### COURSE STRUCTURE FOR B.TECH DEGREE IN INSTRUMENTATION AND CONTROL ENGINEERING

#### 3RD SEMESTER [2ND YEAR 1ST SEMESTER]

<table>
<thead>
<tr>
<th>Sl NO</th>
<th>CODE</th>
<th>TITLE</th>
<th>CONTACT PERIODS PER WEEK</th>
<th>TOTAL PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>CS 302</td>
<td>Data structure and Algorithms</td>
<td>3</td>
<td>1</td>
<td>_</td>
</tr>
<tr>
<td>2</td>
<td>M(CS ) 312</td>
<td>Numerical Methods and Programming</td>
<td>3</td>
<td>0</td>
<td>_</td>
</tr>
<tr>
<td>3</td>
<td>EE 301</td>
<td>Circuit Theory and Networks</td>
<td>3</td>
<td>1</td>
<td>_</td>
</tr>
<tr>
<td>4</td>
<td>IC 301</td>
<td>Measurement Fundamentals</td>
<td>3</td>
<td>1</td>
<td>_</td>
</tr>
<tr>
<td>5</td>
<td>M 302</td>
<td>Mathematics</td>
<td>3</td>
<td>1</td>
<td>_</td>
</tr>
<tr>
<td>6</td>
<td>MS301</td>
<td>Material Science</td>
<td>3</td>
<td>0</td>
<td>_</td>
</tr>
</tbody>
</table>

**TOTAL OF THEORY**

|       |       |                                      | 22 | 22 |

<table>
<thead>
<tr>
<th>Sl NO</th>
<th>CODE</th>
<th>TITLE</th>
<th>CONTACT PERIODS PER WEEK</th>
<th>TOTAL PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>M(CS ) 382</td>
<td>Numerical Methods and Programming</td>
<td>_</td>
<td>_</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>CS 392</td>
<td>Data Structure Lab</td>
<td>_</td>
<td>_</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>EE 391</td>
<td>Circuits and Network Lab</td>
<td>_</td>
<td>_</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>IC 391</td>
<td>Measurement Fundamentals Lab</td>
<td>_</td>
<td>_</td>
<td>3</td>
</tr>
</tbody>
</table>

**TOTAL OF PRACTICAL**

|       |       |                                      | 12 | 8  |

**TOTAL OF SEMESTER**

|       |       |                                      | 34 | 30 |
# Course Structure of Instrumentation and Control Engineering

## FOURTH SEMESTER

### THEORY

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>CODE</th>
<th>TITLE</th>
<th>Contact periods per week</th>
<th>Total</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>IC401</td>
<td>Basic Control Theory</td>
<td>L 3, T 0, P 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>EC 401</td>
<td>Analogue Electronic Circuits</td>
<td>L 3, T 0, P 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>EC 402</td>
<td>Digital Electronics and Integrated Circuits</td>
<td>L 3, T 1, P 0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>EI 401</td>
<td>Sensors and Transducers</td>
<td>L 3, T 0, P 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>EI 402</td>
<td>Electronic Measurements and Instrumentation</td>
<td>L 3, T 1, P 0</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

**TOTAL THEORY**

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### PRACTICAL

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>CODE</th>
<th>TITLE</th>
<th>Contact periods per week</th>
<th>Total</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>EI491</td>
<td>Sensors and Transducers Lab</td>
<td>L 0, T 0, P 3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>EC491</td>
<td>Analogue Electronic Circuits Lab</td>
<td>L 0, T 0, P 3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>EC492</td>
<td>Digital Electronics and Integrated Circuits Lab</td>
<td>L 0, T 0, P 3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>EI 492</td>
<td>Electronic Measurements and Instrumentation Lab</td>
<td>L 0, T 0, P 3</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

**TOTAL PRACTICAL**

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### SESSIONAL

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>CODE</th>
<th>TITLE</th>
<th>Contact periods per week</th>
<th>Total</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>HU 481</td>
<td>Technical Report Writing &amp; Language Practice Lab</td>
<td>L 0, T 0, P 0</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

**TOTAL SESSIONAL**

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TOTAL OF SEMESTER**

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

32 27
**THEORY**

<table>
<thead>
<tr>
<th>SL. NO</th>
<th>CODE</th>
<th>TITLE</th>
<th>Contact periods per week</th>
<th>Total</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>IC 501</td>
<td>Industrial Instrumentation - I</td>
<td>3 1 0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>IC 502</td>
<td>Object oriented programming and design</td>
<td>3 1 0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>IC 503</td>
<td>Microprocessor and Micro-controller</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>IC 504</td>
<td>Advance Control System</td>
<td>3 1 0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>IC 505</td>
<td>Data communication and Telemetry</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>TOTAL THEORY</strong></td>
<td></td>
<td><strong>18</strong></td>
<td><strong>18</strong></td>
</tr>
</tbody>
</table>

**PRACTICAL**

<table>
<thead>
<tr>
<th>SL. NO</th>
<th>CODE</th>
<th>TITLE</th>
<th>Contact periods per week</th>
<th>Total</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>IC 591</td>
<td>Industrial Instrumentation – I Lab</td>
<td>0 0 3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>IC 592</td>
<td>Computer Software Lab</td>
<td>0 0 3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>IC 593</td>
<td>Microprocessor and Micro-controller Lab</td>
<td>0 0 3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>IC 594</td>
<td>Advance Control System Lab</td>
<td>0 0 3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>TOTAL PRACTICAL</strong></td>
<td></td>
<td><strong>12</strong></td>
<td><strong>8</strong></td>
</tr>
</tbody>
</table>

**SESSIONAL**

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>TOTAL SESSIONAL</strong></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL OF SEMESTER</strong></td>
<td><strong>30</strong></td>
<td><strong>26</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### SIXTH SEMESTER

#### THEORY

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>CODE</th>
<th>TITLE</th>
<th>Contact periods per week</th>
<th>Total</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
</tr>
<tr>
<td>1</td>
<td>IC 601</td>
<td>Process Control</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>EI 602</td>
<td>Microprocessor based system</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>CS 611</td>
<td>Computer Network &amp; Internetworking</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>IC 602</td>
<td>Multimedia</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>IC 603</td>
<td>Industrial Instrumentation - II</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>TOTAL THEORY</strong></td>
<td></td>
<td><strong>17</strong></td>
<td><strong>17</strong></td>
</tr>
</tbody>
</table>

#### PRACTICAL

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>CODE</th>
<th>TITLE</th>
<th>Contact periods per week</th>
<th>Total</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>IC 691</td>
<td>Process Control Lab</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>EI 692</td>
<td>Microprocessor based system Lab</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>CS 681</td>
<td>Computer networking Lab</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>IC 692</td>
<td>Multimedia Lab</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>TOTAL PRACTICAL</strong></td>
<td></td>
<td><strong>12</strong></td>
<td><strong>8</strong></td>
</tr>
</tbody>
</table>

#### SESSIONAL

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>CODE</th>
<th>TITLE</th>
<th>Contact periods per week</th>
<th>Total</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>IC 682</td>
<td>Group Discussion and Seminar</td>
<td></td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>TOTAL SESSIONAL</strong></td>
<td></td>
<td><strong>3</strong></td>
<td><strong>2</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>TOTAL OF SEMESTER</strong></td>
<td></td>
<td><strong>32</strong></td>
<td><strong>27</strong></td>
</tr>
</tbody>
</table>

6-weeks’ Industrial Training during summer vacation
### SEVENTH SEMESTER

#### A. THEORY:

<table>
<thead>
<tr>
<th>SL NO.</th>
<th>CODE</th>
<th>THEORY</th>
<th>CONTACT PERIODS PER WEEK</th>
<th>TOTAL</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>IC 701</td>
<td>Digital Signal Processing</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>HU 701</td>
<td>Financial Management &amp; Accounts</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>IC 702</td>
<td>Logic and Distributed control system</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>IC 703</td>
<td>Elective I</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>EI 703</td>
<td>Elective II</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TOTAL THEORY</td>
<td></td>
<td>15</td>
<td>15</td>
</tr>
</tbody>
</table>

#### B. PRACTICAL:

<table>
<thead>
<tr>
<th>SL NO.</th>
<th>CODE</th>
<th>PRACTICAL</th>
<th>CONTACT PERIODS PER WEEK</th>
<th>TOTAL</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>IC 791</td>
<td>DSP Lab</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>IC 792</td>
<td>Logic and Distributed control system Lab</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>IC 794</td>
<td>Assigned Project</td>
<td>6</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TOTAL PRACTICAL</td>
<td></td>
<td>12</td>
<td>8</td>
</tr>
</tbody>
</table>

#### A. SESSIONAL:

| 1      | IC 781| Practical Training Evaluation                | -                        | -     | 3       |
| 2      | IC 782| Seminar on Assigned/selected Topics          | 3                        | 3     | 2       |
|        |       | TOTAL SESSIONAL                              |                          | 3     | 5       |

Total of Semester: 30 28

List of Elective Papers:

<table>
<thead>
<tr>
<th>Elective I (IC 703)</th>
<th>Elective II (EI 703)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Biomedical Instrumentation</td>
<td>a) Ultrasonic Instrumentation</td>
</tr>
<tr>
<td>b) Power Electronics</td>
<td>b) Advanced Sensors</td>
</tr>
<tr>
<td>c) Reliability and safety engineering</td>
<td>d) Microelectronics &amp; VLSI Technology</td>
</tr>
</tbody>
</table>
# Instrumentation & Control Engineering Syllabus upto 7th Semester

