B. Tech. Degree

in

ELECTRICAL AND ELECTRONICS ENGINEERING

SYLLABUS FOR

FLEXIBLE CURRICULUM

(For students admitted in 2019-20)

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
NATIONAL INSTITUTE OF TECHNOLOGY
TIRUCHIRAPPALLI – 620 015
TAMIL NADU, INDIA.
INSTITUTE VISION
• To be a university globally trusted for technical excellence where learning and research integrate to sustain society and industry.

INSTITUTE MISSION
• To offer undergraduate, postgraduate, doctoral and modular programmes in multi-disciplinary / inter-disciplinary and emerging areas.
• To create a converging learning environment to serve a dynamically evolving society.
• To promote innovation for sustainable solutions by forging global collaborations with academia and industry in cutting-edge research.
• To be an intellectual ecosystem where human capabilities can develop holistically.

DEPARTMENT VISION
• To be a centre of excellence in Electrical Energy Systems.

DEPARTMENT MISSION
• Empowering students and professionals with state-of-art knowledge and technological skills.
• Enabling industries to adopt effective solutions in energy areas through research and consultancy
• Evolving appropriate sustainable technologies for rural needs

ORGANIZATION CHART/ VARIOUS COMMITTEES OF THE DEPARTMENT
Programme Educational Objectives (PEOs)

The major objectives of the B. Tech programme in Electrical and Electronics Engineering are to prepare students:

1. for graduate study in engineering
2. to work in research and development organizations
3. for employment in electrical power industries
4. to acquire job in electronic circuit design and fabrication industries
5. to work in IT and ITES industries

Program Outcomes (POs)

The students who have undergone the B.Tech. programme in Electrical and Electronics Engineering (EEE)

1. will have an ability to apply knowledge of mathematics and science in EEE systems.
2. will have an ability to provide solutions for EEE problems by designing and conducting experiments, interpreting and analysing data, and reporting the results.
3. will have comprehensive understanding of the entire range of electronic devices, analog and digital circuits with added state-of-art knowledge on advanced electronic systems.
4. will have knowledge and exposure on different power electronic circuits and drives for industrial applications.
5. will have in-depth knowledge in transmission and distribution systems, power system analysis and protection systems to pursue a career in the power sector.
6. will have a good knowledge in microprocessors/microcontrollers, data structures, computer programming and simulation software.
7. will be able to develop mathematical modelling, analysis and design of control systems and associated instrumentation for EEE.
8. will be able to systematically carry out projects related to EEE.
9. will have an ability to participate as members in various professional bodies as well as multidisciplinary design teams.
10. will demonstrate the ability to choose and apply appropriate resource management techniques so as to optimally utilize the available resources.
11. will be proficient in English language in both verbal and written forms which will enable them to compete globally.
12. will have confidence to apply engineering solutions with professional, ethical and social responsibilities.
13. will be able to excel in their professional endeavours through self-education.
14. will be able to design and build renewable energy systems for developing clean energy and sustainable technologies.
CURRICULUM

The total minimum credits required for completing the B.Tech. programme in Electrical and Electronics Engineering is **163**.

**MINIMUM CREDIT REQUIREMENT FOR THE VARIOUS COURSE CATEGORIES:**

<table>
<thead>
<tr>
<th>Course Structure</th>
<th>Courses</th>
<th>No. of Credits</th>
<th>Weightage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GIR (General Institute Requirement Courses)</td>
<td>22</td>
<td>50</td>
<td>30.67</td>
</tr>
<tr>
<td>PC (Programme Core)</td>
<td>15</td>
<td>55**</td>
<td>33.74</td>
</tr>
<tr>
<td>Programme Electives (PE) / Open Electives (OE)</td>
<td>14$</td>
<td>42</td>
<td>25.77</td>
</tr>
<tr>
<td>Essential Laboratory Requirements (ELR)</td>
<td>Maximum 2 per session up to 6th semester</td>
<td>16</td>
<td>9.82</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>163</strong></td>
<td><strong>100</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Minor (Optional)**

Courses for 15 credits | 15 Additional credits | - |

**Honours (Optional)**

Courses for 15 credits | 15 Additional credits | - |

**Minimum of 4 programme core courses shall be 4 credits each**

$Out of 14 elective courses (PE/OE), the students should study at least eight programme elective courses (PE)

Programme Electives (PE) are offered by the Department of Electrical and Electronics Engineering for students of B.Tech. in Electrical and Electronics Engineering programme. Out of 14 elective courses (PE/OE), the students should study at least eight programme elective courses.

To meet the minimum credit requirement for Electives, the remaining elective courses can be chosen from either PE courses offered by the Department of Electrical and Electronics Engineering, or Open Electives offered by any other Department within National Institute of Technology, Tiruchirappalli and online courses to be approved by the department committee. A student can opt for Project Work instead of two electives equivalent to 6 credits.

**MI – Minor Degree:** To meet the requirement of minor, 15 additional credits should be taken from the MI category over and above the minimum credits specified by the Department. The details of MINOR will be mentioned only in the transcript and not in the Degree certificate.
HO – Honors Degree: 15 credits over and above the minimum credit as specified by the departments. Project work is compulsory for honors.

Online courses: Maximum of 12 credits can be taken from online elective courses listed out by the department.

**GIR Courses**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of the course</th>
<th>Number of courses</th>
<th>Max. Credits</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>Mathematics</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>2.</td>
<td>Physics</td>
<td>1 Theory</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 Lab</td>
<td>2</td>
</tr>
<tr>
<td>3.</td>
<td>Chemistry</td>
<td>1 Theory</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 Lab</td>
<td>2</td>
</tr>
<tr>
<td>4.</td>
<td>Industrial Economics and Foreign Trade</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>English for Communication</td>
<td>1 Theory</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 Lab</td>
<td>2</td>
</tr>
<tr>
<td>6.</td>
<td>Energy and Environmental Engineering</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>7.</td>
<td>Professional Ethics</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>8.</td>
<td>Engineering Graphics</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>9.</td>
<td>Engineering Practice</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>10.</td>
<td>Basic Engineering</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>11.</td>
<td>Introduction to computer Programming</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>12.</td>
<td>Branch Specific Course (Introduction to the Branch of study)</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>13.</td>
<td>Summer Internship</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>14.</td>
<td>Project work</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>15.</td>
<td>Comprehensive viva</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>16.</td>
<td>Industrial Lecture</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>17.</td>
<td>NSS/NCC/NSO</td>
<td>1</td>
<td>Compulsory participation</td>
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<td><strong>Total</strong></td>
<td></td>
<td><strong>22</strong></td>
<td><strong>50</strong></td>
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**Credit Distribution**

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<tr>
<th>Semester</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
<th>VII</th>
<th>VIII</th>
<th>Total</th>
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<tr>
<td>Credit</td>
<td>19</td>
<td>21</td>
<td>25</td>
<td>25</td>
<td>24</td>
<td>14</td>
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<td>163</td>
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I. GENERAL INSTITUTE REQUIREMENT (GIR)

1. MATHEMATICS

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MAIR12</td>
<td>Linear Algebra and Calculus</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>MAIR22</td>
<td>Complex Analysis and Differential Equations</td>
<td>3</td>
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<tr>
<td>3</td>
<td>MAIR32</td>
<td>Fourier Transforms and Numerical Techniques</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total</strong></td>
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</table>

2. PHYSICS

<table>
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<th>Course Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>PHIR11</td>
<td>Physics</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>PHIR12</td>
<td>Physics Lab</td>
<td>2</td>
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3. CHEMISTRY

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<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>1</td>
<td>CHIR11</td>
<td>Chemistry</td>
<td>3</td>
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<td>2</td>
<td>CHIR12</td>
<td>Chemistry Lab</td>
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4. HUMANITIES

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<thead>
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<tbody>
<tr>
<td>1</td>
<td>HSIR13</td>
<td>Industrial Economics and Foreign Trade</td>
<td>3</td>
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5. COMMUNICATION

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<th>Course Title</th>
<th>Credits</th>
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<tr>
<td>1.</td>
<td>HSIR11</td>
<td>English for Communication (Theory and Lab)</td>
<td>2+2</td>
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<tr>
<td></td>
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6. ENERGY AND ENVIRONMENTAL ENGINEERING

<table>
<thead>
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<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>ENIR11</td>
<td>Energy and Environmental Engineering</td>
<td>2</td>
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7. PROFESSIONAL ETHICS

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<tr>
<td>1.</td>
<td>HSIR14</td>
<td>Professional Ethics</td>
<td>3</td>
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</table>

8. ENGINEERING GRAPHICS

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>MEIR12</td>
<td>Engineering Graphics</td>
<td>3</td>
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9. ENGINEERING PRACTICE

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>PRIR11</td>
<td>Engineering Practice</td>
<td>2</td>
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</table>
### 10. BASIC ENGINEERING

<table>
<thead>
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<th>S.No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CEIR11</td>
<td>Basic Civil Engineering</td>
<td>2</td>
</tr>
<tr>
<td>2.</td>
<td>MEIR11</td>
<td>Basic Mechanical Engineering</td>
<td>2</td>
</tr>
<tr>
<td></td>
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<td><strong>Total</strong></td>
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</table>

### 11. INTRODUCTION TO COMPUTER PROGRAMMING

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>CSIR12</td>
<td>Introduction to Computer Programming (Theory and Labs)</td>
<td>3</td>
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### 12. BRANCH SPECIFIC COURSE

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>1.</td>
<td>EEIR15</td>
<td>Introduction to Electrical and Electronics Engineering</td>
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</table>

### 13. SUMMER INTERNSHIP

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>EEIR16</td>
<td>Summer Internship</td>
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</tr>
</tbody>
</table>

The student should undergo industrial training/internship for a minimum period of six weeks during the summer vacation of III year. Registration for this course shall be along with the courses for VII semester. Attachment with an academic institution within the country (IISc/IITs/NITs/IIITs and CFTIs) or university abroad is also permitted instead of industrial training. A report is to be submitted to the Head of the Department and evaluation (2 credit) will be based on the report and viva-voce examination.
### 14. PROJECT WORK

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>EEIR17</td>
<td>Project Work</td>
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</table>

**Total** 6

### 15. COMPREHENSIVE VIVA

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>EEIR18</td>
<td>Comprehensive Viva-Voce Examination</td>
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</tbody>
</table>

**Total** 1

Note: Students can appear for Comprehensive Viva-Voce Examination only after completing all Programme Core (PC) courses.

### 16. INDUSTRIAL LECTURES

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>EEIR19</td>
<td>Industrial Lectures</td>
<td>1</td>
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</table>

**Total** 1

A minimum of five lectures of two hours duration each by industry experts will be arranged by the Department. The evaluation methodology, will in general, be based on quizzes at the end of each lecture. Due weightage shall be given to attendance also. However, the HoD or her/his nominee may devise a suitable methodology for evaluation and the same should be informed to the students before the commencement of the semester.

### 17. NSS/NCC/NSO

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>SWIR11</td>
<td>NSS/NCC/NSO</td>
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</table>

**Total** 0
All students admitted to the B.Tech. Program will have to take either NCC or NSO or NSS as a non-credit extra-curricular Program. NCC Program is not available for foreign nationals. The NCC / NSO / NSS requirement should be completed within the first two semesters.

**II. PROGRAMME CORE (PC)**

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Pre-Req</th>
<th>Credits</th>
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<tbody>
<tr>
<td>1.</td>
<td>EEPC10</td>
<td>Circuit Theory</td>
<td>MAIR21</td>
<td>4</td>
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<tr>
<td>2.</td>
<td>EEPC11</td>
<td>Networks and Linear Systems</td>
<td>EEPC10</td>
<td>4</td>
</tr>
<tr>
<td>3.</td>
<td>EEPC12</td>
<td>DC Machines and Transformers</td>
<td>EEPC10</td>
<td>4</td>
</tr>
<tr>
<td>4.</td>
<td>EEPC13</td>
<td>Electron Devices</td>
<td>-</td>
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<td>5.</td>
<td>EEPC14</td>
<td>Digital Electronics</td>
<td>-</td>
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<td>6.</td>
<td>EEPC15</td>
<td>AC Machines</td>
<td>EEPC12</td>
<td>4</td>
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<tr>
<td>7.</td>
<td>EEPC16</td>
<td>Analog Electronic Circuits</td>
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<td>8.</td>
<td>EEPC17</td>
<td>Transmission and Distribution of Electrical Energy</td>
<td>EEPC10</td>
<td>4</td>
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<td>9.</td>
<td>EEPC18</td>
<td>Power System Analysis</td>
<td>MAIR32</td>
<td>4</td>
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<td>EEPC11</td>
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<td>10.</td>
<td>EEPC19</td>
<td>Power Electronics</td>
<td>MAIR32</td>
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<td></td>
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<td>EEPC10</td>
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<td>EEPC13</td>
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<td>11.</td>
<td>EEPC20</td>
<td>Control Systems</td>
<td>EEPC10</td>
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<td>12.</td>
<td>EEPC21</td>
<td>Linear Integrated Circuits</td>
<td>EEPC10</td>
<td>3</td>
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<tr>
<td>13.</td>
<td>EEPC22</td>
<td>Microprocessors and Microcontrollers</td>
<td>EEPC14</td>
<td>3</td>
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<tr>
<td>14.</td>
<td>EEPC23</td>
<td>Measurements and Instrumentation</td>
<td>EEPC21</td>
<td>3</td>
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<tr>
<td>15.</td>
<td>EEPC24</td>
<td>Power System Protection and Switchgear</td>
<td>EEPC18</td>
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### III. ELECTIVE COURSES

1. PROGRAMME ELECTIVES (PE)

#### LIST OF PROGRAMME ELECTIVE COURSES

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Pre-Req.</th>
<th>Credits</th>
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<tbody>
<tr>
<td>1</td>
<td>EEPE10</td>
<td>Power Generation Systems</td>
<td>-</td>
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<td>Thermodynamics and Mechanics of Fluids</td>
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<td>Fuzzy Systems and Genetic Algorithms</td>
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<td>Industrial Automation</td>
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<td>Digital System Design and HDLS</td>
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<td>Digital Signal Processing</td>
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<td>Artificial Neural Networks</td>
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<td>Design of Electrical Apparatus</td>
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<td>Wind and Solar Electrical Systems</td>
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<td>EEPE27</td>
<td>Solid State Drives</td>
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2. OPEN ELECTIVES (OE)

The courses listed below are offered by the Department of Electrical and Electronics Engineering for students of other Departments.

**LIST OF OPEN ELECTIVES**

<table>
<thead>
<tr>
<th>S.No.</th>
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### LIST OF COURSES FOR B.Tech. (MINOR) PROGRAMME

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<td>Introduction to Microcontrollers</td>
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3. MINOR (MI)

Students who have registered for B.Tech. (Minor) in Electrical and Electronics Engineering can opt to study any 5 of the courses listed below. Students from non-circuit branches alone can opt for this Minor Programme.
IV. ESSENTIAL PROGRAMME LABORATORY REQUIREMENT (ELR)

<table>
<thead>
<tr>
<th>S.No.</th>
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<th>Co-Req*</th>
<th>Credits</th>
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<tbody>
<tr>
<td>1.</td>
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<td>Circuits and Digital Laboratory</td>
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<td>2.</td>
<td>EELR11</td>
<td>DC Machines and Transformers Laboratory</td>
<td>EEPC12</td>
<td>2</td>
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<td>Electronic Circuits Laboratory</td>
<td>EEPC13</td>
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<td>Synchronous and Induction Machines Laboratory</td>
<td>EEPC15</td>
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<td>EELR14</td>
<td>Integrated Circuits Laboratory</td>
<td>EEPC21</td>
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<td>Power Electronics Laboratory</td>
<td>EEPC19</td>
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<tr>
<td>7.</td>
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<td>Micro-controller Laboratory</td>
<td>EEPC22</td>
<td>2</td>
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<td>8.</td>
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<td>Power Systems Laboratory</td>
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**NOTE:** Students can register for 2 laboratory courses during one session along with the regular courses (PC / Electives).

