SCHOOL OF ELECTRONICS ENGINEERING

M. Tech Embedded Systems

Curriculum
(2020-2021 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

1. 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.
2. 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.
M. Tech Embedded Systems

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
M. Tech Embedded Systems

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
M. Tech Embedded Systems

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
M. Tech Embedded Systems

PROGRAMME SPECIFIC OUTCOMES (PSOs)

On completion of M.Tech. Embedded Systems, graduates will be able to

**PSO1.** Apply the advanced concepts of Embedded System Design with real-time constraints using advanced Microcontrollers and FPGA based systems.

**PSO2.** Use the cutting-edge technologies in both hardware and software, to solve real-world multi-disciplinary problems and arrive at a viable solution.

**PSO3.** Independently carry out research on diverse Embedded System strategies to address practical problems and present a substantial technical report.
M. Tech Embedded Systems

CREDIT STRUCTURE

Category-wise Credit distribution

<table>
<thead>
<tr>
<th>Category</th>
<th>Credits</th>
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<tr>
<td>Programme core (PC)</td>
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M. Tech Embedded Systems

DETAILED CURRICULUM

University Core

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<th>S. No.</th>
<th>Course Code</th>
<th>Course Title</th>
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<th>P</th>
<th>J</th>
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<tbody>
<tr>
<td>1.</td>
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University Elective

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# M. Tech Embedded Systems

## Programme Core

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# M. Tech Embedded Systems

## Programme Elective

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<td>AUTOSAR and ISO Standards for Automotive Systems</td>
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<td>Scripting Languages for Design Automation</td>
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University Core
MAT6001 | ADVANCED STATISTICAL METHODS | L | T | P | J | C
| Pre-requisite | None | Syllabus Version | 2.0

Course Objectives

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

Expected Course Outcome

At the end of the course the students are expected to

1. understand the concept of correlation and regression model and able to interpret the effect of variables, regression coefficients, coefficient of determination.
2. make appropriate decisions using inferential statistical tools that are central to experimental research.
3. understand the statistical forecasting methods and model fitting by graphical interpretation of time series data.
4. construct standard experimental designs and describe what statistical models can be estimated using the data.
5. demonstrate R programming for statistical data

Student Learning Outcomes(SLO0 7, 9, 18

[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
[18] Having critical thinking and innovative skills

Module:1 | Basic Statistical Tools for Analysis: | 4 hours

Summary Statistics, Correlation and Regression, Concept of R² and Adjusted R² and Partial and Multiple Correlation, Fitting of simple and Multiple Linear regression, Explanation and Assumptions of Regression Diagnostics

Module:2 | Statistical inference: | 9 hours


Module:3 | Modelling and Forecasting Methods: | 9 hours

Introduction: Concept of Linear and Non Liner Forecasting model ,Concepts of Trend, Exponential Smoothing, Linear and Compound Growth model, Fitting of Logistic curve and their Applications, Moving Averages, Forecasting accuracy tests.

Probability models for time series: Concepts of AR, ARMA and ARIMA models.

Module:4 | Design of Experiments: | 6 hours

Analysis of variance – one and two way classifications – Principle of design of experiments, CRD – RBD – LSD, Concepts of 2² and 2³ factorial experiments.
Module:5 | Contemporary Issues: | 2 hours
---|---|---
Industry Expert Lecture

<table>
<thead>
<tr>
<th>Text Book(s)</th>
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<table>
<thead>
<tr>
<th>Reference Books</th>
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<tr>
<th>Mode of Evaluation</th>
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<tr>
<td>Digital Assignments, Quiz, Continuous Assessments, Final Assessment Test</td>
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<table>
<thead>
<tr>
<th>List of Challenging Experiments (Indicative)</th>
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</thead>
<tbody>
<tr>
<td>1. Computing Summary Statistics using real time data</td>
<td>3 hours</td>
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<tr>
<td>2. Plotting and visualizing data using Tabulation and Graphical Representations.</td>
<td>3 hours</td>
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<tr>
<td>3. Applying simple linear and multiple linear regression models to real dataset; computing and interpreting the coefficient of determination for scale data.</td>
<td>3 hours</td>
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<tr>
<td>4. Testing of hypothesis for Large sample tests for real-time problems.</td>
<td>2 hours</td>
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<tr>
<td>5. Testing of hypothesis for Small sample tests for One and Two Sample mean and paired comparison (Pre-test and Post-test)</td>
<td>2 hours</td>
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<tr>
<td>6. Testing of hypothesis for Small Sample tests for F-test</td>
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<tr>
<td>7. Testing of hypothesis for Small Sample tests for Chi-square test</td>
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<tr>
<td>8. Applying Time series analysis-Trends. Growth ,Logistic, Exponential models</td>
<td>2 hours</td>
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<tr>
<td>9. Applying Time series model AR , ARMA and ARIMA and testing Forecasting accuracy tests.</td>
<td>3 hours</td>
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<tr>
<td>10. Performing ANOVA (one-way and two-way), CRD, RBD and LSD for real dataset.</td>
<td>3 hours</td>
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<tr>
<td>11. Performing $2^2$ factorial experiments with real time Applications</td>
<td>2 hours</td>
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<tr>
<td>No.</td>
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<td>12</td>
<td>Performing $2^3$ factorial experiments with real time Applications</td>
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<td><strong>Total Laboratory Hours</strong></td>
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**Mode of Evaluation**

- Weekly Assessments, Final Assessment Test
- Recommended by Board of Studies: 25-02-2017
- Approved by Academic Council: No. 46, Date: 24-08-2017
# ENG5001  
**Fundamentals of Communication Skills**

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**Pre-requisite**: Not cleared EPT (English Proficiency Test)

**Syllabus version**: 1.0

### Course Objectives:
1. To enable learners learn basic communication skills - Listening, Speaking, Reading and Writing
2. To help learners apply effective communication in social and academic context
3. To make students comprehend complex English language through listening and reading

### Expected Course Outcome:
1. Enhance the listening and comprehension skills of the learners
2. Acquire speaking skills to express their thoughts freely and fluently
3. Learn strategies for effective reading
4. Write grammatically correct sentences in general and academic writing
5. Develop technical writing skills like writing instructions, transcoding etc.,

### Student Learning Outcomes (SLO):
- 18. Having critical thinking and innovative skills
- 20. Having a good digital footprint

### Module:1  
**Listening**
- 8 hours
  - Understanding Conversation
  - Listening to Speeches
  - Listening for Specific Information

### Module:2  
**Speaking**
- 4 hours
  - Exchanging Information
  - Describing Activities, Events and Quantity

### Module:3  
**Reading**
- 6 hours
  - Identifying Information
  - Inferring Meaning
  - Interpreting text

### Module:4  
**Writing: Sentence**
- 8 hours
  - Basic Sentence Structure
  - Connectives
  - Transformation of Sentences
  - Synthesis of Sentences

### Module:5  
**Writing: Discourse**
- 4 hours
  - Instructions
  - Paragraph
  - Transcoding

**Total Lecture hours**: 30 hours

### Text Book(s)

### Reference Books

Authors, book title, year of publication, edition number, press, place

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

<table>
<thead>
<tr>
<th>List of Challenging Experiments (Indicative)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Familiarizing students to adjectives through brainstorming adjectives with all letters of the English alphabet and asking them to add an adjective that starts with the first letter of their name as a prefix.</td>
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<tr>
<td>2. Making students identify their peer who lack Pace, Clarity and Volume during presentation and respond using Symbols.</td>
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<tr>
<td>3. Using Picture as a tool to enhance learners speaking and writing skills</td>
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<tr>
<td>4. Using Music and Songs as tools to enhance pronunciation in the target language / Activities through VIT Community Radio</td>
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<tr>
<td>5. Making students upload their Self-introduction videos in Vimeo.com</td>
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<tr>
<td>6. Brainstorming idiomatic expressions and making them use those in to their writings and day to day conversation</td>
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<tr>
<td>7. Making students Narrate events by adding more descriptive adjectives and add flavor to their language / Activities through VIT Community Radio</td>
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<td>8. Identifying the root cause of stage fear in learners and providing remedies to make their presentation better</td>
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<tr>
<td>9. Identifying common Spelling &amp; Sentence errors in Letter Writing and other day to day conversations</td>
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<tr>
<td>10. Discussing FAQ’s in interviews with answers so that the learner gets a better insight in to interviews / Activities through VIT Community Radio</td>
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**Total Laboratory Hours** | 30 hours |

Mode of evaluation: Online Quizzes, Presentation, Role play, Group Discussions, Assignments, Mini Project

Recommended by Board of Studies | 22-07-2017 |
Approved by Academic Council | No. 46 | Date | 24-8-2017 |
**ENG5002** | Professional and Communication Skills | L | T | P | J | C |
---|---|---|---|---|---|
| | | 0 | 0 | 2 | 0 | 1 |
**Pre-requisite** | ENG5001 | Syllabus version | 1.1 |

**Course Objectives:**
1. To enable students to develop effective Language and Communication Skills
2. To enhance students’ Personal and Professional skills
3. To equip the students to create an active digital footprint

**Expected Course Outcome:**
1. Improve inter-personal communication skills
2. Develop problem solving and negotiation skills
3. Learn the styles and mechanics of writing research reports
4. Cultivate better public speaking and presentation skills
5. Apply the acquired skills and excel in a professional environment

**Student Learning Outcomes (SLO):**
18. Critical thinking and innovative skills.
20. Having a good digital footprint

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<th><strong>Module:</strong></th>
<th><strong>Personal Interaction</strong></th>
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<td>Introducing Oneself- one’s career goals</td>
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<tr>
<td>Activity: SWOT Analysis</td>
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<th><strong>Interpersonal Interaction</strong></th>
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<tbody>
<tr>
<td>Interpersonal Communication with the team leader and colleagues at the workplace</td>
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<tr>
<td>Activity: Role Plays/Mime/Skit</td>
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<table>
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<th><strong>Module:</strong></th>
<th><strong>Social Interaction</strong></th>
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<tbody>
<tr>
<td>Use of Social Media, Social Networking, gender challenges</td>
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<tr>
<td>Activity: Creating LinkedIn profile, blogs</td>
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<thead>
<tr>
<th><strong>Module:</strong></th>
<th><strong>Résumé Writing</strong></th>
<th><strong>4 hours</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Identifying job requirement and key skills</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Activity: Prepare an Electronic Résumé</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Module:</strong></th>
<th><strong>Interview Skills</strong></th>
<th><strong>4 hours</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Placement/Job Interview, Group Discussions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Activity: Mock Interview and mock group discussion</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Module:</strong></th>
<th><strong>Report Writing</strong></th>
<th><strong>4 hours</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Language and Mechanics of Writing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Activity: Writing a Report</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Module:</strong></th>
<th><strong>Study Skills: Note making</strong></th>
<th><strong>2 hours</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Summarizing the report</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Activity: Abstract, Executive Summary, Synopsis</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Module:</strong></th>
<th><strong>Interpreting skills</strong></th>
<th><strong>2 hours</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Interpret data in tables and graphs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Activity: Transcoding</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Module:</strong></th>
<th><strong>Presentation Skills</strong></th>
<th><strong>4 hours</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral Presentation using Digital Tools</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Activity: Oral presentation on the given topic using appropriate non-verbal cues</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Module:</strong></th>
<th><strong>Problem Solving Skills</strong></th>
<th><strong>4 hours</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem Solving &amp; Conflict Resolution</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Activity: Case Analysis of a Challenging Scenario</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Total Lecture hours:** 30 hours

**Text Book(s)**

### Reference Books

<table>
<thead>
<tr>
<th>Reference</th>
<th>Author(s)</th>
<th>Title</th>
<th>Year</th>
<th>Publisher</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Jon Kirkman and Christopher Turk</td>
<td><em>Effective Writing: Improving Scientific, Technical and Business Communication</em>, 2015, Routledge</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Diana Bairaktarova and Michele Eodice</td>
<td><em>Creative Ways of Knowing in Engineering</em>, 2017, Springer International Publishing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>ArunPatil, Henk Eijkman &amp; Ena Bhattacharya</td>
<td><em>New Media Communication Skills for Engineers and IT Professionals</em>, 2012, IGI Global, Hershey PA.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Reference Books

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

**List of Challenging Experiments (Indicative)**

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Description</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SWOT Analysis – Focus specially on describing two strengths and two weaknesses</td>
<td>2 hours</td>
</tr>
<tr>
<td>2</td>
<td>Role Plays/Mime/Skit – Workplace Situations</td>
<td>4 hours</td>
</tr>
<tr>
<td>3</td>
<td>Use of Social Media – Create a LinkedIn Profile and also write a page or two on areas of interest</td>
<td>2 hours</td>
</tr>
<tr>
<td>4</td>
<td>Prepare an Electronic Résumé and upload the same in vimeo</td>
<td>2 hours</td>
</tr>
<tr>
<td>5</td>
<td>Group discussion on latest topics</td>
<td>4 hours</td>
</tr>
<tr>
<td>6</td>
<td>Report Writing – Real-time reports</td>
<td>2 hours</td>
</tr>
<tr>
<td>7</td>
<td>Writing an Abstract, Executive Summary on short scientific or research articles</td>
<td>4 hours</td>
</tr>
<tr>
<td>8</td>
<td>Transcoding – Interpret the given graph, chart or diagram</td>
<td>2 hours</td>
</tr>
<tr>
<td>9</td>
<td>Oral presentation on the given topic using appropriate non-verbal cues</td>
<td>4 hours</td>
</tr>
<tr>
<td>10</td>
<td>Problem Solving -- Case Analysis of a Challenging Scenario</td>
<td>4 hours</td>
</tr>
</tbody>
</table>

**Total Laboratory Hours:** 30 hours

**Mode of evaluation:** Online Quizzes, Presentation, Role play, Group Discussions, Assignments, Mini Project

**Recommended by Board of Studies:** 22-07-2017

**Approved by Academic Council:** No. 47, Date 05-10-2017
## Course Objectives:
The course gives students the necessary background to:

1. Demonstrate competence in reading, writing, and speaking basic French, including knowledge of vocabulary (related to profession, emotions, food, workplace, sports/hobbies, classroom and family).
2. Achieve proficiency in French culture oriented viewpoint.

