B. Tech.

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

FLEXIBLE CURRICULUM
(For students admitted in 2018-19)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
NATIONAL INSTITUTE OF TECHNOLOGY
TIRUCHIRAPPALLI – 620 015
TAMIL NADU, INDIA
MINIMUM CREDIT REQUIREMENT FOR THE VARIOUS COURSE CATEGORIES

The structure of B.Tech. programmes shall have General Institute Requirements (GIR), Programme Core (PC), Elective Courses (PE, OE and MI) and Essential Programme Laboratory Requirements (ELR) as follows:

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>COURSE CATEGORY</th>
<th>Number of Courses</th>
<th>Number of Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>General Institute Requirement (GIR)</td>
<td>17</td>
<td>68</td>
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<tr>
<td>2</td>
<td>Programme Core (PC)</td>
<td>20</td>
<td>65</td>
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<tr>
<td>3</td>
<td>Essential Programme Laboratory Requirement (ELR)</td>
<td>2 per session</td>
<td>16</td>
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<tr>
<td>4</td>
<td>Elective courses</td>
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</tr>
<tr>
<td></td>
<td>a. Programme Electives (PE)</td>
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</tr>
<tr>
<td></td>
<td>b. Open Electives (OE)</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>c. Minor (MI)</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>A student should be allowed a minimum of 50% of the</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>total electives of a programme from (b) and (c) if</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>so desired by the student.</td>
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<tr>
<td>5</td>
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(I) GENERAL INSTITUTE REQUIREMENTS

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of the course</th>
<th>Number of Courses</th>
<th>Maximum Credits</th>
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<tbody>
<tr>
<td>1</td>
<td>Mathematics</td>
<td>4</td>
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<tr>
<td>2</td>
<td>Physics*</td>
<td>2</td>
<td>7</td>
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<td>3</td>
<td>Chemistry*</td>
<td>2</td>
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<tr>
<td>4</td>
<td>Humanities</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>Communication</td>
<td>2</td>
<td>6</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>
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<td>10</td>
<td>Basic Engineering</td>
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<td>11</td>
<td>Introduction to Computer Programming</td>
<td>1</td>
<td>3</td>
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<td>12</td>
<td><strong>Branch Specific Course</strong></td>
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<td></td>
<td>(Introduction to Branch of Study)</td>
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<td>13</td>
<td>Summer Internship</td>
<td>1</td>
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<td>14</td>
<td>Project work</td>
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<td>6</td>
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<td>15</td>
<td>Comprehensive Viva</td>
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<td>3</td>
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<td>16</td>
<td>Industrial lecture</td>
<td>-</td>
<td>1</td>
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<td>17</td>
<td>NSS / NCC / NSC</td>
<td>-</td>
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<td>18</td>
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Including Lab

*Commence During Orientation Programme
## I. GENERAL INSTITUTE REQUIREMENTS

### 1. MATHEMATICS

<table>
<thead>
<tr>
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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>MAIR 11</td>
<td>MATHEMATICS - I</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>MAIR 21</td>
<td>MATHEMATICS - II</td>
<td>4</td>
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<td>3</td>
<td>MAIR34</td>
<td>REAL ANALYSIS AND PARTIAL DIFFERENTIAL EQUATIONS</td>
<td>3</td>
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<td>4</td>
<td>MAIR45</td>
<td>PROBABILITY THEORY AND RANDOM PROCESSES</td>
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<td><strong>Total</strong></td>
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### 2. PHYSICS

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<tbody>
<tr>
<td>1</td>
<td>PHIR 11</td>
<td>PHYSICS I</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>PHIR 13</td>
<td>PHYSICS II</td>
<td>4</td>
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<td><strong>Total</strong></td>
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<td><strong>Total</strong></td>
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### 3. CHEMISTRY

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<tbody>
<tr>
<td>1</td>
<td>CHIR 11</td>
<td>CHEMISTRY I</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>CHIR 12</td>
<td>CHEMISTRY II</td>
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### 4. COMMUNICATION

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<tbody>
<tr>
<td>1</td>
<td>HSIR11</td>
<td>ENGLISH FOR COMMUNICATION</td>
<td>3</td>
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<td>2</td>
<td>HSIR12</td>
<td>PROFESSIONAL COMMUNICATION</td>
<td>3</td>
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<td><strong>Total</strong></td>
<td></td>
<td><strong>Total</strong></td>
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### 5. HUMANITIES

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</thead>
<tbody>
<tr>
<td>1</td>
<td>HSIR 13*</td>
<td>INDUSTRIAL ECONOMICS AND FOREIGN TRADE</td>
<td>3</td>
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<td><strong>Total</strong></td>
<td></td>
<td><strong>Total</strong></td>
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* The above course will be offered in July session

### 6. ENERGY AND ENVIRONMENTAL ENGINEERING

<table>
<thead>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>ENIR11</td>
<td>ENERGY AND ENVIRONMENTAL ENGINEERING</td>
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<td><strong>Total</strong></td>
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7. PROFESSIONAL ETHICS

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<tr>
<td>1</td>
<td>HSIR14</td>
<td>PROFESSIONAL ETHICS</td>
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* The above course will be offered in January session

8. ENGINEERING GRAPHICS

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>1</td>
<td>MEIR12</td>
<td>ENGINEERING GRAPHICS</td>
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9. ENGINEERING PRACTICE

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<th>Credits</th>
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<tbody>
<tr>
<td>1</td>
<td>PRIR11</td>
<td>ENGINEERING PRACTICE</td>
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10. BASIC ENGINEERING

<table>
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<th>Course Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>CEIR11</td>
<td>BASICS OF CIVIL ENGINEERING</td>
<td>2</td>
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<tr>
<td>2</td>
<td>MEIR11</td>
<td>BASICS OF MECHANICAL ENGINEERING</td>
<td>2</td>
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11. INTRODUCTION TO COMPUTER PROGRAMMING

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<tr>
<td>1</td>
<td>CSIR11</td>
<td>BASICS OF PROGRAMMING</td>
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12. BRANCH SPECIFIC COURSE

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<tr>
<td>1</td>
<td>ECIR15</td>
<td>BRANCH SPECIFIC COURSE</td>
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### 13. SUMMER INTERNSHIP

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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>ECIR16</td>
<td>INTERNSHIP / INDUSTRIAL TRAINING / ACADEMIC ATTACHMENT (2 to 3 months duration during summer vacation)</td>
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Total 2

The student should undergo industrial training/internship for a minimum period of two months during the summer vacation of 3rd year. Attachment with an academic institution within the country (IISc/IITs/NITs/IITs and CFTIs) or university abroad is also permitted instead of industrial training.

*To be evaluated at the beginning of VII semester by assessing the report and seminar presentations.*

### 14. PROJECT WORK

<table>
<thead>
<tr>
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<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>1</td>
<td>ECIR17</td>
<td>PROJECT WORK</td>
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Total 6

### 15. COMPREHENSIVE VIVA

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<th>Course Title</th>
<th>Credits</th>
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<tr>
<td>1</td>
<td>ECIR18</td>
<td>COMPREHENSIVE VIVA</td>
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Total 3

### 16. INDUSTRIAL LECTURE

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<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>1</td>
<td>ECIR19</td>
<td>INDUSTRIAL LECTURE</td>
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</table>

Total 1

A course based on industrial lectures shall be offered for 1 credit. A minimum of five lectures of two hours duration 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.

### 17. NSS / NCC / NSO

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
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<td>NSS / NCC / NSO</td>
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Total 0
### (II) PROGRAMME CORE (PC)

<table>
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<tr>
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<th>Course Title</th>
<th>Prerequisites</th>
<th>Credits</th>
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<tbody>
<tr>
<td>1.</td>
<td>ECPC10</td>
<td>SIGNALS AND SYSTEMS</td>
<td>NONE</td>
<td>4</td>
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<td>2.</td>
<td>ECPC11</td>
<td>NETWORK ANALYSIS AND SYNTHESIS</td>
<td>NONE</td>
<td>4</td>
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<td>3.</td>
<td>ECPC12</td>
<td>ELECTRODYNAMICS AND ELECTROMAGNETIC WAVES</td>
<td>NONE</td>
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<td>4.</td>
<td>ECPC13</td>
<td>SEMICONDUCTOR PHYSICS AND DEVICES</td>
<td>NONE</td>
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<tr>
<td>5.</td>
<td>ECPC14</td>
<td>DIGITAL CIRCUITS AND SYSTEMS</td>
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<td>6.</td>
<td>ECPC15</td>
<td>DIGITAL SIGNAL PROCESSING</td>
<td>ECPC10</td>
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<td>7.</td>
<td>ECPC16</td>
<td>TRANSMISSION LINES AND WAVEGUIDES</td>
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<td>8.</td>
<td>ECPC17</td>
<td>ELECTRONIC CIRCUITS</td>
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<tr>
<td>9.</td>
<td>ECPC18</td>
<td>MICROPROCESSORS AND MICRO CONTROLLERS</td>
<td>ECPC14</td>
<td>3</td>
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<td>10.</td>
<td>ECPC19</td>
<td>STATISTICAL THEORY OF COMMUNICATION</td>
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<tr>
<td>11.</td>
<td>ECPC20</td>
<td>DIGITAL SIGNAL PROCESSORS AND APPLICATIONS</td>
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<td>3</td>
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<td>12.</td>
<td>ECPC21</td>
<td>ANALOG COMMUNICATION</td>
<td>ECPC10</td>
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<td>13.</td>
<td>ECPC22</td>
<td>ANTENNAS AND PROPAGATION</td>
<td>ECPC12</td>
<td>3</td>
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<td>14.</td>
<td>ECPC23</td>
<td>ANALOG INTEGRATED CIRCUITS</td>
<td>ECPC17</td>
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<td>15.</td>
<td>ECPC24</td>
<td>DIGITAL COMMUNICATION</td>
<td>ECPC21</td>
<td>3</td>
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<td>16.</td>
<td>ECPC25</td>
<td>MICROWAVE COMPONENTS AND CIRCUITS</td>
<td>ECPC16</td>
<td>3</td>
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<td>17.</td>
<td>ECPC26</td>
<td>VLSI SYSTEMS</td>
<td>ECPC14</td>
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<td>18.</td>
<td>ECPC27</td>
<td>WIRELESS COMMUNICATION</td>
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<tr>
<td>19.</td>
<td>ECPC28</td>
<td>FIBER OPTIC COMMUNICATION</td>
<td>ECPC12 &amp; ECPC21</td>
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<tr>
<td>20.</td>
<td>ECPC29</td>
<td>MICROWAVE ELECTRONICS</td>
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**Total** 65
### (III) ELECTIVES

#### a. PROGRAMME ELECTIVE (PE)

Students who are pursuing B.Tech. in Electronics and Communication Engineering should complete at least three courses from the Programme Electives listed below.

<table>
<thead>
<tr>
<th>Sl. No.</th>
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<th>Course Title</th>
<th>Prerequisites</th>
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<tbody>
<tr>
<td>1.</td>
<td>ECPE10</td>
<td>PRINCIPLES OF RADAR</td>
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<td>2.</td>
<td>ECPE11</td>
<td>SATELLITE COMMUNICATION</td>
<td>ECPC24</td>
<td>3</td>
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<tr>
<td>3.</td>
<td>ECPE12</td>
<td>COGNITIVE RADIO</td>
<td>ECPC15</td>
<td>3</td>
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<td>4.</td>
<td>ECPE13</td>
<td>MULTIMEDIA COMMUNICATION TECHNOLOGY</td>
<td>ECPC15</td>
<td>3</td>
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<td>5.</td>
<td>ECPE14</td>
<td>COMMUNICATION SWITCHING SYSTEMS</td>
<td>ECPC21</td>
<td>3</td>
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<tr>
<td>6.</td>
<td>ECPE15</td>
<td>BROADBAND ACCESS TECHNOLOGIES</td>
<td>ECPC21 &amp; ECPC24</td>
<td>3</td>
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<tr>
<td>7.</td>
<td>ECPE16</td>
<td>DIGITAL SIGNAL PROCESSING FOR WIRELESS COMMUNICATION</td>
<td>ECPC15</td>
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<td>8.</td>
<td>ECPE17</td>
<td>MICROWAVE INTEGRATED CIRCUIT DESIGN</td>
<td>ECPC16 &amp; ECPC25</td>
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<td>9.</td>
<td>ECPE18</td>
<td>RF MEMS CIRCUIT DESIGN</td>
<td>ECPC16 &amp; ECPC25</td>
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<td>10.</td>
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<td>HIGH SPEED SYSTEM DESIGN</td>
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<td>11.</td>
<td>ECPE20</td>
<td>DIGITAL SPEECH PROCESSING</td>
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<td>12.</td>
<td>ECPE21</td>
<td>DIGITAL IMAGE PROCESSING</td>
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<td>13.</td>
<td>ECPE22</td>
<td>PATTERN RECOGNITION</td>
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<td>14.</td>
<td>ECPE23</td>
<td>COMPUTER ARCHITECTURE AND ORGANIZATION</td>
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<td>15.</td>
<td>ECPE24</td>
<td>EMBEDDED SYSTEMS</td>
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<td>16.</td>
<td>ECPE25</td>
<td>ARM SYSTEM ARCHITECTURE</td>
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<tr>
<td>17.</td>
<td>ECPE26</td>
<td>OPERATING SYSTEMS</td>
<td>NONE</td>
<td>3</td>
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<tr>
<td>18.</td>
<td>ECPE27</td>
<td>DISPLAY SYSTEMS</td>
<td>ECPC13</td>
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<tr>
<td>19.</td>
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<td>ECPC15</td>
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<tr>
<td>20.</td>
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<td>NETWORKS AND PROTOCOLS</td>
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<td>21.</td>
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<td>ADHOC WIRELESS NETWORKS</td>
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<td>22.</td>
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<td>3</td>
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<tr>
<td>23.</td>
<td>ECPE32</td>
<td>VLSI SYSTEMS</td>
<td>ECPC14</td>
<td>3</td>
</tr>
<tr>
<td>24.</td>
<td>ECPE33</td>
<td>LOW POWER VLSI CIRCUITS</td>
<td>ECPC26</td>
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**Total** 72
b. OPEN ELECTIVE (OE)

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

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Prerequisites</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>ECOE10</td>
<td>MICROWAVE INTEGRATED CIRCUITS</td>
<td>NONE</td>
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</tr>
<tr>
<td>2.</td>
<td>ECOE11</td>
<td>RF MEMS CIRCUIT</td>
<td>NONE</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>ECOE12</td>
<td>HIGH SPEED SYSTEM DESIGN</td>
<td>NONE</td>
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</tr>
<tr>
<td>4.</td>
<td>ECOE13</td>
<td>DIGITAL SPEECH PROCESSING</td>
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<td>5.</td>
<td>ECOE14</td>
<td>DIGITAL IMAGE PROCESSING</td>
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<td>6.</td>
<td>ECOE15</td>
<td>PATTERN RECOGNITION</td>
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<td>7.</td>
<td>ECOE16</td>
<td>COMPUTER ARCHITECTURE AND ORGANIZATION</td>
<td>NONE</td>
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<td>8.</td>
<td>ECOE17</td>
<td>OPERATING SYSTEMS</td>
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<td>9.</td>
<td>ECOE18</td>
<td>WIRELESS SENSOR NETWORKS</td>
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<td>COMPUTER VISION AND MACHINE LEARNING</td>
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<td>TEXT DATA MINING</td>
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c. MINOR (MI)

Students who have registered for B.Tech Minor in ELECTRONICS AND COMMUNICATION ENGINEERING can opt to study any 5 of the courses listed below.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Prerequisites</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>ECMI10</td>
<td>SIGNALS AND SYSTEMS</td>
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<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>ECMI11</td>
<td>NETWORK ANALYSIS AND SYNTHESIS</td>
<td>NONE</td>
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<tr>
<td>3.</td>
<td>ECMI12</td>
<td>ELECTRODYNAMICS AND ELECTROMAGNETIC WAVES</td>
<td>NONE</td>
<td>3</td>
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<tr>
<td>4.</td>
<td>ECMI13</td>
<td>SEMICONDUCTOR PHYSICS AND DEVICES</td>
<td>NONE</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>ECMI14</td>
<td>DIGITAL CIRCUITS AND SYSTEMS</td>
<td>NONE</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>ECMI15</td>
<td>DIGITAL SIGNAL PROCESSING</td>
<td>ECMI10</td>
<td>3</td>
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<tr>
<td>7.</td>
<td>ECMI16</td>
<td>TRANSMISSION LINES AND WAVEGUIDES</td>
<td>ECMI12</td>
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<td>8.</td>
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<td>ELECTRONIC CIRCUITS</td>
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<tr>
<td>9.</td>
<td>ECMI18</td>
<td>MICROPROCESSORS AND MICRO CONTROLLERS</td>
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<td>10.</td>
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<tr>
<td>11.</td>
<td>ECMI20</td>
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<td>3</td>
</tr>
<tr>
<td>12.</td>
<td>ECMI21</td>
<td>ANALOG COMMUNICATION</td>
<td>ECMI10</td>
<td>3</td>
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<td>13.</td>
<td>ECMI22</td>
<td>ANTENNAS AND PROPAGATION</td>
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<tr>
<td>14.</td>
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<td>ANALOG INTEGRATED CIRCUITS</td>
<td>ECMI17</td>
<td>3</td>
</tr>
<tr>
<td>15.</td>
<td>ECMI24</td>
<td>DIGITAL COMMUNICATION</td>
<td>ECMI21</td>
<td>3</td>
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<tr>
<td>16.</td>
<td>ECMI25</td>
<td>MICROWAVE COMPONENTS AND CIRCUITS</td>
<td>ECMI16</td>
<td>3</td>
</tr>
<tr>
<td>17.</td>
<td>ECMI26</td>
<td>VLSI SYSTEMS</td>
<td>ECMI14</td>
<td>3</td>
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<td>18.</td>
<td>ECMI27</td>
<td>WIRELESS COMMUNICATION</td>
<td>ECMI24</td>
<td>3</td>
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<tr>
<td>19.</td>
<td>ECMI28</td>
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<td>ECMI12 &amp; ECMI21</td>
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<tr>
<td>20.</td>
<td>ECMI29</td>
<td>MICROWAVE ELECTRONICS</td>
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Note: Student should be allowed a minimum of 50% of the total electives of a programme from Open electives and Minor, if so desired by the student.
## (IV) ESSENTIAL PROGRAMME LABORATORY REQUIREMENT (ELR)

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Co requisites</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>ECLR10</td>
<td>DEVICES AND NETWORKS LABORATORY</td>
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<td>2.</td>
<td>ECLR11</td>
<td>DIGITAL ELECTRONICS LABORATORY</td>
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<td>3.</td>
<td>ECLR12</td>
<td>ELECTRONIC CIRCUITS LABORATORY</td>
<td>NONE</td>
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<td>4.</td>
<td>ECLR13</td>
<td>MICROPROCESSOR AND MICROCONTROLLER LABORATORY</td>
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<td>5.</td>
<td>ECLR14</td>
<td>ANALOG INTEGRATED CIRCUITS LABORATORY</td>
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<td>6.</td>
<td>ECLR15</td>
<td>DIGITAL SIGNAL PROCESSING LABORATORY</td>
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<td>7.</td>
<td>ECLR16</td>
<td>VLSI AND EMBEDDED SYSTEM DESIGN LABORATORY</td>
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<td>8.</td>
<td>ECLR17</td>
<td>COMMUNICATION ENGINEERING LABORATORY</td>
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<td>9.</td>
<td>ECLR18</td>
<td>FIBER OPTIC COMMUNICATION LABORATORY</td>
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<td>MICROWAVE LABORATORY</td>
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<td><strong>Total</strong></td>
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<td>16</td>
</tr>
</tbody>
</table>

NOTE: Students can register for 2 laboratory courses during one session along with regular courses (PC / PE / OE / MI).