V. ADVANCED LEVEL COURSES FOR B.Tech. (HONOURS)

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Course Code</th>
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<tbody>
<tr>
<td>1.</td>
<td>EEHO10</td>
<td>Distribution System Automation</td>
<td>EEPC11</td>
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<td>2.</td>
<td>EEHO11</td>
<td>EHV AC and DC Transmission</td>
<td>EEPC11</td>
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<td>3.</td>
<td>EEHO12</td>
<td>Non-linear Control Systems</td>
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<tr>
<td>4.</td>
<td>EEHO13</td>
<td>Power Switching Converters</td>
<td>EEPC19</td>
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<td>5.</td>
<td>EEHO14</td>
<td>Vehicular Electric Power Systems</td>
<td>EEPC15, EEPC19</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Course Code</td>
<td>Course Title</td>
<td>Department</td>
<td>Credits</td>
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<td>6.</td>
<td>EEHO15</td>
<td>Power System Dynamics</td>
<td>EEPC18</td>
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<td>7.</td>
<td>EEHO16</td>
<td>Modern Optimization Techniques for Electric Power Systems</td>
<td>EEPC18</td>
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<td>Computer Relaying and Phasor Measurement Unit</td>
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<td>Power System Restructuring</td>
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<td>EEHO19</td>
<td>Design with PIC Microcontrollers</td>
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</table>

- **Eligibility for Award of B.Tech. (Honours) Degree:**
  - Students should not have obtained “V” or “X” grade in any course.
  - Continue to maintain the CGPA of 8.5 in all semesters excluding honours courses.
  - Completed additional theory courses for 15 credits from the basket of honors generally in the level of P.G. courses offered by the department, maintaining an aggregate of at least B grade in Honours courses.
- B.Tech. (Honours) students are permitted to take one M.Tech. (Power Systems/Power Electronics) course offered during a session in their 4th year of study.
- B.Tech. (Honours) students must earn 15 credits in addition to the credits specified by the department for B.Tech degree. They can register an additional course from the 5th semester from the basket of honours courses offered by the department.
## Curriculum Structure

### Semester I (July Session)

<table>
<thead>
<tr>
<th>S No</th>
<th>Code</th>
<th>Course</th>
<th>Credits</th>
<th>Category</th>
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<tbody>
<tr>
<td>1</td>
<td>ENIR11</td>
<td>Energy and Environmental Engineering</td>
<td>2</td>
<td>GIR</td>
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<td>2</td>
<td>MAIR12</td>
<td>Linear Algebra and Calculus</td>
<td>3</td>
<td>GIR</td>
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<td>3</td>
<td>PHIR11</td>
<td>Physics</td>
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<td>Physics Lab</td>
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<td>GIR</td>
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<tr>
<td>5</td>
<td>CSIR12</td>
<td>Introduction to Computer Programming (Theory &amp; lab)</td>
<td>3</td>
<td>GIR</td>
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<tr>
<td>6</td>
<td>MEIR11</td>
<td>Basics of Mechanical Engineering</td>
<td>2</td>
<td>GIR</td>
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<td>7</td>
<td>PRIR11</td>
<td>Engineering Practice</td>
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<td>CEIR11</td>
<td>Basics of Civil Engineering</td>
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**Total Credit 19**

### Semester II (January Session)

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<tbody>
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<td>English for Communication (Theory and lab)</td>
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<td>2</td>
<td>MAIR22</td>
<td>Complex Analysis and Differential Equations</td>
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<td>GIR</td>
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<td>3</td>
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<td>CHIR12</td>
<td>Chemistry Lab</td>
<td>2</td>
<td>GIR</td>
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<tr>
<td>5</td>
<td>EEIR15</td>
<td>Introduction to Electrical and Electronics Engineering</td>
<td>2</td>
<td>GIR</td>
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<td>6</td>
<td>MEIR12</td>
<td>Engineering Graphics</td>
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<td>GIR</td>
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<td>Circuit Theory (Programme Core – I)</td>
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**Total Credit 21**

### Semester III (July Session)

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<td>Fourier Transforms and Numerical Techniques</td>
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<td>EEPC11</td>
<td>Networks &amp; Linear Systems (Programme Core – II)</td>
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<td>DC Machines &amp; Transformers (Programme Core – III)</td>
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<td>Electron Devices (Programme Core - IV)</td>
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<td>EEPC14</td>
<td>Digital Electronics (Programme Core - V)</td>
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<td>Circuits &amp; Digital Laboratory (Laboratory - I)</td>
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**Total Credit 25**

*Note: Department(s) to offer Minor (MI) Course, ONLINE Course (OC) and Honors to those willing students in addition to 25 credits.*
### Semester IV (January Session)

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<td>AC Machines (Programme Core – VI)</td>
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<td>Analog Electronic Circuits (Programme Core - VII)</td>
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<td>Transmission &amp; Distribution of Electrical Energy (Programme Core - VIII)</td>
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<td>Electronics Circuits Laboratory (Laboratory - III)</td>
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<td>Synchronous &amp; Induction Machines Laboratory (Laboratory - IV)</td>
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**Note:** Department(s) to offer MI/PE/OE/OC and Honours course as 2/3/4 credits to those willing students in addition to 25 credits.

### Semester V (July Session)

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<td>Power Electronics (Programme Core - X)</td>
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<td>Control Systems (Programme Core - XI)</td>
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<td>Linear Integrated Circuits (Programme Core - XII)</td>
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<td>Integrated Circuits Laboratory (Laboratory - V)</td>
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<td>Power Electronics Laboratory (Laboratory - VI)</td>
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**Note:** Department(s) to offer MI/PE/OE/OC and Honours course as 2/3/4 credits to those willing students in addition to 25 credits.

### Semester VI (January Session)

<table>
<thead>
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<td>Industrial Lecture</td>
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<td>EEPC22</td>
<td>Microprocessors &amp; Microcontrollers (Programme Core - XIII)</td>
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<td>EEPC23</td>
<td>Measurements &amp; Instrumentation (Programme Core - XIV)</td>
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<td>Power System Protection &amp; Switchgear (Programme Core - XV)</td>
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<td>PC</td>
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<td>EELR16</td>
<td>Microcontroller Laboratory (Laboratory - VII)</td>
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<td>S No</td>
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<td>Power Systems Laboratory (Laboratory - VIII)</td>
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<td>ELR</td>
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<td>HSIR14</td>
<td>Professional Ethics</td>
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**Note:** Department(s) to offer MI/PE/OE/OC and Honors course as 2/3/4 credits to those willing students in addition to 25 credits.

### Semester VII (July Session)

<table>
<thead>
<tr>
<th>S No</th>
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<th>Credits</th>
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**Note:** Department(s) to offer MI/PE/OE/OC and Honors course as 2/3/4 credits to those willing students in addition to 14 credits.

### Semester VIII (January Session)

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**Note:** Department(s) to offer MI/PE/OE/OC and Honors course as 2/3/4 credits to those willing students in addition to 10 credits.

$^5$Optional course
GENERAL INSTITUTE REQUIREMENT
MAIR12 LINEAR ALGEBRA AND CALCULUS
(Common to CSE, EEE, ECE and ICE)

Course Type: General Institute Requirement (GIR)  Pre-requisites: --
No. of Credits: 3

OBJECTIVES:

1. Introduce vector space and inner product space and its properties.
2. Introduce eigen value and eigen vectors and its properties.
3. Determine canonical form of given quadratic form.
4. Discuss the convergence of infinite series.
5. Analyze and discuss the extrema of the functions of several variables.
6. Evaluate the multiple integrals and apply in solving problems.

COURSE CONTENT:


Sequence and series: Convergence of sequence. Infinite Series-Tests for Convergence-Integral test, comparison test, Ratio test, Root test, Raabe’s test, Logarithmic test and Leibnitz’s test; Power series;

Functions of two variables: Limit, continuity and partial derivatives; Total derivative, Jacobian, Taylor series, Maxima, minima and saddle points; Method of Lagrange multipliers; Double and triple integrals, change of variables, multiple integral in cylindrical and spherical coordinates.

COURSE OUTCOME:

1. Compute eigenvalues and eigenvectors of the given matrix.
2. Identity vector space and its basis.
3. Construct orthonormal basis for a given vector space.
4. Transform given quadratic form into canonical form.
5. Discuss the convergence of infinite series by applying various tests.
6. Compute partial derivatives of function of several variables.
7. Write Taylor’s series for functions with two variables.
8. Evaluate multiple integral and its applications in finding area, volume.

REFERENCES:

MAIR22 COMPLEX ANALYSIS AND DIFFERENTIAL EQUATIONS
(Common to CSE, EEE, ECE and ICE)

Course Type: General Institute Requirement (GIR)  Pre-requisites: --

No. of Credits: 3

OBJECTIVES
The course presents
1. an introduction to analytic functions and power series.
2. various Cauchy’ theorems and its applications in evaluation of integral.
3. various approach to find general solution of the ordinary differential equations
4. Laplace transform techniques to find solution of differential equations
5. Partial differential equations and methods to find solution of it.

COURSE CONTENT:
Analytic functions; Cauchy-Riemann equations; Line integral, Cauchy's integral theorem and integral formula (without proof); Taylor's series and Laurent series; Residue theorem (without proof) and its applications.

Higher order linear differential equations with constant coefficients; Second order linear differential equations with variable coefficients; Method of variation of parameters; CauchyEuler equation.


Formation of partial differential equations by eliminating arbitrary constants and functions – solution of first order equations – four standard types – Lagrange’s equation. Method of separation of variables

COURSE OUTCOME
Completion of the course, student will be able to
1. understand analytic functions discuss its properties
2. obtain series representation of analytic functions
3. evaluate various integrals by using Cauchy’s residue theorem
4. classify singularities and derive Laurent series expansion
5. find the solutions of first and some higher order ordinary differential equations
6. apply properties of special functions in discussion the solution of ODE.
7. Find Laplace transform of a given function and its inverse Laplace transform.

REFERENCES:
MAIR32 - FOURIER TRANSFORMS AND NUMERICAL TECHNIQUES

Course Type: General Institute Requirement (GIR)  
Pre-requisites: MAIR12, MAIR22

No. of Credits: 4

1. understand the importance of transform techniques to solve engineering problems.
2. apply Laplace and Fourier transform to solve the mathematical equations arising in mechanical engineering.
3. understand Fourier series analysis and its use in solving boundary value problems.
4. Numerical Methods for Solving Linear Systems
5. Methods to solve equations of One Variable as well as system of equations with two variables.
6. curve fitting for the given data.
7. numerical solution of linear difference equation.

Course Content:


Solution of linear system - Gaussian elimination and Gauss-Jordan methods - LU - decomposition methods - Crout's method - Jacobi and Gauss-Seidel iterative methods - sufficient conditions for convergence

Solution of nonlinear equation - Bisection method - Secant method - Regula falsi method - Newton-Raphson method for f(x) = 0 and for f(x,y) = 0, g(x,y) = 0 - Order of convergence.

Newton’s forward, backward and divided difference interpolation – Lagrange’s interpolation –

Curve fitting - Method of least squares and group averages - Least square approximation of functions - solution of linear difference equations with constant coefficients.

Reference Books:

**PHIR11 PHYSICS**

*Course Type:* General Institute Requirement (GIR)  
*Pre-requisites:* --  
*No. of Credits:* 3

**OBJECTIVES:**

- To introduce the notions of light matter interaction, fabrication of lasers, light propagation in waveguides, applications of lasers and optical fibers to engineering students.
- To comprehend and explain the concepts of matter waves, wave functions and its interpretation to understand the matter at atomic scale.
- To teach the fundamentals of nuclear forces, models and classification of matter.
- To impart knowledge about the basics of conductors, superconductors, nanomaterials and their applications in science, engineering and technology.

**COURSE CONTENT:**

**Lasers**  

**Fiber Optics**  
Snell’s law-optical fiber – principle and construction – acceptance cone - numerical aperture - types of fibers, fiber optic communication principle – fiber optic sensors-other applications of optical fibers.

**Quantum Mechanics:**  

**Nuclear and Particle Physics:**  
Nuclear properties and forces - Nuclear models - Shell model - Nuclear reaction - Radioactivity - types and half-life. Fundamental forces - Particle physics - classification of matter - quark model.

**Physics of Advanced Materials:**  

**COURSE OUTCOME**

1. On completion of this course, the students will be able to,
2. know principle, construction and working of lasers and their applications in various science and engineering.
3. explain light propagation in optical fibers, types and their applications.
4. experience and appreciate the behaviour of matter at atomic scale, and to impart knowledge in solving problems in modern science and engineering.
5. understand the role of nuclear and particle physics in applications like radioactivity and nuclear reactions.
6. recognize, choose and apply knowledge to develop materials for specific applications for common needs.
References
PHIR12 PHYSICS LAB

Course Type: General Institute Requirement (GIR)  
Prerequisite: --
No. of Credits: 2

OBJECTIVES

- To introduce the spirit of experiments to verify physics concepts such as reflection, refraction, diffraction and interference on light matter interaction.
- To perform experiments to estimate the materials properties and to check their suitability in science and engineering.
- To familiarize physics concepts and to design instruments and experimental set up for better and accurate measurements.
- To teach and apply knowledge to measure and verify the values of certain constants in physics

LABORATORY EXPERIMENTS:

1. Determination of rigidity modulus of a metallic wire
2. Conversion of galvanometer into ammeter and voltmeter
3. Wavelength of laser using diffraction grating
4. Dispersive power of a prism – Spectrometer
5. Radius of curvature of lens-Newton’s Rings
6. Numerical aperture of an optical fiber
7. Field along the axis of a Circular coil
8. Wavelength of white light – Spectrometer
9. Calibration of Voltmeter – Potentiometer
10. Thickness of a thin wire – Air Wedge
11. Specific rotation of a liquid – Half Shade Polarimeter
12. Photoelectric effect – Planck’s constant

COURSE OUTCOME

On completion of this course, the students will be able to
1. Know how to calibrate a galvanometer and convert it into a current and voltmeters.
2. To make experimental setup to verify certain physics concepts of wave and particle nature of light.
3. Understand the light propagation in fibers, light matter interaction and use of lasers in science and engineering.
4. Acquire knowledge, estimate and suggest materials for engineering applications.

References

1. Physics Laboratory Manual, Department of Physics, National Institute of Technology Tiruchirappalli, 2018.
CHIR11 - CHEMISTRY

Course Type:  General Institute Requirement (GIR)  Pre-requisites:  --
No. of Credits:  3

OBJECTIVES:
To introduce the student's basic principles of Electrochemistry and Corrosion. They will be familiar with phase rule & its applications. Students will know about the essential requirements of water and its importance in day-to-day life. To provide students with a brief outline of the types and applications of polymers. Finally, students will be equipped with the usage of spectroscopy in industrial applications.

COURSE CONTENT

Electrochemistry and Corrosion
Cell EMF- its measurement and applications - concentration cell - electrode electrolyte concentration cell - concentration cell with and without transference - Dry corrosion and wet corrosion, mechanisms, types of corrosion, Differential metal corrosion, differential aeration corrosion, intergranular, Passivity, Pitting, Polarization - Chemical conversion coatings and organic coatings- Paints, enamels.

Phase rule

Water
Sources, Hard & soft water, Estimation of hardness by EDTA method, Scale & Sludge- Caustic embrittlement - softening of water, zeolite process & demineralization by ion exchangers, boiler feed water, internal treatment methods-specifications for drinking water, BIS & WHO standards, treatment of water for domestic use, desalination - Reverse osmosis & Electrodialysis.

Spectroscopy

Polymers and composites
Concept of macromolecules- Tacticity- Classification of Polymers- Types of Polymerization-Mechanism- - Ziegler Natta Polymerization - Effect of Polymer structure on properties -Important addition and condensation polymers –synthesis and properties – Molecular mass determination of polymers- Static and dynamic methods, Light scattering- Rubbers –Vulcanization – Synthetic rubbers – Conducting polymers- Composite materials

COURSE OUTCOMES

- Students will learn about the Electrochemistry and phase rule.
- They will be familiarized with the importance of polymer and its application in industries.
- Additionally, a brief introduction in the area of water, spectroscopy will be very useful for the students in future endeavour
References & Text Books

CHIR12 - CHEMISTRY LAB

Course Type: General Institute Requirement (GIR)  
Pre-requisites: --
No. of Credits: 2

LIST OF EXPERIMENTS

1. Estimation of carbonate, non-carbonate and total hardness in the given water sample.
2. Estimation of dissolved oxygen in the given water sample.
3. Determination of the percentage of Fe in the given steel sample.
4. Estimation of Fe3+ by spectrophotometer.
5. Corrosion rate by polarization technique
6. Conductometric titration
7. Potentiometric titration
8. pH-metric titration
9. Percentage purity of bleaching powder
10. Determination of molecular weight of the polymer by Viscometry
11. Study of three component system.
12. Demonstration experiments using Advanced Spectroscopic Techniques, (UV-Vis, FTIR, Raman)

COURSE OUTCOME

- The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering.
- The students will learn how to estimate various components from the corresponding bulk mixture.