## Instruments and Control Engineering

### EIGHTH SEMESTER

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Code</th>
<th>Subject</th>
<th>Contact Periods per Week</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
</tr>
<tr>
<td>A. Theory</td>
<td></td>
<td></td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>HU 801</td>
<td>Values and Ethics in Profession</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>HU 802</td>
<td>Industrial Management</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>EI/IC 801</td>
<td>Elective III</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>M/EE/EI/CS 801/802</td>
<td>Elective IV</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total Theory</strong></td>
<td>12</td>
<td>0</td>
</tr>
</tbody>
</table>

### B. Practical

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Code</th>
<th>Subject</th>
<th>Contact Periods per Week</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>IC 893</td>
<td>Assigned Project</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total Practical</strong></td>
<td>12</td>
<td>0</td>
</tr>
</tbody>
</table>

### C. Sessional

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Code</th>
<th>Subject</th>
<th>Contact Periods per Week</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>IC 881</td>
<td>Personality Development</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>IC 882</td>
<td>Comprehensive Viva Voce</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total Sessional</strong></td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total of Semester</strong></td>
<td>27</td>
<td>26</td>
</tr>
</tbody>
</table>

### List of Elective Papers:

<table>
<thead>
<tr>
<th>Elective III</th>
<th>Elective IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>EI 801(C)</td>
<td>M 801(A)</td>
</tr>
<tr>
<td>EI 801(A)</td>
<td>EE 802(G)</td>
</tr>
<tr>
<td>IC 801(B)</td>
<td>EI 802(C)</td>
</tr>
<tr>
<td>IC 801(C)</td>
<td>CS 802(G)</td>
</tr>
</tbody>
</table>

- Analytical Instrumentation
- Project Management and Operations Research
- Opto-electronics and Laser-based Instrumentation
- Non Conventional Energy Sources
- Product Design and Development
- Robotics
- Power Plant Instrumentation and Control
- Soft Computing – Theory and Applications
Data Structures and Algorithms

**Code:** CS 302  
**Contact:** 3L + IT  
**Credit:** 4

**Overview of C language**

Time and Space analysis of Algorithms - Order Notations.

Linear Data Structures - Sequential representations - Arrays and Lists, Stacks, Queues and Dequeues, strings, Application.

Linear Data Structures, Link Representation, Linear linked lists, Circularly linked lists. Doubly linked lists, application.

Recursion - Design of recursive algorithms, Tail Recursion, When not to use recursion, Removal of recursion.


Hashing - Hashing Functions, collision Resolution Techniques.

Sorting and Searching Algorithms - Bubble sort, Selection Sort, Insertion Sort, Quick sort, Merge Sort, Heap sort and Radix Sort

File Structures - Sequential and Direct Access. Relative Files, Indexed Files - B+ tree as index. Multi-indexed Files, Inverted Files, Hashed Files.

**Text book:**

1. Data Structures and Algorithms, O.G. Kakde and U.A. Deshpandey, ISTE/EXCEL BOOKS
3. Drozdek- Data Structures and Algorithms, Vikas
   2. Lipschutz: Data Structures TMH

**References:**

1. Heileman :Datastructure Algorithms &OOP
2. Data Structure Using C – M.Radhakrishnan, V.Srinivasan, ISTE/EXCEL BOOKS
5. Tanenbaum A. S. , “Data Structures using ‘C’ ”

Circuit Theory & Networks

**Code:** EE 301  
**Contact:** 3L + IT  
**Credit:** 4

Different types of systems & networks: continuous & Discrete, Fixed and Time varying, Linear and Non-linear, Lumped and distributed, Passive & Active Networks & Systems

Laplace transform of impulse and sinusoidal steps waveforms for RL, RC, LC and RLC Circuits.

Transient analysis of different electrical circuits with and without initial conditions, Fourier Series and Fourier Transform

Network theorems and their applications in circuit analysis, Formulation of network equations, Source transformations, Loop variable analysis and node variable analysis

Graph of network, concept of tree branch, tree link. Incidence matrix, Tie-set matrix and loop currents, Cut set matrix and node pair potentials

Two port networks, Open circuit Impedance and Short circuit Admittance parameters, Transmission parameters, hybrid parameters, and their inter-relations

Indefinite admittance matrix- their applications to the analysis of active network
Active filter analysis and synthesis using operational amplifier

SPICE: How SPICE works. Model statement, models for passive and active device, D.C. circuits analysis, small signal analysis, capacitors and inductors in D.C. Circuits, steady state and transient, plotting and printing, input and output Impedance, D.C. sensitivity analysis, harmonic decomposition (Fourier Series), Harmonic re-composition, voltage controlled components

**Text books :**
1. Sudhakar:Circuits & Networks:Analysis & Synthesis 2/e TMH New Delhi
3. Engineering circuit analysis with PSPICE and probe-Roger
4. Engg Circuit Analysis,: Hayt 6/e Tata Mcgraw-Hill
5. A. Chakravarty: Networks, Filters & Transmission Lines
6. D.Chattopadhayay and P.C.Rakshit: Electrical Circuits
7. A.V. Oppenheimer and A.S.Wilsky: Signals & Systems, PHI
8. R.V. Jalgaonkar.: Network Analysis & Synthesis.EPH.
9. Sivandam- Electric Circuits Analysis,Vikas

**References :**

**MATHEMATICS**

**Code:** M 302  
**Contacts:** 3L + 1T  
**Credits:** 4

Fourier Series:
Introduction: Euler’s formula; Problems on general Fourier Series; Conditions for Fourier Expansion; Fourier Expansions of Discontinuous Functions; Even and Odd functions; Change of interval; Half range series; Typical Waveforms (Square, Saw-toothed, Triangular, Half Wave rectifier, Full Wave rectifier); Parseval’s Identity (statement only); Fourier Transform (FT) and its properties; Inverse Fourier Transform (statement only); Fourier transform of derivative (statement only); Convolution (statement only); Application of Fourier Transform in solving partial differential equations — Laplace’s Equation (2D only), Heat Conduction Equation (1D only) and Wave Equation (1D only).

12L

Calculus of Complex Variable:
Functions; Limits and Continuity; Analytic Functions; Cauchy Riemann Conditions; Analytic Continuation; Complex Integration and Cauchy's Theorem; Cauchy's Integral Formula; Taylor's and Laurent Series; Zeros of an Analytic Function; Poles; Essential Singularities; Residue Theorem (statement only) and it's application to evaluation of integral; Introduction to Conformal Mapping; Simple problems.

14L

Probability and Statistics:
Mean, Median, Mode and Standard Deviation; Samples Space; Definition of Probability; Conditional Probability; General Multiplication Theorem; Independent Events; Bayes' Theorem; Random Variable; Discrete and Continuous Probability Distributions - Probability mass function; Probability density function; Distribution Function; Expectation; Variance; Probability Distribution—Binomial, Poisson and Normal. Correlation and Regression; Method of Least Squares; Linear Curve Fitting.

10L
Graph Theory:
Graphs; Digraphs; Isomorphism; Walk; Path; Circuit; Shortest Path: Dijkstra's Algorithm; Tree; Properties of Tree; Binary Tree; Fundamental Circuit; Minimal Spanning Tree: Kruskal's Algorithm; Prim’s Algorithm. Cut Set; Fundamental Cut Set and Cut Vertices; Matrix Representation of Graphs (Adjacency and Incidence Matrices); Network; Flow Augmenting Path; Ford-Fulkerson Algorithm for Maximum Flow; Max Flow – Min Cut Theorem (statement only).

12L

Text Books:
1. Rathor, Choudhari,: Descrete Structure And Graph Theory.
10. West D.B.: Introduction to Graph Theory - Prentice Hall
11. Deo N: Graph Theory with Applications to Engineering and Computer Science - Prentice Hall.
14. Jana- Undergradute Mathematics
15. Lakshminarayan- Engineering Math 1.2.3
16. Gupta- Mathematical Physics (Vikas)
17. Singh- Modern Algebra
18. Rao B: Differential Equations with Applications & Programs, Universities Press
19. Murray: Introductory Courses in Differential Equations, Universities Press
22. Chowdhury: Elements of Complex Analysis, New Age International
23. Bhat: Modern Probability Theory, New Age International
26. Dhami: Differential Calculus, New Age International

NUMERICAL METHODS AND PROGRAMMING

Code: M(CS) 312
Contacts: 3L
Credits: 3

Computer Number Systems; Overflow and underflow; Approximation in numerical computation; Truncation and round off errors; Propagation and control of round off errors; Chopping and rounding off errors; Pitfalls (hazards) in numerical computations (ill conditioned and well conditioned problems).

2L
Algorithmic Approach in C Language to all the Numerical Problems Discussed below must be followed:

**Interpolation:**
Lagrange’s Interpolation, Newton’s forward & backward Interpolation Formula. Extrapolation; 4L Newton’s Divided Difference Formula; Error; Problems.