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

A student can obtain B.Tech. (Honours) degree provided the student has;

i. Registered at least for 12 theory courses and 2 ELRs in the second year.

ii. Consistently obtained a minimum GPA of 8.5 in the first four sessions

iii. Continue to maintain the same GPA of 8.5 in the subsequent sessions (including the Honours courses)

iv. Completed 3 additional theory courses specified for the Honors degree of the programme.

v. Completed all the courses registered, in the first attempt and in four years of study.
Details of the flow of courses for a particular programme should be made available to the students at the beginning of the programme (I Year). The feasible year (I to IV year of study) and session of study for each core course should also be given.

**Course flow:** X → Y Z Where X, Y, and Z are courses

The following table should be prepared before the commencement of the programme

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Co requisites</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>ECHO10</td>
<td>ADVANCED DIGITAL SIGNAL PROCESSING</td>
<td>ECPC15</td>
<td>3</td>
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<tr>
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<td>ECHO11</td>
<td>SPECTRAL ANALYSIS OF SIGNALS</td>
<td>ECPC15</td>
<td>3</td>
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<td>3.</td>
<td>ECHO12</td>
<td>DETECTION AND ESTIMATION</td>
<td>MAIR 45</td>
<td>3</td>
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<td>4.</td>
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<td>WAVELET SIGNAL PROCESSING</td>
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<tr>
<td>5.</td>
<td>ECHO14</td>
<td>RF CIRCUITS</td>
<td>NONE</td>
<td>3</td>
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<td>6.</td>
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<td>NUMERICAL TECHNIQUES FOR MIC</td>
<td>ECPC25</td>
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<td>7.</td>
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<td>APPLIED PHOTONICS</td>
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<td>8.</td>
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<td>9.</td>
<td>ECHO18</td>
<td>BIO MEMS</td>
<td>ECPC18</td>
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<td>10.</td>
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<td>ANALOGIC DESIGN</td>
<td>ECPC23</td>
<td>3</td>
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<td>11.</td>
<td>ECHO20</td>
<td>VLSI SYSTEM TESTING</td>
<td>ECPE32</td>
<td>3</td>
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<tr>
<td>12.</td>
<td>ECHO21</td>
<td>ELECTRONIC DESIGN AUTOMATION TOOLS</td>
<td>NONE</td>
<td>3</td>
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<tr>
<td>13.</td>
<td>ECHO22</td>
<td>DESIGN OF ASICS</td>
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<tr>
<td>14.</td>
<td>ECHO23</td>
<td>DIGITAL SYSTEM DESIGN</td>
<td>ECPC14</td>
<td>3</td>
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<tr>
<td>15.</td>
<td>ECHO24</td>
<td>OPTIMIZATIONS OF DIGITAL SIGNAL PROCESSING</td>
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<tr>
<td>17.</td>
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<td>DIGITAL SIGNAL PROCESSING FOR MEDICAL IMAGING</td>
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Total 63
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<tr>
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<td>REAL ANALYSIS AND PARTIAL DIFFERENTIAL EQUATIONS</td>
<td>II</td>
<td>July</td>
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<td>SIGNALS AND SYSTEMS</td>
<td>II</td>
<td>July</td>
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<td>NETWORK ANALYSIS AND SYNTHESIS</td>
<td>II</td>
<td>July</td>
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<td>ELECTRODYNAMICS AND ELECTROMAGNETIC WAVES</td>
<td>II</td>
<td>July</td>
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<td>SEMICONDUCTOR PHYSICS AND DEVICES</td>
<td>II</td>
<td>July</td>
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<td>6.</td>
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<td>DIGITAL CIRCUITS AND SYSTEMS</td>
<td>II</td>
<td>July</td>
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<td>7.</td>
<td>ECLR10</td>
<td>DEVICES AND NETWORKS LABORATORY</td>
<td>II</td>
<td>July</td>
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<td>July</td>
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<td>PROBABILITY THEORY AND RANDOM PROCESS</td>
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<td>January</td>
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<td>TRANSMISSION LINES AND WAVEGUIDES</td>
<td>II</td>
<td>January</td>
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<td>ELECTRONIC CIRCUITS</td>
<td>II</td>
<td>January</td>
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<td>II</td>
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<td>15.</td>
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<td>MICROPROCESSOR AND MICROCONTROLLER LABORATORY</td>
<td>II</td>
<td>January</td>
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<tr>
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<td>III</td>
<td>July</td>
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<td>ECPC20</td>
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<td>III</td>
<td>July</td>
</tr>
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<td>18.</td>
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<td>ANALOG COMMUNICATION</td>
<td>III</td>
<td>July</td>
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<td>19.</td>
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<td>ANTENNAS AND PROPAGATION</td>
<td>III</td>
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<td>July</td>
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<tr>
<td>23.</td>
<td>ECPC24</td>
<td>DIGITAL COMMUNICATION</td>
<td>III</td>
<td>January</td>
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<tr>
<td>24.</td>
<td>ECPC25</td>
<td>MICROWAVE COMPONENTS AND CIRCUITS</td>
<td>III</td>
<td>January</td>
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<tr>
<td>25.</td>
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<td>VLSI AND EMBEDDED SYSTEM DESIGN LABORATORY</td>
<td>III</td>
<td>January</td>
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<td>WIRELESS COMMUNICATION</td>
<td>IV</td>
<td>July</td>
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<td>28.</td>
<td>ECPC28</td>
<td>FIBER OPTIC COMMUNICATION</td>
<td>IV</td>
<td>July</td>
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<td>29.</td>
<td>ECPC29</td>
<td>MICROWAVE ELECTRONICS</td>
<td>IV</td>
<td>July</td>
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<td>30.</td>
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<td>July</td>
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<td>III &amp; IV</td>
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<td>SATELLITE COMMUNICATION</td>
<td>III &amp; IV</td>
<td>July / January</td>
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<td>ECPE12</td>
<td>COGNITIVE RADIO</td>
<td>III &amp; IV</td>
<td>July / January</td>
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</table>
Course Code : MAIR34
Course Title : REAL ANALYSIS AND PARTIAL DIFFERENTIAL EQUATIONS
Number of Credits : 3
Prerequisites (Course code) : NONE
Course Type : GIR

Course Learning Objective
- To expose the students to the basics of real analysis and partial differential equations required for their subsequent course work.

Course Content
Functions of real variables, Limits, continuity and differentiability, Taylor’s formula, Extrema of functions.
Riemann integral, mean value theorems, Differentiation under integral sign, Change-of-variables formula, Sequences and series of functions, Point wise and uniform convergence.
Method of separation of variables-Fourier series solution applications to one dimensional wave equation and one-dimensional heat flow equation.
Laplace and Helmholtz equations, Boundary and initial value problems, Solution by separation of variables and Eigen Function Expansion.

Text Books

Reference Books

Course outcomes
At the end of the course student will be able
CO1: Develops an understanding for the construction of proofs and an appreciation for deductive logic.
CO2: Explore the already familiar properties of the derivative and the Riemann Integral, set on a more rigorous and formal footing which is central to avoiding inconsistencies in engineering applications.
CO3: Explore new theoretical dimensions of uniform convergence, completeness and important consequences as interchange of limit operations.
CO4: Develop an intuition for analysing sets of higher dimension (mostly of the $\mathbb{R}^n$ type) space.
CO5: Solve the most common PDEs, recurrent in engineering using standard techniques and understanding of an appreciation for the need of numerical techniques.
Course Code : MAIR 45  
Course Title : PROBABILITY THEORY AND RANDOM PROCESS  
Number of Credits : 3  
Prerequisites (Course code) : MAIR 34  
Course Type : GIR

Course Learning Objective

- To expose the students to the basics of probability theory and random processes essential for their subsequent study of analog and digital communication.

Course Content


Random variables and random vectors. Distributions and densities. Independent random variables. Functions of one and two random variables.

Moments and characteristic functions. Inequalities of Chebyshev and Schwartz. Convergence concepts.


Text Books


Reference Books


Course outcomes

At the end of the course student will be able

CO1: understand the axiomatic formulation of modern Probability Theory and think of random variables as an intrinsic need for the analysis of random phenomena.

CO2: characterize probability models and function of random variables based on single & multiples random variables.

CO3: evaluate and apply moments & characteristic functions and understand the concept of inequalities and probabilistic limits.

CO4: understand the concept of random processes and determine covariance and spectral density of stationary random processes.

CO5: demonstrate the specific applications to Poisson and Gaussian processes and representation of low pass and band pass noise models.
Course Code : ECPC10
Course Title : SIGNALS AND SYSTEMS
Number of Credits : 4
Prerequisites (Course code) : NONE
Course Type : PC

Course Learning Objectives
- Understanding the fundamental characteristics of signals and systems.
- Understanding the concepts of vector space, inner product space and orthogonal series.
- Understanding signals and systems in terms of both the time and transform domains, taking advantage of the complementary insights and tools that these different perspectives provide.
- Development of the mathematical skills to solve problems involving convolution, filtering, modulation and sampling.

Course Content

Continuous-time signals, classifications. Periodic signals. Fourier series representation, Hilbert transform and its properties.


Text Books

Reference Books

Course outcomes
At the end of the course student will be able
CO1: apply the knowledge of linear algebra topics like vector space, basis, dimension, inner product and orthogonal basis to signals.
CO2: analyse the spectral characteristics of continuous-time periodic and a periodic signals using Fourier analysis.
CO3: classify systems based on their properties and determine the response of LSI system using convolution.
CO4: analyse system properties based on impulse response and Fourier analysis.
CO5: apply the Laplace transform and Z- transform for analyze of continuous-time and discrete-time signals and systems.
CO6: understand the process of sampling and the effects of under sampling.

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<td>Course Title</td>
<td>NETWORK ANALYSIS AND SYNTHESIS</td>
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**Course Learning Objectives**
- To make the students capable of analysing any given electrical network.
- To make the students to learn synthesis of an electrical network for a given impedance/admittance function.

**Course Content**


**Text Books**

**Reference Books**

**Course outcomes**
At the end of the course student will be able
- CO1: analyse the electric circuit using network theorems
- CO2: understand and Obtain Transient & Forced response
- CO3: determine Sinusoidal steady state response; understand the real time applications of maximum power transfer theorem and equalizer
- CO4: understand the two–port network parameters, are able to find out two-port network parameters & overall response for interconnection of two-port networks.
- CO5: synthesize one port network using Foster form, Cauer form.
Course Code: ECPC12
Course Title: ELECTRODYNAMICS AND ELECTROMAGNETIC WAVES
Number of Credits: 4
Prerequisites (Course code): NONE
Course Type: PC

Course Learning Objective

- To expose the students to the rudiments of Electromagnetic theory and wave propagation essential for subsequent courses on microwave engineering, antennas and wireless communication

Course Content


Text Books


Reference Books


Course outcomes

At the end of the course student will be able

CO1: recognize and classify the basic Electrostatic theorems and laws and to derive them.
CO2: discuss the behaviour of Electric fields in matter and Polarization concepts.
CO3: classify the basic Magneto static theorems and laws and infer the magnetic properties of matter.
CO4: summarize the concepts of electrodynamics &to derive and discuss the Maxwell’s equations.
CO5: students are expected to be familiar with Electromagnetic wave propagation and wave polarization.
Course Code : ECPC13
Course Title : SEMICONDUCTOR PHYSICS AND DEVICES
Number of Credits : 3
Prerequisites (Course code) : NONE
Course Type : PC

Course Learning Objectives
- To make the students understand the fundamentals of electronic devices.
- To train them to apply these devices in mostly used and important applications.

Course Content
Semiconductor materials: crystal growth, film formation, lithography, etching and doping. Formation of energy bands in solids, Concept of hole, Intrinsic and extrinsic semiconductors, conductivity, Equilibrium Carrier concentration, Density of states and Fermi level, Carrier transport – Drift and Diffusion, continuity equation, Hall effect and its applications.

P-N junction diodes, Energy band diagram, biasing, V-I characteristics, capacitances. Diode models, Break down Mechanisms, Rectifiers, Limiting and Clamping Circuits, types of diodes.

BJT Physics and Characteristics modes of operation, Ebers-Moll Model, BJT as a switch and Amplifier, breakdown mechanisms, Photo devices.

MOSFET: Ideal I-V characteristics, non-ideal I-V effects, MOS Capacitor, MOSFET as switch, CMOS Logic gate Circuits, Bi-CMOS circuits, CCDs.

Power devices, operation and characteristics. Thyristor family. Power diodes. Power transistors. Display devices, Operation of LCDs, Plasma, LED and HDTV

Text Books
1. S.M.Sze, Semiconductors Devices, Physics and Technology, (2/e), Wiley, 2002

Reference Books

Course outcomes
At the end of the course student will be able
- CO1: Apply the knowledge of basic semiconductor material physics and understand fabrication processes.
- CO2: Analyze the characteristics of various electronic devices like diode, transistor etc.,
- CO3: Classify and analyze the various circuit configurations of Transistor and MOSFETs.
- CO4: Illustrate the qualitative knowledge of Power electronic Devices.
- CO5: Become Aware of the latest technological changes in Display Devices.
Course Code : ECPCT4
Course Title : DIGITAL CIRCUITS AND SYSTEMS
Number of Credits : 3
Prerequisites (Course code) : NONE
Course Type : PC

Course Learning Objective

- To introduce the theoretical and circuit aspects of digital electronics, which is the back bone for the basics of the hardware aspect of digital computers

Course Content

Review of number systems-representation-conversions, error detection and error correction. Review of Boolean algebra- theorems, sum of product and product of sum simplification, canonical forms-min term and max term, Simplification of Boolean expressions-Karnaugh map, completely and incompletely specified functions, Implementation of Boolean expressions using universal gates.

Combinational logic circuits- adders, subtrators, BCD adder, ripple carry look ahead adders, parity generator, decoders, encoders, multiplexers, de-multiplexers, Realization of Boolean expressions- using decoders-using multiplexers. Memories – ROM- organization, expansion. PROMs. Types of RAMs – Basic structure, organization, Static and dynamic RAMs, PLDs, PLAs.


Synchronous circuit analysis and design: structure and operation, analysis-transition equations, state tables and state diagrams, Modelling- Moore machine and Mealy machine- serial binary adder, sequence recogniser, state table reduction, state assignment. Hazard; Overview and comparison of logic families.

Introduction to Verilog HDL, Structural, Dataflow and behavioural modelling of combinational and sequential logic circuits.

Text Books


Reference Books


Course outcomes

At the end of the course student will be able

CO1: Apply the knowledge of Boolean algebra and simplification of Boolean expressions to deduce optimal digital networks.

CO2: Study and examine the SSI, MSI and Programmable combinational networks.

CO3: Study and investigate the sequential networks suing counters and shift registers; summarize the performance of logic families with respect to their speed, power consumption, number of ICs and cost.

CO4: Work out SSI and MSI digital networks given a state diagram based on Mealy and Moore configurations.

CO5: Code combinational and sequential networks using Virology HDL.
Course Code: ECPC15  
Course Title: DIGITAL SIGNAL PROCESSING  
Number of Credits: 4  
Prerequisites (Course code): ECPC10  
Course Type: PC

Course Learning Objective
- The subject aims to introduce the mathematical approach to manipulate discrete time signals, which are useful to learn digital tele-communication.

Course Content
Review of VLSI system theory, DTFT, Frequency response of discrete time systems, all pass inverse and minimum phase systems.

DFT, Relationship of DFT to other transforms, FFT, DIT and DIF, FFT algorithm, Linear filtering using DFT and FFT.

Frequency response of FIR filter types, Design of FIR filters, IIR filter design, Mapping formulas, Frequency transformations.

Direct form realization of FIR and IIR systems, Lattice structure for FIR and IIR systems, Finite word length effects. Limit cycle oscillations.

Sampling rate conversion by an integer and rational factor, Poly phase FIR structures for sampling rate conversion.

Text Books

Reference Books

Course outcomes
At the end of the course student will be able
- CO1: analyze discrete-time systems in both time & transform domain and also through pole-zero placement.
- CO2: analyze discrete-time signals and systems using DFT and FFT.
- CO3: design and implement digital finite impulse response (FIR) filters.
- CO4: design and implement digital infinite impulse response (IIR) filters.
- CO5: understand and develop multirate digital signal processing systems.
Course Code         : ECPC16
Course Title        : TRANSMISSION LINES AND WAVEGUIDES
Number of Credits   : 3
Prerequisites (Course code) : ECPC12
Course Type         : PC

Course Learning Objective
- To expose students to the complete fundamentals and essential feature of waveguides, resonators and microwave components and also able to give an introduction to microwave integrated circuit design.

Course Content
Classification of guided wave solutions-TE, TM and TEM waves. Field analysis transmission lines.


Impedance transformation and matching. Smith Chart, Quarter-wave and half-wave transformers. Binomial and Tchebyshev transformers. Single, double and triple stub matching.


Text Books

Reference Books

Course outcomes
At the end of the course student will be able
- CO1: classify the Guided Wave solutions -TE, TM, and TEM.
- CO2: analyze and design rectangular waveguides and understand the propagation of electromagnetic waves.
- CO3: evaluate the resonance frequency of cavity Resonators and the associated modal field.
- CO4: analyze the transmission lines and their parameters using the Smith Chart.
- CO5: apply the knowledge to understand various planar transmission lines.
Course Code : ECPC17
Course Title : ELECTRONIC CIRCUITS
Number of Credits : 3
Prerequisites (Course code) : ECPC13
Course Type : PC

Course Learning Objective
- To make the students understand the fundamentals of electronic circuits.

Course Content
Load line, operating point, biasing methods for BJT and MOSFET. Low frequency and high models of BJT and MOSFET, Small signal Analysis of CE, CS, CD and Cascade amplifier

MOSFET amplifiers: Current mirrors: Basic current mirror, Cascade current mirror, Single-ended amplifiers: CS amplifier – with resistive load, diode connected load, current source load, triode load, source degeneration. CG and CD amplifiers, Cascade amplifier,

Frequency response of amplifiers, Differential Amplifiers, CMRR, Differential amplifiers with active load, two stage amplifiers

Feedback concept, Properties, Feedback amplifiers, Stability analysis, Condition for oscillation, Sinusoidal oscillators.

Power amplifiers- class A, class B, class AB, Biasing circuits, class C and class D

Text Books

Reference Books

Course outcomes
At the end of the course student will be able
CO1: illustrate about rectifiers, transistor and FET amplifiers and its biasing. Also compare the performances of its low frequency models.
CO 2: discuss about the frequency response of MOSFET and BJT amplifiers.
CO 3: illustrate about MOS and BJT differential amplifiers and its characteristics.
CO4: discuss about the feedback concepts and construct feedback amplifiers and oscillators. Also summarizes its performance parameters.
CO 5: explain about power amplifiers and its types and also analyze its characteristics.
Course Code: ECPC18
Course Title: MICROPROCESSORS AND MICRO CONTROLLERS
Number of Credits: 3
Prerequisites (Course code): ECPC14
Course Type: PC

Course Learning Objective
- This subject deals about the basics of 16-bit Microprocessor, 8-bit and 16-bit Micro controllers, their architectures, internal organization and their functions, peripherals, and interfacing.

Course Content


Text Books

Reference Books

Course outcomes
At the end of the course student will be able to
CO1: recall and apply the basic concept of digital fundamentals to Microprocessor based personal computer system.
CO2: identify the detailed s/w & h/w structure of the Microprocessor.
CO3: illustrate how the different peripherals are interfaced with Microprocessor.
CO4: distinguish and analyze the properties of Microprocessors & Microcontrollers.
CO5: analyze the data transfer information through serial & parallel ports.
Course Code : ECPC19
Course Title : STATISTICAL THEORY OF COMMUNICATION
Number of Credits : 4
Prerequisites (Course code) : MAIR 45
Course Type : PC

Course Learning Objective
- The subject aims to make the students to understand the statistical theory of telecommunication, which are the basics to learn analog and digital telecommunication.

Course Content


Coherent signal detection in the presence of additive white and non-white Gaussian noise. Matched filter.