Reference Books

1. Laboratory Manual, Department of Chemistry, National Institute of Technology, Tiruchirappalli.
Course Type: General Institute Requirement (GIR)  
No. of Credits: 3

Course Objectives:
To provide a thorough understanding of the principles of economics that apply to the decisions of individuals and the application of those principles to the world around them and a framework for consistent reasoning about international flows of goods, factors of production, and financial assets, and trade policy.

Course Content:

Demand Analysis and Forecasting: Cardinal Ordinal Approaches. Demand and Supply, Elasticities, Forecasting techniques, Consumer behavior.

Production, Cost, and Market structure: Variable proportions, Returns to Scale, Isoquants Analysis, Production Function, Cost Curves, Cost Function, Market Analysis and game theory.

Types, Location, Efficiency and Finance: Mergers & Amalgamations, Location of Industries and Theories, Productivity and Capacity Utilization, Shares, Debentures, Bonds, Deposits, Loan etc., FDI, Foreign Institutional Investment, Euro Issues, GDR, ADR, External Commercial Borrowings.

Introduction: Features of International Trade, Inter-regional and international Trade, Problems of International Trade. Theories:
Terms of Trade- Concept, Measurement, Types, Factors affecting Terms of Trade, Exchange rate.
Free Trade, Protection and Tariffs, Balance of Payments: Free Trade, Protection- Quotas, Dumping, etc., Balance of Trade and Balance of Payments.

Regional Economic Groupings and International Institutions: BRICS, EU, SAARC, OPEC, ASEAN. International Institutions: GATT, WTO, UNCTAD, IBRD, IMF.

Reference Books:

COURSE OUTCOMES:
Upon completion of this course, the students will be able to understand the principles of economics and International Trade.
HSIR11- ENGLISH FOR COMMUNICATION

Course Type: General Institute Requirement (GIR)  
Pre-requisites: --  
No. of Credits: 4

Course Objectives:

- The primary objective is to develop in the under-graduate students of engineering a level of competence in English required for independent and effective communication for academic and social needs.

Course Content:


Analytical and critical reading practice- critical, creative and lateral thinking- language and thinking – thinking process and language development.


Reciprocal relationship between reading and writing –thinking and writing - Argument Writing practice – Perspectives in writing –professional writing - Narrative writing.

Lab: Listening process & practice – Exposure to recorded & structured talks, class room lectures – Problems in comprehension & retention – Note-taking practice – Listening tests- Importance of listening in the corporate world.

Barriers to listening: Physical & psychological – Steps to overcome them – Purposive listening practice – Active listening and anticipating the speaker – Use of technology to improve the skill.


COURSE OUTCOMES:

The students will be able to express themselves in a meaningful manner to different levels of people in their academic and social domains.

Reference Books:

ENIR11 - ENERGY AND ENVIRONMENTAL ENGINEERING

Course Type: General Institute Requirement (GIR)  Pre-requisites: --
No. of Credits: 2

Course Objectives:

- To teach the principal renewable energy systems.
- To explore the environmental impact of various energy sources and also the effects of different types of pollutants.

Course Content:

Present Energy resources in India and its sustainability - Different type of conventional Power Plant--Energy Demand Scenario in India-Advantage and Disadvantage of conventional Power Plants – Conventional vs Non-conventional power generation.


Power and energy from wind turbines- India’s wind energy potential- Types of wind turbines- Off shore Wind energy- Environmental benefits and impacts.

Biomass resources-Biomass conversion Technologies- Feedstock preprocessing and treatment methods- Bioenergy program in India-Environmental benefits and impacts.


Air pollution- Sources, effects, control, air quality standards, air pollution act, air pollution measurement. Water pollution-Sources and impacts, Soil pollution-Sources and impacts, disposal of solid waste.


COURSE OUTCOMES:

Students will be introduced to the Principal renewable energy systems and explore the environmental impact of various energy sources and also the effects of different types of pollutants.

Reference Books:

HSIR14 - PROFESSIONAL ETHICS

Course Type: General Institute Requirement (GIR)  
No. of Credits: 3  
Pre-requisites: --

Course Objectives:

- Identify the core values that shape the ethical behavior of an engineer.
- To create an awareness on professional ethics and Human Values
- To appreciate the rights of others

Course Content:

UNIT I: HUMAN VALUES

UNIT II: ENGINEERING ETHICS

UNIT III: ENGINEERING AS SOCIAL EXPERIMENTATION
Engineering as experimentation – engineers as responsible experimenters – Research ethics – Codes of ethics – Industrial Standard – Balanced outlook on law – the challenger case study.

UNIT IV: SAFETY, RESPONSIBILITIES AND RIGHTS

UNIT V: GLOBAL ISSUES
Multinational corporations – Business ethics – Environmental ethics – computer ethics – Role in Technological Development – Weapons development – engineers as managers – consulting engineers – engineers as expert, witnesses and advisors – Honesty – Leadership – sample code of conduct ethics like ASME, ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management, Institution of Electronics and Telecommunication Engineers (IETE), India, etc.,

Text Books:


2. Govindarajan M., Natarajan S., Senthil Kumar V. S., ‘Engineering Ethics’ Prentice Hall of India,
New Delhi, 2004.


COURSE OUTCOMES:

Upon completion of this course, the students should have understood the core values that shape the ethical behavior of an engineer, and they have exposed an awareness on professional ethics and human values.
MEIR12 - ENGINEERING GRAPHICS

Course Type: General Institute Requirement (GIR)  Pre-requisites: --
No. of Credits: 3

Course Objectives:

- Irrespective of engineering discipline, it has become mandatory to know the basics of Engineering graphics. The student is expected to possess the efficient drafting skill depending on the operational function in order to perform day to day activity.
- Provide neat structure of industrial drawing.
- Enables the knowledge about position of the component and its forms Interpretation of technical graphics assemblies.
- Preparation of machine components and related parts.

Course Content:

Fundamentals: Drawing standard - BIS, dimensioning, lettering, type of lines, scaling- conventions.

Orthographic projection: Introduction to orthographic projection, drawing orthographic views of objects from their isometric views - Orthographic projections of points lying in four quadrants.

Orthographic projection of lines parallel and inclined to one or both planes Orthographic projection of planes inclined to one or both planes. Projections of simple solids - axis perpendicular to HP, axis perpendicular to VP and axis inclined to one or both planes.

Sectioning of solids: Section planes perpendicular to one plane and parallel or inclined to other plane.

Intersection of surfaces: Intersection of cylinder & cylinder, intersection of cylinder & cone, and intersection of prisms.

Development of surfaces: Development of prisms, pyramids and cylindrical & conical surfaces.

Isometric and perspective projection: Isometric projection and isometric views of different planes and simple solids, introduction to perspective projection.

COURSE OUTCOMES:

- At the end of the course the students will be able to visualize the engineering components. A number of chosen problems will be solved to illustrate the concepts clearly.

Reference Books:

**PRIR11 - ENGINEERING PRACTICE**

*Course Type:* General Institute Requirement (GIR)  
*Pre-requisites:* --  
*No. of Credits:* 2

**Course Objectives:**

- To use hand tools and machinery in Carpentry, welding shop, Foundry, Fitting shop and Sheet Metal work.  
- To manufacture engineering products or prototypes.

**Course Content:**

- **Foundry:** Mould preparation for Flange and Hand Wheel, Plastic moulding / Wax moulding.  
- **Welding:** Fabrication of Butt Joint and Fabrication of Lap Joint.  
- **Carpentry:** Wood sizing exercise in planning, marking, sawing, chiseling and grooving to make; Tee Through Halving Joint and Dovetail Scarf Joint.  
- **Fitting:** Preparation of joints, markings, cutting and filling for making; Semi-circle part with the given work piece, Dovetail part with the given work piece.  
- **Sheet metal:** Fabrication of Dust Pan and Fabrication of Corner Tray.

**COURSE OUTCOME**

1. Know to utilize hand tools and machineries in Carpentry, Welding shop, Foundry, Fitting shop and Sheet Metal work.  
2. Produce simple engineering products or prototypes

**References**

CEIR11 – BASIC CIVIL ENGINEERING

Course Type: General Institute Requirement (GIR)  Pre-requisites: --
No. of Credits: 2

Course Objectives:

- To give an overview of the fundamentals of the Civil Engineering fields to the students of all branches of Engineering.
- To realize the importance of the Civil Engineering Profession in fulfilling societal needs.

Course Content:

Properties and uses of construction materials - stones, bricks, cement, concrete and steel.

Site selection for buildings - Component of building - Foundation- Shallow and deep foundations - Brick and stone masonry - Plastering - Lintels, beams and columns - Roofs.


Surveying -Classification-Chain Survey- Ranging - Compass Survey - exhibition of different survey equipment.

Sources of Water - Dams- Water Supply-Quality of Water-Waste water Treatment – Sea Water Intrusion – Recharge of Ground Water.

COURSE OUTCOMES:

1. The students will gain knowledge on site selection, construction materials, components of buildings, roads and water resources.
2. A basic appreciation of multidisciplinary approach when involved in Civil-Related Projects.

Reference Books:

5. Lecture notes prepared by Department of Civil Engineering, NITT.
MEIR11 - BASIC MECHANICAL ENGINEERING

Course Type: General Institute Requirement (GIR)  
Pre-requisites: --
No. of Credits: 2

Course Objectives:
1. To introduce and define the basics concept of mechanical engineering.
2. To familiarize the working principles of IC engines and automobile systems.
3. To enable the students to understand the details about the energy systems and its components.
4. To demonstrate the various machine elements, materials and its function.
5. To help the students acquire knowledge about the various manufacturing process.

Course Content:

IC Engines – 2 Stroke and 4 stroke systems in IC Engines. Automobiles - Transmission systems, Suspension system, E-Vehicles.


Engineering materials, Machine elements, Transmission, Fasteners, Support systems.

Manufacturing, Classification, Metal forming, Casting, Lathe, Drilling machines, Milling machines, Metal joining.

COURSE OUTCOMES:
At the end of the course, students will be able
1. To identify the basic concept and fundamentals of mechanical engineering.
2. To understand the working principle of IC engines and Energy systems.
3. To appreciate the process and materials involved in the manufacture of various machine element components.

Reference Books:
4. Lecture notes prepared by Department of Mechanical Engineering, NITT, 2018.
Course Type: General Institute Requirement (GIR)  Pre-requisites: --
No. of Credits: 3

Course Objectives:

- To learn the fundamentals of computers.
- To learn the problem solving techniques writing algorithms and procedures.
- To learn the syntax and semantics for C programming language.
- To develop the C code for simple logic.
- To understand the constructs of structured programming including conditionals and iterations.

Course Content:

Introduction to computers - Types of programming languages- Developing a program - Algorithms- Characteristics- Flow Charts- Principles of structured programming- Sequential selecting structures- Repetitive Structures- Bounded, Unbounded and Infinite iterations.

Introduction to C- C character set- Identifiers and Keywords- Data types- Constants- Variables- Declarations- Expressions- Statements- Symbolic Constants- Operators- Library Functions- Data input and output: Single character input and output- Entering input data- Writing output data- gets and puts functions - Control Statements- Branching: if-else-looping: while- do-while-for; Nested control Structures- switch statements- Break statements- Continue Statements- Comma operator- goto statements.

Modular Programming- Functions and Procedures - Examples- Parameters passing methods - Arrays- Defining an array- Processing an array- Multi dimensional arrays- Pointers- Variables definitions and initializations- Pointer operators- Pointer expressions and arithmetic- Pointers and one dimensional arrays - String operations.


Files – Input / Output using files – fread, fwrite, fprintf, fscanf – Formatted input – File access - argc, argv.

COURSE OUTCOMES:

1. Ability to write algorithms for problems
2. Knowledge of the syntax and semantics of C programming language
3. Ability to code a given logic in C language
4. Knowledge in using C language for solving problems

Reference Books:

Course Type: General Institute Requirement (GIR)  
Pre-requisites: --  
No. of Credits: 2

Course Objectives:

- This course facilitates the students to get a comprehensive exposure to electrical and electronics engineering.

Course Content:

History, major inventions, scope, significance and job opportunities in electrical and electronics engineering, brief overview of various energy resources.

Basics of energy conversion, Power apparatus used in power generation, transmission and distribution, Power apparatus used in various industries.

Basic ideas about utility supply, electrical tariff, energy audit and importance of energy saving.

Introduction to different types of electrical circuits, house wiring, electronic circuits for signal processing, specifications of electronic components.

Brief overview of curriculum, laboratories and various software packages, electronic testing and measuring equipment.

Reference Books:


COURSE OUTCOMES:

The students shall develop an insightful knowledge on various fundamental elements of electrical and electronics engineering.
PROGRAMME CORE
EEPC10 - CIRCUIT THEORY

Course Type: Programme Core (PC)  
Pre-requisites: MAIR21  
No. of Credits: 4

Course Objectives:
To provide the key concepts and tools in a logical sequence to analyze and understand electrical and electronic circuits.

Course Content:
Fundamental concepts of R, L and C elements, DC circuits, series and parallel circuits - loop and nodal analysis, AC circuits - complex impedance - phasor diagram, real and reactive power - loop and nodal analysis applied to AC circuits.

Voltage source –current source transformations, Various Network theorems and applications to dc and ac circuits, star-delta transformations.

Resonance in series and parallel circuits, self and mutual inductances, coefficient of coupling - dot convention - analysis of coupled circuits.

Three-phase star and delta circuits with balanced and unbalanced loads - power measurements - power factor calculations.

Time response of RL, RC and RLC circuits for step and sinusoidal inputs.

Text Books:

Reference Books:

COURSE OUTCOMES:
Upon completion of the course, the student will be able to

1. Understand the technical representation of common electrical systems.
2. Analyze and compute the time domain behavior of linear (AC and DC) electric circuits with single or multiple power sources.
3. Compute the performance of AC Networks (1-port) which may be 1-Φ or 3-Φ using phasor analysis.
4. Understand the flow of real and reactive power components in AC systems.
5. Analyze simple electro-magnetic circuits.
EEPC11 - NETWORKS AND LINEAR SYSTEMS

Course Type: Programme Core (PC)  
Pre-requisites: EEPC10  
No. of Credits: 4

Course Objectives:
To emphasize the relationship between the conceptual understanding and problem-solving approach for (i) analyzing the electric circuit/system excited with non-sinusoidal and non-periodic source,(ii) one-port and two-port networks, (iii) system modeling and simplifications, (iv) transfer function, state-space analysis and z-transform analysis.

Course Content:


Differential equation of translational and rotational systems - transfer function modeling for simple electrical and mechanical systems-open loop and closed loop systems - block diagram representation -Block diagram algebra - signal flow graph - Mason's gain formula.

Concepts of state and state variables – state space modeling for simple electrical and mechanical systems – state transition matrix - solution of state equations.


Text Books:

Reference Books:

COURSE OUTCOMES:
Upon completion of the course, the student will be able to
1. Understand the significance of Fourier series and Fourier Transform and apply them for typical electrical systems.
2. Apply Laplace Transform for typical circuits and be able to determine the two-port network parameters.
3. Model the systems in transfer function and state-space domains and analyze the system using these models.
4. Apply Z-transforms for the analysis of discrete time systems.
Course Type: Programme Core (PC)  

Pre-requisites: EEPC10  

No. of Credits: 4

Course Objectives:

This course aims to equip the students with a basic understanding of DC machines and Transformer fundamentals, machine parts and help to gain the skills for operating DC machines and Transformers. The course also equips students with ability to understand and analyze the equivalent circuits of DC machines and Transformers.

Course Content:

Principles of Energy conversion – basic magnetic circuit analysis, Faraday’s law of electromagnetic induction – singly and doubly excited magnetic field systems – torque production in rotating machines and general analysis of electro mechanical system.

DC Generator – construction, principle of operation – emf equation– types, Characteristics, commutation - armature reaction.


Three-phase transformer connection-Scott connection – all day efficiency - Sumpner's test - parallel operation of transformers.

Text Books:


Reference Books:

COURSE OUTCOMES:

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

1. Understand various properties and applications of magnetic circuits in linear and rotational systems.
2. Understand constructional details and principles of DC machines and transformers.
3. Analyze the performance parameters/characteristics of the DC machines under various operating conditions through proper testing.
4. Evaluate the performance of single-phase transformer using equivalent circuits and phasor diagrams.
5. Understand various connection and performance testing of various transformers.
EEPC13 - ELECTRON DEVICES

Course Type: Programme Core (PC)  Pre-requisites: -
No. of Credits: 3

Course Objectives:
To educate on the construction and working of common electronic devices and to prepare for application areas.

Course Content:
Semi-conductors – charge carriers, electrons and holes in intrinsic and extrinsic semi-conductors –Hall effect.