**Numerical Differentiation:**
Use of Newton’s forward and backward interpolation formula only. 1L

**Numerical Integration:**
Trapezoidal formula (composite); Simson’s 1/3rd formula (composite); Romberg Integration (statement only); Problems. 2L

**Numerical Solution of System of Linear Equations:**
Gauss elimination method; Matrix Inversion; Operations Count; LU Factorization Method (Crout’s Method); Gauss-Jordan Method; Gauss-Seidel Method; Sufficient Condition of Convergence. 6L

**Numerical Solution of Algebraic and Transcendental Equations:**
Iteration Method: Bisection Method; Secant Method; Regula-Falsi Method; Newton-Raphson Method. 4L

**Numerical Solution of Initial Value Problems of First Order Ordinary Differential Equations:**
Taylor’s Series Method; Euler’s Method; Runge-Kutta Method (4th order); Modified Euler’s Method and Adams-Moulton Method. 6L

**C Language Overview:**
Loop; Recursion; Function; Array; Pointers; Structures and Unions; Various types of File Access Methods: Sequential, Indexed Sequential, Random; Binary.
Various types of Files in C and Various types of File Handling Statements in C 11L

Total 36L

Implementation above Numerical & Statistical Problems in C Language:

**Text Books:**
2. C Language and Numerical Methods by C.Xavier
3. Introductory Numerical Analysis by Dutta & Jana
4. Numerical Method:Balagurusamy
5. Numerical Mathematical Analysis by J.B.Scarborough
6. Numerical Methods (Problems and Solution) by Jain, Iyengar , & Jain
8. Computer Oriented Numerical Method- Dutta,N ,Vikas
11. Numerical Methods for Engineers – Gupta, New Age International
MATERIAL SCIENCE
Code : MS 301
Contacts : 3L
Credits :3

Introduction : Classification of materials; Structure-property Relations; Metals & Alloys, Ceramics, Polymers, Composites and Semiconductors. Atomic Structure & Intermolecular Bonding ; Fundamentals of Atomic Structure and Chemical Bonding; Atomic Bonding in Solids.

Phase Diagrams : Phase Rules; Single component and Binary Phase diagrams; The Level Rule; Hume-Rothery rules of alloying.

Diffusion in solids : Fick’s Laws of Diffusion; The Atomic Model of Diffusion

Phase Transformations: Nucleation and Growth , Recovery, Recrystallization and Grain Growth.

Environmental Degradation of materials : Oxidation and Corrosion; Thermal and Photo Degradation; Chemical Degradation; Radiation Damage.

Structure of solids : Crystalline and Non-crystalline states; Crystallographic directions and phases; Determination of crystal structures.

Defects and imperfections in solids : Point, Line and Planer defects; Interfacial defects and volume defects; impurities in solids.

Elastic, Plastic and Viscoelastic Behaviour of materials: Stress-strain relationship; relaxation and creep; strengthening mechanism and fracture.

Thermal properties of materials : Heat capacity; Thermal expansion and thermal conductivity.

Electrical properties : Electronic and Ionic conduction; Energy Band structures in solids ; Electron Mobility ; Temperature variation of conductivity.

Dielectric behaviour : Capacitance ; Types of polarization ; Frequency dependence of dielectric constant; Ferroelectricity and Piezoelectricity in materials.

Magnetic properties : Diamagnetic; Ferromagnetic, antiferromagnetic and Ferrimagnetic behaviour of materials; soft and hard magnetic materials; superconductivity.

Optimal properties : Light interaction with solids; Absorption, Transmission and Reflection; Luminescence; Photoconductivity; Lasers.

Materials selection : Material properties and Engineering Design parameters; General effects of processing on parameters; selection of structural; Electronic and Magnetic Materials – case studies.

Text Books:
IC – 301: MEASUREMENT FUNDAMENTALS

OBJECTIVE:

Exposing the students to the art and science of measurement with a view to impress:

- Knowledge of the physical world depends on observation and measurement adds quantitative meaning to our knowledge.
- Observation, monitoring, control, analysis and sympathy towards the instruments form the basis of measurement.
- The method of measurement is a comparison.
- The aids of measurement are standard.
- Measurement is complete only when accompanied by a quantitative statement of its uncertainty.

NOTE

Students are required to answer six questions out of nine set as follows:

1. There shall be one objective compulsory question comprising ten parts spread evenly over the syllabus and each carrying two marks.
2. There shall be at least one question form each module of the syllabus out of the remaining eight.

PREREQUISITE: None

MODULE – I:

standard. Time and frequency standards. Introduction to Transducers – Classification and Selection

Criteria.

(09 lectures)

MODULE – II:
measurement data. Probability of Errors. Error estimates from the Normal Distribution. Curve Fitting –

(07 lectures)

MODULE – III:
Static characteristics of measurement system – Range, Span, Linearity, Non-linearity, Sensitivity,
Dependence on environmental effects, Hysteresis, Resolution, Wear and ageing, Accuracy, Precision,
Repeatability, Reproducibility, Tolerance, Bias, Threshold and Loading Effect.

Dynamic characteristics of measurement system: Step-response – rise time. Frequency response –
bandwidth. Time lag (dead-time)

(09 lectures)

MODULE – IV:
Testing and calibration: Traceability. Measurement reliability. Calibration experiment and evaluation of
calibration. Calibration of a voltmeter, ammeter and an oscilloscope.

(07 lectures)

MODULE – V:
Product standards: Reasons for product standards. Standards setting Organizations. Bureau of
standard: ISO 9000 family of standards. Relationship between product standard and process quality
standard.

(05 lectures)

TEXT BOOKS
2. A K Sawhney: A course on electrical and electronic measurements and instrumentation, Dhanpat
   Raj & Co, 2005
5. David A Bell: Electronic Instrumentation and measurement, Prentice Hall of India
OBJECTIVE: Confirmation of Engineering Concepts
In the classroom, the teachers present physical concepts, theories, and formulas without much emphasis on the validity of such material in the laboratory environment. On the contrary, in the laboratory students assume the validity of the concept introduced in the classroom and proceed with experimentation to produce results in order to audit the validity of these concepts.

PREREQUISITE: IC – 301

Hands-on Experience
Connect two resistances 100 KΩ and 50 KΩ in series driven by a dc voltage source. Measure the voltages across these resistances using a multi-range voltmeter and an oscilloscope. Repeat the experiment with an ac source. [Note that in the dc measuring setup the supply and the measuring equipment are floating. Whereas in the ac measuring situation one of the terminals of the supply and the oscilloscope has internal connection with the outside world.]
- Troubleshoot simple measurement systems.
- Apply judgement when faced with indeterminate problems.
- Acknowledge disparity between theory and experimental results in terms of the scientific method.

Measurement Basics
Draw the load voltage versus load current characteristic when the load is driven by a voltage source with an appreciable internal resistance. Perform experiment in order to determine the value of the source voltage and the source resistance using the graphical technique. Use both analog and digital measuring instruments.
- Understand the purposes of measurements: comparison with models, performance measurements, and physical constant determination.
- Choose and apply appropriate measurement techniques based on linearity.
• Compute uncertainty, and understand the concept of error.
• Apply standards for calibration, if necessary.
• Comment on the range and linearity for a large number of readings.

Repeatability and Accuracy
Connect a voltage source in series with a switch, a 100KΩ resistance and a 1000µF capacitor. Close the switch and plot the voltage using an appropriate voltmeter across the capacitance against time recorded by a stopwatch. Take large number of readings.

• Comment on the repeatability, precision and accuracy.
• Analyze the cause of possible errors.

Loading Effect
A 20V dc source is connected in series with two resistances one having 150KΩ value and a variable R.

With an analog voltmeter having sensitivity, say 1.0KΩ/V, set on, say 50V range, measure the voltage across R varying from a low to high value. Repeat the experiment with a voltmeter of sensitivity, say 10KΩ/V set on 20V range (say).

• Compare the measured voltages with the theoretical values.
• Comment on and interpret results.
• Estimate errors due to loading effect.

Sensitivity
Measure an unknown resistance using a dc Wheatstone bridge set on voltage sensitive mode. Use a voltmeter of sensitivity 1.0 KΩ/V (say) as a measuring instrument. Repeat the experiment with a voltmeter having a sensitivity of 20.0 KΩ/V (say).

• Select three resistors from decade resistance box.
• Measure and record their values, using DMM.
• Connect the unknown resistance and determine its value, using the two voltmeters.
• Comment on the use of two voltmeters.
• Select four 1.0 KΩ resistors (Check the color code)
• Measure and record their values, using DMM.
• Check the voltage across the balancing points using the two voltmeters.
• Comment on the observed voltages measured by the two voltmeters.
• Change the resistances of the ratio arms and exhibit in a tabular form.
• Explain the possibility of using an oscilloscope as a null detector.

Modeling, Curve Fitting and Uncertainty Analysis
A mercury-in-glass thermometer (0 – 110° C) is dipped in a temperature-controlled water-bath maintained at 100°C (boiling water). Measure the temperature with a stopwatch. Repeat the observations at time t= 4.0s, 8.0s, 12.0s, 16.0s, 20.0s, 24.0s
Evaluate the time constant of the thermometer by drawing smooth curve through scattered
observed points (regression).

Develop a model of the experiment and use MATLAB SIMULINK to compare the outcome of the
experiment.

Comment on the uncertainty for the single measurement and the repeated measurements.

Compute and apply basic statistics concepts for the analysis of data.

