# Faculty of Engineering and Technology

## CURRICULUM, PRE-REQUISITES/ CO-REQUISITES CHART, AND SYLLABUS FOR B.TECH.

### UNDER CHOICE BASED FLEXIBLE CREDIT SYSTEM

### REGULATIONS 2015

(For students admitted from 2015-16 onwards)

**Specialization**: Electronics and Instrumentation Engineering
**Offering Department**: EIE

**Placed in the 32nd Academic Council Meeting held on 23rd July 2016**

**CONTENTS**

## STUDENT OUTCOMES

The curriculum and syllabus for B.Tech programs (2015) conform to outcome based teaching learning process. In general, ELEVEN STUDENT OUTCOMES (a-k) have been identified and the curriculum and syllabus have been structured in such a way that each of the courses meets one or more of these outcomes. Student outcomes describe what students are expected to know and be able to do by the time of graduation. These relate to the skills, knowledge, and behaviors that students acquire as they progress through the program. Further each course in the program spells out clear instructional objectives which are mapped to the student outcomes.

**The student outcomes are:**

**(a)** an ability to apply knowledge of mathematics, science, and engineering

**(b)** an ability to design and conduct experiments, as well as to analyze and interpret data

**(c)** an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

**(d)** an ability to function on multidisciplinary teams

**(e)** an ability to identify, formulate, and solve engineering problems

**(f)** an understanding of professional and ethical responsibility

**(g)** an ability to communicate effectively

**(h)** the broad education necessary to understand the impact of engineering solutions in global, economic, environmental, and societal context

**(i)** a recognition of the need for, and an ability to engage in life-long learning

**(j)** a knowledge of contemporary issues

**(k)** an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

## C-D-I-O INITIATIVE

The CDIO Initiative (CDIO is a trademarked initialism for **Conceive — Design — Implement — Operate**) is an innovative educational framework for producing the next generation of engineers. The framework provides students with an education stressing engineering fundamentals set in the context of Conceiving — Designing — Implementing — Operating real-world systems and products. Throughout the world, CDIO Initiative collaborators have adopted CDIO as the framework of their curricular planning and outcome-based assessment.

In the syllabus, every topic has been classified under one or more of C-D-I-O so that students and faculty alike are clear about the scope of learning to take place under each one of the topics.

## SYMBOLS AND ABBREVIATIONS

| | | |
|---|---|---|
| **AR** | -- | **Architecture Courses** |
| **B** | -- | **Courses under Basic Science and Mathematics** |
| **BT** | -- | **Biotechnology Courses** |
| **C-D-I-O** | -- | **Conceive-Design-Implement-Operate** |
| **CE** | -- | **Civil Engineering Courses** |
| **CS** | -- | **Computer Science and Engineering Courses** |
| **CY** | -- | **Chemistry Courses** |
| **Dept.** | -- | **Department of Electronics and Instrumentation Engineering** |
| **E with course code** | -- | **Elective Courses** |
| **E** | -- | **Courses under Engineering Sciences** |
| **EC** | -- | **Electronics and Communication Engineering Courses** |
| **EE** | -- | **Electrical and Electronics Engineering Courses** |
| **EI** | - | **Electronics and Instrumentation Engineering Courses** |
| **G** | -- | **Courses under Arts and Humanities** |
| **IOs** | -- | **Instructional Objectives** |
| **L** | -- | **Laboratory / Project / Industrial Training Courses** |
| **LE** | -- | **Language Courses** |
| **L-T-P-C** | -- | **L- Lecture Hours Per Week** |
| | | **T- Tutorial Hours Per Week** |
| | | **P- Practical Hours Per Week** |
| | | **C- Credits for a Course** |
| **M** | -- | **Courses with Multi Disciplinary Content** |
| **MA** | -- | **Mathematics Courses** |
| **ME** | -- | **Mechanical Engineering Courses** |
| **MH** | - | **Mechatronics Engineering Courses** |
| **NC** | -- | **NCC- National Cadet Corps** |
| **NS** | -- | **NSS – National Service Scheme** |
| **NT** | - | **Nanotechnology Courses** |
| **P** | -- | **Professional Core Courses** |
| **PD** | -- | **Personality Development Courses** |
| **PY** | -- | **Physics Courses** |
| **SO/SOs** | -- | **Student Outcomes (a-k)** |
| **SP** | -- | **NSO- National Sports Organization** |
| **YG** | -- | **Yoga Course** |