Bipolar junction transistors – Characteristics – Analysis of CB, CE, CC amplifier configurations.

Unipolar devices – FET, MOSFET, UJT and Opto-Electronic devices – theory and characteristics.

Rectifiers and switched mode power supplies – theory and design, filter circuits, applications.

Text Books:

Reference Books:

COURSE OUTCOMES:
Upon completion of this course, students will be able to
1. Understand the semiconductor physics of the intrinsic, p and n materials and various devices and characteristics.
2. Analyze simple diode circuits under DC and AC excitation.
3. Analyze and design simple amplifier circuits using BJT in CE, CC and CB configurations.
4. Understand the analysis and salient features of CE, CC & CB amplifier circuits.
5. Understand the construction and characteristics of FET, MOSFET and UJT.
Course Type: Programme Core (PC)  
Pre-requisites: -  
No. of Credits: 3

Course Objectives:
This subject exposes the student to digital fundamentals.

Course Content:
Review of number systems, binary codes, error detection and correction codes. Digital Logic Families – Introduction to RTL, DTL, TTL, ECL and MOSL families – wired and operation, characteristics of digital logic family – comparison of different logic families.


Synchronous Sequential Logic circuits - state table and excitation tables - state diagrams - Moore and Mealy models - design of counters - analysis of synchronous sequential logic circuits - state reduction and state assignment.

Asynchronous sequential logic circuits-Transition table, flow table – race conditions – circuits with latches, analysis of asynchronous sequential logic circuits – introduction to design – implication table – hazards - programmable logic array and devices.

Text Books:

Reference Books:

COURSE OUTCOMES:
Upon completion of the course, the student will be able to
1. Interpret, convert and represent different number systems.
2. Manipulate and examine Boolean algebra, logic operations, Boolean functions and their simplification.
3. Design and analyze combinational and sequential logic circuits.
Course Type: Programme Core (PC)  
Pre-requisites: EEPC12  
No. of Credits: 4

Course Objectives:

This course provides a basic understanding of AC machinery fundamentals, machine parts and helps to gain the skills for operating AC machines. The course also equips students with ability to understand and analyse the phasor diagrams and equivalent circuits of AC Induction and Synchronous Machines.

Course Content:


Synchronous motors - Synchronous machines on infinite bus bars - phasor diagram - V and inverted-V curves - Hunting and its suppression - starting methods.


Text Books:


Reference Books:


COURSE OUTCOMES:

Upon completion of the course, the students will be able to

1. Understand the constructional details and principle of operation of AC Induction and Synchronous Machines.
2. Understand and appraise the principle of operation and performance of single-phase induction motors and other special motors.
3. Analyze the performance of the AC Induction and Synchronous Machines using the phasor diagrams and equivalent circuits.
4. Select appropriate AC machine for any application and appraise its significance.
EEPC16 - ANALOG ELECTRONIC CIRCUITS

Course Type: Programme Core (PC)  Pre-requisites: EEPC13
No. of Credits: 4

Course Objectives:
To give a comprehensive exposure to all types of amplifiers and oscillators constructed with discrete components such as BJTs and FETs. This helps to develop a strong basis for building linear and digital integrated circuits.

Course Content:
Small signal amplifiers - biasing circuits of BJT and FET transistors, analysis and design of BJT and FET amplifiers, chopper stabilized amplifiers, case studies – application of current amplifiers in SCR firing circuits and power supplies.

Large signal amplifiers – analysis and design of class A and class B power amplifiers, class C and class D amplifiers, thermal considerations, tuned amplifiers.

Feedback amplifiers – gain with feedback – effect of feedback on gain stability, distortion, bandwidth, input and output impedances; topologies of feedback amplifiers, case studies – application of negative feedback in dc-dc converters.


Text Books:

Reference Books:

COURSE OUTCOMES:
Upon completion of the course, the student will be able to
1. Understand the working of different types of amplifier, oscillator and multivibrator circuits.
2. Design BJT and FET amplifier and oscillator circuits.
3. Analyze transistorized amplifier and oscillator circuits.
4. Understand the applications of different types of amplifier, oscillator, attenuators and multivibrator circuits.
EEPC17 - TRANSMISSION AND DISTRIBUTION OF ELECTRICAL ENERGY

Course Type: Programme Core (PC)  Pre-requisites: EEPC10
No. of Credits: 4

Course Objectives:

- Identify major components of power transmission and distribution systems.
- Describe the principle of operation of transmission and distribution equipment.
- Know and appreciate the key factors in transmission and distribution system equipment specification and network design.

Course Content:


Text Books:


Reference Books:


COURSE OUTCOMES:

Upon completion of the course, the student will

1. Understand the major components of Transmission and Distribution Systems (TDS) and its practical significance.
2. Have good Knowledge of various equipment specifications and design for TDS.
3. Have awareness of latest technologies in the field of electrical transmission and distribution.
EEPC18 - POWER SYSTEM ANALYSIS

Course Type: Programme Core (PC)  
Pre-requisites: MAIR32, EEPC11  
No. of Credits: 4

Course Objectives:
To model various power system components and carry out load flow, short-circuit and stability studies.

Course Content:
Modeling of power system components – single line diagram – per unit quantities– bus impedance and admittance matrix.


Fault studies – Symmetrical fault analysis, Analysis through impedance matrix, Current limiting reactors.

Fault analysis - Unsymmetrical short circuit analysis - LG, LL, LLG; Fault parameter calculations – Open circuit faults.


Text Books:

Reference Books:

COURSE OUTCOMES:
Upon completion of the course, the student will be able to
1. Carry out load flow study of a practical system.
2. Simulate and analyze fault.
3. Study the stability of power systems.
EEPC19 - POWER ELECTRONICS

Course Type:  Programme Core (PC)  Pre-requisites:  MAIR32, EEPC10
No. of Credits:  4 & EEPC13

Course Objectives:
This course aims to equip the students with a basic understanding of modern power semiconductor devices, various important topologies of power converter circuits for specific types of applications. The course also equips students with an ability to understand and analyze non-linear circuits involving power electronic converters.

Course Content:
Power Semiconductor Devices –power diodes, power transistors, SCRs, TRIAC, GTO, power MOSFETs, IGBTs-Principles of operation, characteristics, ratings, protection and gate drive circuits.

Controlled rectifiers- single- phase and three-phase- power factor improvement - dual converters.

DC-DC converters- Buck, Boost, Buck-Boost- with circuit configuration and analysis.

DC-AC converters- single-phase/three-phase, VSI, CSI, frequency and voltage control.

AC-AC converters- single/three-phase controllers, phase control, PWM AC voltage controller, Principle of ON-OFF control and cyclo-converters.

Text Books:

Reference Books:

COURSE OUTCOMES:
Upon completion of the course, the student will be able to
1. Understand the principle of operation of commonly employed power electronic converters.
2. Analyze non-linear circuits with several power electronic switches.
3. Equipped to take up advanced courses in Power Electronics and its application areas.
Course Type: Programme Core (PC)  
Pre-requisites: MAIR32  
No. of Credits: 4

Course Objectives:  
To equip the students with the fundamental concepts in control systems.

Course Content:  
Modelling of physical systems: Electrical systems - Electromechanical systems – Mechanical systems – Thermal systems.


Root Locus Technique: Definitions - Root locus diagram - Rules to construct root loci - Effect of pole-zero additions on the root loci.

Frequency domain analysis: Bode plot - Polar plot - Nyquist plot - phase-margin - gain margin - Nyquist stability criterion.

Controller design: Design of P, PI, PID, lag, lead, lead-lag compensator design.

Text Books:  

Reference Books:  

COURSE OUTCOMES:  
Upon completion of the course, the student will be able to  
1. Understand the concepts of closed loop control systems.  
2. Analyze the stability of closed loop systems.  
3. Apply the control techniques to any electrical systems.  
4. Design the classical controllers such as P, PI, etc., for electrical systems.
EEPC21 - LINEAR INTEGRATED CIRCUITS

Course Type: Programme Core (PC)  
No. of Credits: 3  
Pre-requisites: EEPC10

Course Objectives:
To provide in-depth instructions on the characteristics and applications of operational amplifiers, timers and voltage regulators.

Course Content:
- Oscillators, sine wave, square wave, triangular wave, saw tooth wave generation, Schmitt trigger, window detector.
- Analog-to-digital, digital-to-analog, sample and hold circuits; voltage controlled oscillator, phase locked loop – operating principles, applications of PLL.
- IC555 Timer, monostable and astable modes of operation; voltage regulators - fixed voltage regulators, adjustable voltage regulators - switching regulators.

Text Books:

Reference Books:

COURSE OUTCOMES:
Upon completion of this course, students will be able to
1. Describe the various ideal and practical characteristics of an OPAMP.
2. Develop simple OPAMP based circuits.
3. Implement various analog signal processing circuits.
4. Analyze and design various types of ADCs and DACs.
5. Analyze and construct various application circuits using 555 timer.
EEPC22 – MICROPROCESSORS AND MICROCONTROLLERS

Course Type: Programme Core (PC)
Pre-requisites: EEPC14
No. of Credits: 3

Course Objectives:
To gain knowledge on the architecture of 8085 microprocessors and 8051 micro controller, their programming and associated peripheral interface devices.

Course Content:
8-Bit Microprocessor - 8085 architecture and memory interfacing (RAM & ROM), interfacing I/O devices - instruction set - addressing modes - assembly language programming – interrupts - timing diagram.

8051 Microcontroller - Intel 8051 architecture, memory organization, flags, stack, and special function registers, I/O, ports - connecting external memory, counters and timers, serial data I/O, Interrupts.

Microcontroller instructions - addressing modes, moving data, logical operations, arithmetic operations, jump and call instructions – subroutines - Interrupts and returns.

Microcontroller programming – Assembly Language Programming, timer and counter programming, connection to RS 232 and RS 485, Interrupt programming.

Peripherals and interfacing - Serial and parallel I/O (8251 and 8255), Programmable DMA controller, Programmable interrupt controller, ADC/DAC interfacing.

Text Books:

Reference Books:

COURSE OUTCOMES:
Upon completion of the course, the student will be able to

1. Have a clear understanding of the architecture and instruction set of 8085 and 8051.
2. Be able to interface peripherals and memories with 8085 and 8051.
3. Be able to understand the application of 8085 and 8051 in waveform generators.
**EEPC23 - MEASUREMENTS AND INSTRUMENTATION**

**Course Type:** Programme Core (PC)  
**Pre-requisites:** EEPC21  
**No. of Credits:** 3

**Course Objectives:**
To understand the basic operation of different measuring instruments and thereby able to choose appropriate instruments for measuring different parameters.

**Course Content:**

**Text Books:**

**Reference Books:**

**COURSE OUTCOMES:**
Upon completion of the course, the student will be able to
1. Describe the working principle of different measuring instruments.
2. Choose appropriate measuring instruments for measuring various parameters in their laboratory courses.
3. Correlate the significance of different measuring instruments, recorders and oscilloscopes.
4. Develop a micro-processor based measuring unit for any practical application.
EEPC24 - POWER SYSTEM PROTECTION AND SWITCHGEAR

Course Type: Programme Core (PC)  Pre-requisites: EEPC18
No. of Credits: 4

Course Objectives:
To give a broad coverage on all types of protective relays, circuit breakers and provide a strong background for working in a practical power system protection.

Course Content:
Relays – General classification, Principle of operation, types, characteristics, Torque equation, Relaying Schemes, Relay Co-ordination.


Introduction to substation architecture, automation and protection - Protection against over voltages – Causes of over voltage, Ground wires, Surge absorbers and diverters. Earthing - types. Insulation co-ordination.

Theory of arcing and arc quenching circuit breakers-types – rating and comparison, RRRV, Resistor switching and capacitor switching.


Text Books:

Reference Books:

COURSE OUTCOMES:
Upon completion of the course, the student will be able to
1. Classify and describe the working of various relaying schemes.
2. Identify and implement an appropriate relaying scheme for different power apparatus.
3. Illustrate the function of various CBs and related switching issues.
4. Describe the causes of overvoltage and protection against overvoltage.
ESSENTIAL LABORATORY REQUIREMENT
EELR10 - CIRCUITS AND DIGITAL LABORATORY

Course Type: Essential Laboratory Requirement (ELR)  Co-requisites: EEPC10
No. of Credits: 2

Course Objectives:

- To understand and analyze the basic theorems of Circuit theory
- Understand and analyze series & parallel circuits and measurement of single and three-phase power.
- Understand and analyze different applications of diode and characteristics of Transistor.
- Understand the basics of digital design

List of Experiments

- Characteristics of CB and CE configuration of BJT.
- I-V Characteristics of p-channel and n-channel MOSFET.
- Verification of Thevenin and Maximum Power Transfer Theorem.
- Verification of Superposition Theorem.
- Verification of Kirchhoff’s Current and Voltage law.
- Transient characteristics of R-L series circuit.
- Transient characteristics of R-C series circuit.
- Transient characteristics of R-L-C series circuit.

- Design of combinatorial logic circuits
- Design of synchronous sequential logic circuits
- Design of asynchronous sequential logic circuits

Mini-Project

COURSE OUTCOMES:

Upon completion of the course, the students will be able to

1. Verify the network theorems and operation of typical electrical and electronic circuits.

2. Choose the appropriate equipment for measuring electrical quantities and verify the same for different circuits.

3. Prepare the technical report on the experiments carried.

4. Design basic digital logic circuits
Course Type: Essential Laboratory Requirement (ELR)  
No. of Credits: 2

Course Objectives:
The main objective of the course is to give the students an insight into the constructional details of dc machines and transformers with a view for better understanding of their working principles. The course also equips the students to test and evaluate the performance of various dc machines and Single-phase transformers by conducting appropriate experiments.

List of Experiments
A demonstration of the static and rotational electrical machines (constructional details) is ought to be done in an introductory class.

- Open circuit and load characteristics of DC shunt/compound generator
- Swinburne's test and Speed control of DC shunt motor
- Load test on DC shunt motor
- Load test on DC series motor
- Open circuit and short circuit test on single-phase transformer
- Sumpner's test
- Parallel operation of single-phase transformer
- Electrical braking in DC shunt motor
- Three-phase transformer connections

Mini-Project

COURSE OUTCOMES:
Upon completion of the course, the student will be able to

1. Interpret the constructional details of the DC machines and Transformers and also understand the significance of different connections of three-phase transformers.
2. Estimate or test the performance of any DC machine (shunt, series or compound) and single-phase transformer, by conducting suitable experiments and report the results.
3. Experiment and analyze the various speed control and braking techniques for DC motors.
4. Develop simulation models and prototype modules in view of implementing any control technique upon dc motors and single-phase transformers for various applications.
Course Type: Essential Laboratory Requirement (ELR)  
Co-requisites: EEPC13  
No. of Credits: 2

Course Objectives:

Design of amplifiers and other electronic systems to satisfy specifications.

List of Experiments

- Frequency analysis of Common Emitter amplifier.
- Measurement of input/output impedance of Common Collector amplifier.
- Design and verification of characteristics of RC oscillators.
- Design and characterization of Monostable multivibrator.
- Design and characterization of Astable multivibrator.
- Characteristics of UJT and applications of UJT oscillator.
- Frequency analysis of FET Amplifier.
- Frequency response of series voltage negative feedback Amplifier.
- Square waveform generation using transistor based Schmitt trigger.
- Design and characterization of Bistable Multivibrator.

Mini-Project.

COURSE OUTCOMES:

Upon completion of the course, the students will be able to

1. Design a complete electronic circuit using a top-down approach which starts from specifications.
2. Design and analyze electronic circuits using BJT and FET.
3. Design and characterization of electronic circuits using UJT.
5. Prepare the technical report and provide solutions to real time problems.
**EELR13 - SYNCHRONOUS AND INDUCTION MACHINES LABORATORY**

**Course Type:** Essential Laboratory Requirement (ELR)  
**No. of Credits:** 2  
**Co-requisites:** EEPC15

**Course Objectives:**

The main objective of the course is to give the students an insight into the constructional details of the induction and synchronous machines with a view for better understanding of their working principles. The course also equips the students to test and evaluate the performance of induction and synchronous machines by conducting appropriate experiments.

**List of Experiments**

A demonstration of the static and rotational electrical machines (constructional details) is ought to be done in an introductory class.

- Load test on three-phase induction motor
- No-load and blocked rotor test on three-phase induction motor
- Load test on grid connected induction generator
- Load test on self-excited induction generator
- Load test on single-phase induction motor
- Regulation of three-phase alternator by E.M.F and M.M.F methods
- Load test on three-phase alternator
- Synchronization of three-phase alternator with infinite bus bar
- V and inverted V-curves of synchronous motor
- Speed Control on three-phase induction motor

**Mini-project**

**COURSE OUTCOMES:**

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

1. Estimate or test the performance of induction and synchronous machines by conducting suitable experiments and report the results.