Text Books

Reference Books

Course outcomes
At the end of the course student will be able
- CO1: show how the information is measured and able to use it for effective coding.
- CO2: summarize how the channel capacity is computed for various channels.
- CO3: use various techniques involved in basic detection and estimation theory to solve the problem.
- CO4: summarize the applications of detection theory in telecommunication.
- CO5: summarize the application of estimation theory in telecommunication.
Course Code : ECPC20
Course Title : DIGITAL SIGNAL PROCESSORS AND APPLICATIONS
Number of Credits : 3
Prerequisites (Course code) : ECPC15
Course Type : PC

Course Learning Objective

- To give an exposure to the various fixed point and floating point DSP architectures, to understand the techniques to interface sensors and I/O circuits and to implement applications using these processors.

Course Content


Text Books


Reference Books

Course outcomes
At the end of the course student will be able
  CO1: learn the architecture details of fixed point DSPs.
  CO2: learn the architecture details of floating point DSPs
  CO3: infer about the control instructions, interrupts, pipeline operations, memory and
        buses.
  CO4: illustrate the features of on-chip peripheral devices and its interfacing with real time
        application devices.
  CO5: learn to implement the signal processing algorithms and applications in DSPs
Course Code : ECPC21
Course Title : ANALOG COMMUNICATION
Number of Credits : 3
Prerequisites (Course code) : ECPC10
Course Type : PC

Course Learning Objective
- To develop a fundamental understanding on Communication Systems with emphasis on analog modulation techniques and noise performance.

Course Content


Noise - Internal and External Noise, Noise Calculation, Noise Figure. Noise in linear and nonlinear AM receivers, Threshold effect.

Noise in FM receivers, Threshold effect, Capture effect, FM Threshold reduction, Pre-emphasis and De-emphasis.


Text Books

Reference Books

Course outcomes
At the end of the course student will be able
- CO1: Understand the basics of communication system and analog modulation techniques
- CO2: Apply the basic knowledge of signals and systems and understand the concept of Frequency modulation.
- CO3: Apply the basic knowledge of electronic circuits and understand the effect of Noise in communication system and noise performance of AM system
- CO4: Understand the effect of noise performance of FM system.
- CO5: Understand TDM and Pulse Modulation techniques.
Course Learning Objective

- To impart knowledge on basics of antenna theory and to analyze and design a start of art antenna for wireless communications.

Course Content


Wave Propagation: Propagation in free space. Propagation around the earth, surface wave propagation, structure of the ionosphere, propagation of plane waves in ionized medium, Determination of critical frequency, MUF. Fading, tropospheric propagation, Super refraction.

Text Books

Reference Books

Course outcomes
At the end of the course student will be able

CO1: select the appropriate portion of electromagnetic theory and its application to antennas.

CO2: distinguish the receiving antennas from transmitting antennas, analyze and justify their characteristics.

CO3: assess the need for antenna arrays and mathematically analyze the types of antenna arrays.

CO4: distinguish primary from secondary antennas and analyze their characteristics by applying optics and acoustics principles.

CO5: outline the factors involved in the propagation of radio waves using practical antennas.
Course Code: ECPC23
Course Title: ANALOG INTEGRATED CIRCUITS
Number of Credits: 3
Prerequisites (Course code): ECPC17
Course Type: PC

Course Learning Objective

- To introduce the theoretical & circuit aspects of an Op-amp.

Course Content

Active filters: Second order filter transfer function (low pass, high pass, band pass and band reject), Butterworth, Chebyshev and Bessel filters. Switched capacitor filter. Notch filter, all pass filters, self-tuned filters

Opamp as a comparator, Schmitt trigger, Astable and monostable multivibrators, Triangular wave generator, Multivibrators using 555 timer, Data converters: A/D and D/A converters

PLL- basic block diagram and operation, four quadrant multipliers. Phase detector, VCO, Applications of PLL: Frequency synthesizers, AM detection, FM detection and FSK demodulation.

CMOS differential amplifiers: DC analysis and small signal analysis of differential amplifier with Resistive load, current mirror load and current source load. Input common-mode range and Common-mode feedback circuits. OTAs Vs Opamps. Slew rate, CMRR, PSRR. Two stage amplifiers, Compensation in amplifiers (Dominant pole compensation).

Text Books
2. Sedra and Smith, Microelectronics Circuits, Oxford Univ. Press, 2004

Reference Books

Course outcomes
At the end of the course student will be able

CO1: infer the DC and AC characteristics of operational amplifiers and its effect on output and their compensation techniques.
CO2: elucidate and design the linear and nonlinear applications of an op-amp and special application ICs.
CO3: explain and compare the working of multi vibrators using special application IC 555 and general purpose op-amp.
CO4: classify and comprehend the working principle of data converters.
CO5: illustrate the function of application specific ICs such as Voltage regulators, PLL and its application in communication.
Course Code : ECPC24
Course Title : DIGITAL COMMUNICATION
Number of Credits : 3
Prerequisites (Course code) : ECPC21
Course Type : PC

Course Learning Objectives
- To understand the key modules of digital communication systems with emphasis on digital modulation techniques.
- To get introduced to the basics of source and channel coding/decoding and Spread Spectrum Modulation.

Course Content

BASK, BFSK, and BPSK- Transmitter, Receiver, Signal space diagram, Error probabilities.

M-ary PSK, M-ary FSK, QAM, MSK and GMSK- Optimum detector, Signal constellation, error probability.

Linear block codes- Encoding and decoding. Cyclic codes – Encoder, Syndrome Calculator. Convolutional codes – encoding, Viterbi decoding. TCM.

Spread Spectrum (SS) Techniques- Direct Sequence Spread Spectrum modulation, Frequency-hop Spread Spectrum modulation - Processing gain and jamming margin.

Text Books

Reference Books

Course outcomes
At the end of the course student will be able
CO1: Apply the knowledge of signals and system and explain the conventional digital communication system.
CO2: Apply the knowledge of statistical theory of communication and evaluate the performance of digital communication system in the presence of noise.
CO3: Describe and analyze the performance of advance modulation techniques.
CO4: Apply the knowledge of digital electronics and describe the error control codes like block code, cyclic code.
CO5: Describe and analyze the digital communication system with spread spectrum modulation.
Course Code : ECPC25
Course Title : MICROWAVE COMPONENTS AND CIRCUITS
Number of Credits : 3
Prerequisites (Course code) : ECPC16
Course Type : PC

Course Learning Objective
- The subject introduces the essential Microwave Circuit Theory and the design aspects of Microwave Integrated Circuit components.

Course Content
Scattering matrix formulation. Passive microwave devices; terminations, bends, corners, attenuators, phase changers, directional couplers and hybrid junctions. Basics and design considerations of Microstrip line, strip line, coplanar waveguide, Slot line and Fin line.

Microwave measurements; frequency, wavelength, VSWR. Impedance determination. S-parameter measurements. Network analyzer.


MIC filter design. Low pass to high pass, band pass and band stop transformations. Realization using micro strip lines and strip lines.

Design and realization of MIC components.3 dB hybrid design. Rat race Hybrid Ring, Backward wave directional coupler, power divider; realization using micro strip lines and strip lines.

Text Books

Reference Books

Course outcomes
At the end of the course student will be able
- CO1: Learn the basics of S parameters and use them in describing the components
- CO2: Expose to the Microwave Measurements Principle
- CO3: Realize the importance of the theory of Microwave circuit theory.
- CO4: Work out the complete design aspects of various M.I.C. Filters
- CO5: Confidently design all M.I.C. components to meet the industry standard
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<td>Course Title</td>
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**Course Learning Objective**

- To introduce various aspects of VLSI circuits and their design including testing.

**Course Content**

VLSI design methodology, VLSI technology - NMOS, CMOS and BICMOS circuit fabrication. Layout design rules. Stick diagram. Latch up.

Characteristics of MOS and CMOS switches. Implementation of logic circuits using MOS and CMOS technology, multiplexers and memory, MOS transistors, threshold voltage, MOS device design equations. MOS models, small-signal AC analysis. CMOS inverters, propagation delay of inverters, Pseudo NMOS, Dynamic CMOS logic circuits, power dissipation.

Programmable logic devices - anti fuse, EPROM and SRAM techniques. Programmable logic cells. Programmable inversion and expander logic. Computation of interconnect delay, Techniques for driving large off-chip capacitors, long lines. Computation of interconnect delays in FPGAs Implementation of PLD, EPROM, EEPROM, static and dynamic RAM in CMOS.

An overview of the features of advanced FPGAs, IP cores, Soft core processors. Various factors determining the cost of a VLSI, Comparison of ASICs, FPGAs, PDSPs and CBICs. Fault tolerant VLSI architectures

VLSI testing - need for testing, manufacturing test principles, design strategies for test, chip level and system level test techniques.

**Text Books**


**Reference Books**


**Course outcomes**

At the end of the course student will be able

CO1: Describe the techniques used for VLSI fabrication, design of CMOS logic circuits, switches and memory

CO2: Describe the techniques used the design of CMOS logic circuits, switches and memory in VLSI

CO3: Generalize the design techniques and analyze the characteristics of VLSI circuits such as area, speed and power dissipation

CO4: Explain and compare the architectures for FPGA, PAL and PLDs and evaluate their characteristics such as area, power dissipation and reliability

CO5: Use the advanced FPGAs to realize Digital signal processing systems

CO6: Describe the techniques for fault tolerant VLSI circuits

CO6: Explain and compare the techniques for chip level and board level testing
Course Learning Objective

- To get an understanding of mobile radio communication principles, types and to study the recent trends adopted in cellular and wireless systems and standards.

Course Content


Path loss prediction over hilly terrain. Practical link budget design using Path loss models. Design parameters at base station. Antenna location, spacing, heights and configurations.

Multiple access techniques; FDMA, TDMA and CDMA. Spread spectrum. Power control. WCDMA, CDMA network design. OFDM and MC-CDMA.


Text Books:

Reference Books:

Course outcomes
At the end of the course student will be able
CO1: Apply the knowledge of basic communication systems and its principles.
CO2: Describe the cellular concept and analyze capacity improvement Techniques.
CO3: Mathematically analyze mobile radio propagation mechanisms.
CO4: Summarize diversity reception techniques.
CO5: Design Base Station (BS) parameters and analyze the antenna configurations.
CO6: Analyze and examine the multiple access techniques and its application.
CO7: Assess the latest wireless technologies.
Course Code : ECPC28
Course Title : FIBER OPTIC COMMUNICATION
Number of Credits : 3
Prerequisites (Course code) : ECPC12 & ECPC21
Course Type : PC

Course Learning Objective

- To expose the students to the basics of signal propagation through optical fibers, fiber impairments, components, devices and system design.

Course Content


Text Books


Reference Books


Course outcomes

At the end of the course student will be able

CO1: Recognize and classify the structures of Optical fiber and types.
CO2: Discuss the channel impairments like losses and dispersion.
CO3: Classify the Optical sources and calculate various coupling losses.
CO4: Classify detectors and to design a fiber optic link.
CO5: Familiar with concepts of WDM, optical amplifiers and Soliton Propagation.
Course Code : ECPC29
Course Title : MICROWAVE ELECTRONICS
Number of Credits : 3
Prerequisites (Course code) : ECPC25
Course Type : PC

Course Learning Objective

- To impart knowledge on basics of microwave electron beam devices and their applications in X band frequency.

Course Content

Limitations of conventional vacuum tubes, Klystrons: Re-entrant cavities, Two cavity klystron, Velocity modulation process, Bunching process, Power output and efficiency; Multi-cavity klystron, Reflex klystron-Velocity modulation process, Mode Characteristics, Electronic admittance spiral.

Travelling-wave tubes: Slow-wave structures, Helix TWT- Amplification process, Convection current, Wave modes and gain; coupled cavity TWT, Backward wave oscillator.

Crossed-field devices: Magnetrons- Principle of operation, characteristics, Hull cut-off condition; Carcinotron, Gyrotron.

Microwave transistors and FETs: Microwave bipolar transistors-Physical structures, characteristics, Power-frequency limitations; Microwave tunnel diode, Microwave unipolar transistor – Physical structure, principle of operation, characteristics, High electron-mobility transistors.

Transferred electron and Avalanche transit-time devices: Gunn diode, Gunn diode as an oscillator. IMPATT, TRAPATT and BARITT.

Text Books


Reference Books


Course outcomes

At the end of the course student will be able

CO1: Apply the basic knowledge of waveguide and microwave resonator circuits.
CO2: Asses the methods used for generation and amplification of the microwave power.
CO3: Distinguish between the linear and cross field electron beam microwave tubes.
CO4: Critically analyze the operating principles and performances of the microwave semiconductor devices.
CO5: Identify the suitable microwave power sources of given specification for the selected application.
CO6: Aware of current technological changes in the engineering aspects of microwave components.
Course Code: ECPE10
Course Title: PRINCIPLES OF RADAR
Number of Credits: 3
Prerequisites (Course code): ECPC19
Course Type: PE

Course learning Objective

- To expose the students to the working principles of a radar from a signal processing perspective.

Course content


Radar detection. Optimum Bayesian decision rules. Detection criteria for different target models.


Angle measurement and tracking. Angle measurement and tracking by conical scan and mono pulse. Optimum mono pulse systems.

Text Books


Reference Books

4. Recent literature in Principles of Radar.

Course outcomes

At the end of the course student will be able

CO1: Understand the principle behind radar range equation and different types of targets available.
CO2: Appreciate the different compression techniques of radar pulse signals.
CO3: Distinguish between different detection methods of radar signals.
CO4: Appreciate the building blocks for optimum receiver and Doppler measurements.
CO5: Understand the tracking and scanning methods in the mono pulse systems.
Course learning Objectives

- To introduce and to make understand the radio propagation channel for Earth station to satellite & satellite to Earth station.
- To introduce various aspects in the design of communication & multiple access systems for satellite communication.
- To introduce the concept of launchers and design of Earth station and satellite link.

Course content


Elements of communication satellite design. Spacecraft subsystems. Reliability considerations. Spacecraft integration.

Multiple access techniques. FDMA, TDMA, CDMA. Random access techniques. Satellite on-board processing.

Satellite Link Design: Performance requirement and standards. Laser Satellite Communication: Link analysis, optical satellite link transmitter, optical satellite link receiver, satellite beam acquisition, tracking & positioning, deep space optical communication link.

Earth station design. Configurations. Antenna and tracking systems. Satellite broadcasting. GPS. VSAT.

Text Books


Reference Books

4. Recent literature in Satellite Communication.

Course outcomes

At the end of the course student will be able
CO1: learn the dynamics of the satellite.
CO2: learn the spacecraft and subsystems.
CO3: understand how analog and digital technologies are used for satellite communication networks.
CO4: understand the radio frequency channel from Earth station to Satellite.
CO5: study the design of Earth station and tracking of the satellites.
Course Code : ECPE12
Course Title : COGNITIVE RADIO
Number of Credits : 3
Prerequisites (Course code) : ECPC15
Course Type : PE

Course learning Objective

- This subject introduces the fundamentals of multi rate signal processing and cognitive radio.

Course content


Text Books


Reference Books

7. Recent literature in Cognitive Radio

Course outcomes

At the end of the course student will be able

CO1: gain knowledge on multi-rate systems.
CO2: develop the ability to analyze, design, and implement any application using FPGA.
CO3: be aware of how signal processing concepts can be used for efficient FPGA based system design.
CO4: understand the rapid advances in Cognitive radio technologies.
CO5: explore DDFS, CORDIC and its application.
Course Code : ECPE13
Course Title : MULTIMEDIA COMMUNICATION TECHNOLOGY
Number of Credits : 3
Prerequisites (Course code) : ECPC15
Course Type : PE

Course learning Objective

- To made the students to understand various encoding and decoding techniques of audios and videos in multimedia systems.

Course content

Components of multimedia system, Desirable features, Applications of multimedia systems, Introduction to different types, Multimedia storage device.


Feature of MPEG 1, structure of encoding and decoding process, MPEG 2 enhancements, and different blocks of MPEG video encoder.


Text Books


Reference Books

2. Recent literature in Multimedia Communication Technology.

Course outcomes

At the end of the course student will be able

CO1: analyze various components of the multimedia systems and its storage devices.
CO2: appreciate the different coding standards for the digital audio and musical synthesizers.
CO3: understand the various types of DCT based image encoding algorithms.
CO4: understand the encoding and decoding process of the MPEG standards.
CO5: analyze the different content based video processing techniques.
Course Code : ECPE14
Course Title : COMMUNICATION SWITCHING SYSTEMS
Number of Credits : 3
Prerequisites (Course code) : ECPC21
Course Type : PE

Course learning Objective
- To understand the working principles of switching systems from manual and electromechanical systems to stored program control systems.

Course content
Basic elements of communication network. Switching systems. Signaling and signaling functions.


Space division switching. Multiple-stage switching. Design examples. Switching matrix control. Time division switching. Multiple-stage time and spaces witching.


Text Books

Reference Books
4. Recent literature in Communication Switching Systems.

Course outcomes
At the end of the course student will be able
- CO1: explain the working principle of switching systems involved in telecommunication switching
- CO2: assess the need for voice digitization and T Carrier systems
- CO3: compare and analyze Line coding techniques and examine its error performance
- CO4: design multi stage switching structures involving time and space switching stages
- CO5: analyze basic telecommunication traffic theory
Course Code : ECPE15  
Course Title : BROADBAND ACCESS TECHNOLOGIES  
Number of Credits : 3  
Prerequisites (Course code) : ECPC21 & ECPC24  
Course Type : PE  

Course learning Objective

- To impart fundamentals and latest technologies related to the design of broadband last mile Access technologies for multimedia communication

Course content

Wired access technologies using Phone line modem, ISDN modem. Comparison-Cable, DSL, fiber and wireless access technologies.

Last mile copper access, Flavors of Digital subscriber lines, DSL deployment, Common local loop impairments, discrete multi-tone modulation, VDSL deployment and frequency plans. Standards for XDSL and comparison.

Last mile HFC access, Cable modems. Modulation schemes, DOCSIS. Standards-comparison, physical and MAC layer protocols for HFC networks, ATM and IP-centric modem. Switched digital video.

Fiber access technologies and architectures. ATM passive optical networks, Upstream and downstream transport, Frame format, Ethernet passive optical network, Gigabit passive optical networks.

Survey on emerging broadband wireless access technologies. LMDS, MMDS, WIMAX and WIFI, Satellite technologies serving as last mile solutions, Wireless LAN, Wireless personal area networking, 3G and 4G wireless systems.

Text Books

1. N. Jayant, “Broadband last mile”-Taylor and Francis group, 2005  

Reference Books

5. DOCSIS 2.0 “Radio frequency interface specification” www.cablemodem.com  
7. Recent literature in Broadband Access Technologies.

Course outcomes

At the end of the course student will be able

CO1: recall and identify the basics of broadband technology systems and differentiate the differences between the various wired and wireless technology system

CO2: illustrate the aspects of last mile data transport on copper wire networks and flavors of DSL
CO3: summarize the versions of cable network standard and MAC protocols for HFC networks
CO4: distinguish the cost effective broadband services for residential users and ATM based and Ethernet based passive optical networks
CO5: outline the types of broadband wireless access technologies and their characteristics.

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<thead>
<tr>
<th>Course Code</th>
<th>ECPE16</th>
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<tbody>
<tr>
<td>Course Title</td>
<td>DIGITAL SIGNAL PROCESSING FOR WIRELESS COMMUNICATION</td>
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<tr>
<td>Number of Credits</td>
<td>3</td>
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<tr>
<td>Prerequisites (Course code)</td>
<td>ECPC15</td>
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<td>Course Type</td>
<td>PE</td>
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</table>

**Course learning Objective**

- The subject aims to make the students to understand the signal processing approach for wireless communication

**Course content**

Physical model for wireless channel- Input /Output models for wireless channel: System function and impulse response of LTV system-Doppler spread-Coherence time-Delay spread-Coherence frequency-Base band system functions and impulse response.