## Expected Course Outcome:
The students will be able to

1. Remember the daily life communicative situations via personal pronouns, emphatic pronouns, salutations, negations, interrogations etc.
2. Create communicative skill effectively in French language via regular / irregular verbs.
3. Demonstrate comprehension of the spoken / written language in translating simple sentences.
4. Understand and demonstrate the comprehension of some particular new range of unseen written materials.
5. Demonstrate a clear understanding of the French culture through the language studied.

### Student Learning Outcomes (SLO):

<table>
<thead>
<tr>
<th>SLO</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>Having problem solving ability- solving social issues and engineering problems</td>
</tr>
<tr>
<td>10</td>
<td>Having a clear understanding of professional and ethical responsibility</td>
</tr>
</tbody>
</table>

### Module:1  Saluer, Se présenter, Etablir des contacts  
3 hours

### Module:2  Présenter quelqu’un, Chercher un(e) correspondant(e), Demander des nouvelles d’une personne.  
3 hours
La conjugaison des verbes Pronominaux, La Négation, L’interrogation avec ‘Est-ce que ou sans Est-ce que’.

### Module:3  Situer un objet ou un lieu, Poser des questions  
4 hours
L’article (défini/ indéfini), Les prépositions (à/en/aux/sur/dans/avec etc.), L’article contracté, Les heures en français, La Nationalité du Pays, L’adjectif (La Couleur, l’adjectif possessif, l’adjectif démonstratif/ l’adjectif interrogatif (quel/quelles/quelle/quelles), L’accord des adjectifs avec le nom, L’interrogation avec Comment/ Combien / Où etc.,

### Module:4  Faire des achats, Comprendre un texte court, Demander et indiquer le chemin.  
6 hours
La traduction simple :(français-anglais / anglais –français)

### Module:5  Trouver les questions, Répondre aux  
5 hours
<table>
<thead>
<tr>
<th>questions générales en français.</th>
</tr>
</thead>
<tbody>
<tr>
<td>L’article Partitif, Mettez les phrases aux pluriels, Faites une phrase avec les mots donnés, Exprimez les phrases données au Masculin ou Féminin, Associez les phrases.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:6</th>
<th>Comment écrire un passage</th>
<th>3 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Décrivez :</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>La Famille /La Maison, /L’université /Les Loisirs/ La Vie quotidienne etc.</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:7</th>
<th>Comment écrire un dialogue</th>
<th>4 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dialogue:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) Réserver un billet de train</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b) Entre deux amis qui se rencontrent au café</td>
<td></td>
<td></td>
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<tr>
<td>c) Parmi les membres de la famille</td>
<td></td>
<td></td>
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<tr>
<td>d) Entre le client et le médecin</td>
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</table>

<table>
<thead>
<tr>
<th>Module:8</th>
<th>Invited Talk: Native speakers</th>
<th>2 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Lecture hours:</strong></td>
<td><strong>30 hours</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Text Book(s)**


**Reference Books**

3. ALTER EGO 1, Méthode de français, Annie Berthet, Catherine Hugo, Véronique M. Kizirian, Béatrix Sampsonis, Monique Waendendries, Hachette livre 2006.

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

**Recommended by Board of Studies**

**Approved by Academic Council** No 41 Date 17-06-2016
Course Objectives:
The course gives students the necessary background to:
1. Enable students to read and communicate in German in their day to day life
2. Become industry-ready
3. Make them understand the usage of grammar in the German Language.

Expected Course Outcome:
The students will be able to
1. Create the basics of German language in their day to day life.
2. Understand the conjugation of different forms of regular/irregular verbs.
3. Understand the rule to identify the gender of the Nouns and apply articles appropriately.
4. Apply the German language skill in writing corresponding letters, E-Mails etc.
5. Create the talent of translating passages from English-German and vice versa and To frame simple dialogues based on given situations.

Student Learning Outcomes (SLO): 9, 10
9. Having problem solving ability- solving social issues and engineering problems
10. Having a clear understanding of professional and ethical responsibility

Module: 1
3 hours
Einleitung, Begrüssungsformen, Landeskunde, Alphabet, Personalpronomen, Verb Konjugation, Zahlen (1-100), W-fragen, Aussagesätze, Nomen – Singular und Plural
Lernziel:
Elementares Verständnis von Deutsch, Genus- Artikelwörter

Module: 2
3 hours
Konjugation der Verben (regelmässig/unregelmässig) die Monate, die Wochentage, Hobbys, Berufe, Jahreszeiten, Artikel, Zahlen (Hundert bis eine Million), Ja-/Nein- Frage, Imperativ mit Sie
Lernziel:
Sätze schreiben, über Hobbys erzählen, über Berufe sprechen usw.

Module: 3
4 hours
Possessivpronomen, Negation, Kasus- AkkusativundDativ (bestimmter, unbestimmterArtikel), trennbare verben, Modalverben, Adjektive, Uhrzeit, Präpositionen, Mahlzeiten, Lebensmittel, Getränke
Lernziel:
Sätze mit Modalverben, Verwendung von Artikel, über Länder und Sprachen sprechen, über eine Wohnung beschreiben.

Module: 4
6 hours
Übersetzungen : (Deutsch – Englisch / Englisch – Deutsch)
Lernziel:
Grammatik – Wortschatz – Übung
### Module 5
**Leseverständnis, Mindmap machen, Korrespondenz - Briefe, Postkarten, E-Mail**

**Lernziel:**
Wortschatzbildung und aktiver Sprachgebrauch

<table>
<thead>
<tr>
<th>Module 5</th>
<th>5 hours</th>
</tr>
</thead>
</table>

### Module 6
**Aufsätze:**
Meine Universität, Das Essen, mein Freund oder meine Freundin, meine Familie, ein Fest in Deutschland usw

<table>
<thead>
<tr>
<th>Module 6</th>
<th>3 hours</th>
</tr>
</thead>
</table>

### Module 7
**Dialoge:**
- e) Gespräche mit Familienmitgliedern, Am Bahnhof,
- f) Gespräche beim Einkaufen; in einem Supermarkt; in einer Buchhandlung;
- g) in einem Hotel - an der Rezeption; ein Termin beim Arzt.

Treffen im Café

<table>
<thead>
<tr>
<th>Module 7</th>
<th>4 hours</th>
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</thead>
</table>

### Module 8
**Guest Lectures/Native Speakers / Feinheiten der deutschen Sprache, Basisinformation über die deutschsprachigen Länder**

<table>
<thead>
<tr>
<th>Module 8</th>
<th>2 hours</th>
</tr>
</thead>
</table>

### Total Lecture hours: 30 hours

**Text Book(s)**


**Reference Books**

1. Netzwerk Deutsch als Fremdsprache A1, Stefanie Dengler, Paul Rusch, Helen Schmitz, Tanja Sieber, 2013
3. Deutsche Sprachlehre für Ausländer, Heinz Griesbach, Dora Schulz, 2011
4. *Themen Aktuell 1*, Hartmut Aufderstrasse, Heiko Bock, Mechthild Gerdes, Jutta Müller und Helmut Müller, 2010

- [www.goethe.de](http://www.goethe.de)
- [wirtschaftsdeutsch.de](http://wirtschaftsdeutsch.de)
- [hueber.de](http://hueber.de), klett-sprachen.de
- [www.deutschtraining.org](http://www.deutschtraining.org)

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

**Recommended by Board of Studies**

**Approved by Academic Council**

| No. 41 | Date | 17-06-2016 |
### STS5001 Essentials of Business Etiquettes

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<td>0</td>
<td>0</td>
<td>1</td>
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<tr>
<td>Syllabus version</td>
<td>2.0</td>
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</table>

### Course Objectives:

1. To develop the students’ logical thinking skills
2. To learn the strategies of solving quantitative ability problems
3. To enrich the verbal ability of the students
4. To enhance critical thinking and innovative skills

### Expected Course Outcome:

- Enabling students to use relevant aptitude and appropriate language to express themselves
- To communicate the message to the target audience clearly

### Student Learning Outcomes (SLO): 7, 9

7. Having Computational thinking (Ability to translate vast data into abstract concepts and to understand database reasoning)

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

### Module:1 Business Etiquette: Social and Cultural Etiquette and Writing Company Blogs and Internal Communications and Planning and Writing press release and meeting notes 9 hours

Value, Manners, Customs, Language, Tradition, Building a blog, Developing brand message, FAQs’, Assessing Competition, Open and objective Communication, Two way dialogue, Understanding the audience, Identifying, Gathering Information,. Analysis, Determining, Selecting plan, Progress check, Types of planning, Write a short, catchy headline, Get to the Point –summarize your subject in the first paragraph,. Body – Make it relevant to your audience,

### Module:2 Study skills – Time management skills 3 hours

Prioritization, Procrastination, Scheduling, Multitasking. Monitoring. Working under pressure and adhering to deadlines

### Module:3 Presentation skills – Preparing presentation and Organizing materials and Maintaining and preparing visual aids and Dealing with questions 7 hours

10 Tips to prepare PowerPoint presentation, Outlining the content, Passing the Elevator Test, Blue sky thinking. Introduction , body and conclusion, Use of Font, Use of Color, Strategic presentation, Importance and types of visual aids, Animation to captivate your audience, Design of posters, Setting out the ground rules, Dealing with interruptions, Staying in control of the questions, Handling difficult questions

### Module:4 Quantitative Ability -L1 – Number properties and Averages and Progressions and 11 hours
### Percentages and Ratios

- Number of factors, Factorials, Remainder Theorem, Unit digit position, Tens digit position, Averages, Weighted Average, Arithmetic Progression, Geometric Progression, Harmonic Progression, Increase & Decrease or successive increase, Types of ratios and proportions

### Module: 5  Reasoning Ability-L1 – Analytical Reasoning  8 hours

- Data Arrangement (Linear and circular & Cross Variable Relationship), Blood Relations, Ordering/ranking/grouping, Puzzle test, Selection Decision table

### Module: 6  Verbal Ability-L1 – Vocabulary Building  7 hours

- Synonyms & Antonyms, One word substitutes, Word Pairs, Spellings, Idioms, Sentence completion, Analogies

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

<table>
<thead>
<tr>
<th>Websites:</th>
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</thead>
<tbody>
<tr>
<td>1. <a href="http://www.chalkstreet.com">www.chalkstreet.com</a></td>
</tr>
<tr>
<td>2. <a href="http://www.skillsyouneed.com">www.skillsyouneed.com</a></td>
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<tr>
<td>3. <a href="http://www.mindtools.com">www.mindtools.com</a></td>
</tr>
<tr>
<td>4. <a href="http://www.thebalance.com">www.thebalance.com</a></td>
</tr>
<tr>
<td>5. <a href="http://www.eguru.ooo">www.eguru.ooo</a></td>
</tr>
</tbody>
</table>

**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. 45\textsuperscript{th} AC | Date | 15/06/2017 |
**Course Objectives:**
5. To develop the students’ logical thinking skills
6. To learn the strategies of solving quantitative ability problems
7. To enrich the verbal ability of the students
8. To enhance critical thinking and innovative skills

**Expected Course Outcome:**
- Enabling students to simplify, evaluate, analyze and use functions and expressions to simulate real situations to be industry ready.