**Calibration [using standards]**

- Calibrate an ammeter and evaluate the result.
- Calibrate a voltmeter and evaluate the result.
- Calibrate an oscilloscope and evaluate the result.

**Product standard**

- Conformance test a simple ISI marked product.
- Implementing specifications of a simple process according to ISO standa
1. Assignments on Interpolation: Newton forward & backward, Lagrange.


6. Assignments on Statistical Problems: Mean, Median, Mode, Standard deviation (for simple & frequency type data), Linear Correlation & Regression.

CIRCUITS & NETWORK LAB

Code: EE 391
Contact: 3P
Credit: 2

List of Experiments:

1. Transient response in R-L and R-C Network: Simulation/hardware
2. Transient response in R-L-C Series & Parallel circuits Network: Simulation/hardware
3. Determination of Impedance (Z) and Admittance(Y) parameters of two port network
4. Frequency response of LP and HP filters
5. Frequency response of BP and BR filters
6. Generation of Periodic, Exponential, Sinusoidal, Damped sinusoidal, Step, Impulse, Ramp signals using MATLAB in both discrete and analog form
7. Evaluation of convolution integral, Discrete Fourier transform for periodic & non-periodic signals and simulation of difference equations using MATLAB
8. Representation of poles and zeros in z-plane, determination of partial fraction expansion in z-domain and cascade connection of second order system using MATLAB
9. Determination of Laplace transform and inverse Laplace transformation using MATLAB
10. Spectrum analysis of different signals

Note: An Institution/College may opt for some other software or hardware simulation wherever possible in place of MATLAB
DATA STRUCTURE LAB
Code: CS 392
Contact: 3P
Credit: 2

Experiments should include but not limited to:
Implementation of array operations
Stacks and Queues: adding, deleting elements
Circular Queue: Adding & deleting elements
Merging
Problem: Evaluation of expressions operations on Multiple stacks & queues:
Implementation of linked lists: inserting, deleting, inverting a linked list.
Implementation of stacks & queues using linked lists:
Polynomial addition, Polynomial multiplication
Sparse Matrices: Multiplication, addition.
Recursive and Non-recursive traversal of Trees
Threaded binary tree traversal. AVL tree implementation.
Application of Trees, Application of sorting and searching algorithms
Hash tables implementation: searching, inserting and deleting, searching & sorting techniques.

Laboratory Report Writing

It is extremely important that a student should learn to communicate ideas, concepts, and results clearly
and accurately to other individuals. The results of the experiment lose significance if not meaningfully
developed, appropriately formatted and reported in a professional manner.

Cover Page
- Laboratory Report
- Name of the experiment and Subject Code.
- Submitted by
- Student’s name, year and roll number.

Abstract
- What is the report about?
- What was the objective of the experiment?
- Briefly describe the results.
- Give major conclusions of the experiment.

INTRODUCTION
- What is the objective for performing the experiment?
- What is the motivation behind the experiment?
- What are the principles or concepts of the experiment?
- What results do you expect and why?

EXPERIMENT SETUP
- What was measured?
- What were the measurement instruments?
- What were the physical parameters (i.e. dimensions) of the system?
- What observations were made while performing the experiment?
- What are the sources of error for the experiment?
- What were the results of the uncertainty analysis?

RESULTS AND DISCUSSION
- What were the results?
- How do your results compare with what you expected?
West Bengal University of Technology  
BF-142, Salt Lake City, Kolkata-700064  
Instrumentation & Control Engineering Syllabus upto 7th Semester  
Other Syllabi to be Published

- How do you explain the trends seen in your data?
- Do the results support the underlying concepts of the experiment?

Concluding Remarks

---------------------------------------------------------------------------------------
Preamble

Instrumentation design combines knowledge from physics and chemistry with signal processing techniques. For example, CAT-Scans combine X-ray imaging (from physics) with image reconstruction algorithms (from signal processing) to produce three-dimensional images of the body. Accurate instrumentation is vital to control. Control performance is limited by the precision of measurement. An Instrumentation and Control Engineer needs to have various skills at his command - knowledge of control system engineering, instrumentation engineering, electronics and pneumatic systems, a working understanding of process applications and, increasingly today, an understanding of computers and digital communications.

OBJECTIVES

Control engineering is about controlling systems. This course introduces the basic concepts of control system, design and analysis.

NOTE

a. Nine questions are to be set, out of which six are to be answered.
b. Question No. 1 shall be compulsory and objective type with ten parts distributed evenly over the entire syllabus each having two marks.
c. Remaining eight questions each of ten marks will be set taking at least one from each module.

Module I: Basic definition; basic elements of control system, open loop control system, closed loop control system, control system terminology, manually controlled closed loop systems, automatic controlled closed loop systems, basic elements of a servo mechanism, electrical analogue of mechanical, thermal, hydraulic and pneumatic systems, block diagram representation of physical systems, derivation of transfer functions of physical systems, signal flow graphs, basic control action; block diagram reduction technique, signal flow graph, Mason’s gain formula, conversion of block diagram to signal flow graph. (10 hours)

Module II: Standard test signals, Time response analysis, impulse response function, Analysis of first, and second systems, stability of control system, Routh-Hurwitz’s stability criterion, static and dynamic errors coefficients, and errors criteria. (8 hours)

Module III: Introduction of Root Locus method; Rules for constructing root loci, stability analysis of systems using Root locus, determination of roots of the closed loop system, transient response and stability from root locus inverse root locus, concept of dominant, effects of parameter variations on closed loop poles, closed loop pole pair, Root-contour plots, effect of zeros & poles. (8 hours)

Module IV: Introduction of Frequency Response, Bode plots, stability margins on the Bode plot, stability analysis of systems using Bode plots, polar plots, Nyquist stability criterion, relative stability. (6 hours)

Module V: State Space Representation of systems, conversion of state variable models to transfer functions. (3 hours)

Module VI: Compensators: Introduction, different types of compensators, design of lag, lead, lag-lead compensators using root locus and Bode diagrams; design of P, I and PID controllers by analytical method, frequency response method and root locus technique. (5 hours)
HISTORICAL NOTE

Feedback control is the basic mechanism by which systems, whether mechanical, electrical, or biological, maintain their equilibrium or homeostasis. In the higher life forms, the conditions under which life can continue are quite narrow. A change in body temperature of half a degree is generally a sign of illness. In 1948 N Wiener showed that the homeostasis of the body is maintained through the use of feedback control. A primary contribution of C.R. Darwin during the nineteenth century was the theory that feedback over long time periods is responsible for the evolution of species. In 1931 V. Volterra explained the balance between two populations of fish in a closed pond using the theory of feedback. In 1934, Házen coined the word servomechanisms, which implies a master/slave relationship in systems.

BOOK

1. K. Ogata: Modern Control Engineering. (PHI)

INDUSTRIAL INSTRUMENTATION – I

<table>
<thead>
<tr>
<th>MODULE</th>
<th>OBJECT</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Introduction to Industrial Instrumentation: Temperature and heating, definitions, temperature scales, bimetallic thermometers, filled-bull and glass stem thermometers. Thermocouples: Thermoelectric effects, law of thermocouple, cold junction compensation techniques, thermocouple types, construction, installation and protection, measuring circuits thermocouple burnout detection and high temperature measurement methods.</td>
</tr>
<tr>
<td>II</td>
<td>Temperature Measurement: Resistance Temperature Detector (RTD), principle, and types, construction requirements for industry, measuring circuits. <strong>Thermistors:</strong> Principle and sensor types, manufacturing techniques, measuring circuits linearization methods and applications. Pneumatic and suction pyrometers, Integrated circuit sensor, diode type sensors, Ultrasonic thermometers, Johnson noise thermometer, fluidic sensors, Spectroscopic temperature measurement, thermograph, temperature switches and thermostats.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NO OF CLASSES</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
</tr>
<tr>
<td>9</td>
</tr>
</tbody>
</table>
### III
Radiation measurement: Radiation thermometers, introduction, definition of terms, general form of radiation measurement system, radiation thermometer types, photo electric radiation thermometers, signal conditioning for radiation thermometers, remote reading thermometers. Temperature sensor selection and application, sensor calibrators and simulators.

### IV
Pressure measurement basics, mechanical type instruments, electro mechanical type, low-pressure measurement, related accessories, pressure measuring standards, selection and application. Transmitter definition, classification, pneumatic transmitter – force balance type, torque balance type, two wire and four wire transmitter, I/P and P/I converter.

### V

### TEXT BOOKS :-

### References:-

### OBJECT ORIENTED PROGRAMMING AND DESIGN
IC-502

**MODULE-I**
- Introduction to C++. Tokens, expressions and control structures in C++. Functions in C++

**MODULE -II**
- Classes and objects in C++. Constructors and destructors. Operator overloading and type conversions.
MODULE - III
Inheritance in C++, pointers, virtual functions and polymorphism, templates and exception handling.
Managing console input output operations with C++. Working with files using C++.

MODULE - IV
Software complexity; designing complex system; Elements of the objects model; Applying the object model; Nature of an object; Relationship among objects; Nature of a class; Relationship among classes; Interplay of classes and objects; Identifying classes and objects; Key abstraction and mechanism.

MODULE - V
Elements of the notation; Class diagrams; state transition diagrams; process diagrams; module diagrams.
Applying the notation. Applications: Data acquisition; Inventory tracking, command and control.