Statistical channel model-Binary detection in flat Rayleigh fading- Non-coherent detection in flat Rician fading-Channel measurement-Use of probing signals to estimate the channel- Rake receiver-Jakes model- Jakes spectrum-Ground reflections-Okumura model-Log normal shadowing- Hata model.

Cellular communication-Frequency reuse- Practical Link budget design using path loss models- Design parameters at base station-Antennal location, spacing, heights and configurations- Tele traffic theory.

Multiple access techniques: TDMA, FDMA, CDMA: PN sequences-Multipath diversity-Rake receiver- Receiver synchronization-Multicarrier modulation. Orthogonal frequency division Multiplexing (OFDM): Cyclic prefix-Frequency offset-Peak to average power ratio problem.


**Textbooks**


**Reference Books**

5. A. K.Jagannatham,” Advanced 3G and 4G wireless mobile communications“, IIT Kanpur, NPTEL Video lectures [http://nptel.iitm.ac.in](http://nptel.iitm.ac.in)
6. Recent literature in Digital Signal Processing for Wireless Communication.

**Course outcomes**

At the end of the course student will be able

CO1: describe the Coherence time, Coherence frequency, Doppler spread and Delay spread
Course Code : ECPE17
Course Title : MICROWAVE INTEGRATED CIRCUIT DESIGN
Number of Credits : 3
Prerequisites (Course code) : ECPC16 & ECPC25
Course Type : PE

Course learning Objective
- To impart knowledge on basics of microwave electron beam devices and their applications in X band frequency.

Course content
Design and realization of power dividers, hybrids, directional couplers etc using strip lines and micro strip lines.


Transistor oscillator's .Active devices for microwave oscillators. Three port S parameter characterization of transistors. Oscillation and stability conditions.


Text Books

Reference Books
4. Recent literature in Microwave Integrated Circuit Design.

Course outcomes
At the end of the course student will be able
- CO1: the topics will make students design of the important and essential M.I.C components
- CO2: Filter is the most needed circuit for many applications and the unit will make the student confident in filter design
- CO3:All aspects and different parameters, design factors and properties will me made thorough
- CO4: One will be confident to handle any oscillator design
- CO5: The student will become familiar and confident in the design of Mixers, the other essential circuits.
Course Code: ECPE18
Course Title: RF MEMS CIRCUIT DESIGN
Number of Credits: 3
Prerequisites (Course code): ECPC16 & ECPC25
Course Type: PE

Course learning Objective
- To impart knowledge on basics of MEMS and their applications in RF circuit design.

Course content


Text Book

Reference Books
3. Recent literature in RF MEMS Circuit Design.

Course outcomes
At the end of the course student will be able
- CO1: learn the Micromachining Processes
- CO2: learn the design and applications of RF MEMS inductors and capacitors.
- CO3: learn about RF MEMS Filters and RF MEMS Phase Shifters.
- CO4: learn about the suitability of micro machined transmission lines for RF MEMS
- CO5: learn about the Micro machined Antennas and Reconfigurable Antennas
**Course Learning Objective**

- To expose the students to all aspects of electronic packaging including electrical, thermal, mechanical and reliability issues.

**Course Content**

Functions of an Electronic Package, Packaging Hierarchy, IC packaging: MEMS packaging, consumer electronics packaging, medical electronics packaging, Trends, Challenges, Driving Forces on Packaging Technology, Materials for Microelectronic packaging, Packaging Material Properties, Ceramics, Polymers, and Metals in Packaging, Material for high density interconnect substrates

Overview of Transmission line theory, Clock Distribution, Noise Sources, power Distribution, signal distribution, EMI; crosstalk and non-ideal effects; signal integrity: impact of packages, via, traces, connectors; non-ideal return current paths, high frequency power delivery, simultaneous switching noise; system-level timing analysis and budgeting; methodologies for design of high speed buses; radiated emissions and minimizing system noise.


**Text Book**

Reference Books

4. R.G. Kaduskar and V.B.Baru, Electronic Product design, Wiley India, 2011
6. Recent literature in Electronic Packaging.

Course outcomes
At the end of the course student will be able
   CO1: Design of PCBs which minimize the EMI and operate at higher frequency.
   CO2: Enable design of packages which can withstand higher temperature, vibrations and shock.
Course Code : ECPE20
Course Title : DIGITAL SPEECH PROCESSING
Number of Credits : 3
Prerequisites (Course code) : NONE
Course Type : PE

Course learning Objective
- The purpose of this course is to explain how DSP techniques could be used for solving problems in speech communication.

Course content

Feature extraction of the speech signal: Endpoint detection-Dynamic time warping- Pitch frequency estimation: Autocorrelation approach- Homomorphic approach-Formant frequency estimation using vocal tract model and Homomorphic approach-Linear predictive co-efficient -Poles of the vocal tract-Reflection co-efficient-Log Area ratio.

Cepstrum- Line spectral frequencies- Functional blocks of the ear- Mel frequency cepstral co-efficient- Spectrogram-Time resolution versus frequency resolution-Discrete wavelet transformation.


Text Books
1. L.R.Rabiner and R.W.Schafer, "Introduction to Digital speech processing", now publishers USA,2007

Reference Books
4. Recent literature in Digital speech processing.

Course outcomes
At the end of the course student will be able
CO1: illustrate how the speech production is modeled
CO2: summarize the various techniques involved in collecting the features from the speech signal in both time and frequency domain
CO3: summarize the functional blocks of the ear
CO4: compare the various pattern recognition techniques involved in speech and speaker detection
CO5: summarize the various speech compression techniques

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<tr>
<th>Course Code</th>
<th>ECPE21</th>
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<tbody>
<tr>
<td>Course Title</td>
<td>DIGITAL IMAGE PROCESSING</td>
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<tr>
<td>Number of Credits</td>
<td>3</td>
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<tr>
<td>Prerequisites (Course code)</td>
<td>NONE</td>
</tr>
<tr>
<td>Course Type</td>
<td>PE</td>
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</tbody>
</table>

**Course learning Objective**
- To treat the 2D systems as an extension of 1D system design and discuss techniques specific to 2D systems.

**Course content**
Linearity and space-invariance. PSF, Discrete images and image transforms, 2-D sampling and reconstruction, Image quantization, 2-D transforms and properties.


**Text Books**

**Reference Books**
3. Recent literature in Digital Image processing.

**Course outcomes**
At the end of the course student will be able
CO1: analyze the need for image transforms, types and their properties.
CO2: become skilled at different techniques employed for the enhancement of images both in spatial and frequency domain.
CO3: explore causes for image degradation and to teach various restoration techniques.
CO4: evaluate the image compression techniques in spatial and frequency domain.
CO5: gain knowledge of feature extraction techniques for image analysis and recognition.
Course Code : ECPE22
Course Title : PATTERN RECOGNITION
Number of Credits : 3
Prerequisites : NONE
Course Type : PE

Course learning Objective
- The subject aims to make the students to understand the mathematical approach for pattern recognition.

Course content

Linear models for regression and classification: Linear basis function models for regression - Bias variance decomposition-Bayesian linear regression-Discriminant functions - Fisher’s linear discriminant analysis (LDA) - Principal Component Analysis (PCA) - Probabilistic generative model - Probabilistic discriminative model.


Neural networks: Feed- forward Network functions-Network training - Error Back propagation - The Hessian Matrix - Regularization in Neural Network - Mixture density networks – Bayesian Neural Networks

Text Books

Reference Books
3. Recent literature in Pattern Recognition.

Course outcomes
At the end of the course student will be able
CO1: summarize the various techniques involved in pattern recognition
CO2: identify the suitable pattern recognition techniques for the particular applications.
CO3: categorize the various pattern recognition techniques into supervised and unsupervised.
CO4: summarize the mixture models based pattern recognition techniques
CO5: summarize the artificial neural network based pattern recognition techniques
Course Code: ECPE23
Course Title: COMPUTER ARCHITECTURE AND ORGANIZATION
Number of Credits: 3
Prerequisites (Course code): ECPC18
Course Type: PE

Course Learning Objectives
- To understand how computers are constructed out of a set of functional units and how the functional units operate, interact, and communicate.
- To make the students understand the concept of interfacing memory and various I/O devices to a computer system using a suitable bus system.

Course Content

Representation of Instructions: Machine instructions, Memory locations & Addresses, Operands, Addressing modes, Instruction formats, Instruction sets, Instruction set architectures - CISC and RISC architectures, Super scalar Architectures, Fixed point and floating point operations.

Basic Processing Unit: Fundamental concepts, ALU, Control unit, Multiple bus organization, Hardwired control, Micro programmed control, Pipelining, Data hazards, Instruction hazards, Influence on instruction sets, Data path and control considerations, Performance considerations.

Memory organization: Basic concepts, Semiconductor RAM memories, ROM, Speed - Size and cost, Memory Interfacing circuits, Cache memory, Improving cache performance, Memory management unit, Shared/Distributed Memory, Cache coherency in multiprocessor, Segmentation, Paging, Concept of virtual memory, Address translation, Secondary storage devices.

I/O Organization: Accessing I/O devices, Input/output programming, Interrupts, Exception Handling, DMA, Buses, I/O interfaces- Serial port, Parallel port, PCI bus, SCSI bus, USB bus, Firewall and Infinity band, I/O peripherals.

Text Books

Reference Books
4. Recent literature in Computer Architecture and Organization.
Course outcomes
At the end of the course student will be able to
CO1: apply the basic knowledge of digital concept to the functional components of a Computer System.
CO2: analyze the addressing mode concepts and design the instruction set Architecture.
CO3: identify the functions of various processing units within the CPU of a Computer System.
CO4: analyze the function of the memory management unit and create suitable memory interface to the CPU.
CO5: recognize the need for recent Bus standards and I/O devices.


Course Code: ECPE24
Course Title: EMBEDDED SYSTEMS
Number of Credits: 3
Prerequisites (Course code): NONE
Course Type: PE

Course Learning Objectives
- To make the students to understand and program embedded systems using modern embedded processors.
- This course describes example embedded platforms, interfaces, peripherals, processors and operating systems associated with embedded systems, a comprehensive view of the software framework being developed around embedded SOCs.

Course Content


Case studies: Programming in Embedded C, Embedded system design using Arduino, ATOM processors, Galileo and Tiva based embedded system applications.

Text Books

Reference Books
4. Recent literature in Embedded Systems.
Course outcomes

At the end of the course student will be able to

CO1: get an insight into the overall landscape and characteristics of embedded systems.
CO2: facilitate a comprehensive understanding of the overall platform architecture of modern embedded computing systems.
CO3: develop application software for embedded systems using the RTOS functions.
CO4: enable network connectivity of the embedded systems via a combination of wired and wireless network interfaces.
CO5: design and program embedded systems based on their applications.
Course Code : ECPE25
Course Title : ARM SYSTEM ARCHITECTURE
Number of Credits : 3
Prerequisites (Course code) : NONE
Course Type : PE

Course learning Objective
- The objective of this course is to give the students a thorough exposure to ARM architecture and make the students to learn the ARM programming & Thumb programming models.

Course Content
RISC machine. ARM programmer’s model. ARM Instruction Set. Assembly level language programming. Development tools.

ARM organization. ARM instruction execution. ARM implementation. ARM coprocessor interface. Flynn’s Taxonomy, SIMD and Vector Processors, Vector Floating Point Processor (VFP), VFP and ARM interactions, vector operation.


Thumb programmer’s model. Thumb Instruction set. Thumb implementation. AMBA Overview, Typical AMAB Based Microcontroller, AHB bus features, AHB Bus transfers, APB bus transfers and APB Bridge.


Text Books

Reference Books
1. Technical reference manual for ARM processor cores, including Cortex, ARM 11, ARM 9 & ARM 7 processor families.
4. Recent literature in ARM System Architecture.

Course outcomes
At the end of the course student will be able to
CO1: understand the programmer’s model of ARM processor and test the assembly level programming.
CO2: analyze various types of coprocessors and design suitable co-processor interface to ARM processor.
CO3: analyze floating point processor architecture and its architectural support for higher level language.
CO4: become aware of the Thumb mode of operation of ARM.
CO5: identify the architectural support of ARM for operating system and analyze the function of memory Management unit of ARM.
Course Code : ECPE26
Course Title : OPERATING SYSTEMS
Number of Credits : 3
Prerequisites (Course code) : NONE
Course Type : PE

Course learning Objective
- To expose the principles and practice of operating system design and to illustrate the current design practices using DOS and UNIX operating systems.

Course content
Types of operating systems, Different views of the operating system, Principles of Design and Implementation. The process and threads. System programmer's view of processes, Operating system's views of processes, Operating system services for process management. Process scheduling, Schedulers, Scheduling algorithms. Overview of Linux operating system.

Inter process synchronization, Mutual exclusion algorithms, Hardware support, Semaphores, Concurrent programming using semaphores.

Conditional critical regions, Monitors, Inter process communication: Messages, Pipes.


Text Books

Reference Books
5. Recent literature in Operating Systems.

Course outcomes
At the end of the course student will be able
- CO1: Understand the different types of Operating systems and scheduling algorithms.
- CO2: Understand the synchronization algorithms and semaphores.
- CO3: Appreciate the inter process communication and deadlock handling.
- CO4: Critically evaluate the different memory allocation techniques.
- CO5: Appreciate the importance of file system organization, I/O management and disk scheduling.
Course Code : ECPE27
Course Title : DISPLAY SYSTEMS
Number of Credits : 3
Prerequisites (Course code) : ECPC13
Course Type : PE

Course learning Objective

- To expose the students to the basics of the display systems and to illustrate the current design practices of the display systems.

Course content

Introduction to displays. Requirements of displays. Display technologies, CRT, Flat panel and advanced display technologies. Technical issues in displays.

Head mounted displays. Displays less than and greater than 0.5 m diagonal. Low power and light emitting displays.

Operation of TFTs and MIMS. LCDs, Brightness. Types of LCD displays.

Emissive displays, ACTFEL, Plasma display and Field emission displays, operating principle and performance.

Types of Displays: 3D, HDTV, LED, Touch screen.

Text Books

Reference Book
2. Recent literature in Display Systems.

Course outcomes

At the end of the course student will be able

- CO1: appreciate the technical requirement of different types of displays systems
- CO2: analyze the various low power lighting systems
- CO3: understand the operation of TFTs and LCD displays.
- CO4: analyze the various kinds of emissive displays
- CO5: critically evaluate the recent advancements in the displays device technology.
Course Code : ECPE28  
Course Title : STATISTICAL SIGNAL PROCESSING  
Number of Credits : 3  
Prerequisites (Course code) : ECPC15  
Course Type : PE  

Course learning Objectives

- To develop algorithms for optimum filtering (and prediction) and for adaptive filtering for the given observation processes.
- To enable the students understand the frequency analysis and estimation methods

Course content


Text Book


Reference Books

2. Recent literature in Statistical Signal Processing.
Course outcomes

At the end of the course student will be able

CO1: Apply the knowledge of the discrete-time stochastic processes & its measures and understand various stochastic models.
CO2: Develop algorithms for optimum linear filtering and prediction for the given observation processes.
CO3: Develop steepest descent, Least Mean Square (LMS), and Recursive Least Squares (RLS) adaptive filter algorithms.
CO4: Derive and analyze the statistical properties of the conventional spectral estimators, namely the periodogram, averaged & modified periodogram and Blackman-Tukey methods.
CO5: Formulate parametric spectral estimators based upon autoregressive (AR), moving average (MA), and autoregressive moving average (ARMA) models, and detail their statistical properties.
CO6: Select an appropriate array processing algorithms for frequency estimation based on the observation models.
Course Code: ECPE29
Course Title: NETWORKS AND PROTOCOLS
Number of Credits: 3
Prerequisites (Course code): NONE
Course Type: PE

Course Learning Objectives
- To get an understanding on the fundamentals of networks and issues involved.
- To acquire an understanding on the set of rules and procedures that mediates the exchange of information between communicating devices.

Course Content
Network Components, Topologies, Network hardware and software, Network Models: OSI Model & TCP/IP Protocol stack, HTTP FTP, SMTP, POP, SNMP, DNS, Socket programming with TCP and UDP.

Transport Layer services, UDP, TCP, SCTP, Principles of reliable data transfer, Flow control, Congestion Control, Quality of Service.

Network Layer services, Datagram and Virtual circuit service, DHCP, IPV4, IPV6, ICMP, Unicast routing protocols: DV, LS and Path vector routing, Multicast routing.

Data Link Layer services, Overview of Circuit and Packet switches, ARP, Data link control: HDLC & PPP, Multiple access protocols, Wireless LAN, Comparison wired and wireless LAN.


Text Books

Reference Books
4. Recent literature in Networks and Protocols.

Course outcomes
At the end of the course student will be able
CO1: Compare and examine, OSI and TCP/IP protocol stacks
CO2: Categorize services offered by all layers in TCP/IP protocol stack
CO3: Analyze a network under congestion and propose solutions for reliable data transfer
CO4: Examine the protocols operating at different layers of TCP/IP model
CO5: Assess the cryptographic techniques.
CO6: Manage a network and propose solutions under network security threats.
Course Code : ECPE30
Course Title : ADHOC WIRELESS NETWORKS
Number of Credits : 3
Prerequisites (Course code) : ECPE29
Course Type : PE

Course learning Objective
- To analyse the various design issues and challenges in the layered architecture of Ad hoc wireless networks

Course content

Design goals of a MAC protocol, Contention based protocols; Contention based protocols with reservation mechanisms and scheduling mechanisms, MAC protocols using directional antennas.

Table driven routing protocols, On demand routing protocols, hybrid routing protocols, Hierarchical routing protocols, Power aware routing protocols, Tree based and mesh based multicast routing protocols

Network security requirements-Issues and challenges, network security attacks, key management, secure routing protocols

Energy management schemes-Battery management, transmission power management, system power management schemes. Quality of service solutions in ad hoc wireless networks.

Text books
2. S.Basagni, M.Conti, “Mobile ad hoc networking”, Wielyinterscience2004

References books
4. Recent literature in ADHOC Wireless Networks.

Course outcomes
At the end of the course student will be able
CO1: compare the differences between cellular and ad hoc networks and the analyze the challenges at various layers and applications
CO2: summarize the protocols used at the MAC layer and scheduling mechanisms
CO3: compare and analyze types of routing protocols used for unicast and multicast routing
CO4: examine the network security solution and routing mechanism
CO5: evaluate the energy management schemes and Quality of service solution in ad hoc networks
**Course Code**: ECPE31  
**Course Title**: WIRELESS SENSOR NETWORKS  
**Number of Credits**: 3  
**Prerequisites**: ECPE29  
**Course Type**: PE

**Course learning Objective**
- To overview the various design issues and challenges in the layered architecture of Wireless sensor networks

**Course content**
Motivation for a network of wireless sensor nodes-Definitions and background-challenges and constraints for wireless sensor networks-Applications. Node architecture-sensing subsystems, processing Subsystems, Communication interfaces, Prototypes.

Physical layer- Introduction, wireless channel and communication fundamentals – frequency allocation, modulation and demodulation, wave propagation effects and noise, channels models, spread spectrum communication, packet transmission and synchronization, quality of wireless channels and measures for improvement, physical layer and transceiver design consideration in wireless sensor networks, Energy usage profile, choice of modulation, Power Management

Data link layer- Fundamentals of wireless MAC protocols, Characteristics of MAC protocol in wireless sensor networks contention-based protocols, Contention free MAC protocols, Hybrid MAC protocols

Network layer-routing metrics-Flooding and gossiping, Data centric routing, proactive routing on demand routing, hierarchical routing, Location based routing, QOS based routing. Data Aggregation – Various aggregation techniques.

Case study-Target detection tracking, Habitat monitoring, Environmental disaster monitoring, Practical implementation issues, IEEE 802.15.4 low rate WPAN, Operating System Design Issues. Simulation tools.