**Student Learning Outcomes (SLO):** 9, 10
9. Having problem solving ability- solving social issues and engineering problems
10. Having a clear understanding of professional and ethical responsibility

<table>
<thead>
<tr>
<th>Module:1</th>
<th>Interview skills – Types of interview and Techniques to face remote interviews and Mock Interview</th>
<th>3 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Structured and unstructured interview orientation, Closed questions and hypothetical questions, Interviewers’ perspective, Questions to ask/not ask during an interview, Video interview, Recorded feedback, Phone interview preparation, Tips to customize preparation for personal interview, Practice rounds</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:2</th>
<th>Resume skills – Resume Template and Use of power verbs and Types of resume and Customizing resume</th>
<th>2 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Structure of a standard resume, Content, color, font, Introduction to Power verbs and Write up, Quiz on types of resume, Frequent mistakes in customizing resume, Layout - Understanding different company's requirement, Digitizing career portfolio</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:3</th>
<th>Emotional Intelligence - L1 – Transactional Analysis and Brain storming and Psychometric Analysis and Rebus Puzzles/Problem Solving</th>
<th>12 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Introduction, Contracting, ego states, Life positions, Individual Brainstorming, Group Brainstorming, Stepladder Technique, Brain writing, Crawford's Slip writing approach, Reverse brainstorming, Star bursting, Charlotte procedure, Round robin brainstorming, Skill Test, Personality Test, More than one answer, Unique ways</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:4</th>
<th>Quantitative Ability-L3 – Permutation-Combinations and Probability and Geometry and mensuration and Trigonometry and Logarithms and Functions and Quadratic Equations and Set Theory</th>
<th>14 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Counting, Grouping, Linear Arrangement, Circular Arrangements, Conditional Probability,</td>
<td></td>
</tr>
</tbody>
</table>

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Independent and Dependent Events, Properties of Polygon, 2D & 3D Figures, Area & Volumes, Heights and distances, Simple trigonometric functions, Introduction to logarithms, Basic rules of logarithms, Introduction to functions, Basic rules of functions, Understanding Quadratic Equations, Rules & probabilities of Quadratic Equations, Basic concepts of Venn Diagram

<table>
<thead>
<tr>
<th>Module:5</th>
<th>Reasoning ability-L3 – Logical reasoning and Data Analysis and Interpretation</th>
<th>7 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Syllogisms, Binary logic, Sequential output tracing, Crypto arithmetic, Data Sufficiency, Data interpretation-Advanced, Interpretation tables, pie charts &amp; bar chats</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:6</th>
<th>Verbal Ability-L3 – Comprehension and Logic</th>
<th>7 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Reading comprehension, Para Jumbles, Critical Reasoning (a) Premise and Conclusion, (b) Assumption &amp; Inference, (c) Strengthening &amp; Weakening an Argument</td>
<td></td>
</tr>
</tbody>
</table>

**Total Lecture hours:** 45 hours

**Reference Books**


**Websites:**

1. [www.chalkstreet.com](http://www.chalkstreet.com)
2. [www.skillsyouneed.com](http://www.skillsyouneed.com)
3. [www.mindtools.com](http://www.mindtools.com)
4. [www.thebalance.com](http://www.thebalance.com)
5. [www.eguru.ooo](http://www.eguru.ooo)

**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 |
Programme Core
Course Code: ECE5041  
Course Title: EMBEDDED SYSTEM DESIGN  
Pre-requisite: Nil  
Syllabus Version 1.1

Course Objectives:
The course aimed at
1. Ability to understand comprehensively the technologies and techniques underlying in building an embedded solution to a wearable, mobile and portable system.
2. Analyze UML diagrams and advanced Modelling schemes for different use cases.
3. Understand the building process of embedded systems

Expected Course Outcome:
The students will be able to
1. Define an embedded system and compare with general purpose system.
2. Appreciate the methods adapted for the development of a typical embedded system.
3. Get introduced to RTOS and related mechanisms.
4. Classify types of processors and memory architecture
5. Differentiate the features of components and networks in embedded systems
6. Develop real-time working prototypes of different small-scale and medium-scale embedded Systems.
7. Apprehend the various concepts in Multi Tasking

Student Learning Outcomes (SLO): 5, 6, 7

[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  
[7] Having computational thinking

Module:1  Introduction to Embedded System  5 hours
Embedded system processor, hardware unit, software embedded into a system, Example of an embedded system, Embedded Design life cycle, Layers of Embedded Systems.

Module:2  Embedded System Design Methodologies  5 hours
Embedded System modelling [FSM, SysML, MARTE], UML as Design tool, UML notation, Requirement Analysis and Use case Modelling, Design Examples

Module:3  Building Process For Embedded Systems  4 hours
Preprocessing, Compiling, Cross Compiling, Linking, Locating, Compiler Driver, Linker Map Files, Linker Scripts and scatter loading, Loading on the target, Embedded File System.

Module:4  System design using general purpose processor  7 hours
Microcontroller architectures (RISC, CISC), Embedded Memory, Strategic selection of processor and memory, Memory Devices and their Characteristics, Cache Memory and Various mapping techniques, DMA.

Module:5  Component Interfacing & Networks  9 hours
Memory Interfacing, I/O Device Interfacing, Interrupt Controllers, Networks for Embedded systems- USB, PCI,PCI Express, UART, SPI, I2C, CAN, Wireless Applications - Bluetooth, Zigbee, Wi-Fi., 6LoWPAN, Evolution of Internet of things (IoT).

### Module: 6  Operating Systems  7 hours
Introduction to Operating Systems, Basic Features & Functions of an Operating System, Kernel & its Features [polled loop system, interrupt driven system, multi rate system], Processes/Task and its states, Process/Task Control Block, Threads, Scheduler, Dispatcher.

### Module: 7  Multi Tasking  6 hours
Context Switching , Scheduling and various Scheduling algorithms, Inter-process Communication (Shared Memory, Mail Box, Message Queue), Inter Task Synchronization (Semaphore, Mutex), Dead Lock, Priority Inversion (bounded and unbounded), Priority Ceiling Protocol & Priority Inheritance Protocol.

### Module: 8  Contemporary issues:  2 hours

| Total Lecture hours: | 45 hours |

### Text Book(s)

### Reference Books

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

Recommended by Board of Studies  12/09/2020
Approved by Academic Council No. 59 Date 24/09/2020
## Course code: ECE5042
### Course Title: Microcontroller Architecture and Organization

<table>
<thead>
<tr>
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<th>J</th>
<th>C</th>
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<tr>
<td>2</td>
<td>0</td>
<td>2</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

### Pre-requisite
Nil

### Syllabus version: 1

## Course Objectives:
The course is aimed at:

1. Describing the architecture of 8051 microcontroller and ARM processor.
2. Teaching the instruction set of 8051 and ARM microcontroller to efficient programs.
3. Designing system in block level using microcontroller, memory devices, buses and other peripheral devices.

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

1. Describe the architectures of processors.
2. Develop Assembly program applying Digital logic and mathematics using 8051.
3. Develop Assembly Language Program ALP for ARM and ARM peripherals.
4. Develop ALP with minimum instructions and memory.
5. Analyze and evaluate the given program in terms of code size and computational time.
6. Design Microcontroller based system within realistic constraint like user specification, availability of components etc.
7. Solve real life problem and construct a complete system as a solution.
8. Integrate and build a working model using the laboratory components and IDE tools.

### Student Learning Outcomes (SLO):
1. Having an ability to apply mathematics and science in engineering applications.
4. Having Sense-Making Skills of creating unique insights in what is being seen or observed (Higher level thinking skills which cannot be codified).
14. Having an ability to design and conduct experiments, as well as to analyze and interpret data.

### Module: Introduction to Microcontrollers
#### 2 hours
Microprocessors Vs Microcontrollers; Classification – bits, memory architecture, ISA; Little Endian Vs Big Endian.

### Module: 8051 Microcontroller
#### 2 hours
Architecture – Timers, Interrupts, Register Architecture (banks), PSW register, Memory architecture; Instruction set.

### Module: 8051 Programming and Interfaces
#### 5 hours

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

### Module: ARM Instruction Set
#### 6 hours
ARM Instruction- data processing instructions, branch instructions, load store instructions, SWI instruction, Loading instructions, conditional Execution, Assembly Programming.

### Module: Thumb Instruction Set
#### 4 hours
Thumb Instruction-Thumb Registers, ARM Thumb interworking, branch instruction, data processing instruction, single/multiple load store instruction, Stack instruction, SWI instruction, Assembly Programming.

### Module: ARM Core based Microcontroller
#### 6 hours

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

**Text Book(s)**


**Reference Books**


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

**List of Challenging Experiments (Indicative)**

1. **Task-1: 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
   - 7 hours

2. **Task-2: Speed control 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
   - 7 hours

3. **Task-3: 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.
   - 8 hours

4. **Task-4: Sensor interfacing with ARM LPC2148**
   - Sub Task 1: Interface IR with LPC2148
   - Sub Task 2: Interface temperature sensor with LPC2148
   - Sub Task 3: Interface Bluetooth with LPC2148
   - Sub Task 4: Transmit the IR detail and sensor data to another LPC2148 via Bluetooth.
   - 8 hours

**Total Laboratory Hours**

30 hours

**Typical Projects**

1. Develop an ARM based waste management system. In this, 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 ARM Micro controller. The controller will give indication to the driver of garbage collection truck as to which garbage bin is completely filled and needs urgent attention. ARM 7 will give indication by sending SMS using GSM technology.

2. Design an ARM 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.

3. Implement a Digital Clock and Alarm using ARM 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.

4. Develop an ARM 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.
Course Code | Course Title | L | T | P | J | C
---|---|---|---|---|---|---
ECE5053 | ELECTRONICS HARDWARE SYSTEM DESIGN | 2 | 0 | 2 | 4 | 4

Pre-requisite: Nil

Course Objectives:
The course is aimed at
[1] Emphasizing students the significant role of FPGA in System design and development.
[2] Teaching the students to develop program using Hardware Descriptive Language and model digital logic combinational and sequential circuits.
[3] Enabling the students acquire knowledge in Interfacing peripherals, Board Design, Packaging, PCB Design and Analysis

Course Outcomes (CO):
At the end of the course the student will be able to
[1] Comprehend the architecture of FPGA and design flow
[2] Understand Hardware Description Language/
[5] Interface peripherals with FPGA.
[6] Design the PCB
[7] Design FPGA based system
[8] Comprehend upcoming trends in FPGA.

Student Learning Outcomes (SLO):

Student Learning Outcomes involved:
[4] Having Sense-Making Skills of creating unique insights in what is being seen or observed (Higher level thinking skills which cannot be codified)
[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 analyze and interpret data

Module:1 Programmable Logic Devices & FPGAs 3 hours
Introduction to FPGAs, FPGA technologies, FPGA Architectures [Xilinx, Altera, ACTEL, LATTICE], FPGA Design Flow Prototyping with Xilinx FPGAs, FPGA based Testing.

Module:2 Hardware Descriptive Language (Verilog/VHDL) 3 hours
Introduction, HDL Design flow, Language constructs -operators –Data types, Different architectures (Structural, Behavioural, Dataflow)-Design examples

Module:3 Modeling of Combinational logic circuits 4 hours
Half adder, Full adder, 4-bit/8-bit binary adder, ALU design, Multiplexer and De-multiplexer, Encoder, Decoder, Comparator, Ripple Carry Adder, Carry Look ahead adder.

Module:4 Modeling of Sequential logic circuits 4 hours
Flip Flops-Realization of Shift Register -Realization of a Counter-Synchronous and Asynchronous – BCD counter, Mealy and Moore State Machines, Sequence detector, FIFO, Memory Design, Serial Data Receiver, Serial to parallel data converter.

Module:5 Interfacing peripherals and Board Design 5 hours
Interfacing to 7 segment display, Stepper Motor, ADC and Sensors, FPGA System Architecture, Constraints –Logical –Electrical -Physical, Power distribution for FPGAs, Clock design, I/O buses.

Module:6 Introduction to Packaging &PCB Design 4 hours
Physical integration of circuits, packages, boards and full electronic systems - Package

### Module: 7  High Speed PCB design and Analysis  5 hours

High speed PCB design - EMI/EMC analysis - Thermal management of electronic devices and systems - Thermal interface material, Cooling mechanisms - System level design of electronic hardware for automotive applications - System level testing and validation of automotive electronics systems for reliability. Layout constraints for FPGAs, FPGA-based PCB schematics.

### Module: 8  Contemporary issues:  2 hours

**Text Book(s)**

**Reference Books**
2. Ian Grout, Digital Systems, Design with FPGAs and CPLDs, 2012, Re-Print, Newness, UK.

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

**List of Challenging Experiments (Indicative)**

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Description</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Task 1: Combination Logic:- Design a 16-bit microprocessor that is capable of performing both logical and arithmetic operation.</td>
<td>8 hours</td>
</tr>
<tr>
<td>2.</td>
<td>Task 2: Sequential Logic:- Design a controller for vending machine which sells candy bars for Rs 5, 10 and 20.</td>
<td>8 hours</td>
</tr>
<tr>
<td>3.</td>
<td>Task 3: Peripheral Interfacing:- Design a car speed monitor using the following components (a) 7 segment display (b) LEDs (c) Switches for speed selection and (d) Buzzer. The car's electronic speedometer provides a clock signal whose frequency is proportional to the speed. To check the functioning of the design use function generator to provide the speedometer clock.</td>
<td>8 hours</td>
</tr>
<tr>
<td>4.</td>
<td>Task 4: PCB Design:- Design a PCB for a circuit with a mixture of analog and digital parts, multiple power planes, and a single Ground plane split into analog and digital sections that have a common reference point using open source tool.</td>
<td>6 hours</td>
</tr>
</tbody>
</table>

**Total Laboratory Hours : 30 Hours**

Mode of Evaluation: Continuous Assessment Test, Final Assessment Test

**Typical Projects:**

1. Design face recognition based Authenticated Door Opening System using FPGA. Database consisting of authorised persons faces should be created and the same should be compared with the real time camera input faces such that, if face matching happens then the door actuator needs to be triggered to open the door.
2. FPGA Implementation of Digital Clock and Alarm 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 and 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.