TUTORIALS:
These tutorials are to be conducted in a computer centre with any available C++ compiler to give the students a hands-on programming experience of C++ language.
Creating objects
Using member functions, Using constructors and destructors, Designing and Implementing classes,
Overloading operators, Using different forms of inheritance, Using pointer, Templates and Exception handling, Console I/O operations, File operations

TEXT BOOKS:

REFERENCES:

MICROPROCESSOR AND MICROCONTROLLER

IC – 503

Introduction to 8085A CPU architecture-register organization, addressing modes and their features.
Software instruction set and Assembly Language Programming. Pin description and features.

Instruction cycle, machine cycle, Timing diagram.

Hardware Interfacing: Interfacing memory, peripheral chips (IO mapped IO & Memory mapped IO).
Interrupts and DMA.

Peripherals: 8255, 8251, 8253, 8237, 8259, A/D and D/A converters and interfacing of the same.

Microcontroller system software and hardware design, development and trouble shooting tools.

Typical applications of a microprocessor.

16 bit processors: 8086 and architecture, segmented memory has cycles, read/write cycle in min/max mode.
Reset operation, wait state, Halt state, Hold state, Lock operation, interrupt processing. Addressing modes and their features. Software instruction set (including specific instructions like string instructions, repeat, segment override, lock prefizers and their use) and Assembly Language programming with the same.
References:

3. An introduction to micro computers Vol. 2 – some real Microprocessor – Galgotia Book Source, New Delhi by Adam Osborne and J. Kane
4. Advanced Microprocessors by Ray and Bhurchandi - TMH
7. Assembly Language Programming the IBM PC by Alan R. Miller, Subex Inc, 1987

ADVANCED CONTROL SYSTEMS
IC – 504

<table>
<thead>
<tr>
<th>MODULE</th>
<th>OBJECT</th>
<th>NO OF CLASSES</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Systems in State Space</td>
<td>12</td>
</tr>
</tbody>
</table>
### III Non-linear systems Analysis

Introduction to non-linear systems,
Behaviour of non-linear systems,
Different methods of linearization,
Phase plane analysis:
  - Phase plane analysis of linear and non-linear control systems.
Singular points,
Classification of singular points,
Constructing phase portraits,
Limit cycle: existence of limit cycles.

### IV Describing Function Analysis

Describing function fundamental,
Basic assumptions and basic definitions,
Common Physical non-linearities,
Describing function of common non-linearities,
Describing function analysis of non-linear system,
Stability of limit cycles,
Reliability of describing function analysis.

### V Liapunov Stability Analysis

Definitions:
  - Systems, Equilibrium state, Equilibrium points.
Stability definitions:
  - Asymptotic stability, Asymptotic stability in the large, Instability.
Scalar functions,
  1. Positive definiteness of scalar functions
  2. Negative definiteness of scalar functions
  3. Positive semidefiniteness of scalar functions
  4. Negative semidefiniteness of scalar functions
  5. Indefiniteness of scalar functions
Quadratic Forms,
  Direct method or Second Method of Liapunov,
Liapunov’s stability analysis of linear system,
Liapunov’s methods in feedback design.

### TEXT BOOKS


### References

Course aim: The course introduces basic concepts used in the communication engineering for transferring information and lays foundation for a higher level course in computer networking.

Module: I

**Linear Modulation:** Introduction, Amplitude Modulation (AM), modulators and demodulators, power in AM wave, spectrum of AM wave, DSB/SC, SSB and VSB signals, their spectra and circuitry for generation and demodulation. Phase modulation.

Module: II

**Pulse analog modulation:** Practical aspects of sampling, reconstruction of a message process from its samples, Time Division Multiplexing (TDM), comparison of TDM and FDM, Pulse Amplitude Modulation (PAM), Pulse Width Modulation (PWM), circuitry for generation and recovery. Pulse digital modulation: Pulse Code Modulation (PCM), noise PCM system, Differential Pulse Code Modulation (DPCM), Delta Modulation (DM), Digital multiplexers, T1 System.

Module: III


Module: IV

**Introduction to data communication:** Data transfer modes, parallel I/O and serial I/O, asynchronous and synchronous data transfer schemes, using USART for data transfer, interface standards for serial/I/O and parallel I/O, protocols for synchronous communication, BISYNC and HDLC, stop and wait, go back N and selective repeat request protocols.

Module: V

Data communication through telephone network, the basic telephone, telephone office function, Telephone line Echoes. Digital Private Automatic Branch Exchanges (PABX), modems, modem functions, interface between modem and USART, synchronous and statistical multiplexers.

TEXT:

**References:**

**Industrial Instrumentation-I Laboratory**

**IC – 591**

Experimentation on:

1. Calibration of pressure gauge by Dead weight Tester
3. Study of RTD characteristics and use in temperature sensitive bridge.

COMPUTER SOFTWARE LABORATORY
IC – 592

1. Structures
2. Classes and Objects
   3. Function Overloading.
   4. Operator Overloading.
   5. Pointers.
   6. Inheritance.
3. Virtual Functions
8. Input-Output File handling.

Microprocessor and Micro-controller Lab
IC – 593

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of the Experiments</th>
<th>NO. OF HOURS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Familiarization with 8085 register level architecture and trainer kit components,</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>including the memory map. Familiarization with the process of storing and viewing the</td>
<td></td>
</tr>
<tr>
<td></td>
<td>contents of memory as well as registers.</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Study of prewritten programs on trainer kit using the basic instruction set (data</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>transfer, Load/Store, Arithmetic, Logical)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a) Assignments based on above.</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Familiarization with 8085 simulator on PC.</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Study of prewritten programs using basic instruction set (data transfer, Load/Store,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Arithmetic, Logical) on the simulator.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a) Assignments based on above.</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Programming using kit/simulator for</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>i) table look up</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ii) Copying a block of memory</td>
<td></td>
</tr>
<tr>
<td></td>
<td>iii) Shifting a block of memory</td>
<td></td>
</tr>
<tr>
<td></td>
<td>iv) Packing and unpacking of BCD numbers</td>
<td></td>
</tr>
<tr>
<td></td>
<td>v) Addition of BCD numbers</td>
<td></td>
</tr>
<tr>
<td></td>
<td>vi) Binary to ASCII conversion</td>
<td></td>
</tr>
<tr>
<td></td>
<td>vii) String Matching</td>
<td></td>
</tr>
<tr>
<td></td>
<td>viii) Multiplication using Booth’s Algorithm</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Program using subroutine calls and IN/OUT instructions using 8255 PPI on the trainer</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>kit eg, subroutine for delay, reading switch state &amp; glowing LEDs accordingly, finding</td>
<td></td>
</tr>
<tr>
<td></td>
<td>out the frequency of a pulse train etc</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Interfacing any 8-bit Latch (eg, 74LS373) with trainer kit as a peripheral mapped</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>output port with absolute address decoding</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Interfacing with I/O modules:</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>a) ADC</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b) Speed control of mini DC motor using DAC</td>
<td></td>
</tr>
</tbody>
</table>
Syllabus of Instrumentation & Control Engineering

c) Keyboard
d) Multi-digit Display with multiplexing
e) Stepper motor

8. Writing programs for ‘Wait Loop (busy waiting)’ and ISR for vectored interrupts (eg, counting number of pulses within specified time period) 3

9. Study of 8051 Micro controller kit and writing programs for the following tasks using the kit 6
   a) Table look up
   b) Basic arithmetic and logical operations
   c) Interfacing of Keyboard and stepper motor

10. Familiarization with EPROM programming and Erasing 3

ADVANCED CONTROL SYSTEMS LABORATORY
IC- 594

1. Microprocessor based servo system.
2. Voltage regulator system. (Open loop & closed loop).
3. Speed Control system (Open loop & closed loop).
4. Frequency response characteristics of a second order system.
5. Time response characteristics of a second order system.
6. Determination of phase margin and gain margin.
7. Constant gain compensation in time and frequency domain.
8. a) Lead compensator b) Lag compensator
9. Gifford’s bridge.
10. Design of state feedback.
11. Observer design.
12. Study of PD, PI, PID controller.

PROCESS CONTROL
IC – 601

Terms and objectives of process control, Classification of variables, Process characteristics; Process lag, load disturbance and its effects - Self regulating, interacting and non-interacting process. Controller modes. Continuous controller modes and composite controller modes, Electronics Controllers.

Process loop tuning; Closed loop response of I & II order systems.

Final control elements.

Cascade control, Ratio control, feed forward control, dead time compensation. Interaction of control loops. Case studies.

Text Books:

Reference Books:
INTRODUCTION
Block Diagram of a typical microprocessor based system pointing out the role of microprocessor and other peripheral blocks.