**Text Books**

**Reference Books**

Course outcomes
At the end of the course student will be able
CO1: analyze the challenges and constraints of wireless sensor network and its subsystems
CO2: examine the physical layer specification, modulation and transceiver design considerations
CO3: analyze the protocols used at the MAC layer and scheduling mechanisms
CO4: compare and analyse the types of routing protocols and data aggregation techniques
CO5: identify the application areas and practical implementation issues.
Course Code: ECPE32
Course Title: VLSI SYSTEMS
Number of Credits: 3
Prerequisites (Course code): ECPC14
Course Type: PE

Course Learning Objective
- To introduce various aspects of VLSI circuits and their design including testing.

Course Content
VLSI design methodology, VLSI technology - NMOS, CMOS and BICMOS circuit fabrication. Layout design rules. Stick diagram. Latch up.

Characteristics of MOS and CMOS switches. Implementation of logic circuits using MOS and CMOS technology, multiplexers and memory, MOS transistors, threshold voltage, MOS device design equations. MOS models, small-signal AC analysis. CMOS inverters, propagation delay of inverters, Pseudo NMOS, Dynamic CMOS logic circuits, power dissipation.

Programmable logic devices - antifuse, EPROM and SRAM techniques. Programmable logic cells. Programmable inversion and expander logic. Computation of interconnect delay. Techniques for driving large off-chip capacitors, long lines. Computation of interconnect delays in FPGAs Implementation of PLD, EPROM, EEPROM, static and dynamic RAM in CMOS.

An overview of the features of advanced FPGAs, IP cores, Softcore processors. Various factors determining the cost of a VLSI. Comparison of ASICs, FPGAs, PDSPs and CBICs. Fault tolerant VLSI architectures

VLSI testing - need for testing, manufacturing test principles, design strategies for test, chip level and system level test techniques.

Text Books

Reference Books

Course outcomes
At the end of the course student will be able

CO1: Describe the techniques used for VLSI fabrication, design of CMOS logic circuits, switches and memory
CO2: Describe the techniques used the design of CMOS logic circuits, switches and memory in VLSI
CO3: Generalize the design techniques and analyze the characteristics of VLSI circuits such as area, speed and power dissipation
CO4: Explain and compare the architectures for FPGA, PAL and PLDs and evaluate their characteristics such as area, power dissipation and reliability
CO4: Use the advanced FPGAs to realize Digital signal processing systems
CO5: Describe the techniques for fault tolerant VLSI circuits
CO6: Explain and compare the techniques for chip level and board level testing
Course Code : ECPE33
Course Title : LOW POWER VLSI CIRCUITS
Number of Credits : 3
Prerequisites (Course code) : ECPC26
Course Type : PE

Course learning Objective

- To expose the students to the low voltage device modelling, low voltage, low power VLSI CMOS circuit design.

Course content

CMOS fabrication process, Shallow trench isolation. Lightly-doped drain. Buried channel. Fabrication process of BiCMOS and SOI CMOS technologies.

Modeling of CMOS devices parameters. Threshold voltage, Body effect, Short channel and Narrow channel effects, Electron temperature, and MOS capacitance.

CMOS inverters, static logic circuits of CMOS, pass transistor, BiCMOS, SOI CMOS and low power CMOS techniques.

Basic concepts of dynamic logic circuits. Various problems associated with dynamic logic circuits. Differential, BiCMOS and low voltage dynamic logic circuits.

CMOS memory circuits, Decoders, sense amplifiers, SRAM architecture. Low voltage SRAM techniques.

Text Books


Reference Book

2. Recent literature in Low Power VLSI Circuits.

Course outcomes

At the end of the course student will be able

CO1: acquire the knowledge about various CMOS fabrication process and its modeling.

CO2: infer about the second order effects of MOS transistor characteristics.

CO3: analyze and implement various CMOS static logic circuits.

CO4: learn the design of various CMOS dynamic logic circuits.

CO5: learn the different types of memory circuits and their design.
Course Code : ECOE10
Course Title : MICROWAVE INTEGRATED CIRCUITS
Number of Credits : 3
Prerequisites : NONE
(Course code)
Course Type : OE

Course learning Objective
- To impart knowledge on basics of microwave electron beam devices and their applications in X band frequency.

Course content
Design and realization of power dividers, hybrids, directional couplers etc using strip lines and micro strip lines.

Text Books

Reference Books
4. Recent literature in Microwave Integrated Circuit Design.

Course outcomes
At the end of the course student will be able
CO1: the topics will make students design of the important and essential M.I.C components
CO2: Filter is the most needed circuit for many applications and the unit will make the student confident in filter design
CO3: All aspects and different parameters, design factors and properties will me made thorough
CO4: One will be confident to handle any oscillator design
CO5: The student will become familiar and confident in the design of Mixers, the other essential circuits.
Course Code : ECOE11
Course Title : RF MEMS CIRCUIT
Number of Credits : 3
Prerequisites
(Course code) : NONE
Course Type : OE

Course learning Objective

- To impart knowledge on basics of MEMS and their applications in RF circuit design.

Course content


Text Book


Reference Books

3. Recent literature in RF MEMS Circuit Design.

Course outcomes

At the end of the course student will be able

- CO1: learn the Micro machining Processes
- CO2: learn the design and applications of RF MEMS inductors and capacitors.
- CO3: learn about RF MEMS Filters and RF MEMS Phase Shifters.
- CO4: learn about the suitability of micro machined transmission lines for RF MEMS
- CO5: learn about the Micro machined Antennas and Reconfigurable Antennas
Course Code: ECOE12
Course Title: HIGH SPEED SYSTEM DESIGN
Number of Credits: 3
Prerequisites: NONE
Course Type: OE

Course Learning Objective
- To expose the students to all aspects of electronic packaging including electrical, thermal, mechanical and reliability issues.

Course Content
Functions of an Electronic Package, Packaging Hierarchy, IC packaging: MEMS packaging, consumer electronics packaging, medical electronics packaging, Trends, Challenges, Driving Forces on Packaging Technology, Materials for Microelectronic packaging, Packaging Material Properties, Ceramics, Polymers, and Metals in Packaging, Material for high density interconnect substrates

Overview of Transmission line theory, Clock Distribution, Noise Sources, power Distribution, signal distribution, EMI; crosstalk and nonideal effects; signal integrity: impact of packages, vias, traces, connectors; non-ideal return current paths, high frequency power delivery, simultaneous switching noise; system-level timing analysis and budgeting; methodologies for design of high speed buses; radiated emissions and minimizing system noise.


Text Book
Reference Books

4. R.G. Kaduskar and V.B.Baru, Electronic Product design, Wiley India, 2011
6. Recent literature in Electronic Packaging.

Course outcomes

At the end of the course student will be able

CO1: Design of PCBs which minimize the EMI and operate at higher frequency.
CO2: Enable design of packages which can withstand higher temperature, vibrations and shock.
Course Code: ECOE13
Course Title: DIGITAL SPEECH PROCESSING
Number of Credits: 3
Prerequisites (Course code): NONE
Course Type: OE

Course learning Objective
- The purpose of this course is to explain how DSP techniques could be used for solving problems in speech communication.

Course content

Feature extraction of the speech signal: Endpoint detection-Dynamic time warping- Pitch frequency estimation: Autocorrelation approach- Homomorphic approach-Formant frequency estimation using vocal tract model and Homomorphic approach-Linear predictive co-efficient -Poles of the vocal tract-Reflection co-efficient-Log Area ratio.

Cepstrum- Line spectral frequencies- Functional blocks of the ear- Mel frequency cepstral co-efficients- Spectrogram-Time resolution versus frequency resolution-Discrete wavelet transformation.


Text Books
1. L.R.Rabiner and R.W.Schafer, "Introduction to Digital speech processing", now publishers USA,2007

Reference Books
4. Recent literature in Digital speech processing.

Course outcomes
At the end of the course student will be able
CO1: illustrate how the speech production is modeled
CO2: summarize the various techniques involved in collecting the features from the speech signal in both time and frequency domain
CO3: summarize the functional blocks of the ear
CO4: compare the various pattern recognition techniques involved in speech and speaker detection
CO5: summarize the various speech compression techniques
Course Code: ECOE14
Course Title: DIGITAL IMAGE PROCESSING
Number of Credits: 3
Prerequisites (Course code): NONE
Course Type: OE

Course learning Objective
- To treat the 2D systems as an extension of 1D system design and discuss techniques specific to 2D systems.

Course content
Linearity and space-invariance. PSF, Discrete images and image transforms, 2-D sampling and reconstruction, Image quantization, 2-D transforms and properties.

Text Books

Reference Books
3. Recent literature in Digital Image processing.

Course outcomes
At the end of the course student will be able
CO1: analyze the need for image transforms, types and their properties.
CO2: become skilled at different techniques employed for the enhancement of images both in spatial and frequency domain.
CO3: explore causes for image degradation and to teach various restoration techniques.
CO4: evaluate the image compression techniques in spatial and frequency domain.
CO5: gain knowledge of feature extraction techniques for image analysis and recognition.
Course Code : ECOE15
Course Title : PATTERN RECOGNITION
Number of Credits : 3
Prerequisites (Course Code) : NONE
Course Type : OE

Course learning Objective
- The subject aims to make the students to understand the mathematical approach for pattern recognition.

Course content

Linear models for regression and classification: Linear basis function models for regression - Bias variance decomposition-Bayesian linear regression-Discriminate functions - Fisher's linear discriminate analysis (LDA) - Principal Component Analysis (PCA) - Probabilistic generative model - Probabilistic discriminative model.


Neural networks: Feed- forward Network functions-Network training - Error Back propagation - The Hessian Matrix - Regularization in Neural Network - Mixture density networks – Bayesian Neural Networks

Text Books

Reference Books
3. Recent literature in Pattern Recognition.

Course outcomes
At the end of the course student will be able
CO1: summarize the various techniques involved in pattern recognition
CO2: identify the suitable pattern recognition techniques for the particular applications.
CO3: categorize the various pattern recognition techniques into supervised and unsupervised.
CO4: summarize the mixture models based pattern recognition techniques
CO5: summarize the artificial neural network based pattern recognition techniques
Course Code: ECOE16
Course Title: COMPUTER ARCHITECTURE AND ORGANIZATION
Number of Credits: 3
Prerequisites (Course Code): NONE
Course Type: OE

Course learning Objectives
- To understand how computers are constructed out of a set of functional units and how the functional units operate, interact, and communicate.
- To make the students to understand the concept of interfacing memory and various I/O devices to a computer system using a suitable bus system.

Course content


Representation of Instructions: Machine instructions, Memory locations & Addresses, Operands, Addressing modes, Instruction formats, Instruction sets, Instruction set architectures - CISC and RISC architectures, Super scalar Architectures, Fixed point and floating point operations.

Basic Processing Unit: Fundamental concepts, ALU, Control unit, Multiple bus organization, Hardwired control, Micro programmed control, Pipelining, Data hazards, Instruction hazards, Influence on instruction sets, Data path and control considerations, Performance considerations.

Memory organization: Basic concepts, Semiconductor RAM memories, ROM, Speed - Size and cost, Memory Interfacing circuits, Cache memory, Improving cache performance, Memory management unit, Shared/Distributed Memory, Cache coherency in multiprocessor, Segmentation, Paging, Concept of virtual memory, Address translation, Secondary storage devices.

I/O Organization: Accessing I/O devices, Input/output programming, Interrupts, Exception Handling, DMA, Buses, I/O interfaces- Serial port, Parallel port, PCI bus, SCSI bus, USB bus, Firewall and Infini band, I/O peripherals.

Text Books

References Books
2. D. A. Patterson and J. L. Hennessy, "Computer Organization and Design,
5. Recent literature in Computer Architecture and Organization.
Course outcomes
At the end of the course student will be able
CO1: apply the basic knowledge of digital concept to the functional components of a Computer System.
CO2: analyze the addressing mode concepts and design the instruction set Architecture.
CO3: identify the functions of various processing units within the CPU of a Computer System.
CO4: analyze the function of the memory management unit and create suitable memory interface to the CPU.
CO5: recognize the need for recent Bus standards and I/O devices.
Course Code : ECOE17
Course Title : OPERATING SYSTEMS
Number of Credits : 3
Prerequisites (Course code) : NONE
Course Type : OE

Course learning Objective

- To expose the principles and practice of operating system design and to illustrate the current design practices using DOS and UNIX operating systems.

Course content

Types of operating systems, Different views of the operating system, Principles of Design and Implementation. The process and threads. System programmer’s view of processes, Operating system’s views of processes, Operating system services for process management. Process scheduling, Schedulers, Scheduling algorithms. Overview of Linux operating system.

Interprocess synchronization, Mutual exclusion algorithms, Hardware support, Semaphores, Concurrent programming using semaphores.


Text Books

Reference Books
5. Recent literature in Operating Systems.

Course outcomes

At the end of the course student will be able

- CO1: Understand the different types of Operating systems and scheduling algorithms.
- CO2: Understand the synchronization algorithms and semaphores.
- CO3: Appreciate the inter process communication and deadlock handling.
- CO4: Critically evaluate the different memory allocation techniques.
- CO5: Appreciate the importance of file system organization, I/O management and disk scheduling.
Course Code : ECOE18
Course Title : WIRELESS SENSOR NETWORKS
Number of Credits : 3
Prerequisites (Course code) : ECPE29
Course Type : OE

Course learning Objective

- To overview the various design issues and challenges in the layered architecture of Wireless sensor networks

Course content

Motivation for a network of wireless sensor nodes-Definitions and background-challenges and constraints for wireless sensor networks-Applications. Node architecture-sensing subsystems, processing Subsystems, Communication interfaces, Prototypes.

Physical layer- Introduction, wireless channel and communication fundamentals – frequency allocation, modulation and demodulation, wave propagation effects and noise, channels models, spread spectrum communication, packet transmission and synchronization, quality of wireless channels and measures for improvement, physical layer and transceiver design consideration in wireless sensor networks, Energy usage profile, choice of modulation, Power Management

Data link layer- Fundamentals of wireless MAC protocols, Characteristics of MAC protocol in wireless sensor networks contention-based protocols, Contention free MAC protocols, Hybrid MAC protocols

Network layer-routing metrics-Flooding and gossiping, Data centric routing, proactive routing on demand routing, hierarchical routing, Location based routing, QOS based routing. Data Aggregation – Various aggregation techniques.

Case study-Target detection tracking, Habitat monitoring, Environmental disaster monitoring, Practical implementation issues, IEEE 802.15.4 low rate WPAN, Operating System Design Issues. Simulation tools.

Text Books


Reference Books


Course outcomes
At the end of the course student will be able
CO1: analyze the challenges and constraints of wireless sensor network and its subsystems
CO2: examine the physical layer specification, modulation and transceiver design considerations
CO3: analyze the protocols used at the MAC layer and scheduling mechanisms
CO4: compare and analyse the types of routing protocols and data aggregation techniques
CO5: identify the application areas and practical implementation issues.
Course Code: ECOE19
Course Title: ARM SYSTEM ARCHITECTURE
Number of Credits: 3
Prerequisites (Course code): None
Course Type: OE

Course learning Objective

- The objective of this course is to give the students a thorough exposure to ARM architecture and make the students to learn the ARM programming & Thumb programming models.

Course Content

RISC machine. ARM programmer’s model. ARM Instruction Set. Assembly level language programming. Development tools.

ARM organization. ARM instruction execution. ARM implementation. ARM coprocessor interface. Flynn’s Taxonomy, SIMD and Vector Processors, Vector Floating Point Processor (VFP), VFP and ARM interactions, vector operation.


Thumb programmer’s model. Thumb Instruction set. Thumb implementation. AMBA Overview, Typical AMAB Based Microcontroller, AHB bus features, AHB Bus transfers, APB bus transfers and APB Bridge.


Text Books


Reference Books

1. Technical reference manual for ARM processor cores, including Cortex, ARM 11, ARM 9 & ARM 7 processor families.
4. Recent literature in ARM System Architecture.

Course outcomes

At the end of the course student will be able to

- CO1: understand the programmer’s model of ARM processor and test the assembly level programming.
- CO2: analyze various types of coprocessors and design suitable co-processor interface to ARM processor.
- CO3: analyze floating point processor architecture and its architectural support for higher level language.
- CO4: become aware of the Thumb mode of operation of ARM.
- CO5: identify the architectural support of ARM for operating system and analyze the function of memory Management unit of ARM.
Course Code : ECOE20
Course Title : LOW POWER VLSI CIRCUITS
Number of Credits : 3
Prerequisites (Course code) : ECPE32
Course Type : OE

Course learning Objective
- To expose the students to the low voltage device modelling, low voltage, low power VLSI CMOS circuit design.

Course content
CMOS fabrication process, Shallow trench isolation. Lightly-doped drain. Buried channel. Fabrication process of BiCMOS and SOI CMOS technologies.
Modeling of CMOS devices parameters. Threshold voltage, Body effect, Short channel and Narrow channel effects, Electron temperature, and MOS capacitance.
CMOS inverters, static logic circuits of CMOS, pass transistor, BiCMOS, SOI CMOS and low power CMOS techniques.
Basic concepts of dynamic logic circuits. Various problems associated with dynamic logic circuits. Differential, BiCMOS and low voltage dynamic logic circuits.
CMOS memory circuits, Decoders, sense amplifiers, SRAM architecture. Low voltage SRAM techniques.

Text Books

Reference Book
2. Recent literature in Low Power VLSI Circuits.

Course outcomes
At the end of the course student will be able
CO1: acquire the knowledge about various CMOS fabrication process and its modeling.
CO2: infer about the second order effects of MOS transistor characteristics.
CO3: analyze and implement various CMOS static logic circuits.
CO4: learn the design of various CMOS dynamic logic circuits.
CO5: learn the different types of memory circuits and their design.
Course Code: ECOE21
Course Title: COMPUTER VISION AND MACHINE LEARNING
Number of Credits: 3
Prerequisites (Course code): NONE
Course Type: OE

Course Learning Objectives

- Be familiar with the theoretical aspects of computing with images;
- Describe the foundation of image formation, measurement, and analysis;

Course Content


Segmentation - Object Recognition, Activity Recognition, and Gesture Recognition - Image features: Colour, Shape, Texture Shape orientation descriptors – SIFT, SURF, Viola Jones Feature detectors, Harris. Integral Histogram.

Adaboost: concept of ensemble of classifiers; basic algorithm; case study- Face detection


Text Books

Reference Books

Course outcomes
At the end of the course student will be able
CO1: learn the basics of computer vision.
CO2: learn the vision features.
CO3: understand issue of segmentation in computer vision algorithms.
CO4: study the basics of Machine learning.
CO5: know the design of Deep learning architectures.
**Course Code**: ECOE22  
**Course Title**: TEXT DATA MINING  
**Number of Credits**: 3  
**Prerequisites (Course code)**: NONE  
**Course Type**: OE

**Course Learning Objective**
- To understand the role played by text mining in Information retrieval and extraction.

**Course content**

Data, information and knowledge, Models of knowledge representation information retrieval and data mining -relevance, association rules, and knowledge discovery. Conceptual models of an information retrieval and knowledge discovery system.

Information extraction- prediction and evaluation- Textual information to numerical vectors - Types and tokens, Document similarity Vector space models, TF-IDF weighting Indexing, Boolean search Evaluation of IR systems Ranked retrieval Relevance feedback.


Visualization Approaches - Architectural Considerations - Visualization Techniques in Link Analysis - Example- Mining Text Streams - Text Mining in Multimedia - Text Analytics in Social Media - Opinion Mining and Sentiment Analysis - Document Sentiment Classification Aspect-Based Sentiment Analysis - Opinion Spam Detection – Text Mining Applications and Case studies.