3. Design a GCD (Greatest Common divider) processor in FPGA. Use finite state machine approach of modelling the processor and generate the structure of Controller and Data path. The input should be given through the keypad which is to be interfaced with FPGA and the results should be serially transmitted to the Personal Computer through UART (Universal Asynchronous Receiver Transmitter) communication protocol.

4. Design a PCB of 3.3V/5V Power Supply and GSM Module. Individual switches need to be included to ON/OFF the individual Power Supply. The power supply and GSM schematic, top layer, bottom layer, top silk, top mask, top preview, bottom preview, bottom mask, drill file should be generated and captured during the design phase.
Course code | Course Title | L | T | P | J | C
--- | --- | --- | --- | --- | --- | ---
ECE5043 | EMBEDDED PROGRAMMING | 3 | 0 | 2 | 0 | 4

Pre-requisite | None

Syllabus version

Course Objectives:
The course is aimed
1. To acquaint students with fundamentals of C
2. To familiarize the students with data structures
3. To introduce the students with SHELL programming and Linux
4. To Implement the Device drivers in LINUX environment

Expected Course Outcome:
At the end of the course the students will be able to
1. Comprehend the fundamentals of C
2. Comprehend the Data structures
3. Comprehend the basics of Linux
4. Showcase the skill, knowledge and ability of SHELL programming
5. Exhibit the working knowledge of basic Embedded Linux
6. Comprehend the concepts of Kernel module Programming
7. Write Device driver programs
8. Have hands on experience in using state-of-art hardware and software tools

Student Learning Outcomes (SLO): 4,5,17
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
17. Having an ability to use techniques, skills and modern engineering tools necessary for engineering Practice

Module: 1 | C Language | 7 hours
Basic concepts of C, Embedded C Vs C, Embedded programming aspects with respect to firmware and OS Functions, Arrays, pointers, structures and Inputs/Outputs.

Module: 2 | Data structures of kernel programming | 6 hours
Linked list, Single linked list, Double linked list and Queues.

Module: 3 | Linux | 6 hours
Command prompt, X windows basics, Navigating file system, finding files, working with folders, reading files text editing in Linux, Compression and archiving tools, Basic shell commands, File Management, I/O Handling, File Locking.

Module: 4 | Shell Programming | 7 hours
Processes, giving more than one command at a time, prioritizing and killing processes, Scheduling Commands, pipes and redirection, regular expression, pattern matching, Scripting using for while, if and other commands.

Module: 5 | Embedded Linux | 6 hours
Linux Basics, Booting process, make files, using SD card and reader to transfer programs, Introduction to LINUX system calls, API’s, device drivers, compiling and installing a device
Module:6  Kernel Module Programming  6 hours
Compiling kernel, Configuring Kernel and compilation, Kernel code, browsers.-Static linking, dynamic linking of modules, User space, kernel space concepts, Writing simple modules – Writing, Make-files for modules.

Module:7  Device Driver concepts  5 hours
Driver concepts, Block & character driver distinction, Low level drivers, OS drivers etc, Writing character drivers, Device major, minor number.

Module:8  Contemporary issues:  2 hours

Total Lecture hours:  45 hours

Text Books

Reference Books

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

List of Challenging Experiments (Indicative)

1. Task1: C programming
   - Implement a binary tree sorting
   - Implement a dice throw game
   - Implement a command line argument based application of automation  6 hours

2. Task2: Implementation of data structure for an application
   Write a SortedMerge() function that takes two lists, each of which is sorted in increasing order, and merges the two together into one list which is in increasing order. SortedMerge() should return the new list. The new list should be made by splicing together the nodes of the first two lists.  6 hours

3. Task3: Shell Programming
   Development of inventory management system using Shell scripting with the following features
   - User may add/update/delete inventory.
   - User may add/update inventory details.
   - Details include cost, quantity and description.
   - Includes forms for inventory inwards and outwards.
   - User may create sub-inventories.
   - An interactive user interface.
   - A flexible inventory management system.  6 hours

4. Task4: Build process for an embedded board  6 hours
Build a kernel for a Beagle Bone Black (BBB) board and board bring up, kernel module program on an embedded board

<table>
<thead>
<tr>
<th>Task 5: Device driver programming – Implementation of Device Driver</th>
<th>6 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Laboratory Hours</td>
<td>30 hours</td>
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</tbody>
</table>

Mode of evaluation: Continuous Lab Assessment

Recommended by Board of Studies: 12/09/2020

Approved by Academic Council: No. 59th Date: 24/09/2020
<table>
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<tr>
<th>Course Code</th>
<th>Course Title</th>
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<th>P</th>
<th>J</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECE5054</td>
<td>REAL TIME OPERATING SYSTEMS</td>
<td>3</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>4</td>
</tr>
</tbody>
</table>

Pre-requisite: Nil

Syllabus Version: 1.1

Course Objectives:
The course is aimed at

[1] Introducing the students about Operating Systems and acquainting students to Real Time Operating Systems
[2] Teaching the students about Task Management and Enabling students to understand RTOS Scheduling
[3] Introducing the students about interprocess communication and Memory Management

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

[1] Comprehend the basic components of an operating system
[2] Learn about the basics of real-time concepts
[3] Acquire knowledge about task management
[4] Acquaint with RTOS scheduling
[5] Learn about IPC synchronization
[6] Learn about IPC data exchange
[7] Perform memory management in RTOS
[8] Apply the knowledge for developing practical applications of modern real-time systems.

Student Learning Outcomes (SLO):

4, 5, 7

Student Learning Outcomes involved:

[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
[7] Having computational thinking (Ability to translate vast data in to abstract concepts and to understand database reasoning)

Module: 1 Introduction to Operating Systems
6 hours
- Layers of Operating Systems, Operating systems functions, System Boot up - BIOS & Boot Process, Kernel – Monolithic and Microkernel

Module: 2 Real Time Operating Systems
7 hours
- Tradeoffs for RTOS, POSIX

Module: 3 Task Management
7 hours
- Process and Threads, Process Control Block, Process Attributes, POSIX Threads.

Module: 4 RTOS Scheduling
7 hours
- Priority based scheduling, Rate-Monotonic scheduling, Earliest Deadline first scheduling, Linux RT scheduler.

Module: 5 IPC - Synchronization
7 hours
- IPC, Race conditions and critical sections, Signals, Atomic operations, Semaphore, Mutex, Spinlock, Priority Inversion and Priority ceiling.

Module: 6 IPC – Data Exchange
7 hours
- Shared memory, FIFO, Messages and Mailbox, Circular and swinging buffers, RPC

Module: 7 Memory Management
2 hours
- Memory Management, shared memory

Module: 8 Contemporary issues:
2 hours

Total Lecture hours: 45 hrs

Text Book(s):

M.TECH (ES)
Mode of Evaluation: Continuous Assessment Test, Quiz, Digital Assignment, Challenging Experiments, Final Assessment Test.

**List of Challenging Experiments (Indicative)**

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Description</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Write a C code for a simple calculator (+, -, *, /) using functional pointer as argument in a function</td>
<td></td>
</tr>
<tr>
<td>    int add (int x, int y)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>    int sub (int x, int y)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>    int mul (int x, int y)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>    int div (int x, int y)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>    int (*mathop)(int, int)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>    int domath(int (*mathop)(int, int), int x, int y)</td>
<td>6 hours</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Write a program to create multiple threads carrying out different functions.</td>
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</tr>
<tr>
<td>  Thread 1: Accepting a string from the user.</td>
<td></td>
<td></td>
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<tr>
<td>  Thread 2: Display the string in upper case.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>  Thread 3: Count the number of vowels in the string</td>
<td></td>
<td></td>
</tr>
<tr>
<td>  Thread 4: Count the number of special characters in the string</td>
<td>6 hours</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Write a program to create three threads, which are implemented using function pointers. First thread is for getting a list of numbers from the keyboard, second thread is helpful to extract the ODD and EVEN list from the given list, and the third one is used to arrange the ODD and EVEN list of numbers in an order. Use Mutex semaphore.</td>
<td></td>
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<tr>
<td>  Note:</td>
<td></td>
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</tr>
<tr>
<td>    First Thread for getting input data from keyboard.</td>
<td></td>
<td></td>
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<tr>
<td>    Second Thread to identify the ODD and EVEN list</td>
<td></td>
<td></td>
</tr>
<tr>
<td>    Third Thread to get descending ordered ODD list</td>
<td></td>
<td></td>
</tr>
<tr>
<td>    Fourth Thread to get ascending ordered EVEN list</td>
<td></td>
<td></td>
</tr>
<tr>
<td>  Input data: 56, 23, 12, 64, 87, 02, 45, 88, 35, 67</td>
<td>6 hours</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Write a Vx Works code for the given scenario. Also identify the proper mechanism to avoid this problem.</td>
<td>6 hours</td>
</tr>
</tbody>
</table>
5. Write a VxWorks code for the given scenario. Also identify the proper mechanism to avoid this problem.
Programme Elective
Course Code: ECE6036  
Course Title: IN-VEHICLE NETWORKING  
L | T | P | J | C  
--- | --- | --- | --- | ---  
3 | 0 | 0 | 0 | 3  
Pre-requisite: Nil  
Syllabus Version: 1.2

Course Objectives:

- Providing students a working knowledge of in-vehicle network systems
- Giving an exposure to aspects of design, development, application and performance issues associated with in vehicle networking systems.
- Illustrating concepts of sensor data capture, storage and exchange of data to access remote services

Expected Course Outcome:

- The students will be able to
  1. Know the need for In Vehicle Networking and the basics of data communication and networking concepts.
  2. Comprehend protocols like CAN used in automotive applications.
  3. Have an overview of the CAN higher layer protocols like CAN open, Device Net, TTCAN and SAE J1939.
  4. Understand the working mechanism of LIN protocol.
  5. Get an overview of MOST protocol used in automotive for multimedia applications.
  6. Comprehend protocols like FlexRay used in automotive for fault tolerant applications.
  7. Comprehend the general protocols and their usage in automotive sector

Student Learning Outcomes (SLO): 1,4,9

- [1] Having an ability to apply mathematics and science in engineering applications.
- [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 | Concepts of In-vehicle networking  
---  
Overview of Data communication and networking–need for In-Vehicle networking–layers of OSI reference model–multiplexing and de-multiplexing concepts–vehicle buses.

Module:2 | Networks and protocols  
---  

Module:3 | CAN higher layer protocol  
---  

Module:4 | LIN protocol  
---  
LIN standard overview – applications – LIN communication concept message frame–development flow.

Module:5 | MOST  
---  
MOST overview–data rates–data types–topology –application areas.
<table>
<thead>
<tr>
<th>Module:6</th>
<th>FlexRay</th>
<th>6 hours</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Module:7</th>
<th>General purpose protocols</th>
<th>7 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>GSM- WiFi – Bluetooth and NFC Implementation –Ethernet, TCP, UDP, IP.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

**Text Book(s)**


**Reference Books**


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

**Recommended by Board of Studies** 12/09/2020

**Approved by Academic Council** No. 59th Date 24-09-2020
Course Code: ECE6042  
Course Title: WIRELESS AND MOBILE COMMUNICATIONS  
L  T  P  J  C: 3 0 0 0 3

Pre-requisite: Nil

Course Objectives:
The course aimed at
1. To know about wireless mobile communication system & related issues, and
2. To keep abreast of the future of mobile communication

Expected Course Outcome:
The students will be able to
1. Get introduced Cellular Mobile Communication systems
2. Understand and solve telecommunication design issues using cellular and trunking theory.
3. Analyze the effect of multipath channels and suggest a suitable model for indoor or outdoor applications.
4. Demonstrate the implications of multipath parameters in mobile communication.
5. Will train the Channel coding for Mobile Radio
6. Interpret the Modulation techniques for Mobile Radio
7. Get introduced to Advanced Communication Systems and Wireless Standards

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

Module: 1  Cellular Mobile Systems  4 hours
Cellular Mobile Communication Evolution - Types of mobile wireless services/systems – 1G & 2G Mobile Communication Technology

Module: 2  Cellular Concept  7 hours
Cellular concept – Frequency reuse – Channel assignment strategies – Handoff strategies – Interference & system capacity – Trunking & Grade of service – Improving coverage and capacity in cellular system.