FACULTY OF ENGINEERING AND TECHNOLOGY, SRM UNIVERSITY

DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

**B.TECH ELECTRONICS AND INSTRUMENTATION ENGINEERING CHOICE BASED FLEXIBLE CREDIT SYSTEM (CBFCS) Curriculum Under Regulations 2015 (For students admitted from 2015-16 onwards)**

**L** Lecture Hours / Week | **T** Tutorial Hours / Week | **C** Credits | **P** Practical Hours / Week | **L** Laboratory Course | **E** Elective Courses | **J** Theory jointly with Lab | **M** Course with Multidisciplinary content

| Category | Category - wise % of Credits | Year 1 | | | | | | | | | | | | Year 2 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1st Semester | | | | | 2nd Semester | | | | | | | 1st Semester | | | | | 2nd Semester | | | | | | |
| | | Course Code | Course Title | L | T | P | C | Course Code | Course Title | L | T | P | C | Course Code | Course Title | L | T | P | C | Course Code | Course Title | L | T | P | C |
| Arts & Humanities-G | 8.33% | 15LE101 | English | 2 | 0 | 0 | 2 | 15LE102 | Value Education | 2 | 0 | 0 | 2 | 15LE201E | German Language - I | 2 | 0 | 0 | 2 | 15LE207E | German Language - II | 2 | 0 | 0 | 2 |
| | | 15PD101 | Soft Skills - I | 1 | 1 | 0 | 1 | 15PD102 | Soft Skills - II | 1 | 1 | 0 | 1 | 15LE202E | French Language - I | | | | | 15LE208E | French Language - II | | | | |
| | | | | | | | | 15NC101 | NCC- National Cadet Corps | 0 | 0 | 1 | 1 | 15LE203E | Japanese Language - I | | | | | 15LE209E | Japanese Language - II | | | | |
| | | | | | | | | 15NS101 | NSS- National Service Scheme | | | | | 15LE204E | Korean Language - I | | | | | 15LE210E | Korean Language - II | | | | |
| | | | | | | | | 15SP101 | NSO- National Sports Organization | | | | | 15LE205E | Chinese Language - I | | | | | 15LE211E | Chinese Language - II | | | | |
| | | | | | | | | 15YG101 | Yoga | | | | | 15PD201 | Quantitative Aptitude & Logical Reasoning –I | 1 | 1 | 0 | 1 | 15PD202 | Verbal Aptitude | 1 | 1 | 0 | 1 |
| | **15** | | Total | 3 | 1 | 0 | 3 | | Total | 3 | 1 | 1 | 4 | | Total | 3 | 1 | 0 | 3 | | Total | 3 | 1 | 0 | 3 |
| Basic Sciences - B | 19.44% | 15MA101 | Calculus And Solid Geometry | 3 | 1 | 0 | 4 | 15MA102 | Advanced Calculus And Complex Analysis | 3 | 1 | 0 | 4 | 15MA201 | Transforms And Boundary Value Problems | 4 | 0 | 0 | 4 | 15MA206 | Numerical Methods | 4 | 0 | 0 | 4 |
| | | 15PY101 | Physics | 3 | 0 | 0 | 3 | 15PY102L | Materials Science | 2 | 0 | 2 | 3 | | | | | | | | | | | | |
| | | 15PY101L | Physics Laboratory | 0 | 0 | 2 | 1 | 15CY102 | Principles Of Environmental Science | 2 | 0 | 0 | 2 | | | | | | | | | | | | |
| | | 15CY101 | Chemistry | 3 | 0 | 0 | 3 | | | | | | | | | | | | | | | | | | |