**Text Books**


**Reference Books**


**Course Outcomes**

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

- **CO1**: know about the basics of text mining.
- **CO2**: Identify the different features that can be mined from text and web documents.
- **CO3**: learn about text classification.
- **CO4**: learn to improve the efficiency of features and reduce the dimensionality.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>ECMI10</th>
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<tr>
<td>Course Title</td>
<td>SIGNALS AND SYSTEMS</td>
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<tr>
<td>Number of Credits</td>
<td>3</td>
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<tr>
<td>Prerequisites (Course code)</td>
<td>NONE</td>
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<td>Course Type</td>
<td>MI</td>
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**Course Learning Objectives**
- Understanding the fundamental characteristics of signals and systems.
- Understanding the concepts of vector space, inner product space and orthogonal series.
- Understanding signals and systems in terms of both the time and transform domains, taking advantage of the complementary insights and tools that these different perspectives provide.
- Development of the mathematical skills to solve problems involving convolution, filtering, modulation and sampling.

**Course Content**

Continuous-time signals, classifications. Periodic signals. Fourier series representation, Hilbert transform and its properties.


**Text Books**

**Reference Books**
Course outcomes

At the end of the course student will be able

CO1: apply the knowledge of linear algebra topics like vector space, basis, dimension, inner product, norm and orthogonal basis to signals.

CO2: analyse the spectral characteristics of continuous-time periodic and a periodic signals using Fourier analysis.

CO3: classify systems based on their properties and determine the response of LSI system using convolution.

CO4: analyze system properties based on impulse response and Fourier analysis.

CO5: apply the Laplace transform and Z- transform for analyze of continuous-time and discrete-time signals and systems.

CO6: understand the process of sampling and the effects of under sampling.
Course Code : ECMI11
Course Title : NETWORK ANALYSIS AND SYNTHESIS
Number of Credits : 3
Prerequisites (Course code) : NONE
Course Type : MI

Course Learning Objectives
- To make the students capable of analysing any given electrical network.
- To make the students to learn synthesis of an electrical network for a given impedance/admittance function.

Course Content


Text Books

Reference Books

Course outcomes
At the end of the course student will be able
CO1: analyze the electric circuit using network theorems
CO2: understand and Obtain Transient & Forced response
CO3: determine Sinusoidal steady state response; understand the real time applications of maximum power transfer theorem and equalizer
CO4: understand the two–port network parameters, are able to find out two-port network parameters & overall response for interconnection of two-port networks.
CO5: synthesize one port network using Foster form, Cauer form.
Course Code : ECMI12
Course Title : ELECTRODYNAMICS AND ELECTROMAGNETIC WAVES
Number of Credits : 3
Prerequisites (Course code) : NONE
Course Type : MI

Course Learning Objective
- To expose the students to the rudiments of Electromagnetic theory and wave propagation essential for subsequent courses on microwave engineering, antennas and wireless communication

Course Content


Text Books

Reference Books

Course outcomes
At the end of the course student will be able
CO1: recognize and classify the basic Electrostatic theorems and laws and to derive them.
CO2: discuss the behaviour of Electric fields in matter and Polarization concepts.
CO3: classify the basic Magneto static theorems and laws and infer the magnetic properties of matter.
CO4: summarize the concepts of electrodynamics &to derive and discuss the Maxwell’s equations.
CO5: students are expected to be familiar with Electromagnetic wave propagation and wave polarization.
Course Code : ECMI13
Course Title : SEMICONDUCTOR PHYSICS AND DEVICES
Number of Credits : 3
Prerequisites (Course code) : NONE
Course Type : MI

Course Learning Objective
- To make the students understand the fundamentals of electronic devices.
- To train them to apply these devices in mostly used and important applications.

Course Content
Semiconductor materials: crystal growth, film formation, lithography, etching and doping. Formation of energy bands in solids, Concept of hole, Intrinsic and extrinsic semiconductors, conductivity, Equilibrium Carrier concentration, Density of states and Fermi level, Carrier transport – Drift and Diffusion, continuity equation, Hall effect and its applications.

P-N junction diodes, Energy band diagram, biasing, V-I characteristics, capacitances. Diode models, Break down Mechanisms, Rectifiers, Limiting and Clamping Circuits, types of diodes.

BJT Physics and Characteristics modes of operation, Ebers-Moll Model, BJT as a switch and Amplifier, breakdown mechanisms, Photo devices.

MOSFET: Ideal I-V characteristics, non-ideal I-V effects, MOS Capacitor, MOSFET as switch, CMOS Logic gate Circuits, Bi-CMOS circuits, CCDs.

Power devices, operation and characteristics. Thyristor family. Power diodes. Power transistors. Display devices, Operation of LCDs, Plasma, LED and HDTV

Text Books
1. S.M.Sze, Semiconductors Devices, Physics and Technology, (2/e), Wiley, 2002

Reference Books

Course outcomes
At the end of the course student will be able

CO1: Apply the knowledge of basic semiconductor material physics and understand fabrication processes.
CO2: Analyze the characteristics of various electronic devices like diode, transistor etc.,
CO3: Classify and analyze the various circuit configurations of Transistor and MOSFETs.
CO4: Illustrate the qualitative knowledge of Power electronic Devices.
CO5: Become Aware of the latest technological changes in Display Devices.
Course Code : ECMI14  
Course Title : DIGITAL CIRCUITS AND SYSTEMS  
Number of Credits : 3  
Prerequisites (Course code) : NONE  
Course Type : MI

Course Learning Objective
- To introduce the theoretical and circuit aspects of digital electronics, which is the back bone for the basics of the hardware aspect of digital computers

Course Content

Combinational logic circuits- adders, subtractors, BCD adder, ripple carry look ahead adders, parity generator, decoders, encoders, multiplexers, DE multiplexers, Realization of Boolean expressions- using decoders-using multiplexers. Memories – ROM- organization, expansion. PROMs. Types of RAMs – Basic structure, organization, Static and dynamic RAMs, PLDs, PLAs.


Synchronous circuit analysis and design: structure and operation, analysis-transition equations, state tables and state diagrams, Modelling- Moore machine and Mealy machine- serial binary adder, sequence recogniser, state table reduction, state assignment. Hazard; Overview and comparison of logic families.

Introduction to Verilog HDL, Structural, Dataflow and behavioural modelling of combinational and sequential logic circuits.

Text Books

Reference Books

Course outcomes
At the end of the course student will be able
CO1: Apply the knowledge of Boolean algebra and simplification of Boolean expressions to deduce optimal digital networks.
CO2: Study and examine the SSI, MSI and Programmable combinational networks.
CO3: Study and investigate the sequential networks suing counters and shift registers; summarize the performance of logic families with respect to their speed, power consumption, number of ICs and cost.
CO4: Work out SSI and MSI digital networks given a state diagram based on Mealy
Course Code : ECMI15
Course Title : DIGITAL SIGNAL PROCESSING
Number of Credits : 3
Prerequisites (Course code) : ECMI10
Course Type : MI

Course Learning Objective

- The subject aims to introduce the mathematical approach to manipulate discrete time signals, which are useful to learn digital tele-communication.

Course Content

Review of VLSI system theory, DTFT, Frequency response of discrete time systems, all pass inverse and minimum phase systems.

DFT, Relationship of DFT to other transforms, FFT, DIT and DIF, FFT algorithm, Linear filtering using DFT and FFT.

Frequency response of FIR filter types, Design of FIR filters, IIR filter design, Mapping formulas, Frequency transformations.

Direct form realization of FIR and IIR systems, Lattice structure for FIR and IIR systems, Finite-word length effects. Limit cycle oscillations.

Sampling rate conversion by an integer and rational factor, Poly phase FIR structures for sampling rate conversion.

Text Books


Reference Books


Course outcomes

At the end of the course student will be able

CO1: analyze discrete-time systems in both time & transform domain and also through pole-zero placement.
CO2: analyze discrete-time signals and systems using DFT and FFT.
CO3: design and implement digital finite impulse response (FIR) filters.
CO4: design and implement digital infinite impulse response (IIR) filters.
CO5: understand and develop multirate digital signal processing systems.
Course Code : ECMI16
Course Title : TRANSMISSION LINES AND WAVEGUIDES
Number of Credits : 3
Prerequisites (Course code) : ECMI12
Course Type : MI

Course Learning Objective

- To expose students to the complete fundamentals and essential feature of waveguides, resonators and microwave components and also able to give an introduction to microwave integrated circuit design.

Course Content

Classification of guided wave solutions-TE, TM and TEM waves. Field analysis transmission lines.


Impedance transformation and matching. Smith Chart, Quarter-wave and half-wave transformers. Binomial and T-chebeyshev transformers. Single, double and triple stub matching.

Microstriplines, stripline, slot lines, coplanar waveguide and fin line. Micro strip MIC design aspects. Computer-aided analysis and synthesis.

Text Books

Reference Books

Course outcomes

At the end of the course student will be able
CO1: classify the Guided Wave solutions -TE, TM, and TEM.
CO2: analyze and design rectangular waveguides and understand the propagation of electromagnetic waves.
CO3: evaluate the resonance frequency of cavity Resonators and the associated modal field.
CO4: analyze the transmission lines and their parameters using the Smith Chart.
CO5: apply the knowledge to understand various planar transmission lines.
Course Code : ECMI17
Course Title : ELECTRONIC CIRCUITS
Number of Credits : 3
Prerequisites (Course code) : ECMI13
Course Type : MI

Course Learning Objective
- To make the students understand the fundamentals of electronic circuits.

Course Content
Load line, operating point, biasing methods for BJT and MOSFET. Low frequency and high models of BJT and MOSFET, Small signal Analysis of CE, CS, CD and Cascade amplifier

MOSFET amplifiers: Current mirrors: Basic current mirror, Cascade current mirror, Single-ended amplifiers: CS amplifier – with resistive load, diode connected load, current source load, triode load, source degeneration. CG and CD amplifiers, Cascade amplifier,

Frequency response of amplifiers, Differential Amplifiers, CMRR, Differential amplifiers with active load, two stage amplifiers

Feedback concept, Properties, Feedback amplifiers, Stability analysis, Condition for oscillation,
Sinusoidal oscillators.

Power amplifiers- class A, class B, class AB, Biasing circuits, class C and class D

Text Books

Reference Books

Course outcomes
At the end of the course student will be able
CO1: illustrate about rectifiers, transistor and FET amplifiers and its biasing. Also compare the performances of its low frequency models.
CO 2: discuss about the frequency response of MOSFET and BJT amplifiers.
CO 3: illustrate about MOS and BJT differential amplifiers and its characteristics.
CO4: discuss about the feedback concepts and construct feedback amplifiers and oscillators. Also summarizes its performance parameters.
CO 5: explain about power amplifiers and its types and also analyze its characteristics.
Course Learning Objective

- This subject deals about the basics of 16-bit Microprocessor, 8-bit and 16-bit Microcontrollers, their architectures, internal organization and their functions, peripherals, and interfacing.

Course Content


Text Books


Reference Books


Course outcomes

At the end of the course student will be able

- CO1: recall and apply the basic concept of digital fundamentals to Microprocessor based personal computer system.
- CO2: identify the detailed s/w & h/w structure of the Microprocessor.
- CO3: illustrate how the different peripherals are interfaced with Microprocessor.
- CO4: distinguish and analyze the properties of Microprocessors & Microcontrollers.
- CO5: analyze the data transfer information through serial & parallel ports.
- CO6: train their practical knowledge through laboratory experiments.
Course Code : ECMI19  
Course Title : STATISTICAL SIGNAL PROCESSING  
Number of Credits : 3  
Prerequisites (Course code) : ECMI 15  
Course Type : MI

Course learning Objectives

- To develop algorithms for optimum filtering (and prediction) and for adaptive filtering for the given observation processes.
- To enable the students understand the frequency analysis and estimation methods.

Course content


Text Book


Reference Books

2. Recent literature in Statistical Signal Processing.
Course outcomes
At the end of the course student will be able

CO1: apply the knowledge of the discrete-time stochastic processes & its measures and understand various stochastic models.
CO2: develop algorithms for optimum linear filtering and prediction for the given observation processes
CO3: develop steepest descent, Least Mean Square (LMS), and Recursive Least Squares (RLS) adaptive filter algorithms
CO4: derive and analyze the statistical properties of the conventional spectral estimators, namely the periodogram, averaged & modified periodogram and Blackman-Tukey methods
CO5: formulate parametric spectral estimators based upon autoregressive (AR), moving average (MA), and autoregressive moving average (ARMA) models, and detail their statistical properties.
CO6: select an appropriate array processing algorithms for frequency estimation based on the observation models.
Course Code : ECMI20
Course Title : DIGITAL SIGNAL PROCESSORS AND APPLICATIONS
Number of Credits : 3
Prerequisites (Course code) : ECMI15
Course Type : MI

Course Learning Objective

- To give an exposure to the various fixed point and floating point DSP architectures, to understand the techniques to interface sensors and I/O circuits and to implement applications using these processors.

Course Content


Text Books


Reference Books


Course outcomes

At the end of the course student will be able
- CO1: learn the architecture details of fixed point DSPs.
- CO2: learn the architecture details of floating point DSPs
- CO3: infer about the control instructions, interrupts, pipeline operations, memory and buses.
CO4: illustrate the features of on-chip peripheral devices and its interfacing with real time application devices.

CO5: learn to implement the signal processing algorithms and applications in DSPs

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<td>Course Title</td>
<td>ANALOG COMMUNICATION</td>
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<tr>
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<td>Prerequisites (Course code)</td>
<td>ECMI10</td>
</tr>
<tr>
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<td>MI</td>
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</tbody>
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**Course Learning Objective**

- To develop a fundamental understanding on Communication Systems with emphasis on analog modulation techniques and noise performance.

**Course Content**


Noise - Internal and External Noise, Noise Calculation, Noise Figure. Noise in linear and nonlinear AM receivers, Threshold effect.

Noise in FM receivers, Threshold effect, Capture effect, FM Threshold reduction, Pre-emphasis and De-emphasis.


**Text Books**


**Reference Books**


**Course outcomes**

At the end of the course student will be able:

- CO1: Understand the basics of communication system and analog modulation techniques
- CO2: Apply the basic knowledge of signals and systems and understand the concept of Frequency modulation.
- CO3: Apply the basic knowledge of electronic circuits and understand the effect of Noise in communication system and noise performance of AM system
- CO4: Understand the effect of noise performance of FM system.
- CO5: Understand TDM and Pulse Modulation techniques.
**Course Learning Objective**

- To impart knowledge on basics of antenna theory and to analyze and design a start of art antenna for wireless communications.

**Course Content**


Wave Propagation: Propagation in free space. Propagation around the earth, surface wave propagation, structure of the ionosphere, propagation of plane waves in ionized medium, Determination of critical frequency, MUF. Fading, tropospheric propagation, Super refraction.

**Text Books**


**Reference Books**


**Course outcomes**

At the end of the course student will be able

CO1: select the appropriate portion of electromagnetic theory and its application to antennas.

CO2: distinguish the receiving antennas from transmitting antennas, analyze and justify their characteristics.

CO3: assess the need for antenna arrays and mathematically analyze the types of antenna arrays.

CO4: distinguish primary from secondary antennas and analyze their characteristics by applying optics and acoustics principles.

CO5: outline the factors involved in the propagation of radio waves using practical antennas.
Course Code: ECMI23
Course Title: ANALOG INTEGRATED CIRCUITS
Number of Credits: 3
Prerequisites (Course code): ECMI17
Course Type: MI

Course Learning Objective
- To introduce the theoretical & circuit aspects of an Op-amp.

Course Content

Active filters: Second order filter transfer function (low pass, high pass, band pass and band reject), Butterworth, Chebyshev and Bessel filters. Switched capacitor filter. Notch filter, all pass filters, self-tuned filters

Opamp as a comparator, Schmitt trigger, Astable and monostable multivibrators, Triangular wave generator, Multivibrators using 555 timer, Data converters: A/D and D/A converters

PLL- basic block diagram and operation, four quadrant multipliers. Phase detector, VCO, Applications of PLL: Frequency synthesizers, AM detection, FM detection and FSK demodulation.

CMOS differential amplifiers: DC analysis and small signal analysis of differential amplifier with Resitive load, current mirror load and current source load, Input common-mode range and Common-mode feedback circuits. OTAs vsOpamps. Slew rate, CMRR, PSRR. Two stage amplifiers, Compensation in amplifiers (Dominant pole compensation).

Text Books
2. Sedra and Smith, Microelectronics Circuits, Oxford Univ. Press, 2004

Reference Books

Course outcomes
At the end of the course student will be able
- CO1: infer the DC and AC characteristics of operational amplifiers and its effect on output and their compensation techniques.
- CO2: elucidate and design the linear and nonlinear applications of an op-amp and special application ICs.
- CO3: explain and compare the working of multi vibrators using special application IC 555 and general purpose op-amp.
- CO4: classify and comprehend the working principle of data converters.
- CO5: illustrate the function of application specific ICs such as Voltage regulators, PLL and its application in communication.
Course Code : ECM24  
Course Title : DIGITAL COMMUNICATION  
Number of Credits : 3  
Prerequisites (Course code) : ECM21  
Course Type : MI

**Course Learning Objectives**

- To understand the key modules of digital communication systems with emphasis on digital modulation techniques.
- To get introduced to the basics of source and channel coding/decoding and Spread Spectrum Modulation.

**Course Content**


BASK, BFSK, and BPSK- Transmitter, Receiver, Signal space diagram, Error probabilities.

M-ary PSK, M-ary FSK, QAM, MSK and GMSK- Optimum detector, Signal constellation, error probability.

Linear block codes- Encoding and decoding. Cyclic codes – Encoder, Syndrome Calculator.

Convolutional codes – encoding, Viterbi decoding. TCM.

Spread Spectrum (SS) Techniques- Direct Sequence Spread Spectrum modulation, Frequency-hop Spread Spectrum modulation - Processing gain and jamming margin.

**Text Books**


**Reference Books**


**Course outcomes**

At the end of the course student will be able

CO1: Apply the knowledge of signals and system and explain the conventional digital communication system.

CO2: Apply the knowledge of statistical theory of communication and evaluate the performance of digital communication system in the presence of noise.

CO3: Describe and analyze the performance of advance modulation techniques.

CO4: Apply the knowledge of digital electronics and describe the error control codes like block code, cyclic code.

CO5: Describe and analyze the digital communication system with spread spectrum modulation.
Course Code : ECMI25
Course Title : MICROWAVE COMPONENTS AND CIRCUITS
Number of Credits : 3
Prerequisites (Course code) : ECMI16
Course Type : MI

Course Learning Objective

- The subject introduces the essential Microwave Circuit Theory and the design aspects of Microwave Integrated Circuit components.

Course Content

Scattering matrix formulation. Passive microwave devices; terminations, bends, corners, attenuators, phase changers, directional couplers and hybrid junctions. Basics and design considerations of Microstripline, strip line, coplanar waveguide, Slot line and Finline.

Microwave measurements; frequency, wavelength, VSWR. Impedance determination. S-parameter measurements. Network analyzer.


MIC filter design. Low pass to high pass, band pass and band stop transformations. Realization using microstrip lines and strip lines.

Design and realization of MIC components.3 dB hybrid design. Ratrace Hybrid Ring, Backward wave directional coupler, power divider; realization using microstrip lines and strip lines.

Text Books


Reference Books


Course outcomes

At the end of the course student will be able

CO1: Learn the basics of S parameters and use them in describing the components
CO2: Expose to the Microwave Measurements Principle
CO3: Realize the importance of the theory of Microwave circuit theory.
CO4: Work out the complete design aspects of various M.I.C. Filters
CO5: Confidently design all M.I.C. components to meet the industry standard
Course Code : ECMI26
Course Title : VLSI SYSTEMS
Number of Credits : 3
Prerequisites (Course code) : ECMI14
Course Type : MI

Course Learning Objective

- To introduce various aspects of VLSI circuits and their design including testing.

Course Content

VLSI design methodology, VLSI technology - NMOS, CMOS and BICMOS circuit fabrication. Layout design rules. Stick diagram. Latch up.