Module: 3  Mobile Radio Propagation  9 hours

Module: 4  Small Scale Propagation models  4 hours
Parameters of mobile multipath channels – Types of small scale fading – Fading effects due to Multipath time delay spread and Doppler spread

Module: 5  Information Theory and Coding  6 hours
### Module:6  **Multiplexing & Modulation Schemes**  
6 hours  
FDMA, TDMA, CDMA, QPSK, WCDMA, OFDM/OFDMA, MC CDMA and SC FDMA, CP-OFDM and DFT-s-OFD (16QAM, 64QAM, 256QAM)

### Module:7  **Advanced Communication Systems and Wireless Standards**  
7 hours  
3G, 4G and 5G and beyond wireless standards – WLAN Architecture design and WIMAX – VANETS

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

**Total Lecture hours:** 45 hours

### Text Book(s)

### Reference Books
2. Schiller, Mobile Communications; Pearson Education Asia Ltd., 2008

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

Recommended by Board of Studies | 12/09/2020  
Approved by Academic Council | No. 59th Date | 24/09/2020
Course Code | Course Title | L | T | P | J | C  
--- | --- | --- | --- | --- | --- | ---  
ECE6043 | ADVANCED PROCESSORS AND ITS APPLICATIONS | 2 | 0 | 0 | 4 | 3  
Pre-requisite | Nil | Syllabus Version 1.1  

**Course Objectives:**

The course is aimed at
1. Providing a complete understanding of the ARM Cortex architecture.
2. Imparting the knowledge of programming ARM Cortex architecture.
3. Providing knowledge on programmable DSPs Architecture, On-chip Peripherals and Instruction set.

**Expected Course Outcome:**

The students will be able to
1. Learn the architecture and instruction set of ARM Cortex M4.
2. Program GPIOs and Interrupts of an ARM cortex M4.
3. Develop applications based on Timers, PWM and ADC with ARM cortex M4.
4. Understand and program the various communication modules of ARM Cortex M4.
5. Acquire knowledge about ARM Cortex A architecture.
6. Comprehend programming of ARM 64 bit architecture.
7. Demonstrate their ability to program the DSP processor for signal processing applications.
8. Design application for various social relevant and real time issues.

**Student Learning Outcomes (SLO):**

| 1 | Having an ability to apply mathematics and science in engineering applications.  
| 4 | Having Sense-Making Skills of creating unique insights in what is being seen or observed (Higher level thinking skills which cannot be codified).  
| 17 | Having an ability to use techniques, skills and modern engineering tools necessary for engineering practice.  

**Module:1**  
ARM architecture and Cortex – M series  
4 hours

Introduction to the ARM Cortex M4 and its targeted applications, ARM Cortex M4 architecture address space, on-chip peripherals (analog and digital) Register sets, addressing modes and instruction set basics.

**Module:2**  
Microcontroller Programming  
6 hours

ARM Cortex M4: I/O pin multiplexing, pull up/down registers, GPIO control, Memory Mapped Peripherals, programming System registers. Introduction to Interrupts, Interrupt vector table, interrupt programming.

**Module:3**  
Timers, PWM and Mixed Signals Processing  
4 hours

Timer, Basic Timer, Real Time Clock (RTC), Timing generation and measurements, ADC. PWM Module & Quadrature Encoder Interface (QEI).

**Module:4**  
Communication protocols and Interfacing with external devices  
4 hours

I2C protocol, SPI protocol, USB & UART protocol. Implementing and programming I2C, SPI, USB & UART interface.
Module:5 | ARM Cortex A Architecture | 4 hours |
---|---|---|
Introduction to ARMv8-A, ARMv8-A Memory Management, ARMv8-A Memory Model, Caches and Branch Prediction, Synchronization and Cache coherency.

Module:6 | Software Engineers guide to ARM Cortex 64 bit architecture | 2 hours |
---|---|---|
Booting, Power Management, Virtualization, Security, Debugging.

Module:7 | DSP Processors | 4 hours |
---|---|---|
Architecture of TMS320CXX Processor – Addressing modes – Assembly language Instructions – Assembler directives, Pipeline structure, On-chip Peripherals – Block Diagram of DSP starter kit (DSK) – Software Tools, DSK on-board peripherals, – Code Composer Studio – Support Files - Application Programs for processing real time signals.

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

**Total Lecture hours:** 30 hours

**Text Book(s)**

**Reference Books**

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

**Typical Projects:**
1. Adaptive Temporal Attenuator using C5x/C6x.
2. Filter Design and Implementation using a Modified Prony’s Method.
3. Voice Detection and Reverse Playback using C5x/C6x.
4. Acoustic Direction Tracker using C5x/C6x.
5. Multirate Filter using C5x/C6x.
6. Four-Channel Multiplexer for Fast Data Acquisition using C5x/C6x.
7. Video Line Rate Analysis using C5x/C6x.

<table>
<thead>
<tr>
<th>Mode of Evaluation: Project Reviews I,II,III</th>
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<tbody>
<tr>
<td>Recommended by Board of Studies</td>
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<tr>
<td>Approved by Academic Council</td>
</tr>
<tr>
<td>Date:</td>
</tr>
</tbody>
</table>
**Course Objectives:**
The course is aimed at
[1] Imparting knowledge about EMI environment
[2] Teaching EMI coupling principles, EMI control techniques and design of PCBs for EMC

**Expected Course Outcome:**
At the end of the course, the students will be able to
[1] Understand terminologies of EMI and EMC
[2] Analyze and understand various EMI coupling mechanisms
[3] List various EMI Test and Measurement methods
[4] Analyze various techniques needed to suppress EMI
[5] Perceive different EMC regulations followed worldwide
[7] Analyze and comprehend different techniques needed for Signal Integrity and ability to understand various models for EMI/EMC

**Student Learning Outcomes (SLO):**

<table>
<thead>
<tr>
<th>SLO</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Having an ability to apply mathematics and science in engineering applications</td>
</tr>
<tr>
<td>4</td>
<td>Having Sense-Making Skills of creating unique insights in what is being seen or observed (Higher level thinking skills which cannot be codified)</td>
</tr>
<tr>
<td>6</td>
<td>Having an ability to design a component or a product applying all the relevant standards and with realistic constraints</td>
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</tbody>
</table>

**Module: 1**
**EMI Environment**
4 hours

- EMI-EMC Definitions and units of Parameters, Sources of EMI, conducted and radiated EMI, Transient EMI

**Module: 2**
**EMI Coupling Mechanisms**
6 hours

- Conducted, Radiated and Transient Coupling, Common Impedance Ground Coupling,
- Radiated Common Mode and Ground Loop Coupling, Radiated Differential Mode Coupling,
- Near Field Cable to Cable Coupling, Power Mains and Power Supply Coupling.

**Module: 3**
**EMI Test and Measurements**
8 hours


**Module: 4**
**EMI Control Techniques**
7 hours

- Shielding, Filtering, Grounding, Bonding, Isolation Transformer, Transient Suppressors, Cable Routing, Signal Control, Component Selection and Mounting, Electrostatic discharge protection schemes

**Module: 5**
**EMC Standards and Regulations**
5 hours

<table>
<thead>
<tr>
<th>Module:6</th>
<th>System Design for EMC</th>
<th>8 hours</th>
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<tbody>
<tr>
<td></td>
<td>PCB Traces Cross Talk, Impedance Control, Power Distribution Decoupling, Zoning, Motherboard Designs and Propagation Delay Performance Models, <strong>System Enclosures, Power line filter placement, Interconnection and Number of Printed Circuit Boards, PCB and subsystem decoupling</strong></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Module:7</th>
<th>Signal Integrity and EMI/EMC Models</th>
<th>5 hours</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Effect of terminations on line wave forms, Matching schemes for Signal Integrity, <strong>Effects of line discontinuities, Statistical EMI/EMC models.</strong></td>
<td></td>
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</table>

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

**Total Lecture hours:** 45 hours

**Text Book(s)**

**Reference Books**

Recommended by Board of Studies : 12/09/2020
Approved by Academic Council : No: 59\textsuperscript{th} Date : 24-09-2020
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>ECE5045</td>
<td>ADVANCED DIGITAL IMAGE PROCESSING</td>
<td>3</td>
<td>0</td>
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</table>

Pre-requisite: Nil

Syllabus Version: 1.2

Course Objectives:
The course is aimed at

1. Revising the basics of digital image processing namely; image acquisition, digitizing, enhancing images in spatial domain, image transforms and enhancing images in frequency domain.

2. Enabling the students to acquire knowledge in image restoration, image compression, image segmentation and object recognition.

3. Motivating the students to apply image processing and classification algorithms for solving real life problems and introducing students to upcoming trends in Computer Vision.

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

1. Comprehend the image acquisition, digitization, and processing in spatial domain.

2. Understand algorithms and programs for processing an image in transform domain

3. Acquaint with the image enhancement and restoration techniques

4. Implement different compression techniques to compress an image

5. Adopt different segmentation and image representation techniques for image processing.

6. Understand the pattern recognition approaches for implementing the visual system.

7. Identify computer vision techniques in various real-time applications.

Student Learning Outcomes (SLO):

1, 4, 9

Student Learning Outcomes involved:

1. Having an ability to apply knowledge of mathematics, science and engineering.

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

**Image Processing in Spatial Domain**

7 hours


**Colour image Processing**: Models, Transformation

Module: 2

**Image Transforms**

6 hours
**Image Transforms:** Two dimensional Fourier Transform- Discrete cosine transform - Multi-resolution analysis – **Haar Transform**- Discrete Wavelet Transform. Karhunen-Loeve transform. and SVD

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<tr>
<th>Module:3</th>
<th>Frequency domain filtering and Image Restoration</th>
<th>6 hours</th>
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<tr>
<td></td>
<td>Smoothing frequency domain filters- sharpening frequency domain filters- Homomorphic filtering.</td>
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</table>

**Image Restoration:** Image deformation and geometric transformations, Restoration techniques, Noise characterization, Linear, Position invariant degradations, Adaptive filters.

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<tr>
<th>Module:4</th>
<th>Image Compression</th>
<th>6 hours</th>
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<tr>
<td></td>
<td>Image Compression Techniques- Lossy and Lossless compression- Entropy Encoding-JPEG and MPEG standards</td>
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<tr>
<th>Module:5</th>
<th>Image Segmentation</th>
<th>7 hours</th>
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<tbody>
<tr>
<td></td>
<td>Detection of discontinuities – point, corner, edge detection - thresholding -edge based segmentation-region based segmentation- morphological segmentation - watershed algorithm</td>
<td></td>
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<td></td>
<td>Descriptors: Boundary descriptors-Region descriptors- Texture descriptors, RANSAC.</td>
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<tr>
<th>Module:6</th>
<th><strong>RECOGNITION and CLASSIFICATION</strong></th>
<th>7 hours</th>
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<tr>
<th>Module:7</th>
<th><strong>COMPUTER VISION APPLICATIONS</strong></th>
<th>4 hours</th>
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<tbody>
<tr>
<td></td>
<td>Face recognition application: personal photo collections – Instance recognition application:</td>
<td></td>
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<tr>
<td></td>
<td>Location recognition – Machine learning applications: Deep voting, transfer learning and structured regression for image analysis and categorization.</td>
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</tbody>
</table>

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<thead>
<tr>
<th>Module:8</th>
<th>Contemporary issues:</th>
<th>2 hours</th>
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**Total Lecture hours: 45 hrs**

**Text Book(s)**


**Reference Books**


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

Recommended by Board of Studies: 12/09/2020

Approved by Academic Council: 59th Date: 24/09/2020
<table>
<thead>
<tr>
<th>Course Code</th>
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<tbody>
<tr>
<td>ECE6037</td>
<td>FAULT TOLERANT AND DEPENDABLE SYSTEMS</td>
<td>3</td>
<td>0</td>
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<tr>
<td>Pre-requisite</td>
<td>Nil</td>
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</table>

**Course Objectives:**
The course is aimed at

1. Providing students with a working knowledge of the potential faults and errors occurring in an embedded system.
2. Providing knowledge in concepts of fault detection and fault tolerance.
3. Teaching students dependability concepts
4. Exposing the fault tolerance strategies and design techniques.

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

1. Gain knowledge in concepts involving fault detection
2. Comprehend dependability concepts
3. Understand tolerance and correction mechanisms in real world scenarios.
4. Design and develop dependable systems for mission critical applications.
5. Understand Fault tolerance in interconnected systems.
6. Understand Fault tolerance in distributed systems.
7. Apply Dependability evaluation techniques and tools

**Student Learning Outcomes (SLO):**
4, 17, 18

**Student Learning Outcomes involved:**

4. Having Sense-Making Skills of creating unique insights in what is being seen or observed  
   (Higher level thinking skills which cannot be codified)
17. Having an ability to use techniques, skills and modern engineering tools necessary for engineering practice
18. Having critical thinking and innovative skills

**Module:1**  
Faults and Failures  
4 hours

**Module:2**  
Dependability Concepts  
5 hours

**Module:3**  
Fault Tolerance Strategies  
6 hours

**Module:4**  
Fault tolerant design techniques  
8 hours

**Module:5**  
Fault tolerance in Interconnects  
6 hours

**Module:6**  
Fault Tolerance in Distributed Systems  
8 hours

**Module:7**  
Dependability evaluation techniques and tools  
6 hours

Fault trees - Markov chains - HIMAP tool

**Module:8**  
Contemporary issues:  
2 hours
<table>
<thead>
<tr>
<th><strong>Text Book(s)</strong></th>
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</table>

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

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

Recommended by Board of Studies : 12/09/2020  
Approved by Academic Council : No. 59th  
Date : 24/09/2020
Course Code | Course Title | L | T | P | J | C  
---|---|---|---|---|---|---  
ECE6046 | ADVANCED EMBEDDED PROGRAMMING | 3 | 0 | 0 | 0 | 3  
Pre-requisite | Nil  

Course Objectives:
The course is aimed at making the students
[1] To learn advanced programming skills of the Embedded C and Linux and the range of embedded applications.
[2] To develop skills and understand the embedded Linux device drivers.