2. Experiment and analyze the speed control techniques for three-phase induction motors.

3. Evaluate the different modes of operating the induction generators and justify their usage in wind power generation.

4. Experiment synchronization of alternators and power exchange with the grid to get convinced with their usage at conventional power generation stations.

5. Develop simulation models and prototype modules in view of implementing any control technique upon Single-phase and three-phase induction motors for various applications.
EELR14 - INTEGRATED CIRCUITS LABORATORY

Course Type: Essential Laboratory Requirement (ELR)  
Co-requisite: EEPC21  
No. of Credits: 2

Course Objectives:

To enrich the students’ knowledge on practical circuit design using analog and digital ICs.

List of Experiments

- Understanding of Op-Amp Imperfections
- Linear Applications of Op-Amp
- Non-Linear Applications of Op-Amp
- Design of Active filters using Op-Amp
- Analog-to-Digital Conversion
- Digital-to-Analog conversion
- Timing circuits using 555 Timer
- Combinational and Sequential logic circuits
- Design of Code converter with seven-segment display

Mini-Project

COURSE OUTCOMES:

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

2. Analyze and prepare the technical report on the experiments carried out.
3. Design application-oriented circuits using Op-amp and 555 timer ICs.
4. Create and demonstrate live project using ICs.
EELR15 - POWER ELECTRONICS LABORATORY

Course Type: Essential Laboratory Requirement (ELR)  
Co-requisites: EEPC19  
No. of Credits: 2

Course Objectives:
To enable the students to develop hands-on experience in analyzing, designing and carrying out experiments on various electrical networks by make use of power electronic components. It aims to familiarize the switching devices, power converters and their applications in various systems for power control.

List of Experiments

- Characteristics of SCR, IGBT, MOSFET
- Single-phase Fully Controlled SCR Converter
- Buck Converter using MOSFET
- Boost Converter using MOSFET
- Buck-Boost Converter using IGBT
- Single-phase Inverter using IGBT
- Single-phase step-down Cyclo-converter
- Speed Control of single-phase A.C Motor
- Single-phase Half Controlled SCR Converter
- Illumination Control of Lamp
- Speed Control of single-phase Capacitor Run Induction Motor Mini-Project

COURSE OUTCOMES:

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

1. Understand the characteristics of various switching devices and appreciate its applications in various electrical networks/systems.
2. Analyze and design the operation of power switching converters.
3. Develop practical control circuits for various real time applications.
4. Analyze and prepare the technical report on the experiments carried out.
EELR16 – MICRO-CONTROLLER LABORATORY

Course Type: Essential Laboratory Requirement (ELR)  Co-requisites: EEPC22
No. of Credits: 2

Course Objectives:
To train the students to use micro-controller for computational and logical applications. Also, this course prepares the students to provide solutions to real-time problems.

List of Experiments

1. An assembly language program to add, subtract, multiply and divide.
2. An assembly language program to generate 10 KHz square wave.
3. Study and interface display devices like LCD, LED and 7-Segment display.
4. Study of implementation of steeper motor angle control.
5. Study of implementation of DC Motor control using PWM method.
7. Study of Programming and Transmission and Reception of data through serial port.
8. To study implementation and programming of Pressure measurement.
9. To study implementation and programming of Temperature measurement.

COURSE OUTCOMES:
Upon completion of the course, the student will be able to

1. Accomplish arithmetic and logical operations with micro-controllers.
2. Generate firing pulses for various control applications related to electrical machines and power electronics.
3. Illustrate various interfacing techniques related to real-time applications using micro-controllers.
4. Design and implement control circuitry using micro-controllers for any engineering and real world problems.
EELR17 - POWER SYSTEMS LABORATORY

Course Type: Essential Laboratory Requirement (ELR)  Co-requisites: EEPC18
No. of Credits: 2

Course Objectives:
To enhance the analyzing and problem solving skills of the students in the area of power system and power electronics through computer programming and simulation.

List of Experiments

- Real and Reactive Power Computation
- Transmission Line Parameter Calculation
- Bus Admittance Matrix Formulation
- Load Flow Analysis
- Z-bus Formation
- Symmetrical Fault Analysis
- Unsymmetrical Fault Analysis

Mini-Project

COURSE OUTCOMES:
Upon completion of the course, the student will be able to
1. Develop computer programs for power system studies.
2. Design, simulate and analyze power electronics circuits using simulation packages.
3. Prepare laboratory reports that clearly communicate experimental information in a logical and scientific manner.
ELECTIVES
EEPE10 – POWER GENERATION SYSTEMS

Course Type: Programme Elective (PE) Pre-requisites: --
No. of Credits: 3

Course Objectives:
To understand the working of different types of power generation systems and to realize the necessity for interconnected operation of different power stations.

Course Content:
Hydro-electric power plants – selection of site, elements of power plant, classification, water turbines, governor action, hydro-electric generator, plant layout, pumped storage plants.

Thermal steam power plants – selection of site, elements and operational circuits of the power plant, turbo-alternators, plant layout, steam turbines, controls and auxiliaries.

Nuclear power plants – selection of site, nuclear reaction – fission process and chain reaction, constituents of power plant and layout, nuclear reactor – working, classification, control, shielding and waste disposal.

Renewable power plants – Solar power generation – Photo-voltaic and solar thermal generation – solar concentrators, Wind power generation – types of wind mills, wind generators, tidal, biomass, geothermal and magneto-hydro dynamic power generation, micro-hydel power plants, fuel cells and diesel and gas power plants

Combined operation of power plants – plant selection, choice of size and number of generator units, interconnected systems, real and reactive power exchange among interconnected systems. Major electrical equipment in power plants, DC systems in power plants, station control - switch yard and control room. Economic considerations – types of costs, tariff and consumers.

Text Books:

Reference Books:

COURSE OUTCOMES:
Upon completion of the course, the student will be able to
1. Appreciate the different types of tariff, consumers and different types of power generation plants.
2. Determine the significance of various components of the power generation plants.
3. Correlate the importance of interconnected operation of different power generation systems.
4. Plan an appropriate scheduling of electric power to satisfy the demand constraint.
EEPE11 / EEOE10 – ELECTRICAL SAFETY

Course Type:  Program Elective (PE) / Open Elective (OE)  Pre-requisites:  -

No. of Credits:  3

Course Objectives:

To provide a comprehensive exposure to electrical hazards, various grounding techniques, safety procedures and various electrical maintenance techniques.

Course Content:

Primary and secondary hazards- arc, blast, shocks-causes and effects-safety equipment- flash and thermal protection, head and eye protection-rubber insulating equipment, hot sticks, insulated tools, barriers and signs, safety tags, locking devices- voltage measuring instruments- proximity and contact testers-safety electrical one line diagram- electrician’s safety kit.

General requirements for grounding and bonding- definitions- grounding of electrical equipment- bonding of electrically conducting materials and other equipment-connection of grounding and bonding equipment-system grounding- purpose of system grounding- grounding electrode system- grounding conductor connection to electrodes-use of grounded circuit conductor for grounding equipment- grounding of low voltage and high voltage systems.

The six step safety methods- pre job briefings - hot-work decision tree-safe switching of power system-lockout-tag out- flash hazard calculation and approach distances- calculating the required level of arc protection-safety equipment, procedure for low, medium and high voltage systems- the one minute safety audit

Electrical safety programme structure, development- company safety team- safety policy- programme implementation- employee electrical safety teams- safety meetings- safety audit- accident prevention- first aid- rescue techniques-accident investigation

Safety related case for electrical maintenance- reliability centered maintenance (RCM) - eight step maintenance programme- frequency of maintenance- maintenance requirement for specific equipment and location- regulatory bodies- national electrical safety code- standard for electrical safety in workplace- occupational safety and health administration standards, Indian Electricity Acts related to Electrical Safety.

Text Books:


Reference Books:


COURSE OUTCOMES:

Upon completion of the course, the students would be able to

1. Describe electrical hazards and safety equipment.
2. Analyze and apply various grounding and bonding techniques.
3. Select appropriate safety method for low, medium and high voltage equipment.
4. Participate in a safety team.
5. Carry out proper maintenance of electrical equipment by understanding various standards.
**Course Type:** Programme Elective (PE)

**No. of Credits:** 3

**Pre-requisites:** Concepts and principles dealing with conservation laws, fluid properties, thermodynamic aspects of fluid flow, Basic knowledge of mathematics.

**Course Objectives:**

- To achieve an understanding of the principles of thermodynamics and to be able to use it in accounting for the bulk behavior of simple physical systems.
- To provide in-depth study of thermodynamic properties of various working fluids.
- To enlighten the basic concepts of energy interacting devices through various thermodynamic cycles.
- To provide basic awareness about fluid behaviour under rest and dynamic conditions.
- To impart knowledge about hydraulic machines.

**Course Content:**

Basic concepts: Thermodynamic equilibrium, quasi-static process, Temperature and zeroth law, work and heat interactions, properties of pure substances, phase equilibrium diagrams. First law for a cycle and a process, steady flow processes.


Otto, diesel and dual cycles, Brayton cycle with regeneration, inter-cooling reheat, Joule-Thompson effect, Rankine cycle, reheat and regenerative cycle, properties of ideal gas, Stirling and Ericson cycles.

Classification of fluids and their physical properties, Fluid statics, manometers, pressure on submerged bodies. Basics of fluid properties - Vapour Pressure – Pressure at a point its variation – Measurement with Piezo meter, manometers and gauges - Continuity equation in one dimension – Bernoulli’s equation – Venturi meters and Orifice meters.


**Reference Books:**

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

1. Understand the fundamentals of first and second laws of thermodynamics and their application to a wide range of systems.
2. Familiarize with calculations of the efficiencies of heat engines and other engineering devices.
3. Familiarize the construction and principles governing the form of simple and complex one-component phase diagrams such as pressure-temperature, volume-temperature & and pressure-volume and the steam tables in the analysis of engineering devices and systems.
4. Calculate various fluid flow parameters.

Determine the optimum working conditions for hydraulic machines

* Will be offered by the Department of Mechanical Engineering.
Course Type: Programme Elective (PE) / Open Elective (OE)  
Pre-requisites: --
No. of Credits: 3

Course Objectives:

- This course aims to expose students to the fundamental principles of fuzzy logic systems.
- Enable the students to apply fuzzy logic concepts to existing and new applications.

Course Content:

Different faces of imprecision – inexactness, ambiguity, undecidability, Fuzziness and certainty, Fuzzy sets and crisp sets.

Intersection of Fuzzy sets, Union of Fuzzy sets - the complement of Fuzzy sets-Fuzzy reasoning.

Linguistic variables, Fuzzy propositions, Fuzzy compositional rules of inference- Methods of decompositions and defuzzification.

Methodology of fuzzy design- Direct & Indirect methods with single and multiple experts, Applications–Fuzzy controllers – Control and Estimation.

Genetic Algorithms- basic structure-coding steps of GA, convergence characteristics, applications.

Text Books:


Reference Books:


COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

1. Understand the fundamentals of Fuzzy logic theory.
2. Employ fuzzy logic principles to existing engineering applications and compare the results with existing methods.
3. Design Fuzzy logic Systems for engineering applications.
**EEPE14 – INDUSTRIAL AUTOMATION**

**Course Type:** Programme Elective (PE)  
**No. of Credits:** 3

**Pre-requisites:** --

**Course Objectives:**

The contents aim to develop the knowledge of the student in the field of automation in industries. This will be compromising knowledge of PLC, DCS and SCADA systems. They will also get familiar with different industrial standard protocols.

**Course Content :**


*Programmable Logic Controller:* Evaluation of PLC, PLC Architecture, Basic Structure. PLC Programming: Ladder Diagram – Ladder diagram symbols, Ladder diagram circuits. PLC Communications and Networking, PLC Selection: I/O quantity and Type, Memory size and type, Programmer Units. PLC Installation, Advantages of using PLCs.

*Distributed Control System:* Introduction, Overview of Distributed Control System, DCS Software configuration, DCS Communication, DCS Supervisory Computer Tasks, DCS Integration with PLCs and Computers, Features of DCS, Advantages of DCS.

**Text Books:**


**Reference Books:**


**COURSE OUTCOMES:**

Upon completion of the course, students will be able to:

1. Implement low cost automation systems using pneumatic and electrical means.  
2. Learn about the modern techniques and devices used for the monitoring and control of manufacturing systems including programming of programmable logic controllers and their interfacing with various sensors and actuators.  
3. Design automated assembly system for industrial applications.
**Course Type:** Programme Elective (PE)  
**Pre-requisites:** EEPC10  
**No. of Credits:** 3

**Course Objectives:**

To dispense an overview of various generation, measurement and testing methodologies of high DC and AC voltages and currents and also to edify the background of various breakdowns.

**Course Content:**

Causes and types of over voltages, effects of over voltages on power system components, Surge diveters, EMI and EMC protection against over voltages; Insulation coordination.

Generation of high AC, DC, impulse and switching voltages; Generation of high impulse currents.

Measurement of high AC, DC, impulse voltages using sphere gaps, peak voltmeters, potential dividers, High speed CRO and digital techniques. Measurement of high currents.

Dielectric breakdown - break down in gases, liquids and solids; partial discharges and corona discharges.

High Voltage Testing- testing of circuit breakers, insulators, bushings and surge diveters. Standards and specifications.

**Text books:**


**COURSE OUTCOMES:**

Upon completion of the course, the students will be able to

1. Describe the causes and types of overvoltage.
2. Illustrate different methods of generating and measuring various high voltages and currents.
3. Explain various breakdown phenomena occurring in gaseous, liquid and solid dielectrics.
4. Identify appropriate testing method(s) for various high voltage apparatus.
Course Type: Programme Elective (PE)
No. of Credits: 3

Pre-requisites: EEPC14

Course Objectives:
This course will render the basic structure of computers, their control design, memory organizations and an introduction to parallel processing.

Course Content:

Control Design - Hardwired control- design - multiplier control unit - CPU control unit and Micro programmed control – microinstructions - Sequencing - prefecting.

Arithmetic and Logic Unit-Fixed point and floating point numbers and operations. Design of arithmetic units.

Memories - cache memories - virtual memories. Input-Output Organization - Data transfer-synchronization-Interrupt handling-I/O interfaces

Introduction to parallel processing- Generation of computer systems – Parallelism in uniprocessor system – Parallel computer structures- architectural classification schemes.

Text Books:

Reference Books:

COURSE OUTCOMES:
Upon completion of this course, students will

1. Describe the general architecture of computers.
2. Be familiar with the history and development of modern computers, the Von Neumann architecture and functional units of the processor such as the register file and arithmetic logical unit.
3. Understand the major components of a computer including CPU, memory, I/O and storage, how computer hardware has evolved to meet the needs of multi-processing systems, the uses for cache memory, parallelism both in terms of a single processor and multiple processors.
4. Design principles in instruction set design including RISC architectures.
5. Analyze and design computer hardware components.
Course Type: Programme Elective (PE)  
No. of Credits: 3  
Pre-requisites: EEPC14

Course Objectives:
To impart the concepts of Digital systems and hardware description languages.

Course Content:
Finite State machines - Mealy and Moore, state assignments, design and examples – Asynchronous finite state machines – design and examples – multi-input system controller design.

Programmable Devices: Simple and Complex Programmable logic devices (SPLD and CPLDs), Field Programmable Gate Arrays (FPGAs), Internal components of FPGA, Case study: A CPLD and a 10 million gates type of FPGA.


Fault classes and models – Stuck at faults, Bridging faults - Transition and Intermittent faults. Fault Diagnosis of combination circuits by conventional methods - Path sensitization technique - Boolean different method and Kohavi algorithm.

Text Books:

Reference Books:

COURSE OUTCOMES:
On completion of the course the students would be able to
1. Understand the insights of the finite state machines.
2. Appreciate and classify the programmable logic devices and FPGA.
3. Design the logic circuits using VHDL.
4. Develop the systems using Verilog HDL.
5. Test the circuits for different faults.
Course Type: Programme Elective (PE)  
No. of Credits: 3  

Course Objectives:  
To explore the basic concepts of digital signal processing in a simple and easy-to-understand manner.

Course Content:  
Linearity shift - invariance - Unit sample response characterization – Convolution summation, causality, linear difference equations with constant coefficients and their solution using Z-transform – System function concept.


Architecture and features of signal processor and motion controller.