MICROPROCESSOR

ADDING MEMORY
Classification, Memory Timing, Interfacing requirements, Interfacing Slow Memory, Interfacing Static RAM (6116 – 2K, 6264 – 8K), Interfacing EPROM (2764 – 8K, 27256 – 32K), Address decoding (using logic gates and decoders, using PAL), Designing Memory Modules (higher capacity say 512K) using memory chips (say 8K), Interfacing Memory Modules to the microprocessor, Interfacing Dynamic RAM, Non Volatile Memories

ADDING INPUT/OUTPUT DEVICES
Designing an 8-bit input port, Designing an 8-bit output port, I/O space, Address decoding for Memory mapped I/O and I/O mapped I/O
Review: I/O Controllers – 8255A, 8250/1, 8279, 8253/4, 8259A, 8237A
Examples: Interfacing and assembly language monitor program for Key Board (one dimensional, two dimensional) through 8255A and 8279, Centronics-type Parallel Printer through 8255A, Display (7-segment, dot-matrix, alphanumeric) through 8255A and 8279, Data Transfer between two microprocessor based systems through 8255As, Mechanical and solid state Relays, Stepper Motor etc.
Analog Interfacing and Industrial Control: Review of Operational amplifier characteristics and circuits, Sensors and transducers (light sensors, temperature sensors, Force and pressure transducers, etc.), signal conditioning – multiplexing, linearization and scaling, 4-20 mA current loop
Examples: Interfacing and assembly language monitor program for D/A Converter (MC1408 8-bit D/A, DAC 1208 12-bit D/A etc.), A/D Converter (ADC0808 8-bit ADC, ICL7109 12-bit ADC etc.)

ADDING TOGETHER
Designing microprocessor based systems with monitor programs for single/multipoint Temperature Monitoring, Data Logger, PID Controller, etc.

EMBEDEDED CONTROLLER
Intel 8051 embedded controller – Architecture and Assembly language programming, system design using 8051

COMMUNICATING WITH OTHERS
Asynchronous serial data communication, Serial Data transmission methods and standards, RS-232C Serial Data Standard (Rs-232C to TTL interfacing, RS-232C signal definitions, Connection), Modems

References:
1. Douglas V. Hall – Microprocessors & Interfacing, Tata McGraw-Hill
2. Mohamed Rafiquzzaman – Microprocessors and Microcomputer based system Design, PHI
4. Ray & Bhurchandi, Advanced Microprocessors & Peripherals, TMH
5. Predko, Programming & Customising 8051 Microcontroller, TMH
Syllabus of Instrumentation & Control Engineering

6. John Uffenbeck – Microcomputers and Microprocessors, PHI/ Pearson Education
7. Chowdhury & Chowdhury, Microprocessor & Peripherals, Scitech
8. Thyagarajan, Microprocessor & Microcontrollers, Scitech
9. Michel Slater – Microprocessor Based Design, PHI
10. Walter A. Tribel – The 8088 and 8086 Microprocessors, PHI
12. Mathivanan, Microprocessors PC Hardware & Interfacing, PHI

Computer Network & Internetworking

CS 611

Introduction to computer networks: What it is; advantage of; structure of communication network; point-to-point, circuit switched, packet switched; network topologies; network protocols; OSI reference model, example networks; physical layer and data transmission – analog and digital; transmission impairments; delay, distortion; transmission media; twisted pair, co-axial, optical fibre, terrestrial microwave, satellite microwave, radio; data encoding and communication: recap on PCM; AM; asynchronous and synchronous transmission; error detection techniques; interfacing: RS-232C, X.21 Digital interface; modems, multiplexer, demultiplexer.

Network layer – connection oriented vs. connectionless services; routing; X2.5; IP; congestion control, internetworking, network layer in the Internet; IP protocol, IP addresses, subnets, OSPF, BGP, CIDR; network layer in ATM.

Transport layer – transport services and protocols; the Internet transport protocols; TCP and UDP, Remote procedure call, ATM AAL layer protocols.

Application layer – network security, DNS, SNMP, FTP, Telnet, E-mail, X-400, digital networks-ISDN; B-ISDN

Text Books:
1. Forouzan, Data Communication & Networking, (3rd Edition ), TMH
3. Zheng & Akhtar, Network for Computer Scientists & Engineers, OUP
4. Black, Data Communication & Networking, PHI
5. Zeimer & Tarnter, Principles of Communication, Jaico
6. Miller, Data Communication & Network, Vikas
7. Mansfield, An introduction to Computer Networking, PHI

References:
1. Black Uyleess – Computer Network Protocols, Standards and Interfaces, PHI
3. S. Mullender – Distributed Systems, Pearson Education

MULTIMEDIA SYSTEMS

IC - 602

Introduction to Multimedia: Overview, Importance, Components, Uses of multimedia, Future Hypertext and hypermedia, different media and channels and modes of communication.
Multimedia Resources: Data rate, cost effectiveness and production time considerations, Analog and digital representations, Image, Video and Audio Standards, Colour space and models, communication standards - ISDN, ATM

Equipment and devices: Display screen, storage devices, communication and interactive peripherals.

Text: Attributes and guidelines, Text markup, HTML, models of hypertext document, XML


Audio: Digital audio, MIDI, Processing sound, sampling, compression.

Video: MPEG Compression standards, Compression through Spatial and Temporal Redundancy, inter-frame and intra-frame Compression.

Animation: Types, techniques, key frame animation, utility, Morphing

Compression techniques: Lossless and lossy compression, Simple compression techniques Interpolative, Predictive, Transform Coding, Discrete Cosine Transform, Statistical Coding - Huffman encoding. JPEG, MPEG

Design and development of multimedia: Tools to support multimedia development, Authoring Multimedia - different type of authoring environments, Media synchronization, Design process, development team Evaluation and Testing - Gagne events, Project management.


Multimedia information management application: Multimedia database and design consideration.

Intellectual property: Foundations of intellectual property, copyrights, issues regarding the use of intellectual property.

Future developments: Virtual reality, newer devices, performance support, knowledge management, interactive interfaces

Text Books:


References:

6. Vannevar Bush (Foundation Paper) - "As we may think"
MODULE – I

Flow measurement: Introduction, definitions and Modules, classification of flow meters, Pitot tubes, orifice meters, venturi tubes, flow tubes, flow nozzles, positive displacement liquid meters and provers, positive displacement gas flowmeters, variable area

MODULE – II

Anemometers: Hot wire/hot film anemometer, Laser Doppler Anemometer (LDA), electromagnetic flowmeter, turbine and other rotary element flowmeters, ultrasonic flowmeters, Doppler flowmeters, cross-correlation flowmeters, vortex flowmeters. Measurement of mass flowrate: Radiation, angular momentum, impeller, turbine, constant torque hysteresis clutch, twin turbine, coriolis, gyroscope and heat transfer type mass flowmeters.

MODULE – III

Target flowmeters, V-cone flowmeters, purge flow regulators, flow switches, flowmeter calibration concepts, flowmeter selection and application. Level measurement: Introduction, float level devices, displacer level detectors, rotating paddle switches, diaphragm and differential pressure detectors, resistance, capacitance and RF probes, radiation, conductivity, field effect, thermal, ultrasonic, microwave, radar and vibrating type level sensors. Level sensor selection and application.

MODULE – IV

Level Measurement: Introduction, float level device, Displacer level detectors
Differential pressure type level detector, Electrical type – resistance and capacitance type, Microwave and Ultrasonic type level detectors.

MODULE – V


MODULE – VI


TEXT BOOKS:


2. D Patranabis, Principle of Industrial Instrumentation, TMH publication.

REFERENCES:


**PROCESS CONTROL LABORATORY**

**IC – 691**

1. Experimental study of PID controller response on a level loop.
2. Experimental study of ON-OFF and Proportional controller responses on temperature loop.
3. Tuning of controllers on a pressure loop.
4. Control valve characteristics with and without positioner.
5. Modeling of flow process.
6. Study of complex control systems (Ratio, Feedforward, and Cascade).
7. Study of basic logic operations, timer, counter, arithmetic operations in PLC.
8. Study of analog operations in PLC.
9. Problem solving in PLC.

The following experiments will be conducted on virtual DCS.

10. Three element boiler control
11. Binary distillation column control
12. Level control in coupled tanks
13. Pressure control in different sized vessels
14. Heat exchanger control
15. Control of rotary dryer

**Microprocessor Based Systems Laboratory**

**EI – 692**

List of Experiments:

11. Familiarization with 8086/88 register level architecture and trainer kit components, including the memory map. Familiarization with the process of storing and viewing the contents of memory as well as registers. 3 Hrs.
12. d) Study of prewritten programs on trainer kit using the basic instruction set (data transfer, Load/Store, Arithmetic, Logical)  
e) Assignments based on above.

13. c) Familiarization with 8086/88 simulator on PC.  
f) Study of prewritten programs using basic instruction set (data transfer, Load/Store, Arithmetic, Logical) on the simulator.  
d) Assignments based on above

14. Programming using kit/simulator for  
i) table look up  
x) Copying a block of memory  
xii) Shifting a block of memory  
xii) Packing and unpacking of BCD numbers  
xiii) Addition of BCD numbers  
xiv) Binary to ASCII conversion  
xv) String Matching  
xvi) Sorting etc.