Characteristics of MOS and CMOS switches. Implementation of logic circuits using MOS and CMOS technology, multiplexers and memory, MOS transistors, threshold voltage, MOS device design equations. MOS models, small-signal AC analysis. CMOS inverters, propagation delay of inverters, Pseudo NMOS, Dynamic CMOS logic circuits, power dissipation.

Programmable logic devices - anti-fuse, EPROM and SRAM techniques. Programmable logic cells. Programmable inversion and expander logic. Computation of interconnect delay, Techniques for driving large off-chip capacitors, long lines. Computation of interconnect delays in FPGAs. Implementation of PLD, EPROM, EEPROM, static and dynamic RAM in CMOS.

An overview of the features of advanced FPGAs, IP cores, Softcore processors, Various factors determining the cost of a VLSI. Comparison of ASICs, FPGAs, PDSPs and CBICs. Fault tolerant VLSI architectures

VLSI testing - need for testing, manufacturing test principles, design strategies for test, chip level and system level test techniques.

Text Books


Reference Books


Course outcomes

At the end of the course student will be able

CO1: Describe the techniques used for VLSI fabrication, design of CMOS logic circuits, switches and memory
CO2: Describe the techniques used the design of CMOS logic circuits, switches and memory in VLSI
CO3: Generalize the design techniques and analyze the characteristics of VLSI circuits such as area, speed and power dissipation
CO4: Explain and compare the architectures for FPGA, PAL and PLDs and evaluate their characteristics such as area, power dissipation and reliability
CO5: Use the advanced FPGAs to realize Digital signal processing systems
CO6: Describe the techniques for fault tolerant VLSI circuits
CO7: Explain and compare the techniques for chip level and board level testing
Course Code: ECMI27
Course Title: WIRELESS COMMUNICATION
Number of Credits: 3
Prerequisites (Course code): ECMI24
Course Type: MI

Course Learning Objective

- To get an understanding of mobile radio communication principles, types and to study the recent trends adopted in cellular and wireless systems and standards.

Course Content


Path loss prediction over hilly terrain. Practical link budget design using Path loss models. Design parameters at base station. Antenna location, spacing, heights and configurations.

Multiple access techniques; FDMA, TDMA and CDMA. Spread spectrum. Power control. WCDMA. CDMA network design. OFDM and MC-CDMA.


Text Books:

Reference Books:

Course outcomes
At the end of the course student will be able
- CO1: Apply the knowledge of basic communication systems and its principles.
- CO2: Describe the cellular concept and analyze capacity improvement Techniques.
- CO3: Mathematically analyze mobile radio propagation mechanisms.
- CO4: Summarize diversity reception techniques.
- CO5: Design Base Station (BS) parameters and analyze the antenna configurations.
- CO6: Analyze and examine the multiple access techniques and its application.
- CO7: Assess the latest wireless technologies.
Course Code : ECMI28
Course Title : FIBER OPTIC COMMUNICATION
Number of Credits : 3
Prerequisites (Course code) : ECMI12 & ECMI21
Course Type : MI

Course Learning Objective

- To expose the students to the basics of signal propagation through optical fibers, fiber impairments, components and devices and system design.

Course Content


Optical sources and detectors. Laser fundamentals. Semiconductor Laser basics. LEDs. PIN and Avalanche photodiodes, Optical TX/RX Circuits.


Text Books


Reference Books


Course outcomes

At the end of the course student will be able

CO1: Recognize and classify the structures of Optical fiber and types.
CO2: Discuss the channel impairments like losses and dispersion.
CO3: Analyze various coupling losses.
CO4: Classify the Optical sources and detectors and to discuss their principle.
CO5: Familiar with Design considerations of fiber optic systems.
Course Code : ECMI29
Course Title : MICROWAVE ELECTRONICS
Number of Credits : 3
Prerequisites (Course code) : ECMI25
Course Type : MI

Course Learning Objective
- To impart knowledge on basics of microwave electron beam devices and their applications in X band frequency.

Course Content
Limitations of conventional vacuum tubes, Klystrons: Re-entrant cavities, Two cavity klystron, Velocity modulation process, Bunching process ,Power output and efficiency; Multi-cavity klystron , Reflex klystron-Velocity modulation process, Mode Characteristics ,Electronic admittance spiral.

Travelling-wave tubes: Slow-wave structures, Helix TWT- Amplification process, Convection current, Wave modes and gain; coupled cavity TWT, Backward wave oscillator.

Crossed -field devices: Magnetrons- Principle of operation, characteristics, Hull cut-off condition; Carcinotron, Gyrotron.

Microwave transistors and FETs: Microwave bipolar transistors-Physical structures, characteristics, Power-frequency limitations; Microwave tunnel diode, Microwave unipolar transistor – Physical structure, principle of operation, characteristics, High electron-mobility transistors.

Transferred electron and Avalanche transit-time devices: Gunn diode, Gunn diode as an oscillator. IMPATT, TRAPATT and BARITT.

Text Books

Reference Books

Course outcomes
At the end of the course student will be able
CO1: Apply the basic knowledge of waveguide and microwave resonator circuits.
CO2: Asses the methods used for generation and amplification of the microwave power.
CO3: Distinguish between the linear and cross field electron beam microwave tubes.
CO4: Critically analyze the operating principles and performances of the microwave semiconductor devices.
CO5: Identify the suitable microwave power sources of given specification for the selected application.
CO6: Aware of current technological changes in the engineering aspects of microwave components.
Course Code : ECLR10
Course Title : DEVICES AND NETWORKS LABORATORY
Number of Credits : 1
Prerequisites (Course code) : NONE
Course Type : ELR

List of Experiments:

1. Study Experiment
2. PN Junction Diode Characteristics
3. Zener diode characteristics and its application
4. Characteristics study of Bipolar Junction Transistor (BJT)
5. Characteristics study of JFET
6. Response study of Series RLC
7. Constant K High pass Filter
8. Attenuators
9. Equalizers
10. Clippers and Clampers
11. SCR Characteristics
12. LAB view implementation

Course Code : ECLR11
Course Title : DIGITAL ELECTRONICS LABORATORY
Number of Credits : 1
Prerequisites (Course code) : NONE
Course Type : ELR

List of Experiments:

1. Study of logic gates and verification of Boolean Laws.
2. Design of adders and subtractors & code converters.
3. Design of Multiplexers & DE multiplexers.
4. Design of Encoders and Decoders.
5. Design of Magnitude Comparators
7. Design and implementation of counters using flip-flops
8. Design and implementation of shift registers.
9. Simulation of adders, subtractors, encoders & decoders using Verilog HDL.
10. Simulation of counters & shift registers using Verilog HDL.
Course Code: ECLR12
Course Title: ELECTRONIC CIRCUITS LABORATORY
Number of Credits: 2
Prerequisites (Course code): NONE
Course Type: ELR

List of Experiments:

Hardware Experiments
1. Stability of Q point
2. Single stage RC coupled CE amplifier
3. Single stage RC coupled Current series CE feedback amplifier
4. Darlington emitter follower
5. Differential Amplifier
6. RC phase shift oscillator
7. Colpitt’s Oscillator
8. Power amplifier – Class A & class AB

Simulation Experiments
9. MOS CS amplifier with resistive load, diode connected load, current source load
10. MOS current mirrors

Course Code: ECLR13
Course Title: MICROPROCESSOR AND MICROCONTROLLER LABORATORY
Number of Credits: 2
Prerequisites (Course code): NONE
Course Type: ELR

List of Experiments:

Intel 8086 – 16bit µP- Emulator.
1. Addressing modes of 8086 Microprocessor.
2. Block move and simple arithmetic operations.
3. Identification and displaying the activated key using DOS and BIOS function calls.

Intel 8051 (8-bit Microcontroller) - Proteus VSM Simulator and Trainer Kit.
6. Toggling the ports and counting the pulses.
7. LCD Interfacing.
8. Generation of different waveforms using DAC (0808)
9. ADC interfacing.

Mixed-Signal Microcontroller – 16bit – MSP430 series
10. PWM generation and speed control of Motors using MSP430.
Course Code : ECLR14
Course Title : ANALOG INTEGRATED CIRCuits LABORATORY
Number of Credits : 2
Prerequisites (Course code) : NONE
Course Type : ELR

List of Experiments:

Hardware Experiments
1. Study the characteristics of negative feedback amplifier
2. Design of an instrumentation amplifier
3. Study the characteristics of regenerative feedback system-Schmitt trigger
4. Study the characteristics of integrator circuit
5. Design of a second order Butterworth band-pass filter for the given higher and lower cut-off frequencies
6. Design of a high-Q Band pass self-tuned filter for a given centre frequency
7. Design of a function generator- Square, Triangular
8. Design of a Voltage Controlled Oscillator
9. Design of a Phase Locked Loop(PLL) (Mini project)

Simulation Experiments
    DC and small signal analysis of differential amplifier with Restive load, current mirror load and current source load, Input common-mode range and Common-mode feedback circuits, CMRR, PSRR.

Course Code : ECLR15
Course Title : DIGITAL SIGNAL PROCESSING LABORATORY
Number of Credits : 2
Prerequisites (Course code) : NONE
Course Type : ELR

List of Experiments:

MATLAB tool based simulation experiments

1. Realization of correlation of two discrete signals
2. Realization of convolution
3. FIR filter design
4. IIR filter design
5. DFT implementation
6. SNR and Power spectral density estimation of signals

TMS320C5416 Digital Signal Processor kit based Experiments

1. Study of various addressing modes and arithmetic sequence generation
2. Convolution using MAC, MACD and MACP instructions. Convolution using overlap add and overlap save method
3. Wave pattern generation
4. FIR filter implementation
5. DFT implementation using FFT radix-2 algorithm
6. Serial interface and data acquisition
### Course Code: ECLR16
### Course Title: VLSI AND EMBEDDED SYSTEM DESIGN LABORATORY
### Number of Credits: 2
### Prerequisites (Course code): NONE
### Course Type: ELR

**List of Experiments:**

**USING QUARTUS II**
1. Adders and subtractors
2. Mux & Demux
3. Encoders & Decoders
4. Flip-Flops
5. Shift-Registers & Counters

**USING XILINX**
6. Working with RAM
7. Comparators, parity generators & ALU
8. Counters and Shift Registers
9. Carry look ahead adder
10. MULTIPLIERS

**WARP DESIGN**
- Lab1: Introduction to WARP Design Flows
- Lab2: Building a Simple Transmitter
- Lab3: Building a Simple and Unidirectional MAC
- Lab4: Building a single-carrier streaming PHY.

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### Course Code: ECLR17
### Course Title: COMMUNICATION ENGINEERING LABORATORY
### Number of Credits: 2
### Prerequisites (Course code): NONE
### Course Type: ELR

**List of Experiments:**
1. AM Modulation and Demodulation
2. DSB-SC Modulation
3. Pulse Amplitude Modulation and Demodulation
4. Pulse Width Modulation and Demodulation
5. Pulse Position Modulation using PLL (IC 565)
6. Amplitude Shift Keying (ASK) Modulation and Demodulation
7. Frequency Shift Keying (FSK) Modulation and Demodulation
8. Frequency Multiplier using PLL
9. Analog and digital modulation using COMMSIM simulation tool
10. Analog and digital modulation using MATLAB
11. Study of wireless communication system using Wi-Comm Kit
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<tr>
<td>Course Title</td>
<td>FIBER OPTIC COMMUNICATION LABORATORY</td>
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List of Experiments:

1. Handling of Fibers  
2. Characteristics of Laser Diode  
3. Characteristics of Photo detector  
4. Characteristics of APD  
5. Numerical Aperture Measurement  
6. Measurement of Attenuation and Bending Loss  
7. Proximity Sensor  
8. Photonics CAD-WDM link  
9. LED Modulation  
10. Fiber Dispersion Measurement  
11. Study of BER and Q-factor estimation in the optical system simulation  
12. Study the effect of optical Receiver Characteristics on a system performance

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<td>Course Type</td>
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</table>

List of Experiments:

1. Characteristics Of Gunn Diode  
2. Characteristics Of Reflex Klystron  
3. Measurement Of Directional Coupler Parameters  
4. Characteristics Of Isolator And Circulator  
5. Characteristics of Waveguide Tees  
6. Frequency And Wavelength Measurement  
7. Impedance Measurement  
8. Antenna Measurement  
9. Propagation Of Microwaves  
10. VSWR measurement
Course Code : ECHO10
Course Title : ADVANCED DIGITAL SIGNAL PROCESSING
Number of Credits : 3
Prerequisites (Course code) : ECPC15
Course Type : HO

Course learning Objective
- To provide rigorous foundations in multirate signal processing, power spectrum estimation and adaptive filters.

Course content
Review of sampling theory. Sampling rate conversion by integer and rational factors. Efficient realization and applications of sampling rate conversion.


Text Books

Reference Books

Course outcomes
At the end of the course student will be able
CO1: summarize multirate DSP and design efficient digital filters.
CO2: construct multi-channel filter banks.
CO3: select linear filtering techniques to engineering problems.
CO4: describe the most important adaptive filter generic problems.
CO5: describe the various adaptive filter algorithms.
CO6: describe the statistical properties of the conventional spectral estimators.
Course Code : ECHO11
Course Title : SPECTRAL ANALYSIS OF SIGNALS
Number of Credits : 3
Prerequisites (Course code) : ECPC15
Course Type : HO

Course learning Objective
- To give an exhaustive survey of methods available for power spectrum estimation.

Course content


Text Books

Reference Books
2. Recent literature in Spectral Analysis of Signals.

Course outcomes
At the end of the course student will be able
CO1: derive and analyse the statistical properties of the conventional spectral estimators, namely the periodogram, averaged & modified periodogram and Blackman-Tukey methods.
CO2: formulate modern, parametric, spectral estimators based upon autoregressive (AR), moving average (MA), and autoregresive moving average (ARMA) models, and detail their statistical properties. Describe the consequence of the term resolution as applied to a spectral estimator.
CO3: define techniques for calculating moments in spectral and temporal domains; Analyze filter bank method, capon methods for spectrum estimation.
CO4: demonstrate knowledge and understanding of the principles of parametric and non-parametric array processing algorithms.
CO5: select an appropriate array processing algorithms for frequency estimation and sonar, radar applications.
Course Code : ECHO12
Course Title : DETECTION AND ESTIMATION
Number of Credits : 3
Prerequisites (Course code) : MAIR 45
Course Type : HO

Course learning Objective
- The objective of this course is to make the students conversant with those aspects of statistical decision and estimation which are indispensable tools required for the optimal design of digital communication systems.

Course content
Binary hypothesis testing; Bayes, minimax and Neyman-Pearson tests. Composite hypothesis testing.


Signal detection in continuous time: Detection of deterministic signals in Gaussian noise. Coherent detection in white Gaussian noise.

TextBooks

ReferenceBooks
4. Recent literature in Detection and Estimation.

Course outcomes
At the end of the course student will be able
CO1: summarize the fundamental concept on Statistical Decision Theory and Hypothesis Testing
CO2: summarize the various signal estimation techniques with additive noise
CO3: summarizer with Bayesian parameter estimation (minimum mean square error (MMSE), minimum mean absolute error (MMAE), maximum a-posterior probability (MAP) estimation methods).
CO4: compare optimal filtering, linear estimation, and Wiener/Kalman filtering. CO5: construct Wiener and Kalman filters (time discrete) and state space models.
Course Code : ECHO13
Course Title : WAVELET SIGNAL PROCESSING
Number of Credits : 3
Prerequisites (Course code) : ECPC15
Course Type : HO

Course learning Objective
- To expose the students to the basics of wavelet theory and to illustrate the use of wavelet processing for data compression and noise suppression.

Course content


Wavelet methods for image processing. Burt-Adelson and Mallat’s pyramidal decomposition schemes. 2D-dyadic wavelet transform.

Text Books

Reference Books
1. A.Teolis, Computational Signal Processing with Wavelets, Birkhauser, 1998
4. Recent literature in Wavelet Signal Processing.

Course outcomes
At the end of the course student will be able
CO1: understand about windowed Fourier transform and difference between windowed Fourier transform and wavelet transform.
CO2: understand wavelet basis and characterize continuous and discrete wavelet transforms
CO3: understand multi resolution analysis and identify various wavelets and evaluate their time-frequency resolution properties
CO4: implement discrete wavelet transforms with multirate digital filters
CO5: understand about wavelet packets
CO6: design certain classes of wavelets to specification and justify the basis of the application of wavelet transforms to different fields.
Course Code : ECHO14
Course Title : RF CIRCUITS
Number of Credits : 3
Prerequisites (Course code) : NONE
Course Type : HO

Course learning Objective
- To impart knowledge on basics of IC design at RF frequencies.

Course content
Characteristics of passive IC components at RF frequencies – interconnects, resistors, capacitors, inductors and transformers – Transmission lines. Noise – classical two-port noise theory, noise models for active and passive components High frequency amplifier design – zeros as bandwidth enhancers, shunt-series amplifier, fdouble, neutralization and uni-lateralization
Low noise amplifier design – LNA topologies, power constrained noise optimization, linearity and large signal performance
Mixers – multiplier-based mixers, subsampling mixers, diode-ring mixers
RF power amplifiers – Class A, AB, B, C, D, E and F amplifiers, modulation of power amplifiers, linearity considerations
Oscillators & synthesizers – describing functions, resonators, negative resistance oscillators, synthesis with static moduli, synthesis with dithering moduli, combination synthesizers – phase noise considerations.

Text Books

Reference Books
4. Recent literature in RF Circuits.

Course outcomes
At the end of the course student will be able
CO1: Understand the Noise models for passive components and noise theory
CO2: Analyze the design of a high frequency amplifier
CO3: Appreciate the different LNA topologies & design techniques
CO4: Distinguish between different types of mixers
CO5: Analyse the various types of synthesizers, oscillators and their characteristics.
Course Code : ECHO15
Course Title : NUMERICAL TECHNIQUES FOR MIC
Number of Credits : 3
Prerequisites (Course code) : ECPC25
Course Type : HO

Course learning Objective
- This subject will prepare the student to face the challenging problem of the most important component of Research namely the numerical analysis.

Course content


Planar Circuit Analysis: Introduction, Planar Circuit Analysis’ Function Approach Impedance Green’s Functions Contour Integral Approach Analysis of Planar Components of Composite Configurations Planar Circuits with Anisotropic Spacing Media Applications of the Planar Circuits Concept Summary

Spectral Domain Approach: Introduction, General Approach for Shielded Microstrip Lines, the Admittance Approach Formulations for Slot lines, Fin lines, and Coplanar Waveguides Numerical Computation


Text Book

Reference Books
2. Recent literature in numerical techniques for microwave integrated circuits.

Course outcomes
At the end of the course student will be able
- CO1: bring awareness of the need for numerical analysis of M.I.C. And prepare to formulate all popular numerical techniques of M.I.C.
- CO2: make one formulate and write coding for Finite Element Method
- CO3: prepare a person to be strong in the planar circuit Analysis
- CO4: bring awareness of the most popular quasi state analysis Spectral Domain Techniques
Course Code : ECHO16
Course Title : APPLIED PHOTONICS
Number of Credits : 3
Prerequisites (Course code) : NONE
Course Type : HO

Course learning Objectives

- To prepare the students understand the fundamental principles of light-matter interaction and photonic band gap structures.
- To enable the students appreciate the diverse applications of fiberoptic sensors.