Text Books:  

Reference Books:  

COURSE OUTCOMES:  
Upon completion of the course, the student will be able to  
1. Understand the operations on digital signals.  
2. Analyze the signal processing concepts.  
3. Design the systems required for digital signal processing.
Course Type: Programme Elective (PE) / Open Elective (OE)  
Pre-requisites*: MAIR32
No. of Credits: 3

Course Objectives:
To learn the fundamentals of ANN and its application to electrical systems.

Course Content:
- Introduction to Neural Networks - Biological Inspiration - Biological Neural Networks to Artificial Neural Networks – Classification of ANN Networks – Development of neural network models – Perceptron Network – Linear Separability.
- Adaline Network – Madaline Network – Back propagation Neural Networks – Kohenen Neural Network – Learning Vector Quantization – Hamming Neural Network-applications
- Adaptive Resonance Theory Neural Networks – Boltzmann Machine Neural Networks – Radial Basis Function Neural Networks – Bi-directional Associative Memory-applications
- Hopfield Neural Networks – Support Vector Machines – Introduction to Spiking Neural Networks – Spike Neuron Models – Hybrid Neural Networks-applications
- Deep Neural Networks- Recurrent Neural Networks- Backpropagation through time (BPTT)- Vanishing and Exploding Gradients- Truncated BPTT-LSTM (Long Short Term Memory) -Bilinear LSTM- Gated Recurrent Units-applications

Text Books:

Reference Books:

COURSE OUTCOMES:
Upon completion of the course, students will be able to
1. Describe the development of artificial neural networks (ANN) and classify various ANN models.
2. Solve and design various ANN models.
3. Apply and construct ANN models to various applications of electrical systems.
**EEPE20 – DESIGN OF ELECTRICAL APPARATUS**

**Course Type:** Programme Elective (PE)  
**Pre-requisites:** EEPC15  
**No. of Credits:** 3

**Course Objectives:**
This course offers the preliminary instructions and techniques to design the main dimensions and other major part of the transformer and DC and AC rotating machines. The course also provides the students with an ability to understand the step by step procedure for the complete design of electrical machines.

**Course Content:**
General concepts in the design of rotating machines-output equation-Magnetic and electric loadings-Common design features of all rotating machines-Conducting, insulating and magnetic materials used in electrical apparatus - mmf calculation for the magnetic circuit of rotating machines-Leakage reactance calculation.

Armature winding –output equation-Choice of specific loadings-Choice of poles-design of conductors, winding, slot, air gap, field poles and field coils, commutator and brush-Predetermination of efficiency, temperature rise and open circuit characteristics from design data (qualitative treatment only).

Output equation-Design of core and coils for single phase and three phase transformers-Design of tank and cooling tubes-Predetermination of circuit parameters, magnetising current, losses, efficiency, temperature rise and regulation from design data (qualitative treatment only).

Output equation-Choice of specific loadings-Design of stator-Design of squirrel cage and slip ring rotors-Stator and rotor winding designs-Predetermination of circuit parameters, magnetising current, efficiency and temperature rise from design data (qualitative treatment only).

Constructional features of synchronous machines-SCR-Output equation-specific loadings-Main dimensions-Stator design-Design of salient pole field coil.

**Text Books:**

**Reference Books:**

**COURSE OUTCOMES:**
Upon completion of the course, the student will be
1. Able to understand the design of main dimensions and other major part of the transformer and DC and AC rotating machines.
2. Capable of evaluating the procedure for the design of main dimensions and other major part of the transformer and DC and AC rotating machines.
3. Equipped to apply in-depth knowledge related to the design of electrical machines.
EEPE21 – UTILIZATION OF ELECTRICAL ENERGY

Course Type: Programme Elective (PE)  
Pre-requisites: EEPC15
No. of Credits: 3

Course Objectives:
To design illumination systems, choose appropriate motors for any drive application, to debug a domestic refrigerator circuit and to design battery charging circuitry for specific applications.

Course Content:


Traction system – power supply, traction drives, electric braking, tractive effort calculations and speed-time characteristics. Locomotives and train - recent trend in electric traction.

Text Books:

Reference Books:

COURSE OUTCOMES:
Upon completion of the course the students would be able to
1. Develop a clear idea on various illumination techniques and hence design lighting scheme for specific applications.
2. Identify an appropriate method of heating for any particular industrial application.
3. Evaluate domestic wiring connection and debug any faults occurred.
4. Construct an electric connection for any domestic appliance like refrigerator as well as to design a battery charging circuit for a specific household application.
5. Realize appropriate type of electric supply system and to evaluate the performance of traction unit.
EEPE22 – COMPUTER NETWORKS

Course Type: Programme Elective (PE)  
Pre-requisites: -  
No. of Credits: 3

Course Objectives:
To know about different network architectures and network protocols, data communications and different IEEE standards.

Course Content:
Introduction - Architecture, Network hardware and software. Physical layer- Guided transmission media - Cable television.

Data Link Layer –Design issues–Channel allocation problem –Multiple access protocols - Ethernet – Wireless LAN -802.11architecture.

Network Layer - Design issues – Routing algorithms - Congestion control algorithms -Quality of Service – Internet working.


Text Books:

Reference Books:

COURSE OUTCOMES:
Upon completion of this course, students will be able to

1. Understand of the fundamental network issues.
2. Analyze the significance of the network layers and their functions.
3. Gain knowledge about the basic network protocols.
4. Have a basic understanding of TCP / IP.
Course Type: Programme Elective (PE) / Open Elective (OE) Pre-requisites*: EEPC20
No. of Credits: 3

Course Objectives:
Apply modern control techniques to electrical systems.

Course Content:
Modelling of physical system in state space format - Definition of state - Basic properties of state - transition matrix - solution to vector differential equation.

Concept of controllability and observability - Concept of stabilizability and detectability - Kalman decomposition.

Pole placement design of controller - Observer design - Stability of controller design based on the observer using separation principle.

Introduction to non-linear systems - Phase plane analysis - Multiple equilibrium points.


Text Books:

Reference books:

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
1. Understand the concepts of modern control theory using state-space approach.
2. Compare and analyse the classical control system with modern control system.
3. Develop advanced controllers to the existing system using modern control design techniques.

*Pre-requisite not required for registration as Open Elective
EEPE24 – FUNDAMENTALS OF FACTS

Course Type: Programme Elective (PE)  Pre-requisites: EEPC11, EEPC19
No. of Credits: 3

Course Objectives:
To familiarize the students with the basic concepts, different types, scope and applications of FACTS controllers in power transmission.

Course Content:
Fundamentals of ac power transmission, transmission problems and needs, emergence of FACTS-FACTS control considerations, FACTS controllers.

Principles of shunt compensation – Variable Impedance type & switching converter type- Static Synchronous Compensator (STATCOM) configuration, characteristics and control.

Principles of static series compensation using GCSC, TCSC and TSSC, applications, Static Synchronous Series Compensator (SSSC).

Principles of operation-Steady state model and characteristics of a static voltage regulators and phase shifters-power circuit configurations.

UPFC-Principles of operation and characteristics, independent active and reactive power flow control, comparison of UPFC with the controlled series compensators and phase shifters.

Text Books:

References:

COURSE OUTCOMES:
Upon completion of the course, the students shall be able to
1. Understand various Power flow control issues in transmission lines, for the purpose of identifying the scope and for selection of specific FACTS controllers.
2. Apply the concepts in solving problems of simple power systems with FACTS controllers.
3. Design simple FACTS controllers.
**EEPE25 – SPECIAL ELECTRICAL MACHINES**

**Course Type:** Programme Elective (PE)  
**No. of Credits:** 3  
**Pre-requisites:** EEPC15, EEPC19

**Course Objectives:**
To expose the students to the construction, principle of operation and performance of special electrical machines as an extension to the study of basic electrical machines.

**Course Content:**


**Text Books:**

**Reference Books:**

**COURSE OUTCOMES:**
Upon completion of the course the students would be able to understand the construction, principle of operation and performance of
1. Synchronous Reluctance motors
2. Stepping motors
3. Switched Reluctance motors
4. Permanent Magnet Brushless D.C. motors
5. Permanent Magnet Synchronous motors.
Course Objectives:
To familiarize the students with basics of solar and wind energy systems and various techniques for the conversion of solar and wind energy into electrical energy.

Course Content:
Basic characteristics of sunlight – solar spectrum – insolation specifics– irradiance and irradiation-
pyranometer – solar energy statics- Solar PV cell – I-V characteristics –P-V characteristics– fill factor-
Modeling of solar cell – maximum power point tracking.


Power electronic converters for interfacing wind electric generators – power quality issues-hybrid systems-
wind-diesel systems – wind-solar systems.

Text Books:

Reference Books:

COURSE OUTCOMES:
Upon completion of this course students will be able to
1. Describe the solar radiation, measurements and characteristics of solar PV cell.
2. Develop the model of a PV system and its applications.
3. Describe the basic types and mechanical characteristics and model of wind turbine.
4. Analyze the electrical characteristics and operation of various wind-driven electrical generators.
5. Understand various power electronic converters used for hybrid system.
EEPE27 – SOLID STATE DRIVES

Course Type: Programme Elective (PE)  
No. of Credits: 3  
Pre-requisites: EEPC15, EEPC19

Course Objectives:

- To understand the basic concept of DC and AC Drives.
- To understand the various control techniques involved with both DC and AC Drives.
- To brief about the working principle of Special Electrical Drives.

Course Content:

Introduction to solid state drives, various components – power converters, motors, loads, coupling mechanisms – Stability of drive.

Modeling of DC motor drives – Transfer function and state-space models - Experimental determination of drive parameters – Speed control using AC to DC converters- Input performance parameters, Speed reversal schemes.

Chopper fed DC motor drives – Four quadrant operation, Input filters design – Dynamic braking with DC chopper - Type-C chopper fed regenerative braking - Operation with non-receptive lines.

Power converters for induction motor speed control - Harmonic behavior of induction motors-harmonic currents and harmonic torques using per phase equivalent circuit – Stator voltage control schemes - Speed control of wound type motors.


Text Books:


Reference Books:


COURSE OUTCOMES:

Upon completion of this course, the student

1. Learns the fundamental concepts of power electronic converter fed DC and AC machines.
2. Can analyze the converter fed motor under different torque/speed conditions.
3. Will be able to design converter fed drives with existing/new control techniques.
EEPE28 – EMBEDDED SYSTEM DESIGN

Course Type: Programme Elective (PE)  
No. of Credits: 3  
Pre-requisites: EEPC22

Course Objectives:
To enable the learner to design a system with combination of hardware and software for a specific application.

Course Content:

Sensor and Actuator I/O – ADC, DAC, timers, Servos, Relays, stepper motors, H-Bridge, CODECs, FPGA, ASIC, diagnostic port.

Real time operating systems (RTOS) – real time kernel – OS tasks – task states – task scheduling – interrupt processing – clocking communication and synchronization – control blocks – memory requirements and control – kernel services.

Embedded Networks – Distributed Embedded Architecture – Hardware and Software Architectures, Networks for embedded systems– I2C, CAN Bus, Ethernet, Internet, Network-based design– Communication Analysis, system performance Analysis, Hardware platform design, Allocation and scheduling, Design Example: Elevator Controller.


Text Books:

Reference Books:

COURSE OUTCOMES:
Upon completion of this course, students will be able to
1. Remember the concepts of process and controllers.
2. Apply the concepts for real-time applications.
3. Create a real-time system for particular applications.
EEPE29 - POWER SYSTEM ECONOMICS AND CONTROL TECHNIQUES

Course Type: Programme Elective (PE)  Pre-requisites: EEPC20  EEPC18
No. of Credits: 3

Course Objectives:

- To understand the economics of power system operation and planning.
- To realize the requirements and methods of real and reactive power control in power system.
- To recognize the recent advancements in power system operation.

Course Content:

Load curves and forecasting – load factor, demand factor, diversity factor, capacity factor, utilization factor - Types of Electrical Tariff – Economic decision making in power system planning

Restructuring of power system – spot and derivative markets – economics of microgrids and distributed generation

Economic Dispatch and Unit Commitment - General problem formulation and constraints - Offer and locational marginal pricing based dispatch - Solution methods.

Load frequency control of single area and two area systems - Tie line bias control - Automatic Voltage Regulator and its dynamics

Reactive power and Voltage control – General concepts of series and shunt compensation – Introduction to FACTS

Text Books:

2. Steven Stoft, ‘Power system economics’, Wiley India, 2002

Reference Books:


COURSE OUTCOMES:

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

1. Calculate various factors such as load factor, demand factor, etc. and interpret different tariff and pricing structures.
2. Develop generation dispatching schemes for conventional and restructured power systems.
3. Apply frequency, voltage and reactive power control schemes on power system.
Course Type: Programme Elective (PE) / Open Elective (OE)  
Pre-requisites*: EEPE18

No. of Credits: 3

Course Objectives:
To learn the digital control design techniques.

Course Content:

ADC model-DAC model-Transfer function of zero order hold-DAC, Analog Subsystem, and ADC Combination Transfer Function-Closed loop transfer function- Steady state error and its constants (MATLAB commands).

Definitions of stability (Asymptotic stability, exponential stability etc) – stable z-domain pole placement locations-stability conditions-Stability determination (Routh array)-Nyquist criterion.

Root locus-root locus design (P-control, PI -control, PD) - Z-domain root locus- z-domain root locus design- digital implementation of analog controller design (differencing methods forward and backward)- bilinear transformation-direct z- domain controller design-frequency response design-Finite time response settling time.

Concept of state space method-state space representations of discrete time systems- solving discrete time state space equations- Pulse transfer function matrix- Discretization of continuous state space equations-Liapunov stability analysis (discrete time) Controllability – observability-design via pole placement-state observers.

Text Books:

Reference books:

COURSE OUTCOMES:
Upon completion of this course, the students can
1. Understand the fundamental differences between continuous time control and digital control.
2. Analyse the advantages of digital control over the continuous time control.
3. Develop digital controllers explicitly compared to continuous time controller.

*Pre-requisite not required for registration as Open Elective
EEPE31 - OPERATIONS RESEARCH*

Course Type: Programme Elective (PE)  
Pre-requisites: MAIR32
No.of Credits: 3

Course Objectives:
To equip students to identify and formulate real life problems using mathematical modeling; devise a solution procedure; analyze and interpret the results; revise for the process based on the actual results.

Course Content:

Sensitivity Analysis - Transportation and Assignment problems: Transportation problem – Assignment problem.

Integer programming and CPM-PERT: Gomory’s method – Branch and bound technique – Critical path in networks – CPM – Time and Cost aspects in networks – PERT.

Queueing Theory and Inventory models: Classification of queues – Poisson arrivals – Exponential service time – M/M/1 and M/M/c models – Inventory control – E.O.Q. with uniform demand, with finite rate of replenishment and with shortage – Buffer stock – Inventory with price breaks – Basic probabilistic models.

Dynamic programming: Recursive equation approach – applications to shortest path network, Inventory and production control – solution of LPP by dynamic programming - Travelling salesman problem.

Text Books:

Reference Books:

COURSE OUTCOMES:
Upon completing the course, the student will be able to
1. Increase the analytical skill of identifying and solving engineering problems.
2. Optimizing the resources and input-output process.
3. Devising new techniques for the better understanding of real-life situation.

*Will be offered by the Department of Mathematics.
Course Type: Programme Elective (PE)  
No.of Credits: 3  
Pre-requisites: -

Course Objectives:
The main objective of this course is to understand the basics of vehicle dynamics, drive train control, energy storage technology and vehicle design.

Course Content:
- Introduction to vehicle dynamics
- Fundamentals of vehicle propulsion and brake
- Dynamic equation of vehicle motion
- Vehicle Resistance
- Tire-Ground Adhesion
- Maximum tractive effort
- Power train tractive effort
- Vehicle power plant characteristics
- Transmission characteristics
- Vehicle Performance
- Gradeability
- Acceleration performance
- Brake performance

Basic components of electric vehicles
- Fundamentals of electric traction
- Basic architecture of electric drive trains
- Electric vehicle drive train topologies
- Configuration and power flow control of series, parallel and hybrid drive trains
- Power converters for electric vehicles

Electric vehicle storage technology
- Different types of batteries for electric vehicles
- Basic battery parameters
- Battery modeling and equivalent circuit
- Methods of electric vehicle battery charging
- Alternative energy sources
- Hydrogen storage systems
- Reformers
- Supercapacitors/Ultracapacitors
- Fuel cell powered vehicles
- Flywheel technology

Electric propulsion drive systems
- DC motor drives and control
- Induction motor drives and control
- Permanent magnet brushless DC motor drives and control
- AC and Switch reluctance motor drives and control
- Drive system efficiency

Design specifications
- Selection of motor and sizing
- Selection of power electronics components and sizing
- Inverter technology
- Design of battery pack and auxiliary energy storage system
- Design of ancillary systems
- EV recharging and refueling system design

Reference Books:
EEPE33/EOE24 - DESIGN THINKING

Course Type: Programme Elective (PE)/Open Elective
No.of Credits: 3

Pre-requisites: -

Course Objectives:
To understand the design philosophy of growth oriented business ideas by creative thinking.