Expected Course Outcome:
At the end of the course, the student will be able to
[1] Develop character driver.
[3] Comprehend Linux device model
[4] Comprehend interrupt handlers in device drivers
[5] Debug a device driver code
[6] Develop I/O management
[7] Develop USB in device driver

Student Learning Outcomes (SLO):  1, 4, 14
[1] Having an ability to apply mathematics and science in engineering applications
[4] Having Sense-Making Skills of creating unique insights in what is being seen or observed (Higher level thinking skills which cannot be codified)
[14] Having an ability to design and conduct experiments, as well as to analyze and interpret data

Module:1 Basic Device driver review  
6 hours
Boot loader, Driver concepts - Block & character driver distinction - Low level drivers, OS drivers etc - Writing character drivers - Device major, minor number.

Module:2 Advanced Device driver characteristics  
6 hours
Interfaces to driver read, write, ioctl etc-Blocking and non-blocking calls, Synchronisation - Semaphores , mutexes ,spinlocks -Proc & Sysfs interfaces

Module:3 The Linux Device Model  
6 hours
K objects, K sets, and Subsystems , Low-Level Sysfs Operations, Hot plug Event Generation Buses, Devices, and Drivers, Classes, Putting It All Together, Hot plug, Dealing with Firmware

Module:4 Interrupt Handling  
6 hours
Interrupts and bottom halves - Writing interrupt driven drivers, Implementing bottom halves- Kernel Threads & Work Queues

Module:5 Time Delays and Debugging Techniques  
6 hours
Timers, Kernel timers, Jiffies, Timer interrupts- Debugging using printing, querying, watching and system defaults-Debugging tools

Module:6 Communicating with Hardware  
6 hours
I/O Mapped I/O, Memory mapped I/O, Understanding DMA operations.

Module:7 USB Driver Model  
7 hours
USB Device Basics, USB and Sysfs, USB Urbs, Writing a USB Driver, USB Transfers without Urbs.

Module:8 Contemporary issues:  
2 hours
Total Lecture hours: 45 hours

Text Book(s)

**Reference Books**

<table>
<thead>
<tr>
<th>Reference</th>
<th>Title</th>
<th>Edition</th>
<th>Publisher</th>
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</table>

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

<p>| Recommended by Board of Studies | 27/02/2016 |
| Approved by Academic Council | No. 40 | Date | 18/03/2016 |</p>
<table>
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<tr>
<th>Course code</th>
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<th>P</th>
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<tbody>
<tr>
<td>ECE 6047</td>
<td>DESIGN AND ANALYSIS OF ALGORITHM</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>4</td>
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**Pre-requisite:** Syllabus version :1

**Course Objectives:**

This course is aimed at

1. Enabling the students to carry out analysis of various algorithms for mainly time and space complexity.
2. Teaching the students how to decide the appropriate data type and data structure for a given problem.
3. Teaching the students how to select the best algorithm to solve a problem by considering various problem characteristics, such as the data size, the type of operations, etc.

**Expected Course Outcome:**

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

1. Develop proficiency in problem solving and programming.
2. Comprehend Combinatorial Optimization
3. Analyse various algorithms for mainly time and space complexity.
4. Comprehend Cryptographic Algorithms
5. Learn Geometric Algorithms
6. Analyse Parallel Algorithms
7. Analyse and evaluate the given program in terms of code size and computational time.
8. Select the best algorithm to solve a problem by considering various problem characteristics, such as the data size, the type of operations, etc.

**Student Learning Outcomes (SLO):** 4,5,18

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
18. Having critical thinking and innovative skills

**Module:1 Introduction:** 7 hours


**Module:2 Combinatorial Optimization:** 5 hours

Backtracking; Dynamic programming; Greedy Technique ; Branch & Bound

**Module:3 Advanced Algorithmic Analysis:** 5 hours

Amortized analysis; Online and offline algorithms; Randomized algorithms, NP Completeness

**Module:4 Cryptographic Algorithms:** 9 hours

Historical overview of cryptography; Private-key cryptography and the key-exchange problem; Public-key cryptography; Digital signatures; Security protocols; Applications (zero-knowledge proofs, authentication etc..)

**Module:5 Geometric Algorithms:** 7 hours

Line segments: properties, intersections; convex hull finding algorithms, Voronoi Diagram, Delaunay Triangulation

**Module:6 Parallel Algorithms:** 5 hours

PRAM model; Exclusive versus concurrent reads and writes; Pointer jumping; Brent’s theorem and work efficiency

**Module:7 Distributed Algorithms:** 5 hours
Consensus and election; Termination detection; Fault tolerance; Stabilization;

<table>
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<tr>
<th>Module:8</th>
<th>Contemporary issues:</th>
<th>2 hours</th>
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<tr>
<td>Total Lecture hours:</td>
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<td>45 hours</td>
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**Text Book(s)**

**Reference Books**

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

**List of Projects (Indicative)**

| I. | Robot Motion Planning Based Projects to apply Computational Geometric Algorithm Principles
| II. | Explore Searching Algorithms : Get into the interiors of indexing, page ranking search algorithms
| III. | Design, analyze, implement and experiment new algorithms and software for solving optimization problems arising in the area of Robotics, Gaming, Telecommunication, Automotive, Genetics, Medical Applications etc.
| IV. | Implement the Algorithm to cater a requirement in Military Application. The chief-commander encrypts the command and communicates to soldiers by using DES. His command contains the data in encrypted form. Also decipher this encrypted command at the receiver.
| V. | Implement the RSA Based Digital Signature scheme
| VI. | Implement & Build Distributed Web Service Access (Ex : Currency Convertor)
| VII. | Implement the algorithm for scheduling independent parallel tasks.
| VIII. | Implement & Solve the following Algorithmic Puzzles using any Programming language
| 1. | Place N chess queens on an $N \times N$ chessboard so that no two queens attack each other using BackTracking Approach
| 2. | Implement an efficient Sudoku Solution : Given a partially filled 9×9 2D array ‘grid[9][9]’, the goal is to assign digits (from 1 to 9) to the empty cells so that every row, column, and subgrid of size 3x3 contains exactly one instance of the digits from 1 to 9.
| 3. | Apply Recursive principles and implement Tower of Hanoi Puzzle.
   - Tower of Hanoi is a mathematical puzzle where we have three rods and n disks.
   - The objective of the puzzle is to move the entire stack to another rod, obeying the following simple rules:
     1) Only one disk can be moved at a time.
     2) Each move consists of taking the upper disk from one of the stacks and placing it on top of another stack i.e. a disk can only be moved if it is the uppermost disk on a stack.
     3) No disk may be placed on top of a smaller disk
4. Implement an efficient program to solve the Egg Drop Puzzle involving n=2 eggs and a building with k=36 floors.

Suppose that we wish to know which stories in a 36-story building are safe to drop eggs from, and which will cause the eggs to break on landing. We make a few assumptions:

- An egg that survives a fall can be used again.
- A broken egg must be discarded.
- The effect of a fall is the same for all eggs.
- If an egg breaks when dropped, then it would break if dropped from a higher floor.
- If an egg survives a fall then it would survive a shorter fall.
- It is not ruled out that the first-floor windows break eggs, nor is it ruled out that the 36th-floor do not cause an egg to break.

If only one egg is available and we wish to be sure of obtaining the right result, the experiment can be carried out in only one way. Drop the egg from the first-floor window; if it survives, drop it from the second floor window. Continue upward until it breaks. In the worst case, this method may require 36 droppings. Suppose 2 eggs are available. What is the least number of egg-droppings that is guaranteed to work in all cases?

Implement an efficient algorithm to solve the puzzle: A man finds himself on a riverbank with a wolf, a goat, and a head of cabbage. He needs to transport all three to the other side of the river in his boat. However, the boat has room for only the man himself and one other item (either the wolf, the goat, or the cabbage). In his absence, the wolf would eat the goat, and the goat would eat the cabbage. Show how the man can get all these “passengers” to the other side.

<table>
<thead>
<tr>
<th>Mode of evaluation: Continuous Assessment Test, Quiz, Digital Assignment, Final Assessment Test, Project Reviews I, II, III</th>
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<tbody>
<tr>
<td>Recommended by Board of Studies</td>
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<tr>
<td>Approved by Academic Council</td>
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</table>
Course Code: ECE6038  
Course Title: VIRTUAL INSTRUMENTATION SYSTEMS  
Pre-requisite: Nil  

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</table>

Course Objectives:
The course is aimed at
[1] Introducing students on Graphical programming concepts
[2] Exposing students to system design using block level approach
[3] Providing basic knowledge about Data Acquisition

Course Outcomes (CO):
At the end of the course the student should be able to
[1] Acquire knowledge about Graphical Programming and able to differentiate from conventional programming
[2] Learn about basics of Graphical Programming and its structure
[3] Understand process of data acquisition using hardware
[4] Provide a solution to engineering problem using virtual instrumentation system

Student Learning Outcomes (SLO):
[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 analyze and interpret data
[17] Having an ability to use techniques, skills and modern engineering tools necessary for engineering practice

Reference Books:

Text Book(s):

List of Challenging Experiments (Indicative):
1. **Introduction**: General functional description of a digital instrument- Block diagram of a Virtual Instrument, Advantages of Virtual instruments over conventional instruments-Architecture of a Virtual instrument and its relation to the operating system, LabVIEW – Graphical user interfaces- Controls and Indicators, 'G' programming – Labels and Text-Shape, Size and Color – Owned and Freeland labels

Lab Exercise:
Examine the following image and develop a VI for the same
2. **Graphical Language:** Datatype, Format, Precision and representation - Datatypes - Dataflow programming, Graphical programming palettes and tools - Front panel objects - Functions and Libraries

   **Lab Exercises:**
   1) Use a while loop and a waveform chart to build a VI that demonstrates software timing
   2) Develop a VI to generate a RAMP signal as shown below

   Input to the VI are Min, Max, Time span[ initial value as 0 and end value only need to give] and the last input is the number of data points. VI takes the difference between Max and Min and divides that interval by the number of data points (# Points) that the user requires. For example this would mean that the user requires 5000 points to span the difference between 0 and 10[time span]. In other words, the value of the ramp function at the i\(^{th}\) point is \(((10-0)/5000)\times i\). The For Loop allows traversing through the values of i from 0 to 5000.

3. **Programming Structure:** FORloops, WHILEloops, CASEStructure, formulanoes, Sequence structures - Arrays and Clusters - Array operations - Bundle - Bundle/Unbundle by name, graphs and charts

   **Lab Exercises:**
   1) Using Error Clusters & Handling to find square root
   2) To design an interface to measure temperature and check its range between
      - 0 to 30
      - 30 to 60
      - more than 60

   Record the highest and lowest temperature. Have a switch to record the selected temperature ranges.

4. **Handling Strings:** String and file I/O - High level and Low level file I/O's - Attributes of modes Local and Global variables

   **Lab Exercises:**
   1) Design a case structured calculator using string as input cases.
   2) Build a VI that creates an array of random numbers, scales the resulting array, and takes a subset of that final array. You create a For Loop that runs for 10 iterations. Each iteration generates a random number and stores it at the output tunnel. Random Array displays an array of 10 random numbers. The VI multiplies each value in Random Array by a Scaling Factor to create another array called Final Array. The VI then takes a subset of the Final Array starting at Start Subset for # of Elements and displays the subset in Subset Array.

5. **Hardware Aspects:** Addressing the hardware in LabVIEW - Digital and Analog I/O function - Data Acquisition - Buffered I/O - Real-time Data Acquisition

   **Lab Exercises:**
Build a Temperature Monitoring VI that continuously measures the temperature once per time unit [variable] and displays the temperature. If the temperature goes above or below the preset limits, the VI turns on a front panel LED. You should be able to set the limit from the front panel. Also modify the temperature monitoring VI so that it records both the highest and lowest recorded temperatures, and also displays the time elapsed (in seconds) since recording began. Add a save option to your temperature-monitoring VI as explained above. The user will have the option to save the acquired data into a spreadsheet file that will also include additional information like the user name. Below shown is the Front panel for your reference.

6. **Case Studies:**
   
6.1 **Lab Exercises:**
   
   1) Interface a temperature sensor to microcontroller, acquire the sensor data and display it in labview
   
   2) Interface a motor to microcontroller and control the speed of it through labview.

   **Total Laboratory Hours** 64 hours

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

**Typical Projects:**

1. Develop a labview based system that controls the speed of a Motor. The motor is interfaced to any Microcontroller which supports the USB communication. In Labview create a UI with slider. The slider in the UI must be used for controlling the speed of motor.

2. Develop an UI in labview that will generate a different pattern based on the random number generated by a random function in labview. The generated pattern must be send out via USB and the same will get displayed in LED’s interfaced with a microcontroller.

3. Develop an UI in Labview which depicts the signal generator functionality. A microcontroller is interfaced with labview and an oscilloscope must be interfaced to capture the signals which are given as an input in UI developed in Labview.

