for analyzing problems that arise in engineering and physical sciences.
2. Use MATLAB as the primary computer language to obtain solutions to a few problems that arise in their respective engineering courses.
3. Impart skills to analyse problems connected with data analysis,
4. Solve ordinary and partial differential equations numerically

Course Outcome

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 to find the solution of 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 | 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
---|---|---

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
Numerical differentiation with interpolation polynomials-maxima and minima for tabulated values-Trapezoidal rule, Simpsons $1/3^{rd}$ and $3/8^{th}$ rules. –Romberg’s method. Two and Three point Gaussian quadrature formula.

<table>
<thead>
<tr>
<th>Module:5</th>
<th>Numerical Solution of Ordinary Differential Equations</th>
<th>8 hours</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Module:6</th>
<th>Numerical Solution of Partial Differential Equations</th>
<th>6 hours</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Module:7</th>
<th>Variational Methods</th>
<th>6 hours</th>
</tr>
</thead>
</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>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Total lecture hours:</th>
<th>45 hours</th>
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<tbody>
<tr>
<td>Tutorial</td>
<td>30 hours</td>
</tr>
<tr>
<td>• A minimum of 10 problems to be worked out by students in every Tutorial Class.</td>
<td></td>
</tr>
<tr>
<td>• Another 5 problems per Tutorial Class to be given for practise.</td>
<td></td>
</tr>
</tbody>
</table>

**Text Book(s)**


**Reference Books**


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

Recommended by Board of Studies 25-02-2017
Approved by Academic Council No.47 Date 05-10-2017
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHY1002</td>
<td>Materials Science</td>
<td>3</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>4</td>
</tr>
</tbody>
</table>

Pre-requisite | PHY1701-Engineering Physics | Syllabus version | 1.0 |

**Course Objectives:**
To enable the students to understand the nature of different types of materials namely Conducting, Semi conducting, Dielectrics, Magnetic and Superconducting materials.

**Course Outcome:** Students will be able to

1. Understand the fundamentals of physics for conducting materials and how it is pertinent for engineering related applications
2. Describe the basic classification of semiconducting materials and how to develop an engineering related devices
3. Describe the fundamental polarization mechanism involved in dielectrics and how it is responsible with different frequency of radiation including how stress and strain plays a major role in piezoelectric.
4. Learn the basic magnetization concepts in detail and study different properties of magnetic materials, including the analysis of various magnetic properties and its applications.
5. Describe the phenomenon of super conduction and explain how superconductors behave in magnetic fields including some engineering applications of superconductors.
6. Gain the basic phenomenon behind the mechanism between materials and light and how a material blacking, absorbing and enhancing the light including the complete idea of negative index and negative materials by understanding the universal parameters of permeability and permittivity.
7. Gain an introduction to nanomaterials and in depth knowledge about synthesis and properties of bulk and nanostructured materials, including their applications.
8. Demonstrate electrical, thermal, dielectric, semiconducting and magnetic properties of materials – LAB

**Student Learning Outcome (SLO):**

1. Having an ability to apply mathematics and science in engineering applications
5. Having design thinking capability
14. Having an ability to design and conduct experiments, as well as to analyse and interpret data
17. Having an ability to use techniques, skills and modern engineering tools necessary for engineering practice

**Module:1 Conducting Materials**
6 hours
Drude-Lorentz Classical free electron theory of metals, electrical conductivity, relaxation time, drift velocity, Matthiessen’s rule, thermal conductivity Wiedemann-Franz law, drawbacks of classical theory, Kronig-Penny Model, Quantum theory (derivation) and its success, Band theory of solids.

**Module:2 Semiconducting Materials**
7 hours
Band theory of solids – Kronig-Penny Model & its success; P and N type – direct and indirect semiconductor; Density of energy state; Variation of Fermi level with respect to temperature and carrier concent r at ion in intrinsic and extrinsic semiconductors; Hall effect – theory – experimental proof; Hall Sensors, Problems.
**Module:3 | Dielectric Materials**  
7 hours  
Introduction, Clausius-Mosotti relation; Polarization mechanisms, electronic, ionic and orientation, Temperature dependence of dielectric constant, Frequency dependence of dielectric constant, Dielectric loss, dielectric breakdown types, dielectric materials as electrical insulators - examples, Problems, Ferroelectric and Piezoelectric materials.

**Module:4 | Magnetic Materials**  
6 hours  

**Module:5 | Superconducting Materials**  
6 hours  
Superconductors, types, properties, Meissner Effect, BCS theory, High Tc Superconductors (YBCO). Applications- Josephson Effect-SQUID-Cryotron; Problems.

**Module:6 | Metamaterials**  
6 hours  

**Module:7 | Material Synthesis**  
6 hours  
Material synthesis processes, PVD sputtering, Chemical Vapor deposition (CVD), Examples: preparation of thin films, bulk and nanomaterials (any one material).

**Module:8 | Contemporary issues:**  
2 hours  
Guest lecture by industry experts.

| 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>No.</th>
<th>Experiment Description</th>
<th>Time (hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Thermal and Electrical Conductivity of a Good Conductor</td>
<td>2</td>
</tr>
<tr>
<td>2.</td>
<td>Dielectric study - dielectric behavior of a ferroelectric ceramic material at various temperature and determine the Curie temperature</td>
<td>2</td>
</tr>
<tr>
<td>3.</td>
<td>Hall Effect - Determine the Hall coefficient of a given Germanium (Semiconductor) crystal</td>
<td>2</td>
</tr>
<tr>
<td>4.</td>
<td>Solar Cell - Draw I-V characteristic of a solar cell and determine the maximum power generated from solar cell, fill factor and efficiency</td>
<td>2</td>
</tr>
<tr>
<td>5.</td>
<td>Magnetic Susceptibility - by Quinke’s Method</td>
<td>2</td>
</tr>
<tr>
<td>6.</td>
<td>Band Gap - using four probe method</td>
<td>2</td>
</tr>
<tr>
<td>7.</td>
<td>Schering bridge: To find unknown capacitance and reactance of the circuit</td>
<td>2</td>
</tr>
<tr>
<td>8.</td>
<td>B-H curve of magnetic materials</td>
<td>2</td>
</tr>
<tr>
<td>9.</td>
<td>Determination of the electron spin g-factor (Lande g-factor) of a given sample by ESR spectrometer</td>
<td>2</td>
</tr>
</tbody>
</table>

**Total laboratory hours**: 30 hours

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

Recommended by Board of Studies: 05-03-2016

Approved by Academic Council: No. 40 Date: 18-03-2016