Course Content :
Understanding human needs
Creating, Delivering and Sustaining values, empathy and understanding, opportunities.

Concept visualization
Methods and Mind sets – outcome formation – case studies

Strategies
Principles and framework, scalability, Assessing current stage, framing opportunities

Transformation
Enterprise innovation, preparing quests, competency mapping, team charters and articulation

Data Mining and Analysis
Data mining, soft data conversion, Creating human archetypes, experience mapping, creating activity systems

Reference Books:
1. Heather M.A. Fraser, Design Works, University of Toronto Press, 2012
2. Nigel Cross, Design Thinking, Bloomsbury Academic, 2016

COURSE OUTCOMES:
Upon completing the course, the student will be able to

1. Conceive need for an enterprise
2. Carry out strategic planning
3. Evolve methodology for innovative implementation
Course: EEPE34- MACHINE LEARNING AND DEEP LEARNING  

Type: Programme Elective (PE)  

Pre-requisites: MAIR32  

No.of Credits: 3  

Course Objectives:  

1. To get familiarize with the introduction to machine learning and deep learning  
2. To analyse and illustrate various categories of learning schemes  
3. To develop skills of solving practical applications  

Course Content:  

Introductions to Machine Learning: Categories, Supervised learning (SL), Classification, Regression-error based learning, examples, LMS, Logistic regression, Perceptron, Exponential family, Generative learning algorithms, Unsupervised Learning (USL), Application of USL for clustering-noise reduction-Dimensionality Reduction, Semi Supervised learning, Reinforced Learning –Genetic algorithm  

Classification and Clustering: k-means clustering, Binary Classification, Multi-Class, Classification Techniques, k-nearest neighbours, Support Vector Machines, Naïve Bayes Classifier-Gaussian based Naïve Bayes, Decision Trees-Binary and Bushy tree building process-Regression trees-Stopping criteria & pruning  

Introduction to neural network: Biological Neural networks- Perceptron Learning Algorithm, Linear Separability-Feedforward Networks: Multilayer Perceptron, Gradient Descent; Training Neural Network-validation and testing, Backpropagation neural networks, Empirical Risk Minimization, regularisation, autoencoders, model selection, and optimization  

Deep Neural Networks: Convolutional Neural networks, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet, Recurrent Neural Networks, Long Short-Term Memory, Gate Recurrent Unit, Deep Belief Network, Ensemble methods: Bagging, boosting, Evaluating and debugging learning algorithms  

ML and DL Applications: Control, Optimisation, Forecasting, Data mining, Pattern recognition, Deep learning tools, Recent trends.
Text Books:

Reference Books:
11. Pattern Recognition and Machine Learning, Christopher Bishop, 2007
13. NPTEL and IEEE Journals related to ML and DL.

COURSE OUTCOMES:

Upon completing the course, the student will be able to
1. Remember various types of machine learning and deep learning algorithms
2. Analyse various classification and Clustering methods in ML and DL
3. Apply ML and DL algorithms for solving practical applications related to electrical and electronics engineering
Course Objectives:
A unique course to explore the nano-electronic devices and its applications.

Course Content:
Limitations of conventional MOSFETS at Nano scales, introductory concepts of Ballistic transport and Quantum confinement, Difference in few electron devices (as analog version) and single Electron Devices (as digital version) of Nano Electronic devices, Quantum Effects in MOSFETS, Double – gate MOSFET, Multi- gate MOSFETs, FIN- FET.
Resonant Tunneling phenomena and applications in diodes & Transistors – principles of single electron Transistor – split- gate transistor, Electron wave Transistor, Electron – spin transistor, Quantum Oscillators, Quantum cellular Automata (QCA), Introduction to Quantum computing devices.
Carbon – Nano tube theory: Structure & nomenclature, Optical properties, Electronic structure of graphene, SW & MW CNTs, 1D quantization in nano tubes, CNTFETs, CNT memories, CNT based switches, Logic gates,
Overview, Characterization of switches and complex molecular devices, poly phenylene based molecular rectifying diode switches. Polymer electronics, self – assembling circuits, optical molecular memories technologies, Quantum mechanical Tunnel devices, Quantum Dots & Quantum wires.
Introduction to spintronics, principles & concepts, spintronic devices & applications, spin – filters, spin diodes, spin transistors.

Reference Books:
2) CNR Rao & A. Govindaraj, “Nano tubes & nano wires”, RSC publishing, 2005

COURSE OUTCOMES:
Upon completing the course, the student will be able to
1. To enrich the electronic device concepts and operation.
2. To understand the devices made for quantum electronics.
3. To appreciate the concepts of carbon nanotubes and its application to circuits.
4. To apply the nanoelectronics concepts for different applications
5. To enlighten the concepts of spintronics and its use in electronic device

* Will be offered by the Department of Electronics and Communication Engineering
**EEPE36 - COMMUNICATION SYSTEMS**

**Course Type:** Programme Elective (PE)  
**No. of Credits:** 3  
**Pre-requisites:** EEPC14, EEPC17

**Course Objectives:**

- To develop a fundamental understanding on communication systems with emphasis on analog and digital modulation techniques.
- To get introduced to the basics of error control coding techniques.

**Course Content:**


Sampling theorem - Pulse Modulation Techniques - PAM, PWM and PPM concepts - PCM system - Data transmission using analog carriers (BASK, BFSK, BPSK, QPSK).


Modern Communication Systems – Microwave communication systems - Optical communication system - Satellite communication system - Mobile communication system.

**Text Books:**


**Reference Books:**


**COURSE OUTCOMES:**

Upon completion of this course, students will be able to

1. Understand the basics of communication system, analog and digital modulation techniques.
2. Apply the knowledge of digital electronics and understand the error control coding techniques.
3. Summarize different types of communication systems and its requirements.

*Will be offered by the Department of Electronics and Communication Engineering*
Course Type: Programme Elective (PE)  
Pre-requisites: -  
No. of Credits: 3

Course Objectives:
To obtain knowledge on data structures, their storage representation and their usage in an algorithmic perspective.

Course Content:

Linear Data structures and their sequential storage representation – arrays, hash, structures and array of structures, stacks, queues; their storage representation and applications. Strings – storage representation and string manipulation applications.

Linear Data structures and their linked storage representation – pointers, linked allocation- single, double and circular linked list and their applications.

Nonlinear data structures – Trees, storage representation and operation on binary trees, application of trees; Graphs- representations and applications of graphs.


File Structures - External Storage Devices, Record Organization, File types and their structure. Exercises covering topics of functions, arrays, stacks, queues, linked lists and trees.

Text Books:

Reference Books:

COURSE OUTCOMES:
Upon completion of the course, the student will have
1. Knowledge on algorithmic notations and concepts; and primitive data structures.
2. Clear understanding of the sequential storage data structures and their applications.
3. Familiarity with linked linear and non-linear data structures and operations on such data structures.
4. The awareness of various sorting, searching algorithms and file structures.
5. The ability to design and develop menu-driven application programs.
EEPE38– ELECTRIC POWER QUALITY

Course Type: Programme Elective (PE)

Pre-requisites: EEPC17, EEPC18

No. of Credits: 3

Course objective:
- To impart knowledge about various electric power quality phenomenon, causes and consequences.
- To familiarize the students to monitoring methods and essential mitigation techniques.

Course Content:
Electric power quality phenomena: Introduction to power quality, IEEE and IEC - EMC standards, overview of power quality disturbances - voltage variations, interruptions, transients, waveform distortion and power frequency variations.

Power quality indices and monitoring: Power definitions and power quality indices for single-phase, three-phase balanced and unbalanced systems under sinusoidal and nonsinusoidal conditions – importance and introduction to power quality monitoring.

Voltage variations: Definitions, sources, measurement, impact on equipment and mitigation of voltage sag, swell, interruption and voltage fluctuation.

Harmonics: Harmonic sources, measurement of harmonic distortion, current and voltage limits of distortion, harmonic analysis using Fourier transform, effects of harmonic distortion and harmonic filters – passive, active and hybrid.

Custom Power Devices: Introduction to shunt and series compensators, DSTATCOM, Dynamic Voltage Restorer (DVR) and Unified Power Quality Conditioner (UPQC).

Text Books:

Reference Books:

Course Outcomes:
Upon completion of the course, the students will be able to

1. Understand different types of power quality problems with their source of generation.
2. Interpret results of power quality monitoring equipment and classify the power quality disturbances.
3. Recommend viable solutions for mitigation of the power quality problems
4. Design active & passive filters for harmonic elimination.
EEPE39 - VLSI DESIGN

Course Type: Programme Elective (PE)  
Pre-requisites: EEPC14, EEPC21
No. of Credits: 3

Course Objectives:
To enrich the student with the concepts of VLSI devices and its fabrication and also to develop different electronic circuits.

Course Content:
MOS characteristics: NMOS characteristics, inverter action – CMOS characteristics, inverter action - models and second order effects of MOS transistors – Current equation – MOSFET Capacitances - MOS as Switch, Diode/resistor – current source and sink – Current mirror.


Memory design – SRAM cell – 6T SRAM – DRAM – 1T, 3T, 4T cells, CMOS Sequential circuits: Static and Dynamic circuits – True Single-phase clocked registers – Clocking schemes.


Text Books:

Reference Books:

COURSE OUTCOMES:
Upon completion of the course, the student will be able to
1. To understand the insights of the MOS devices and its characteristics.
2. To appreciate the different VLSI process technologies.
3. To design the CMOS combinational logic circuits and its layout.
4. To develop the sequential circuits and clocking schemes.
5. To realize the Design flow of application-specific Integrated circuit.
MINOR
EEMI10 / EEOE16 - BASICS OF ELECTRICAL CIRCUITS

Course Type: Minor (MI)/Open Elective (OE)  Pre-requisites: --
No. of Credits: 3

Course Objectives:
The practical application of electricity involves the flow of electric current in a closed path under the influence of a driving force. A complete path, typically through conductors such as wires and through circuit elements, namely, resistor (R), inductor (L) and capacitor (C) is called an electrical circuit. In fact, electrical circuits are everywhere, from tiny ones in integrated circuits in mobile phones and music players, to giant ones that carry power to our homes. This course deals with analysis techniques that can be applied to all such circuits. After completion of this course, one should be able to analyze any linear circuit comprising of circuit elements, R, L and C along with the voltage and current sources.

Course Content:
Review of Electrical elements and circuits, Kirchhoff's laws, voltage and current sources, controlled sources, RMS and average values for typical waveforms, power and energy in electrical elements, phasor representation, series and parallel RLC circuits -simple examples.
Self and mutual inductance, coefficient of coupling, Capacitance, Series-parallel combination of inductance and capacitance, Series and parallel resonant circuits.
Circuit analysis using Node voltage and Mesh current methods, analysis with dependent source and special case.
Equivalent circuits, star-delta transformation, source transformation, Thevenin, Norton, Superposition and Maximum power transfer theorems.
Three-phase circuits, balanced three-phase voltages, analysis of three-phase star and delta connected circuits, balanced and unbalanced systems, power calculations, power measurement using two wattmeter method.

Reference Books:

COURSE OUTCOMES:
After completion of this course, the student will be able to
1. Understand the concept of phasors, waveforms and behaviour of basic circuit components.
2. Obtain the equivalent inductance and capacitance and understand the operation of resonant circuits.
3. Use node voltage and mesh current methods to solve electrical circuits.
4. Obtain the equivalent circuit and apply network theorems to circuits.
5. Analyze the three-phase system.
Course Type: Minor (MI)/Open Elective (OE)  
Pre-requisites: Basic Electrical and Electronics Engineering  
No. of Credits: 3

Course Objectives:

To disseminate an overview of various electric machines used in industries, power generation and home appliances with a technical know-how on the control techniques.

Course Content:

DC motors: Construction and working principle, emf equation, torque equation, starting and running characteristics, speed control, braking, duty of operation, choice of motors.

Transformers: Construction and working principle, equivalent circuit, regulation and efficiency, auto-transformers, industrial applications – welding transformer and furnace transformer.

Three-phase induction machines: Construction and working principle. Induction motors - torque-equation, torque–slip characteristics, starting and running characteristics, speed control, braking, choice of motor for industrial applications and traction.

Synchronous Machines: Construction, principle of operation and types, various types of excitation systems, stand alone and grid connected modes of operation, voltage and frequency control.

Fractional horse power machines: Single phase induction motors – Construction and principle of operation, types, applications in home appliances. Construction, operation and applications of Brushless DC motors, Stepper motors, Servomotors and AC Series motors.

Reference Books:


COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

1. Understand the constructional details and principle of operation of DC motors, induction machines, alternators, transformers and fractional horse-power motors.
2. Evaluate the performance of starting and operating characteristics of various electrical machines used in industrial and domestic applications.
3. Choose an appropriate method of speed control and braking for the drive motors.
EEMI12 / EEOE18 - CONTROL SYSTEMS ENGINEERING

Course Type: Minor (MI)/Open Elective (OE)  Pre-requisites: -
No. of Credits: 3

Course Objectives:
To equip the students with the fundamental concepts in control systems.

Course Content:
Modelling of physical systems – Time-domain specifications – Generalised error series – various test signals and its importance- Routh-Hurwitz stability criterion


Frequency domain analysis – Bode plot - Polar plot - Nyquist plot.

Phase margin - gain margin - Nyquist stability criterion.

Controller design - P, PI, PID, lag, lead, lead-lag compensator design.

Text Books:

Reference Books:

COURSE OUTCOMES:
Upon completion of the course, the student will be able to
1. Understand the concepts of closed loop control systems.
2. Analyse the stability of closed loop systems.
3. Apply the control techniques to any electrical systems.
4. Design the classical controllers such as P, PI, etc., for electrical systems.
**EEMI13 / EEOE19 – ANALOG AND DIGITAL ELECTRONICS**

**Course Type:** Minor (MI)/Open Elective (OE)  
**Pre-requisites**: EEMI10  
**No. of Credits:** 3

**Course Objectives:**
- To understand the concepts of analog and digital circuits.  
- To impart knowledge on signal generation and measuring equipment.

**Course Content:**

Review of digital components - Code converters- Programmable logic devices- CPLDs and FPGAs- Introduction to hardware description languages.


Display Units - optoelectronic devices – Seven-segment displays - LCD and LED display units and applications.


**Reference Books:**

**COURSE OUTCOMES:**
Upon completion of the course, the student will be able to
1. Design and develop circuits using analog and digital components.  
2. Understand the different generators and analyzers.  
3. Appreciate the use of display units.  
4. Identify the suitable oscilloscope for measurement.

*Pre-requisites not required when registering as open elective.*
EEMI14 / EEOE20 - POWER ELECTRONIC SYSTEMS

Course Type: Minor (MI)/Open elective (OE)  
No. of Credits: 3

Pre-requisites*: EEMI11

Course Objectives:
To introduce characteristics of power electronic devices, design of various power converter circuits and speed control concepts of AC and DC drives.

Course Content:
Power Semiconductor Devices – power diodes, power transistors, SCRs, TRIAC, GTO, power MOSFETs, IGBTs: Principle of operation, characteristics, ratings, protection and gate drive circuits.

Power Converters – AC to DC, AC to AC converters.

PWM based Power Converters: DC to DC, DC to AC converters.

Introduction to motor drives – Solid-state speed control of DC motor drive system.

Solid-state speed control of induction motor drive system.

Reference Books:

COURSE OUTCOMES:
Upon completion of the course, the student will be able to
1. Identify various power electronic devices and plot their switching characteristics.
2. Design DC power conversion circuits for simple applications.
3. Analyze inverter and cyclo-converter circuits.
4. Perform speed control of dc and induction motors.

*Pre-requisites not required when registering as open elective.
EEMI15 / EEOE21 - POWER SYSTEMS ENGINEERING

Course Type: Minor (MI)/Open Elective (OE)  Pre-requisites*: EEMI11
No. of Credits: 3

Course Objectives:
To impart knowledge on power generation, transmission, distribution and protection systems, and overview of power system economics and regulations.

Course Content:
Overview of generation systems: Sources of Energy, Steam, Diesel, Nuclear and Hydro power plants – site selection - Layout – essential components and operation.