4. Develop an UI in labview which acquire the sensor data and store it in an Excel sheet of PC. The sensors are interfaced to microcontroller and the microcontroller is interfaced to labview system via USB.

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

**Recommended by Board of Studies : 27/02/2016**

**Approved by Academic Council : No:40 18/03/2016**
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course title</th>
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<th>P</th>
<th>J</th>
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<tbody>
<tr>
<td>ECE6048</td>
<td>EMBEDDED SYSTEM DESIGN USING FPGA</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>3</td>
</tr>
</tbody>
</table>

Pre-requisite: Nil

Syllabus version: 1

Course Objectives:
The course is aimed at
1. Providing in depth understanding of logic and system design.
2. Enabling the students to apply their knowledge for the design of advanced digital hardware systems with help of FPGA tools.
3. Teaching the students scheduling and communication with respect to FPGA.

Expected Course Outcome:
At the end of the course, students will be able to
1. Comprehend overview of Embedded System
2. Learn Hardware Description Languages
3. Acquire abilities to Design an embedded system using FPGA
4. Use Xilinx IP Cores
5. Comprehend Partitioning concepts
6. Comprehend Scheduling & Communication
7. Identify and exploitation of Parallelism concepts
8. Use state-of-art hardware and software to solve real life problems.

Student Learning Outcomes (SLO): 4, 5, 6

Module: 1  Embedded System Overview  4 hours
H/W-FPGA-Embedded SoC and use of VLSI circuit technology-platform FPGA’s- Altera Cyclone

Module: 2  Hardware Description Languages  4 hours
Hardware Description Languages - VHDL, Verilog, Other High-Level HDLs, From HDL to Configuration Bit-stream

Module: 3  System Design using FPGA  4 hours
Principles of system design-Design quality, Modules and interfaces, Abstraction and state, Cohesion and coupling, Designing and Reuse, Control flow graph, Design-Origins of platform FPGA designs

Module: 4  FPGA Platform  4 hours

Module: 5  Partitioning  4 hours
Overview of Partitioning Problem, Analytical Solution to Partitioning-Basic definitions, Expected performance gain, Resource considerations, Analytical Approach

Module: 6  Scheduling & Communication  4 hours
Communication-Invocation/Coordination, Transfer of State, Practical Issues- Profiling Issues, Data Structures Manipulate Feature Size.

Module: 7  Spatial Design  4 hours
Principles of Parallelism - Identifying Parallelism - Spatial Parallelism with Platform FPGAs - Parallelism within FPGA Hardware Cores, Parallelism within FPGA Designs

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

**Text Book(s)**


**Reference Books**


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

**Typical Projects**

1. Bluetooth based home automation using FPGA. A Bluetooth mobile app need to be developed to transfer control information to the Bluetooth receiver which is to be interfaced with the FPGA board. Based upon the received data, the household devices like lamp, fan etc. should be turned ON/OFF.

2. Implement an Interrupt Controller (8259) using FPGA. The entire functional block should be sub divided into various modules like vector address module, command register module, mask register module and finally it need to be integrated into a single unit to accomplish specified tasks.

3. Implement a general purpose processor on FPGA. The purpose of the design is to build an FPGA with the following features: a CPU similar to the Atmel ATmega8, a serial port with a fixed baud rate, and an output for a single digit 7-segment display.

4. Real-time hardware implementation of a motion detection algorithm for vision based automated surveillance systems. The working prototype of a complete standalone automated video surveillance system, including input camera interface, designed motion detection VLSI architecture, and output display interface, with real-time relevant motion detection capabilities, need to be implemented on FPGA.

**Mode of Evaluation:** Project Reviews I, II, III

**Recommended by Board of Studies** 27/02/2016

**Approved by Academic Council** No. 40 | Date 18/03/2016
Course Code | Course Title | L | T | P | J | C
--- | --- | --- | --- | --- | --- | ---
ECE5044 | HARDWARE SOFTWARE CODESIGN | 3 | 0 | 0 | 0 | 3

Pre-requisite: Nil

Syllabus Version:1.1

Course Objective:
The course is aimed at
[1] Providing adequate knowledge in the modeling of heterogeneous embedded systems based on design constraint and provide alternate solution exploring trade-off.
[2] Introducing the importance of estimating the cost analysis in terms of hardware and software parameters.
[3] Introducing various co-synthesis and co-simulation tools for the effective design of embedded systems with better communication between different modules.

Expected Course Outcome:
At the end of the course, the Students will be able to
[1] Apply different MOCs based on system design specification.
[2] Propose an alternate design solution based on constraint analysis.
[3] Identify the partitioning solution based on the algorithms.
[5] Ability to pre-estimate and estimate the performance metrics for hardware and software based on cost analysis.
[6] Approximate the pre-estimate and estimate the performance metrics for software based cost analysis.

Student Learning Outcomes (SLO): | 1, 4 and 6
[1] Having an ability to apply mathematics and science in engineering applications
[4] Having Sense-Making Skills of creating unique insights in what is being seen or observed (Higher level thinking skills which cannot be codified)
[6] Having an ability to design a component or a product applying all the relevant standards with realistic constraints

Module:1 | Specification of embedded systems | 7 hours
Introduction to Co-design - Comparison of co-design approaches – Unified representation-Model
– MoCs: State oriented, Activity oriented, Structure oriented, Data oriented and Heterogeneous – Software CFSMs – Processor Characterization.

Module:2 | HW/SW partitioning Constraints & tradeoffs | 7 hours
Cost modeling, Principle of hardware/software mapping - Real time scheduling - design specification & constraints on Embedded systems - Tradeoffs

Module:3 | HW/SW partitioning methodologies | 7 hours
Partitioning-Types of partitioning-Partitioning granularity - Kernigan-Lin Algorithm - Extended Partitioning - Binary Partitioning: GCLP Algorithm

Module:4 | Co-synthesis | 7 hours
Software synthesis – Hardware Synthesis - Interface Synthesis – Co-synthesis Approaches: Vulcan, Cosyma, Cosmos, Polis and COOL.
<table>
<thead>
<tr>
<th>Module</th>
<th>Estimation</th>
<th>Hours</th>
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<tbody>
<tr>
<td>Module 5</td>
<td>Hardware</td>
<td>4 hours</td>
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<tr>
<td>Module 6</td>
<td>Software</td>
<td>4 hours</td>
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<tr>
<td>Module 7</td>
<td>Co-simulation &amp; Co-verification</td>
<td>7 hours</td>
</tr>
<tr>
<td>Module 8</td>
<td>Contemporary issues</td>
<td>2 hours</td>
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</tbody>
</table>

Total Lecture: 45 hours

**Text Books:**

**References:**

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

Recommended by Board of Studies: 12/09/2020
Approved by Academic Council: No. 59th Date 24/09/2020
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<tr>
<td>ECE6049</td>
<td>MODERN AUTOMOTIVE ELECTRONICS SYSTEMS</td>
<td>2</td>
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</table>

Pre-requisite: Nil

Syllabus Version: 1

**Course Objectives:**

The course is aimed at

1. Instilling fundamental understanding of various automatic control systems and basic instrumentation involved in automobiles.
2. Learning various automobile condition measurement and monitoring mechanisms.
3. Acquiring knowledge of advanced electronic elements and their functional aspects in automobiles.

**Course Outcomes (CO):**

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

1. Comprehend engine management systems.
2. Understand the various Ignition and Injection systems.
3. Explain the automotive control mechanisms.
4. Learn the different monitoring systems for automobiles.
5. Understand the typical sensors for transportation.
6. Acquire knowledge about upcoming trends in automotive electronics systems.
7. Use the knowledge attained and develop appropriate systems for societal issues.

**Student Learning Outcomes (SLO):** 4,9,17

**Student Learning Outcomes involved:**

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

**Engine management systems**  

5 hours  

Introduction - components for engine management system - Open loop and closed loop control system – Engine cranking and warm up control – Acceleration, deceleration and idle speed control.

**Module:2**  

**Injection and ignition systems**  

5 hours  

Feedback carburetor system–Throttle body injection and multi point fuel injection system–Injection system controls – Advantage of electronic ignition systems–Types of solid state ignition systems and their principles of operation – Electronic spark timing control, Exhaust emission control engineering.

**Module:3**  

**Automotive control mechanism**  

4 hours  

Electronic management of chassis systems, Vehicle motion control, anti-lock braking system, Tyre pressure monitoring system, Collision avoidance system, Traction control system.

**Module:4**  

**Automotive Electronics systems**  

4 hours  

Active suspension system, Keyless entry system and Electronic power steering system, Electronic controls - lighting design - Horn – Warning systems – Brake actuation warning systems, Infotainment.

**Module:5**  

**Monitoring of Automotive systems**  

4 hours  

Speed warning systems, oil pressure warning system, engine over heat warning system, air pressure warning system, safety devices-Wind shield wiper and washer, VANET.

**Module:6**  

**Sensors for transportation - I**  

3 hours  


**Module:7**  

**Sensors for transportation - II**  

3 hours  


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

**Text Book(s)**

**Reference Books**

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

**Typical Projects**

1. Design of Real Time Ignition Control System. Implement an automotive throttle control system using fuzzy logic approach and perform the controller synthesis in real time environment.

2. Develop a sliding mode controller to generate appropriate torque for the driving motor of electric vehicles that ensures optimality of the slip ratio for efficient vehicle brake.

3. Design a variable structure controller to deal with the strong nonlinearity of wheel slip in the design of ABS controller. Consider the several situations such as braking in dry road, wet road and snow road.

4. Develop a safety feature in cars to avoid colliding with a vehicle or an obstacle in the way. The main objective of the system is to help driver to prevent car collisions due to blind spots and their carelessness while driving.

5. Design a speed warning system (in-vehicle subsystem) that will monitor the vehicle speed and activate an auditory warning as well as record the violation when the pre-set speed limit is exceeded.

**Recommended by Board of Studies : 27/02/2016**
**Approved by Academic Council : No: 40 Date : 18/03/2016**
<table>
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<tr>
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<tbody>
<tr>
<td>ECE6073</td>
<td>AUTOSAR AND ISO STANDARDS FOR AUTOMOTIVE SYSTEMS</td>
<td>2</td>
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</table>

Pre-requisite: Nil

Syllabus version: 1

Course Objectives: The course is aimed at:
1. Enabling the students to understand Autosar standards
2. Introducing to the students the basic knowledge of Communication Stack in Autosar
3. Preparing the students to understand the implementation and integration in Autosar

Expected Course Outcome:
At the end of the course, the student will be able to
1. Apply the knowledge of various autosar standards
2. Analyze autosar codes
3. Apply the AutoSAR – Implementation Integration
4. Analyze the AutoSAR – System Services
5. Implement CAN programming concepts through Autosar
6. Analyze the ISO/TS 16949 standards
7. Know the implementation aspects of ISO/TS 16949 standards

Student Learning Outcomes (SLO): 1, 4, 9

1. Having an ability to apply mathematics and science in engineering applications
4. Having Sense-Making Skills of creating unique insights in what is being seen or observed (Higher level thinking skills which cannot be codified)
9. Having problem solving ability- solving social issues and engineering problems

Module: 1  | AutoSAR Standards | 3 hours
General requirement on basic software modules – Functional, Fault operation and error detection.

Module: 2  | AutoSAR Standards – Communication Stack | 5 hours
Network Management, TTCAN Interface standards, TTCAN Drivers

Module: 3  | AutoSAR – Implementation Integration | 3 hours
Platform Types, Memory Mapping

Module: 4  | AutoSAR – System Services | 3 hours
Watchdog Manager, Synchronized Time Base Manager

Module: 5  | ISO/TS 16949 | 5 hours

Module: 6  | Introduction to ISO26262 Standard: Basic Concepts | 3 hours
Structure of ISO26262 standard and its parts-Vocabulary-Management of functional Safety-Concept Phase

Module: 7  | Introduction to ISO26262 Standard: Implementation Aspects | 6 hours

Module: 8  | Contemporary Topics | 2 hours

Total Lecture Hours: 30 hours
### Reference Books

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>Automotive Quality systems – David Hoyle, Butterworth Heinemann limited, 2000</td>
</tr>
<tr>
<td>2.</td>
<td><a href="http://www.autosar.org">www.autosar.org</a></td>
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</tbody>
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Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

<table>
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<th>Mode of Evaluation:</th>
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<tr>
<td>Recommended by Board of Studies</td>
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<td>Approved by Academic Council</td>
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</table>
**ECE6092  Intelligent IoT System Design and Architecture**

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</table>

**Pre-requisite**

Nil  

**Syllabus Version:**

### Course Objectives:

1. To explore the characteristics of the Internet of things and its design.
2. To enable the students to get familiar with IoT architecture models.
3. To acquaint the students with various security concepts and data analytics in the IoT system.
4. To develop and deploy an IoT enabled prototypes for real-life use cases.