15. Program using subroutine calls and IN/OUT instructions using 8255 PPI on the trainer kit  
e.g, subroutine for delay, reading switch state & glowing LEDs accordingly, finding out the frequency of a pulse train etc

16. Interfacing with I/O modules:  
f) ADC  
g) Speed control of mini DC motor using DAC  
h) Temperature sensor and display temperature  
i) Relay  
j) Keyboard through 8279 and 8255A  
k) Multi-digit Display with multiplexing through 8255A & 8279  
l) Stepper motor

17. Writing programs for ‘Wait Loop (busy waiting)’ and ISR for vectored interrupts (e.g, counting number of pulses within specified time period)

18. Familiarization with EPROM programming and Erasing

Computer network & Internetworking Lab

CS – 681

Experiments are based on Linux / Unix / Solaris (Text Mode) Operating System

1. Familiarization of NIC, different cabling options (e.g. UTP, Coaxial, optical fibre), Connectors – BNC, RJ45, RS-232C, Interconnecting Devices – Hub, switch, router etc., Preparation of some UTP cables with RJ45 connectors and setting up a small network using either Hub or switch.
2. Configuring NIC, preparing routing table, assignment of IP address & net mask to each machine, concept of subnet, CIDR, socket interface  
3. Configuring PPP  
4. Configuring DNS server (e.g. Bind)  
5. Configuring web server (e.g. Apache)  
6. Configuring mail server (e.g. Postfix, Qmail etc.)  
7. Configuring Telnet, FTP server
Syllabus of Instrumentation & Control Engineering

8. Configuring Firewall (e.g. IP chains, IP tables etc. in Linux)
9. Configuring NFS & NIS
10. C program to implement a simple client
11. C program to implement a simple server (e.g. echo)
12. Concurrent server using process
13. Concurrent server using thread (Linux, Windows)
14. C program to compute checksum
15. C program to implement stop-and-wait ARQ
16. C program to implement GO-back-n ARQ
17. C program to implement selective repeat ARQ

Symbols:

NIC – Network Interface Card
UTP – Unshielded Twisted Pair
CIDR – Classless Inter Domain Routing
PPP – Point to Point Protocol
DNS – Domain Name Server
FTP – File Transfer Protocol
NFS – Network File System
NIS – Network Information System
ARQ – Automatic Repeat request

Multimedia System Laboratory

IC - 692

1. Web document creation using Dreamweaver (6P)
2. Image manipulation and editing with Photoshop (6P)
3. Audio recording and editing (3P)
4. Creating animation using Flash (9P)
5. Individual Project: Development of personal web page and documentation (6P)
Main Project: Group project, complete design documents, implementation of an application (15P).

Seventh Semester

Digital Signal Processing

IC 701

Contacts: 3L

Module I

| Classification of Signals and Systems: Description of signals and their characteristics, types of systems and their behavior. | 1 |
| Discrete-time description of signals: Discrete-time sequences, their frequency domain behavior, comparison with analog signals, convolution of two sequences, sampling a continuous function to generate a sequence, reconstruction of continuous-time signals from discrete-time sequences. | 5 |
| Discrete-time description of systems: Unit-sample response of a system, Time-invariant systems, Superposition principle for linear systems, Stability criterion for discrete-time systems, Causality criterion for discrete-time systems, Linear constant-coefficient difference equations. | 4 |

Module II

| Modeling and analysis of signals and systems using mathematical tools like Fourier transform, z- transform. Discrete-time Fourier transform: Definition of Fourier transform (FT), important properties of FT, properties of FT for real-valued sequences, use of FT in signal processing, FT of special sequences, the inverse FT, FT of the product two discrete-time | 4 |
**Syllabus of Instrumentation & Control Engineering**

<table>
<thead>
<tr>
<th>sequences</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Discrete Fourier Transform:</strong> The definition of the Discrete Fourier Transform (DFT), computation of the DFT from the discrete-time sequence, properties of the DFT, circular convolution, performing a linear convolution with the DFT, computations for evaluating the DFT</td>
<td>6</td>
</tr>
<tr>
<td><strong>Z-transform:</strong> Definition of the z-transform, properties of the z-transform, the system function of a digital filter, combining filter sections to form more complex filters, digital filter implementation from the system function</td>
<td>4</td>
</tr>
<tr>
<td>Relationship between the Fourier transform and the z-transform, the z-transform of symmetric sequences, the inverse z-transform</td>
<td>2</td>
</tr>
</tbody>
</table>

**Module III**

<table>
<thead>
<tr>
<th>sequences</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Digital filter:</strong> Definition and anatomy of a digital filter, frequency domain description of signals and systems, typical applications of digital filters, filter categories: IIR and FIR, recursive and non-recursive</td>
<td>3</td>
</tr>
<tr>
<td><strong>Digital Filter Structures:</strong> The direct form I and II structures, Cascade combination of second-order sections, parallel combination of second-order sections, Linear-phase FIR filter structures, Frequency-sampling structure for the FIR filter.</td>
<td>8</td>
</tr>
</tbody>
</table>

**Books:**

2. Digital Signal Processing – Oppenheim and Schafer, Pearson
3. Discrete Time Signal Processing - Oppenheim, Schafer and Buck, Pearson

**Financial Management and Accounts**

**Code:** HU 701  
**Contacts:** 3L  
**Credits:** 3


Production & cost analysis - use of production and demand functions. Determination of price - pricing under different objectives. Roles, objectives and goals of financial management.

Industrial financing - capital formation and growth. Foreign Industries - export, import and balance of trade.

**References:**

1. Riggs J L - Engineering Economics
2. Dean J - Managerial Economics
3. Samuelson - Economics
5. Batliboi - Double Entry Book Keeping.
MODULE-I


MODULE-II

Programmable logic controller (PLC) basics: Overview of PLC systems, input/output modules, power supplies and isolators. General PLC programming procedures, programming on-off inputs/outputs. Auxiliary commands and functions, PLC Basic Functions, register basics, timer functions, counter functions

MODULE-III

PLC intermediate functions: Arithmetic functions, number comparison functions, Skip and MCR functions, data move systems. PLC Advanced functions: Alternate programming languages, analog PLC operation, networking of PLC, PLC-PID functions, PLC installation, troubleshooting and maintenance. Design of interlocks and alarms using PLC, creating ladder diagrams from process control descriptions.

MODULE-IV

Interface and backplane bus standards for instrumentation systems. Field bus: Introduction, concept. HART protocol: Method of operation, structure, operating conditions and applications. Smart transmitters, IEEE 1451 protocol, smart valves and smart actuators.

MODULE-V

Distributed Control Systems (DCS): Definition, Local Control unit (LCU) architecture, LCU languages, LCU -Process interfacing issues, communication facilities, configuration of DCS, displays, redundancy concept -case studies in DCS.

TEXTBOOKS:


REFERENCES:

BIOMEDICAL INSTRUMENTATION (IC 703 A)

Review of physiology and anatomy, Bioelectric potential, electrode theory and types, physiological transducers, Systems approach to biological systems.

Cardiovascular measurements - EMG, EEG, BP, blood flow cardiac output, plethysmography, impedance cardiology, cardiac arrhythmia’s, pace makers, defibrillators.

Respirator and pulmonary measurements and rehabilitation.

Patient monitoring systems. Sources of electrical hazards and safety techniques.

Recent trends in Imaging.

Text Books:

Reference Books:

POWER ELECTRONICS (IC 703 B)

Power semiconductors switches - Static and dynamic characteristics, Turn on and turn off characteristics. Power semiconductor devices: PNPN diodes, DIACS Thyristors, TRIACS, GTO devices, Power Transistors, Power MOSFET. Rating, losses and cooling. Triggering circuits for SCRs, UJT.

1φ and 3φ bridge rectifiers. Uncontrolled and controlled rectifiers: single phase and poly phase, Bridge rectifiers, Transformer ratings, Inductive load, free wheeling diodes.

Chopper; Principle of chopper operation, Commutation circuits.

Inverters, AC voltage controllers; Single phase and three phase inverters, constant voltage source and constant current source inverters, HF inverters for heating.

Cycloconverters; Basic principle of operation, single phase to single phase cycloconverter, three phase half wave cycloconverters;

Effect of EMI and harmonics.

Text Books:
RELIABILITY AND SAFETY ENGINEERING (IC 703 C)

Reliability.

Use of redundancy and system reliability improvement methods.

Maintainability.

Introduction to life-testing, destructive and non-destructive tests.

Safety.

Text Books:

Reference Books:

Elective – II (EI 703)

Ultrasonic Instrumentation
Code : EI 703 (a)
Contacts: 3L
Credits : 3


References:


Advanced Sensors
Code : EI 703 (b)
Contacts: 3L
Credits : 3


References:
2. Sensors and Actuators – No. 8, 1985 (pp 227-233)-No. 1986 (pp.65-82)
   No. 12, 1987 (pp.129-144)
4. Sensors and Transducer – Patranabis D: PHI

Microelectronics and VLSI Technology
Code : EI 703 (d)
Contacts: 3L
Credits : 3

Basic Consideration in Microelectronics:
Discrete circuits vis-à-vis Microelectronic circuits; Classification of different types of integrated circuits; General outline of hybrid integrated circuits based on thin and thick film technology; Semiconductor monolithic circuits based on bipolar, MOS and CMOS technology, advantages and disadvantages of different types of integrated circuits; Structure-based classification of integrated circuits-SSI, MSI, LSI, VLSI and ULSI.

Thin and Thick Film Integrated Circuits
Methods of producing film, monitoring and control of film thickness; Design and fabrication of individual components; Processing steps for realization of systems.

Monolithic IC Technology:
Planner processing steps for realization of integrated circuit using bipolar, MOS and CMOS technology; Epitaxy; Diffusion; Ion-Implantation; Oxidation and passivation; Masking and lithography; Etching; Metallisation and ohmic contacts; Die and wire bonding, packaging and encapsulation; Advantages and disadvantages of bipolar, MOS and CMOS systems.