Course content

Introduction to photonics; optical waveguide theory; Interference of light waves - numerical techniques and simulation

Photonic waveguide components Optical Modulators and Switches Electro-optics - Acousto-optics - Magneto-optics

Photonic Band gap Structures: Concept of photonic crystal; band gap and band structures in 1D, 2D and 3D photonic crystal structures;

Photo-refractive materials, non-linear optics, recent trends in bio and nano-photonics

Optical fiber sensors - Sensing using optical fibers - Types:- Amplitude, Interferometric, Wavelength, Polarimetric – Distributed Sensors

Text Books

2. Pochi Yeh and Amnon Yariv, "Photonics,” Optical Electronics in Modern Communications”, 2007

Reference Books

4. Recent literature in Applied Photonics.

Course outcomes

At the end of the course student will be able

CO1: understand the interference of light and optical waveguide theory.
CO2: understand the significance of photonic band gap structures and their application
CO3: analyze the different types of optical modulators.
CO4: compare the merits and demerits of different types of fiber optic sensors.
CO5: understand the application of nonlinear optics in bio and nano-photonics.
Course Code : ECHO17  
Course Title : ADVANCED RADIATION SYSTEMS  
Number of Credits : 3  
Prerequisites (Course code) : ECPC22  
Course Type : HO  

Course learning Objectives  
- To prepare the students understand the operating principles of various RF radiating systems.  
- To enable the students appreciate the diverse applications of radiating systems.  
- To design the suitable antenna systems to serve a defined application.  

Course content  
Antenna Fundamentals  
Antenna fundamental parameters, Radiation integrals, Radiation from surface and line current distributions – dipole, monopole, loop antenna; Broadband antennas and matching techniques, Balance to unbalance transformer, Introduction to numerical techniques.  

Apertures Antennas  
Field equivalence principle, Radiation from Rectangular and Circular apertures, Uniform aperture distribution on an infinite ground plane; Slot antenna; Horn antenna; Reflector antenna, aperture blockage, and design consideration.  

Arrays  
General structure of phased array, linear array theory, variation of gain as a function of pointing direction, frequency scanned arrays, digital beam forming, and MEMS technology in phased arrays-Retro directive and self-phased arrays.  

Micro Strip Antenna  
Radiation Mechanism from patch; Excitation techniques; Microstrip dipole; Rectangular patch, Circular patch, and Ring antenna – radiation analysis from transmission line model, cavity model; input impedance of rectangular and circular patch antenna; Application of microstrip array antenna.  

Terahertz Planar Antennas  

Text Books  

Reference Book  
3. Recent literature in Advanced Radiation Systems.  

Course outcomes  
At the end of the course student will be able  
CO1: understand the various antenna parameters and different impedance matching techniques.  
CO2: understand the working principle of apertures antennas.  
CO3: analyze how the electronic beam formation is done using array of antennas.  
CO4: compare the merits and demerits of various microwave patch antenna structures.
CO5: understand the photonic band gap structures and its application in terahertz antennas.
Course Code: ECHO18
Course Title: BIO MEMS
Number of Credits: 3
Prerequisites (Course code): ECPC18
Course Type: HO

Course learning Objective
- To train the students in the design aspects of Bio MEMS devices and Systems.
- To make the students aware of applications in various medical specialists especially the Comparison of conventions methods and Bio MEMS usage.

Course content
Introduction-The driving force behind Biomedical Applications-Biocompatibility-Reliability Considerations-Regularity Considerations-Organizations-Education of Bio MEMS-Silicon Micro fabrication-Soft Fabrication techniques
SENSOR PRINCIPLES and MICRO SENSORS: Introduction-Fabrication-Basic Sensors-Optical fibers- Piezo electricity and SAW devices-Electrochemical detection-Applications in Medicine
MICRO TOTAL ANALYSIS: Lab on Chip-Capillary Electrophoresis Arrays-cell, molecule and Particle Handling-Surface Modification-Microsphere-Cell based Bioassay Systems
Detection and Measurement Methods-Emerging Bio MEMS Technology-Packaging, Power, Data and RF Safety-Biocompatibility, Standards

Text Book

Reference Books
6. Recent literature in Bio MEMS.

Course outcomes
At the end of the course student will be able
CO1: learn and realize the MEMS applications in Bio Medical Engineering
CO2: understand the Micro fluidic Principles and study its applications.
CO3: learn the applications of Sensors in Health Engineering.
CO4: learn the principles of Micro Actuators and Drug Delivery system
CO5: learn the principles and applications of Micro Total Analysis
Course Code : ECHO19
Course Title : ANALOG IC DESIGN
Number of Credits : 3
Prerequisites (Course code) : ECPC23
Course Type : HO

Course learning Objectives
- To develop the ability design and analyze MOS based Analog VLSI circuits to draw the equivalent circuits of MOS based Analog VLSI and analyse their performance.
- To develop the skills to design analog VLSI circuits for a given specification.

Course content
Basic MOS Device Physics – General Considerations, MOS IV Characteristics, Second Order effects, MOS Device models. Short Channel Effects and Device Models. Single Stage Amplifiers – Basic Concepts, Common Source Stage, Source Follower, Common Gate Stage, Cascode Stage.


Band gap References, Introduction to Switched Capacitor Circuits, Nonlinearity and Mismatch.

Text Books

Reference Books
4. Recent literature in Analog IC Design.

Course outcomes
At the end of the course student will be able
CO1: draw the equivalent circuits of MOS based Analog VLSI and analyze their performance.
CO2: design analog VLSI circuits for a given specification.
CO3: Analyse the frequency response of the different configurations of a amplifier.
CO4: Understand the feedback topologies involved in the amplifier design.
CO5: Appreciate the design features of the differential amplifiers.
Course Code : ECHO20  
Course Title : VLSI SYSTEM TESTING  
Number of Credits : 3  
Prerequisites (Course code) : ECPE32  
Course Type : HO

Course learning Objective
- To expose the students, the basics of testing techniques for VLSI circuits and Test Economics.

Course content

Universal test sets: Pseudo-exhaustive and iterative logic array testing. Clocking schemes for delay fault testing. Testability classifications for path delay faults. Test generation and fault simulation for path and gate delay faults.


Design for testability: Scan design, Partial scan, use of scan chains, boundary scan, DFT for other test objectives, Memory Testing.

Built-in self-test: Pattern Generators, Estimation of test length, Test points to improve testability, Analysis of aliasing in linear compression, BIST methodologies, BIST for delay fault testing.

Text Books

Reference Books
4. Recent literature in VLSI System Testing.

Course outcomes
At the end of the course student will be able
CO1: apply the concepts in testing which can help them design a better yield in IC design.
CO2: tackle the problems associated with testing of semiconductor circuits at earlier design levels so as to significantly reduce the testing costs.
CO3: analyze the various test generation methods for static & dynamic CMOS circuits.
CO4: identify the design for testability methods for combinational & sequential CMOS circuits.
CO5: recognize the BIST techniques for improving testability.
Course Code : ECHO21
Course Title : ELECTRONIC DESIGN AUTOMATION TOOLS
Number of Credits : 3
Prerequisites (Course code) : NONE
Course Type : HO

Course learning Objective
- To make the students exposed to Front end and Back end VLSI CAD tools.

Course content
OS Architecture: System settings and configuration. Introduction to UNIX commands Handling directories, Filters and Piping, Wildcards and Regular expression, Power Filters and Files Redirection. Working on Vi editor, Basic Shell Programming, TCL Scripting language.


System Verilog- Introduction, Design hierarchy, Data types, Operators and language constructs. Functional coverage, Assertions, Interfaces and test bench structures.


Text Books

Reference Books
3. Recent literature in Electronic Design Automation Tools.

Course outcomes
At the end of the course student will be able
- CO1: execute the special features of VLSI back end and front end CAD tools and UNIX shell script
- CO2: explain the algorithms used for ASIC construction
- CO3: design synthesizable Verilog and VHDL code.
- CO4: explain the difference between Verilog and system Verilog and are able to write system Verilog code.
- CO5: Model Analog and Mixed signal blocks using Verilog A and Verilog AMS
Course Code : ECHO22
Course Title : DESIGN OF ASICS
Number of Credits : 3
Prerequisites (Course code) : NONE
Course Type : HO

Course learning Objectives

- To prepare the student to be an entry-level industrial standard ASIC or FPGA designer.
- To give the student an understanding of issues and tools related to ASIC/FPGA design and implementation.
- To give the student an understanding of basics of System on Chip and Platform based design.
- To give the student an understanding of High performance algorithms

Course content

Introduction to Technology, Types of ASICs, VLSI Design flow, Design and Layout Rules, Programmable ASICs - Antifuse, SRAM, EPROM, EEPROM based ASICs. Programmable ASIC logic cells and I/O cells. Programmable interconnects. Advanced FPGAs and CPLDs and Soft-core processors.


Semicustom Approach: Synthesis (RTL to GATE netlist) - Introduction to Constraints (SDC), Introduction to Static Timing Analysis (STA). Place and Route (Logical to Physical Implementation): Floor-plan and Power-Plan, Placement, Clock Tree Synthesis (clock planning), Routing, Timing Optimization, GDS generation.


System-On-Chip Design - SoC Design Flow, Platform-based and IP based SoC Designs, Basic Concepts of Bus-Based Communication Architectures. High performance algorithms for ASICs/ SoCs as case studies – Canonic Signed Digit Arithmetic, KCM, Distributed Arithmetic, High performance digital filters for sigma-delta ADC.

Text Books


Reference Books

6. Recent literature in Design of ASICS.
Course outcomes
At the end of the course student will be able
CO1: demonstrate VLSI tool-flow and appreciate FPGA and CPLD architectures
CO2: understand the issues involved in ASIC design, including technology choice, design management and tool-flow.
CO3: understand the algorithms used for ASIC construction.
CO4: understand Full Custom Design Flow and Tool used
CO5: understand Semicustom Design Flow and Tool used - from RTL to GDS and Logical to Physical Implementation
CO6: understand about STA, LEC, DRC, LVS, DFM
CO7: understand the basics of System on Chip and on chip communication architectures appreciate high performance algorithms for ASICs
**Course Code**: ECHO23  
**Course Title**: DIGITAL SYSTEM DESIGN  
**Number of Credits**: 3  
**Prerequisites (Course code)**: ECPC14  
**Course Type**: HO

### Course learning Objective

- To get an idea about designing complex, high speed digital systems and how to implement such design.

### Course content

Mapping algorithms into Architectures: Datapath synthesis, control structures, critical path and worst case timing analysis. FSM and Hazards.


Data path and array subsystems: Addition / Subtraction, Comparators, counters, coding, multiplication and division. SRAM, DRAM, ROM, serial access memory, context addressable memory.

Reconfigurable Computing- Fine grain and Coarse grain architectures, Configuration architectures-Single context, Multi context, partially reconfigurable, Pipeline reconfigurable, Block Configurable, Parallel processing.

### Text Books

### Reference Books
7. Recent literature in Digital System Design.

### Course outcomes

At the end of the course student will be able
- CO1: identify mapping algorithms into architectures.
- CO2: summarize various delays in combinational circuit and its optimization methods.
- CO3: summarize circuit design of latches and flip-flops.
- CO4: construct combinational and sequential circuits of medium complexity that is based on VLSIs, and programmable logic devices.
- CO5: summarize the advanced topics such as reconfigurable computing, partially reconfigurable, Pipeline reconfigurable architectures and block configurable.
Course Code: ECHO24
Course Title: OPTIMIZATIONS OF DIGITAL SIGNAL PROCESSING STRUCTURES FOR VLSI
Number of Credits: 3
Prerequisites (Course code): ECPC20 & ECPE32
Course Type: HO

Course learning Objectives

- To understand the various VLSI architectures for digital signal processing.
- To know the techniques of critical path and algorithmic strength reduction in the filter structures.
- To enable students to design VLSI system with high speed and low power.
- To encourage students to develop a working knowledge of the central ideas of implementation of DSP algorithm with optimized hardware.

Course content

An overview of DSP concepts, Pipelining of FIR filters. Parallel processing of FIR filters. Pipelining and parallel processing for low power, Combining Pipelining and Parallel Processing.

Transformation Techniques: Iteration bound, Retiming, Folding and Unfolding.

Pipeline interleaving in digital filters. Pipelining and parallel processing for IIR filters. Low power IIR filter design using pipelining and parallel processing, Pipelined adaptive digital filters.

Algorithms for fast convolution: Cook-Toom Algorithm, Cyclic Convolution.

Algorithmic strength reduction in filters and transforms: Parallel FIR Filters, DCT and inverse DCT, Parallel Architectures for Rank-Order Filters.

Synchronous pipelining and clocking styles, clock skew and clock distribution in bit level pipelined VLSI designs. Wave pipelining, constraint space diagram and degree of wave pipelining, Implementation of wave-pipelined systems, Asynchronous pipelining.

Text Book

Reference Books
7. Recent literature in Optimizations of Digital Signal Processing Structures for VLSI.

Course outcomes

At the end of the course student will be able
CO1: understand the overview of DSP concepts and design architectures for DSP algorithms.
CO2: improve the overall performance of DSP system through various transformation and optimization techniques.
CO3: perform pipelining and parallel processing on FIR and IIR systems to achieve high speed and low power.
CO4: optimize design in terms of computation complexity and speed.
Course Code : ECHO25
Course Title : LOW POWER VLSI CIRCUITS
Number of Credits : 3
Prerequisites (Course code) : ECPE32
Course Type : HO

Course learning Objective
- To expose the students to the low voltage device modelling, low voltage, low power VLSI CMOS circuit design.

Course content

CMOS fabrication process, Shallow trench isolation. Lightly-doped drain. Buried channel. Fabrication process of BiCMOS and SOI CMOS technologies.

Modeling of CMOS devices parameters. Threshold voltage, Body effect, Short channel and Narrow channel effects, Electron temperature, MOS capacitance.

CMOS inverters, static logic circuits of CMOS, pass transistor, BiCMOS, SOI CMOS and low power CMOS techniques.

Basic concepts of dynamic logic circuits. Various problems associated with dynamic logic circuits. Differential, BiCMOS and low voltage dynamic logic circuits.

CMOS memory circuits, Decoders, sense amplifiers, SRAM architecture. Low voltage SRAM techniques.

Text Books

Reference Book
2. Recent literature in Low Power VLSI Circuits.

Course outcomes
At the end of the course student will be able
CO1: acquire the knowledge about various CMOS fabrication process and its modeling.
CO2: infer about the second order effects of MOS transistor characteristics.
CO3: analyze and implement various CMOS static logic circuits.
CO4: learn the design of various CMOS dynamic logic circuits.
CO5: learn the different types of memory circuits and their design.
Course Code: ECHO26
Course Title: VLSI DIGITAL SIGNAL PROCESSING SYSTEMS
Number of Credits: 3
Prerequisites (Course code): ECPC15 & ECPE32
Course Type: HO

Course learning Objectives
- To enable students to design VLSI systems with high speed and low power.
- To encourage students to develop a working knowledge of the central ideas of implementation of DSP algorithm with optimized hardware.

Course content


Bit level arithmetic Architectures- parallel multipliers, interleaved floor-plan and bit-plane-based digital filters, Bit serial multipliers, Bit serial filter design and implementation, Canonic signed digit arithmetic, Distributed arithmetic.

Redundant arithmetic -Redundant number representations, carry free radix-2 addition and subtraction, Hybrid radix-4 addition, Radix-2 hybrid redundant multiplication architectures, data format conversion, Redundant to Non redundant converter.

Numerical Strength Reduction – Sub expression Elimination, Multiple Constant Multiplication, Sub expression sharing in Digital Filters, Additive and Multiplicative Number Splitting.

Text Book

Reference Book

Course outcomes
At the end of the course student will be able
CO1: Acquire the knowledge of round off noise computation and numerical strength reduction.
CO2: Ability to design Bit level and redundant arithmetic Architectures.
Course Code : ECHO27  
Course Title : ASYNCHRONOUS SYSTEM DESIGN  
Number of Credits : 3  
Prerequisites (Course code) : ECPC14  
Course Type : HO  

Course learning Objectives  
- This subject introduces the fundamentals and performance of Asynchronous system  
- To familiarize the dependency graphical analysis of signal transmission graphs  
- To learn software languages and its syntax and operations for implementing Asynchronous Designs  

Course content  
Fundamentals: Handshake protocols, Muller C-element, Muller pipeline, Circuit implementation styles, theory. Static data-flow structures: Pipelines and rings, Building blocks, examples  
High-level languages and tools: Concurrency and message passing in CSP, Tangram program examples, Tangram syntax-directed compilation, Martin’s translation process, Using VHDL for Asynchronous Design. An Introduction to Balsa: Basic concepts, Tool set and design flow, Ancillary Balsa Tools  

Text Books  

Reference Book  
3. A Designer’s Guide to Asynchronous VLSI, Peter A. Beerel, Recep O. Ozdag, Marcos Ferretti, 2010  
4. Recent literature in Asynchronous System Design.  

Course outcomes  
At the end of the course student will be able  
CO1: understand the fundamentals of Asynchronous protocols  
CO2: analyze the performance of Asynchronous System and implement handshake circuits  
CO3: understand the various control circuits and Asynchronous system modules  
CO4: gain the experience in using high level languages and tools for Asynchronous Design
CO5: learn commands and control flow of Balsa language for implementing Asynchronous Designs

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<tr>
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<tbody>
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<td>Course Title</td>
<td>PHYSICAL DESIGN AUTOMATION</td>
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<tr>
<td>Number of Credits</td>
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<td>Prerequisites</td>
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Course learning Objectives
- Understand the concepts of Physical Design Process such as partitioning, Floor planning, Placement and Routing.
- Discuss the concepts of design optimization algorithms and their application to physical design automation.
- Understand the concepts of simulation and synthesis in VLSI Design Automation
- Formulate CAD design problems using algorithmic methods

Course content
VLSI design automation tools- algorithms and system design. Structural and logic design. Transistor level design. Layout design. Verification methods. Design management tools.


Floor planning and routing- floor planning concepts. Shape functions and floor planning sizing. Local routing. Area routing. Channel routing, global routing and its algorithms.

Simulation and logic synthesis- gate level and switch level modeling and simulation. Introduction to combinational logic synthesis. ROBDD principles, implementation, construction and manipulation. Two level logic synthesis.


Text Books

Reference Books
3. Recent literature in Physical Design Automation.

Course outcomes
At the end of the course student will be able
- CO1: know how to place the blocks and how to partition the blocks while for designing the layout for IC.
- CO2: solve the performance issues in circuit layout.
- CO3: analyze physical design problems and Employ appropriate automation algorithms for partitioning, floor planning, placement and routing
- CO4: decompose large mapping problem into pieces, including logic optimization with partitioning, placement and routing
- CO5: analyze circuits using both analytical and CAD tools
Course Code : ECHO29
Course Title : MIXED - SIGNAL CIRCUIT DESIGN
Number of Credits : 3
Prerequisites (Course code) : NONE
Course Type : HO

Course learning Objective
- To make the students to understand the design and performance measures concept of mixed signal circuit.

Course content

Design methodology for mixed signal IC design using gm/Id concept.
CMOS Digital Circuits Design: Design of MOSFET Switches and Switched-Capacitor Circuits, Layout Considerations.
Design of frequency and Q tunable continuous time filters.

Text Books

Course outcomes
At the end of the course student will be able
CO1: Appreciate the fundamentals of data converters and also optimized their performances.
CO2: Understand the design methodology for mixed signal IC design using gm/Id concept.
CO3: Analyze the design of current mirrors and operational amplifiers
CO4: Design the CMOS digital circuits and implement its layout.
CO5: design the frequency and Q tunable time domain filters.
Course content

Introduction to Magnetic resonance imaging - Bloch equation - Larmor frequency and the tip angle - Trick on MRI - Selecting the human slice and the corresponding external RF pulse.

Measurement of the Transverse component using the receiver antenna - Sampling the MRI image in the frequency domain - Practical difficulties and remedies in MRI Proton-Density, MRI image - $T_2$ MRI image using Spin-Echo and Cartesian scanning - $T_1$ MRI image using spin-echo and polar scanning - $T_1$ MRI image.


Text Books

Reference Books
4. Recent literature in Digital Signal Processing for Medical Imaging.

Course outcomes
At the end of the course student will be able

CO1: Describe the signal processing techniques involved in CT based Imaging techniques
CO2: Describe the signal processing techniques involved in MRI based Imaging techniques
CO3: Describe the signal processing techniques involved in Nuclear Imaging
CO4: Describe the signal processing techniques involved in Ultra sound Imaging
CO5: Describe the signal processing techniques involved in Medical image processing