### Expected Outcomes:

Upon completion of this course, the student will be able to

1. Assimilate the technologies that enable IoT and to interpret the different components in IoT architecture.
2. Comprehend the concepts of edge computing and edge enabled solutions for real-time industrial applications.
3. Envision the IoT communication architecture models and the protocol stack for the cost-effective design of IoT applications on different platforms.
4. Interpret the security threats and to design a resilient IoT Architecture.
5. Perceive the data analytics tools and gain knowledge to devise an intelligent IoT system.
6. Analyze cloud platform services to perform IoT data analytics and make the system intelligent.
7. Design and develop smart IoT prototypes for use cases under discussion.

### Student Learning Outcomes (SLO):

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

<table>
<thead>
<tr>
<th>Module:1</th>
<th>IoT Essentials</th>
<th>4</th>
<th>hours</th>
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<table>
<thead>
<tr>
<th>Module:2</th>
<th>Edge Computing</th>
<th>5</th>
<th>hours</th>
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</thead>
</table>

Introduction to Edge/Fog computing, Edge nodes and gateway, Node to edge interfaces, Protocol and standards for edge devices, IoT edge architecture, IoT supported hardware- Raspberry pi, ARM Cortex Processors, Software Platforms for IoT Edge - Raspbian Pi OS, RIOT, Python packages for edge computing, Edge security, Real time applications of edge computing.
<table>
<thead>
<tr>
<th>Module:3</th>
<th>IoT Communication Architecture and Protocols</th>
<th>5 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Communication models for IoT, 6LoWPAN, IPv4/IPv6, IoT communication protocols - MQTT, CoAP, LoRaWAN, RTLS, RPL, Communication API’s.</td>
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<table>
<thead>
<tr>
<th>Module:4</th>
<th>IoT Security and Privacy</th>
<th>4 hours</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>IoT risks and security challenges, IoT security architecture - A trust model, Restricting network access through security groups- Specific user access control, Data confidentiality and availability, User Authentication/Authorization methods, Block chain for IoT security and privacy.</td>
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<thead>
<tr>
<th>Module:5</th>
<th>Smart Data Analytics</th>
<th>4 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Need for data analytics, Data generation, Data pre-processing, Handling imbalanced data sets, Missing values, Outliers, Intelligent IoT systems –Supervised and Unsupervised machine learning algorithms, Deep learning for IoT- Predictive analytics, Python functions and modules for data analytics, Big Data analytics and frameworks.</td>
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<table>
<thead>
<tr>
<th>Module:6</th>
<th>Data Analytics in Cloud</th>
<th>4 hours</th>
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<tbody>
<tr>
<td></td>
<td>Layered cloud architecture for data analytics, Elasticity in cloud for data warehousing, Virtualization for Data-center automation, Real-time cloud data analytics tools, AI Services-Data based decisions, Cloud data lake, Exploratory data analysis, Open source cloud platforms and services.</td>
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<table>
<thead>
<tr>
<th>Module:7</th>
<th>IoT Architecture for specific use cases</th>
<th>2 hours</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Roadmap for complete IoT solution, Open source IoT platforms, IoT solution to Health care, Automotive applications, Smart IoT architecture for Retail, Logistics and Farming, Intelligent IoT architecture for Home automation, Industry applications, Smart city and other applications to cater the societal requirements.</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>Total Lecture:</td>
<td>30 hours</td>
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</table>

Total Lecture: 30 hours
## Text Books:


## Reference Books:


## Mode of Evaluation:

Continuous Assessment Test, Quiz, Digital Assignment and Final Assessment Test.

## Typical Projects:

1. Voice controlled home automation and security.
2. Vehicle tracking system.
3. Social network data analytics.
4. Secured edge computing with any major cloud platform.
5. Remote monitoring and sensing in agriculture.
6. Automatic parking system.
7. Smart retail management.
8. Predictive analytics in health care.
9. Warehousing and logistics system.
10. Water flow monitoring and management.

## Mode of Evaluation:

Project Reviews I,II and III

Recommended by Board of Studies: 12/09/2020
Approved by Academic Council: No. 59th Date: 24/09/2020
Course Code: ECE 6093
Course Title: Advanced Machine Learning and Deep Learning

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</table>

Pre-requisite: Nil

Syllabus Version: 1.0

Course Objectives:
The course is aimed at

1. Understanding about the fundamentals of machine learning and neural networks
2. Enabling the students to acquire knowledge about pattern recognition.
3. Motivating the students to apply deep learning algorithms for solving real life problems.

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

1. Comprehend the categorization of machine learning algorithms.
2. Understand the types of neural network architectures, activation functions
3. Acquaint with the pattern association using neural networks
4. Explore various terminologies related with pattern recognition
5. Adopt different feature selection and classification techniques
6. Understand the architectures of convolutional neural networks
7. Comprehend advanced neural network architectures such as RNN, Autoencoders, and GANs.

Student Learning Outcomes (SLO):

1, 4, 9

Student Learning Outcomes involved:

1. Having an ability to apply knowledge of mathematics, science and engineering.
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
Learning Problems and Algorithms
4 hours
Various paradigms of learning problems, Supervised, Semi-supervised and Unsupervised algorithms

Module: 2
Neural Network – I
6 hours
Differences between Biological and Artificial Neural Networks – Typical Architecture, Common Activation Functions, Multi-layer neural network, Linear Separability, Hebb Net, Perceptron, Adaline, Standard Back propagation

Module: 3
Neural Network – II
6 hours
Training Algorithms for Pattern Association - Hebb rule and Delta rule, Hetero associative, Auto associative, Kohonen Self Organising Maps, Examples of Feature Maps, Learning Vector Quantization, Gradient descent, Boltzmann Machine Learning

<table>
<thead>
<tr>
<th>Module:4</th>
<th>Machine Learning: Terminologies</th>
<th>7 hours</th>
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<tbody>
<tr>
<td>Classifying Samples: The confusion matrix, Accuracy, Precision, Recall, F1- Score, the curse of dimensionality, training, testing, validation, cross validation, overfitting, under-fitting the data, early stopping, regularization, bias and variance</td>
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<table>
<thead>
<tr>
<th>Module:5</th>
<th>Machine Learning: Feature Selection and Classification</th>
<th>6 hours</th>
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</thead>
<tbody>
<tr>
<td>Feature Selection, normalization, dimensionality reduction, Classifiers: KNN, SVM, Decision trees, Naïve Bayes, Binary classification, multi class classification, clustering.</td>
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<table>
<thead>
<tr>
<th>Module:6</th>
<th>Convolutional Neural Networks</th>
<th>7 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feed forward networks, Activation functions, backpropagation in CNN, optimizers, batch normalization, convolution layers, pooling layers, fully connected layers, dropout, Examples of CNNs.</td>
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<table>
<thead>
<tr>
<th>Module:7</th>
<th>RNNs, Autoencoders and GANs</th>
<th>7 hours</th>
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</thead>
<tbody>
<tr>
<td>State, Structure of RNN Cell, LSTM and GRU, Time distributed layers, Generating Text, Autoencoders: Convolutional Autoencoders, Denoising autoencoders, Variational autoencoders, GANs: The discriminator, generator, DCGANs</td>
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<th>Module:8</th>
<th>Contemporary issues:</th>
<th>2 hours</th>
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**Total Lecture hours: 45 hrs**

**Text Book(s)**


**Reference Books**


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

**Recommended by Board of Studies : 12/09/2020**

**Approved by Academic Council : 59th Date : 24/09/2020**
Course code | Scripting Languages For Design Automation | L | T | P | J | C
---|---|---|---|---|---|---
ECE 6094 | | 2 | 0 | 2 | 0 | 3
Pre-requisite | ECE5043 Embedded Programming | Syllabus version
---|---|---

Course Objectives:
The course is aimed to motivate the students to
1. Work in LINUX environment.
2. Develop the PERL scripts
3. Develop the TCL & TK scripts for automation
4. Develop the python scripts for automation

Expected Course Outcome:
At the end of the course the students will be able to
1. Comprehend PERL Concepts and its range of applications to which they are suited
2. Develop skills and understanding PERL
3. Understanding the basics of TCL scripts
4. Comprehend the concept of Tk
5. Get introduced to Python Programming
6. Develop programming skills on python functions
7. Understanding the OOP and exception Handling using python
8. Expertise in Scripting language

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

Module:1  PERL  4 hours
History and Concepts of PERL - Scalar Data - Arrays and List Data - Control structures – Hashes - Basics I/O - Regular Expressions – Functions - Miscellaneous control structures - Formats.

Module:2  Advanced Topics in PERL  4 hours

Module:3  TCL  4 hours

Module:4  Advanced Topics in TCL  4 hours
Accessing files- Processes. Applications - Controlling Tools - Basics of TK.

Module:5  Python  4 hours
Introduction to Python, Objects: strings, lists, dictionary, tuple, files, Looping constructs

Module:6  Python: Functions and Modules  4 hours
Functions: basics, scope, arguments, Modules: packages (internal and external), decorators

Module:7  Python: OOP and Exception Handling  4 hours
OOP: classes, operator overloading, designing with classes, Exceptions: exception objects, designing with exceptions, Meta-classes

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<td>30 hours</td>
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**Reference Books**


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

**List of Challenging Experiments (Indicative)**

1. **PERL:**
   - Write a script that computes the average of each column in a table of data
   - Write a script extracts a subset of docs from a database
   - Write a script does "string replacement" on the standard input
   - 8 hours

2. **TCL/TK:**
   - Develop a clock that shows time either analog or digital
   - Develop a small calculator in Tcl/Tk. In addition to the buttons on screen, use any of expr's other functionalities via keyboard input.
   - Write a script that allows doodling (drawing with the mouse)
   - 8 hours

3. **Python:**
   - Python Implementation of Mutual-Exclusion (MUTEX algorithm) for Embedded operating systems
   - Python Implementation of Round Robin Scheduling for Embedded OS
   - 8 hours

4. Verification automation tool development using Perl/Python scripts
   - 6 hours

**Total Laboratory Hours**

- 30 hours

**Mode of evaluation:** Continuous Lab Assessment

**Recommended by Board of Studies**

12/09/2020

**Approved by Academic Council**

No. 59th Date 24/09/2020
Course Code: CSE6052  
Course Title: PARALLEL PROCESSING AND COMPUTING  

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<td>PARALLEL PROCESSING AND COMPUTING</td>
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Pre-requisite: Nil  
Syllabus Version: 1

Course Objectives:
The course is aimed at:
1. Teaching the students to understand the scope, design and model of parallelism and to know the parallel computing architecture.
2. Teaching students to do analytical modelling and performance of parallel programs.
3. Teaching students to solve a complex problem with message passing model.
4. Programming with CUDA and analyse complex problems with shared memory programming.

Course Outcomes (CO):
At the end of the course the student will be able to:
1. Understand the fundamentals of parallel processing.
2. Illustrate the scheduling loops and process execution.
3. Realize the parallel system architecture with CUDA.
4. Comprehend the kernel based parallel programming concepts.
5. Apply the performance consideration for parallel processing.
6. Analyse various parallel computation patterns.
7. Perform sparse matrix vector multiplications.

Student Learning Outcomes (SLO):
4, 5, 7

Student Learning Outcomes involved:
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 computational thinking (Ability to translate vast data in to abstract concepts and to understand database reasoning).

Module: 1 Introduction to Parallel Processing  
5 hours
- Parallel processing – Concepts and Terminology
- Parallel Computer Memory Architectures
- Parallel Programming Models
- Designing Parallel Programs
- Performance Analysis

Module: 2 Shared Memory Programming  
6 hours
- Processes and Threads - Scope of Variables – Reduction Clause – Directives – Scheduling Loops
- Caches, Cache coherence and False Sharing – Thread Safety – Examples: Bubble-sort, Odd-even transposition sort

Module: 3 Parallel Computing  
6 hours
- Portability and Scalability - Introduction to CUDA, Data Parallelism and Threads-Memory Allocation and Data Movement API
- Kernel-Based SPMD Parallel Programming-Kernel based Parallel Programming, Multidimensional Kernel Configuration
- Basic Matrix-Matrix Multiplication

Module: 4 Kernel-Based Parallel Programming  
6 hours
- Thread Scheduling-Control Divergence- Memory Model and Locality - CUDA Memories-Tiled Parallel Algorithms
- Tiled Matrix Multiplication- Tiled Matrix Multiplication Kernel-Handling Boundary Conditions in Tiling- A Tiled Kernel for Arbitrary Matrix Dimensions

Module: 5 Performance Considerations  
6 hours
- Warps and Thread execution - Global Memory Bandwidth - DRAM Bandwidth
- Memory Coalescing - Dynamic partition of execution resources

Module: 6 Parallel Computation Patterns  
8 hours
- Convolution- Tiled Convolution- 2D Tiled Convolution Kernel- Data Reuse in Tiled Convolution
- Reduction- A Basic Reduction Kernel- Scan (Prefix Sum)- A Work-Inefficient Scan Kernel- A Work-Efficient Parallel Scan Kernel
### Module: 7
**Sparse Matrix Vector Multiplication**
6 hours
- Parallel SpMV Using CSR-Padding and Transposition-Using Hybrid to Control Padding-
  Sorting and Partitioning for Regularization

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

**Total Lecture hours:** 45 hrs

### Text Book(s)

### Reference Books

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

### Recommended by Board of Studies:
27/02/2016

### Approved by Academic Council:
No. 40 Date: 18/03/2016