VLSI and submicron Technology:
Limitations for micron and submicron integrated circuits; VLSI technology for doping, masking, lithography, etching and contacting.

Design Features and Systems:
Basic consideration and design approach using bipolar and MOS technology; Realisation of passive components, restrictive components and building blocks; Realisation of different active structures. Design considerations in respect of the isolation between components; Polarity dependence, high temperature dependence, poor tolerance of the components; Poor dissipation capability and cost; Design of op-amps, power amplifiers, regulated power supply, digital circuits and memory systems in the integrable form.

Layout:
Syllabus of Instrumentation & Control Engineering

Basic considerations design rules, hand layout and digitization, geometry specific and symbolic layout language; CIF to LSI layout description, Introduction to realization, and characterization of components and systems.

**Yield and Reliability:**

Failure mechanisms and yield loss; Failure analysis; Reliability considerations and improvements.

**References:**

1. Mead and Conway – Introduction to VLSI systems, Addison Wesley.
2. Amar Mukherjee – Introduction to CMOS VLSI, Prentice Hall
3. B. T. Press and M.J. Lorenzetti Benjamin (Eds.) physical design automation of VLSI systems.
5. T. Ohtsuki (Eds.) – Layout design and verification.

**Digital Signal Processing Laboratory**

**IC-791**

1. Sine wave generation using C.
2. Designing an FIR Filter using MATLAB and DSP kit.
3. Designing an IIR Filter using MATLAB and DSP kit.
5. Time and frequency domain properties of different windows using MATLAB.

**LOGIC AND DISTRIBUTED CONTROL SYSTEM LABORATORY**

**IC – 792**

6. Study of basic logic operations in PLC
7. Study the timer operation in PLC
8. Study the counter operation in PLC
9. Study the arithmetic operations in PLC.
10. Study of analog operations in PLC.
11. Study the architecture of DCS
12. Study the analog and digital I/O operation in DCS
13. Study the closed loop control in DCS for different process like flow, pressure, temperature.
14. Study the interfacing of PLC with DCS.
15. Troubleshooting in PLC and D
Values and Ethics in Profession

Code : HU 801
Contacts : 3L
Credits : 3

Science, Technology and Engineering as knowledge and as social and professional activities

Effects of Technological Growth: Rapid Technological growth and depletion of resources, Reports of the Club of Rome. Limits of growth: sustainable development

Energy Crisis: Renewable Energy Resources

Environmental degradation and pollution. Eco-friendly technologies. Environmental regulations,

Environmental ethics

Appropriate Technology Movement of Schumacher; later developments

Technology and developing notions. Problems of Technology transfer, Technology assessment

Impact analysis.

Human Operator in Engineering projects and industries: Problems of man, machine, interaction,

Impact of assembly line and automation. Human centered technology.

Ethics of Profession: Engineering profession: Ethical issues in engineering practice, Conflicts between business demands and professional ideals. Social and ethical responsibilities of technologists.

Codes of professional ethics. Whistle blowing and beyond, Case studies.


Aesthetic values: Perception and enjoyment of beauty, simplicity, clarity

Moral and ethical values: Nature of moral judgements; canons of ethics; ethics of virtue; ethics of duty; ethics of responsibility.

Reference Books:


Industrial Management

Code : HU 802
Contacts : 3L
Credits : 3

Basic concepts of management, objectives, classification and hierarchy, different schools of management thought, principal functions of management, Management as an organizing and directing force, Structure of the management decision making process, Organization structure, authority and responsibility, Organisation dynamics, Managerial leadership, communication systems, Managing human factors in business and industry, Industrial relation, Union activities, trade union acts, collective bargaining, disciplinary procedure.

Organizational objectives and long range forecasting, planning, organizing, programming and controlling process, managerial control strategies; quantity and quality control, cost benefit analysis, present work and breakeven analysis, budgetary control, use of management science for the efficient administration of economic units, production, financial and marketing management.

Adoption of statistical and computer methods and techniques to managerial research and managerial decision making and general management.

Reference Books:
Syllabus of Instrumentation & Control Engineering

8. Freeman, Bell and Balkwill, *Management in Engineering: Principles and Practice*, PHI

**ELECTIVE III**

**ANALYTICAL INSTRUMENTATION**

**Code**: EI 801(C)  
**Contacts**: 3L  
**Credits**: 3


**Reference Books:**


**Opto-electronics and Laser-based Instrumentation**

**Code**: IC 801(A)  
**Contacts**: 3L  
**Credits**: 3

Photometry, radiometry, units and definitions; Photodetectors, CCD, Thermal detectors, Photon devices and their performance parameters.
- Light sources.
- Opto-electronic devices; LED, LASERs – characteristics and its industrial applications, active and passive components.
- Optical fibre – types, properties, application in instrumentation. Fibre optic sensors – different industrial types.
- Opto-electronic instruments: Light power meter, wave length meter, optical time domain refractometer (OTDR); Introduction to integrated optics.
Text Books:


Reference Books:


Product Design and Development

**Code**: IC 801(B)
**Contacts**: 3L
**Credits**: 3

Introduction.
Concept Generation: Concept Selection, Industrial Design, Prototyping, Product Architecture, Peer Concept Review.
Product Development Economics.
Robust Design. Organizing Concurrent Engineering. Supply Chain Design
Concept Testing: Case Study, Design for Environment, Alpha prototype submission, Report on alpha prototype testing and evaluation and the beta prototype submission. The report on beta prototype testing and customer evaluation submission along with final market ready model. Final Presentation.

Text Books:


Web Resources:

1. www.ocw.mit.edu
2. www.uspto.gov
3. www.businessweek.com
4. www.epa.gov
5. www.hbsp.harvard.edu
6. www.patent.gov.uk

Power Plant Instrumentation

**Code**: IC 801(C)
**Contacts**: 3L
**Credits**: 3

General concepts of different power plant set-ups and energy conversion processes.
Thermal power plant Instrumentation – Controlling, monitoring and testing boilers, turbaines, condensers, generators, coal handling units and auxiliary systems; Quality monitoring of air, water and exhaust gases.
Syllabus of Instrumentation & Control Engineering

Salient features of Instrumentation in nuclear, hydro-electric and non conventional power plants. Instrumentation for safety interlocks protective devices; Emergency measures—alarms and alarm analysis, monitoring of environmental pollution.

Text Books:


Reference Books:


ELECTIVE IV

Project Management and Operations Research

Code : M 801 (A)
Contacts : 3L
Credits : 3


Reference Books:

3. Juran, *Quality Planning and Analysis*, 3rd Edn. MGH

Non Conventional Energy Sources

Code : EE 802(G)
Contacts : 3L
Credits : 3

Energy Sources - Classification, Need and potential of NCES, Electricity generation from NCES: Photovoltaics, Mono; poly - crystalline and amorphous Silicon solar cells, Efficiency and cost of PV
systems; Wind electricity - wind as an energy source, wind electricity generating system - basic components, wind electric generators, siting of wind forms; Energy from Biomass - gasifiers and bio-gas reactors; Tidal energy; Wave energy and Geothermal energy; Environmental effects and Economics of NCES.

Reference Books:

2. S P Sukhatme, *Solar Energy*

**Robotics**

<table>
<thead>
<tr>
<th>Code</th>
<th>EI 802(C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contacts</td>
<td>3L</td>
</tr>
<tr>
<td>Credits</td>
<td>3</td>
</tr>
</tbody>
</table>

Robot Anatomy Arm Geometry – Direct and Inverse Kinematics Problem, Arm Dynamics, D Alembert Equations of Motion, Synthesis of elements with movability constraints, manipulations – trajectory planning, joint interpolated trajectories.

Control of Robot Manipulation – computed torque technique, sequential and adaptive control, resolved motion control Robots.


Robot Intelligence – State space search, Robot Learning, Robot Task planning, Knowledge engineering.

Reference Books:

5. Murphy, *Introduction to AI Robotics*, PHI

**Soft Computing – Theory and Applications**

<table>
<thead>
<tr>
<th>Code</th>
<th>CS 802 (G)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contacts</td>
<td>3L</td>
</tr>
<tr>
<td>Credits</td>
<td>3</td>
</tr>
</tbody>
</table>

Introduction to soft Computing and its constituents.

Introduction to Fuzzy Sets and its importance in real life. Definition, Basic Operators, T-norm, S-norm, other aggregation operators. Fuzzy Relations, implications, cylindrical extensions, projection and composition.

Approximate reasoning, compositional rule of inference, rule based system, term set, Fuzzification, reasoning, defuzzification, different fuzzy models (MA/TS) – some applications of fuzzy rule based systems.
Introduction to artificial neural networks, basic models like Hopfield networks, multilayer perception and learning vector quantization network, self organizing features maps – their properties and applications.

Basics of genetic algorithm (GA) and its applications.
Some Hybrid (Neuro-fuzzy, fuzzy-neural and fuzzy-GA) systems.

Reference Books:

1. Dirankov and Hellemdron, *Fuzzy Logic Control*, Narosa
2. S Haykians, *Neural Networks*, Pearson
3. Anderson, *An Introduction to Neural Network*, PHI