Modes of Transmission and Distribution: HVAC and HVDC Transmission system – over-head lines – towers, conductors and insulators, underground cables – types – laying methods and fault location, comparison of over-head and underground systems, distribution system – classification – components, power factor correction.

Basic protection and switchgears: System faults and abnormal conditions, system grounding, need for protection system, overview of apparatus protection, switch gear mechanisms – fuse, switch, isolator and circuit breakers.


Reference Books:

COURSE OUTCOMES:
Upon the completion of this course the student will be able to

1. Illustrate the layout and operation of various power plants.
2. Infer the modes of transmission and distribution of electrical energy.
3. Select the appropriate protection scheme for various power apparatus.
4. Identify tariff structure and calculate the energy pricing.
5. Discuss about Indian electricity act and regulations.

*Pre-requisites not required when registering as open elective.
**EEMI16 / EEOE22 - ELECTRIC POWER UTILIZATION**

**Course Type:** Minor (MI)/Open Elective (OE)  
**Pre-requisites:** EEMI11  
**No. of Credits:** 3

**Course Objectives:**
To understand the principles of operation and utilization of power in domestic and industrial appliances.

**Course Content:**

Refrigeration - Domestic refrigerator and Air coolers, Air-Conditioner – circuit diagram, types and principle of operation.

Domestic utilization of electrical energy – House wiring, Induction based appliances, Online and OFF line UPS, Earthing – domestic, industrial and sub-station.

Electric Heating - Types of heating and applications, Electric furnaces - Resistance, inductance and Arc Furnaces, Electric welding and sources of welding.

Electric Drives and Traction System – Type of drives and loads, Rating and heating of the motors, Types of Traction, Speed-Time curves, recent trends in traction.

**Reference Books:**

**COURSE OUTCOMES:**
Upon completion of the course, the student will be able to
1. Develop a clear idea on various illumination techniques and hence design lightening scheme for specific applications.
2. Construct an electric connection for any domestic appliance like refrigerator and air conditioner units.
3. Evaluate domestic wiring connection and debug any faults occurred.
4. Identify an appropriate method of heating and welding for any particular industrial application.
5. Realize the appropriate type of electrical supply system as to evaluate the performance of tractions and electrical drives.

*Pre-requisites not required when registering as open elective.*
EEMI17 – INTRODUCTION TO MICRO-CONTROLLERS

Course Type: Minor (MI)/Open Elective (OE)  
Pre-requisites*: EEMI13
No. of Credits: 3

Course Objectives:
To impart knowledge on different micro-computing systems and its use in real time.

Course Content:
8051 Micro controller – Architecture - Addressing modes - Instruction set - Interfacing with real time peripherals.


Motivation for MSP430 microcontrollers – Main characteristics of a MSP430 microcontroller, Main features of the MSP430X RISC CPU architecture.

Addressing modes & Instruction set of MSP 430 - Double operand instructions, Single operand instructions, Program flow control – Jumps, Emulated instructions and programming


Reference Books:

COURSE OUTCOMES:
Upon completion of the course, the student will be able to
1. Understand the real time functioning of 8051.
2. Appreciate the functions of PIC microcontroller.
3. Develop systems using MSP430 Microcontroller.

*Pre-requisites not required when registering as open elective.
Course Type: Minor (MI)/Open Elective (OE)  
Pre-requisites*: EEMI14

No. of Credits: 3

Course Objectives:
To impart the knowledge on various forms of renewable energy sources and the process of electric energy conversion.

Course Content:
Environmental aspects of electric power generation from conventional sources: Limitation of fossil fuels - Atmospheric pollution – effects of hydro-electric projects – disposal of nuclear waste – GHG emission from various energy sources and its effects – need for renewable energy sources.


Fuel cell system: Principle of operation of fuel cell, technical parameters of fuel cell, Type of fuel cell – advantages of fuel cell power plants, energy output, efficiency and emf of fuel cell – operating characteristics, applications and environmental impacts.

Hybrid energy systems: Need for hybrid systems, types, configuration and coordination, electrical interface – PV-Diesel, Wind-diesel, wind-PV, wind-PV- fuel cell.

Reference Books:

COURSE OUTCOMES:
Upon the completion of this course the student will be able to:

1. Apprise the environmental impacts of conventional energy sources and the need of renewable energy.
2. Explain the process of PV generation and design stand-alone and grid connected system.
3. Explain the process of wind power generation and choose stand-alone and grid connected configuration.
4. Explain the process of fuel cell power generation and its applications.
5. Suggest and configure the various hybrid systems.

*Pre-requisites not required when registering as open elective.
HONOUR
Course Type: Honours (HO)  
No. of Credits: 3

Pre-requisites: EEPC11

Course Objectives:
To understand and appreciate the basic control techniques involved in distribution automation and also get introduced to the various communication systems involved in distribution automation. Also the objective of the course is to enable the students capable of analyzing the economics behind the automation of distribution system automation.

Course Content:
Introduction to Distribution Automation, Control System Interfaces, Control and Data requirements, Centralized (Vs) Decentralized Control, Distribution Automation System, DAS Hardware, DAS Software, DA Capabilities, Automation system computer facilities.

Layout of substations and feeders - design considerations. Distribution system load flow - optimal siting and sizing of substations - optimal capacitor placement. Distribution system monitoring and control - SCADA, Remote metering and load control strategies - Optimum feeder switching

DA Communication Requirements - reliability, Cost Effectiveness, Data Rate Requirements, Two Way Capability - outages and faults, Ease of operation and maintenance - Communication Systems used - Distribution line carrier (Power line carrier), Telephone, Cable TV, Radio, AM Broadcast, FM SCA, VHF Radio, UHF Radio etc.


Text Books:


Reference Books:


COURSE OUTCOMES:
Upon completion of the course the students would be able to

1. Understand the Distribution Automation Systems and the Control techniques involved.
2. Develop a clear idea on the layout of the substations and feeders and also on the various management techniques viz., load management and voltage management.
3. Identify an appropriate method of communication for any particular distribution system with a view of automation.
4. Evaluate the economic aspects of any distribution system with automation.
EEHO11 – EHV AC AND DC TRANSMISSION

Course Type: Honours (HO)  
No. of Credits: 3  
Pre-requisites: EEPC11

Course Objectives:

- To understand and analyze the HVAC and HVDC transmission systems.
- To plan an appropriate transmission system between two destinations based on the load requirement and anticipated technical performance of power transmission.

Course Content:

Design aspects of HVAC – conductor, tower, insulator and substation structure design, mechanical design - sag-tension calculations, design of EHVAC lines based on steady state limits and transient over voltages - design of extra HV cables - XLPE cables and gas insulated cables.


Introduction to HVDC transmission - Bridge converters – rectifier and inverter operation, equivalent circuit representation, power reversal, desired features of control and actual control characteristics.

Basic HVDC controllers, converter faults, commutation failure, bypass action in bridges, protection issues in HVDC - DC reactors, voltage and current oscillations, DC circuit breakers and over voltage protection.

Harmonics in HVDC - characteristics and uncharacteristic harmonics, troubles due to harmonics, harmonic filters – active and passive filters. Introduction to Hybrid HVDC and Off-shore wind power evacuation schemes.

Text Books:


Reference Books:


Useful web links:

1. http://nptel.iitm.ac.in/courses/108104013

COURSE OUTCOMES:

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

1. Distinguish between the usage of EHVC and HVDC transmission systems.
2. Judge when and where to use EHAV / HVDC transmission systems in practice.
3. Design implementation circuitry for various controllers used in HVDC transmission systems.
4. Plan an appropriate electric power transmission system between two destinations to satisfy the pre-defined load requirement without compromising the technical performance.
Course Type: Honours(HO)  
Pre-requisites: EEPC20

No. of Credits: 4

Course Objectives:
The aim of this course is to introduce the concept of non-linear controller design to the undergraduate student.

Course Content:
Open and closed sets, compact set, dense set, Continuity of functions, Lipschitz condition, smooth functions, Vector space, norm of a vector, normed linear space, inner product space.

Mathematical modeling of simple mechanical and electrical systems, concept of equilibrium points, isolated equilibrium points and limit cycles.


Feedback linearization- dynamic feedback linearization, flatness and back stepping controllers design.

Sliding mode controller design, Lyapunov redesign and energy based controller design.

Text Books:

Reference Books:

COURSE OUTCOMES:
Upon completion of the course, the student will be able to
1. Understand the concept of non-linear system.
2. Design non-linear controller for electrical system.
EEHO13 – POWER SWITCHING CONVERTERS

Course Type: Honours (HO)  
Pre-requisites: EEPC19

No. of Credits: 4

Course Objectives:

This course aims at modeling, analysis and control of various power converter circuits.

Course Content:

Basic converter topologies: Buck, Boost, Buck-Boost converter, steady state converter analysis - Equivalent circuit modelling.

State space averaging of converters- Transfer function of converters- Design of feedback compensators-voltage and current loop.


Isolated converters: forward converter, push-pull converter, fly back converter, half bridge and full bridge converter-operating principles.


Text Books:


Reference Books:


COURSE OUTCOMES:

Upon completion of this course the students will be able to

1. Understand the classification and operation of different types of DC-DC converters.

2. Analyze the steady-state operation of DC-DC converter circuits.

3. Develop the transfer function of DC-DC converter circuits.

4. Design the compensator and reactive elements of DC-DC converter circuits.

5. Illustrate different soft switching techniques in DC-DC converter circuits.
Course Type: Honours (HO)  Pre-requisites: EEPC15, EEPC19
No. of Credits: 4

Course Objectives:

This course introduces the fundamental concepts, principles and analysis of hybrid and electric vehicles.

Course Content:

History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance, Capabilities, Automation system computer facilities.

Introduction to electric components used in hybrid and electric vehicles- Configuration and control of DC Motor drives, Induction Motor drives, Permanent Magnet Motor drives, and Switched Reluctance Motor drives- drive system efficiency.

Energy storage technologies in hybrid vehicles-flywheel, hydraulic, fuel cell and hybrid fuel cell energy storage system-ultra capacitors- comparison- battery charging control.

Introduction to energy management strategies used in hybrid and electric vehicle, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy strategies.

Electrical power system in air craft, sea and undersea vehicles, space vehicles-hybrid vehicle control strategies-supporting subsystem.

Text Books:

Reference Books:

COURSE OUTCOMES:

On completion of the course, the student would be able to
1. Understand the various aspects of hybrid and electric vehicles.
2. Plan the selection of electrical machines for hybrid and electric vehicles.
3. Select various energy storage technologies for hybrid and electric vehicles.
4. Implement energy management techniques for hybrid and electric vehicles.
5. Demonstrate the power system of various vehicular system.
**EEHO15 – POWER SYSTEM DYNAMICS**

**Course Type:** Honours (HO)  
**No. of Credits:** 4  
**Pre-requisites:** EEPC18

**Course Objectives:**
- To explain the power system stability problem.  
- To understand the behavior of synchronous and induction machines during disturbance.  
- To employ mathematical tools for power system stability analysis.

**Course Content:**
Stability considerations – Dynamic modeling requirements- angle stability - equal area criterion- Critical fault clearing time and angle-numerical integration techniques.


Dynamics of Synchronous machines - Mechanical relationships – electrical transient relationships – adjustment of machine models – Park’s equation in the operational form.

Induction motor equivalent circuits and parameters - free acceleration characteristics – dynamic performance – effect of three phase short circuit and unbalanced faults.


**Text Books:**

**Reference Books:**

**COURSE OUTCOMES:**
Upon completion of the course, the students will have acquired

1. Understanding of the dynamic phenomena of the power system operation.

2. Knowledge to employ modeling techniques for investigating the response of system during disturbance.

3. Ability to interpret results coming from the simulation of differential - algebraic systems.
Course Type: Honours (HO)  
No. of Credits: 4  

Pre-requisites: EEPC18

Course Objectives:
To learn the concepts and techniques of evolutionary and optimization techniques in power system applications.

Course Content:
Definition-Classification of optimization problems-Unconstrained and Constrained Optimization-Optimality Conditions-Classical Optimization techniques (Linear and nonlinear programming, Quadratic programming, Mixed integer programming)-Intelligent Search methods (Optimization neural network, Evolutionary algorithms, Tabu search, Particle swarm optimization, Application of fuzzy set theory).


Fundamental principle - Velocity Updating - Advanced operators - Parameter selection - Hybrid approaches (Hybrid of GA and PSO, Hybrid of EP and PSO) -Binary, discrete and combinatorial PSO-Implementation issues - Convergence issues - PSO based OPF problem and unit commitment-PSO for power system reliability and security.

Simulated annealing algorithm- Tabu search algorithm - SA and TS for unit commitment - Ant colony optimization - Bacteria Foraging optimization.

Concept of pareto optimality - Conventional approaches for MOOP - Multi objective GA - Fitness assignment - Sharing function - Economic Emission dispatch using MOGA – Multi objective PSO (Dynamic neighbourhood PSO, Vector evaluated PSO) – Multi objective OPF problem.

Text Books:

Reference Books:

COURSE OUTCOMES:
Upon completion of this course the students will be able to
1. Understand the concept of optimization techniques.
2. Apply evolutionary algorithms for unit commitment and economic dispatch problems.
3. Interpret hybrid approach for power system reliability and security.
Course Type: Honours (HO)  
No. of Credits: 3

Pre-requisites: EEPE18

Course Objectives:

- To understand and analyze the basic architecture of Digital Relay.
- Understand the basics of Phasor Measurement unit (PMU).
- Applications of PMUs in power system.

Course Content:

Mathematical background to protection algorithms-Finite difference technique-Numerical differentiation-Least Squares Method-Fourier analysis-Fourier analysis of analog signals- Fourier analysis of discrete signals-Walsh function analysis.


Text Books:


Reference Books:


COURSE OUTCOMES:

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

1. Understand the operation of computer relay.
2. Understand the basics of phasor measurement unit.
3. Understand the different applications of PMUs in power systems.
EEH018 – POWER SYSTEM RESTRUCTURING

Course Type: Honours (HO)  
Pre-requisites: EEPE29

No. of Credits: 4

Course Objectives:
To understand the electricity power business and technical issues in a restructured power system in both Indian and world scenario.

Course Content:
Introduction – Market Models–Entities– Key issues in regulated and deregulated power markets; Market equilibrium- Market clearing price- Electricity markets around the world
Operational and planning activities of a GENCO -Electricity Pricing and Forecasting -Price Based Unit Commitment Design - Security Constrained Unit Commitment design – Ancillary Services - Automatic Generation Control (AGC).
Introduction-Components of restructured system-Transmission pricing in Open-access system - Open transmission system operation; Congestion management in Open-access transmission systems- FACTS in congestion management-Open-access Coordination Strategies; Power Wheeling- Transmission Cost Allocation Methods
Open Access Distribution – Changes in Distribution Operations-The Development of Competition– Maintaining Distribution Planning
Power Market Development – Electricity Act, 2003 - Key issues and solution; Developing power exchanges suited to the Indian market - Challenges and synergies in the use of IT in power- Competition- Indian power market- Indian energy exchange- Indian power exchange- Infrastructure model for power exchanges- Congestion Management-Day Ahead Market- Online power trading.

Text Books:

Reference Books:

Useful web links:
3. Indian Electricity Regulations: http://www.cercind.gov.in/

COURSE OUTCOMES:
Upon completion of the course the students would be able to
1. Explain and differentiate the key issues involved in the regulated and de-regulated power markets.
2. Describe the operational activities in Generation, Transmission and Distribution system in the restructured environment.
3. Illustrate and solve problems in the de-regulated power System.
4. Explain and analyze the restructuring activities in Indian Power System.
EEHO19 – DESIGN WITH PIC MICROCONTROLLERS

Course Type: HO  
Pre-requisites: EEPC14  
No. of Credits: 4

Course Objectives:
To understand the internal structure and operation of PIC16F876 microcontroller, assembly language programming with MPLAB and PICSTART plus and design methodology for software and hardware applications.

Course Content:
Introduction to PIC microcontrollers - PIC 16F876 microcontroller – device overview-pin diagrams-memory organisation.


Introduction to MPLABIDE and PICSTART plus – Device Programming using MPLAB and PICSTART plus.

Assembly language programming for – Zero crossing detectors - square wave generation –pulse generation for typical applications - ADC program – hardware demonstration.

Text Books:

References Books:

COURSE OUTCOMES:

Upon completion of this course, students will

2. Be able to develop assembly language program.
3. Be able to develop the program using MPLAB and download it to the microcontroller chip using suitable developer.
4. Be able to design and generate pulses for typical applications.