| | | 15CY101L | Chemistry Laboratory | 0 | 0 | 2 | 1 | | | | | | | | | | | | | | | | | | |
| | | 15BT101 | Biology For Engineers | 2 | 0 | 0 | 2 | | | | | | | | | | | | | | | | | | |
| | **35** | | Total | 11 | 1 | 4 | 14 | | Total | 7 | 1 | 2 | 9 | | Total | 4 | 0 | 0 | 4 | | Total | 4 | 0 | 0 | 4 |
| Engineering Sciences -E | 13.33% | 15CE101 | Basic Civil Engineering | 2 | 0 | 0 | 2 | 15ME101 | Basic Mechanical Engineering | 2 | 0 | 0 | 2 | 15CS252J | Data Structures and Algorithms | 2 | 0 | 2 | 3 | 15ME215 | Thermodynamics and Fluid Mechanics | 3 | 0 | 0 | 3 |
| | | 15EE101 | Basic Electrical Engineering | 2 | 0 | 0 | 2 | 15EC101 | Basic Electronics Engineering | 2 | 0 | 0 | 2 | | | | | | | | | | | | |
| | | 15ME105L | Engineering Graphics | 1 | 0 | 4 | 3 | 15EC102L | Electronic Engineering Practices | 0 | 0 | 2 | 1 | | | | | | | | | | | | |
| | | 15CS101L | Programming Laboratory | 1 | 0 | 2 | 2 | 15EE102L | Electrical Engineering Practices | 0 | 0 | 2 | 1 | | | | | | | | | | | | |
| | **24** | | Total | 6 | 0 | 6 | 9 | | Total | 4 | 0 | 4 | 6 | | Total | 2 | 0 | 2 | 3 | | Total | 3 | 0 | 0 | 3 |
| Professional - Core -P | 35.56% | | | | | | | 15EE103 | Analysis of Electric Circuits | 3 | 0 | 0 | 3 | 15EE231 | Electrical Machines | 3 | 0 | 0 | 3 | 15EI204 | Analog Electronic Circuits | 3 | 0 | 0 | 3 |
| | | | | | | | | 15EE103L | Electric Circuits Laboratory | 0 | 0 | 2 | 1 | 15EI201 | Digital Principles and System Design | 3 | 0 | 0 | 3 | 15EI205 | Analog Integrated Circuits | 3 | 0 | 0 | 3 |
| | | | | | | | | | | | | | | 15EI202 | Communication Engineering | 3 | 0 | 0 | 3 | 15EI206 | Measurements and Instrumentation | 3 | 0 | 0 | 3 |
| | | | | | | | | | | | | | | 15EI203J | Transducer Engineering | 2 | 0 | 2 | 3 | 15EI207 | Industrial Instrumentation | 3 | 0 | 0 | 3 |
| | | | | | | | | | | | | | | 15EE231L | Electrical Machines Laboratory | 0 | 0 | 3 | 2 | 15EI204L | Analog Electronic Circuits Laboratory | 0 | 0 | 2 | 1 |
| | | | | | | | | | | | | | | | | | | | | 15EI205L | Analog and Digital Integrated Circuits Laboratory | 0 | 0 | 2 | 1 |
| | **64** | | Total | 0 | 0 | 0 | 0 | | Total | 3 | 0 | 2 | 4 | | Total | 11 | 0 | 5 | 14 | | Total | 12 | 0 | 4 | 14 |
| Prof - Electives -P | 8.33% | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | |
| | **18** | | Total | 0 | 0 | 0 | 0 | | Total | 0 | 0 | 0 | 0 | | Total | 0 | 0 | 0 | 0 | | Total | 0 | 0 | 0 | 0 |
| Project / Seminar / Internship-P | 8.33% | | | | | | | | | | | | | | | | | | | | | | | | |
| | **18** | | Total | 0 | 0 | 0 | 0 | | Total | 0 | 0 | 0 | 0 | | Total | 0 | 0 | 0 | 0 | | Total | 0 | 0 | 0 | 0 |
| Open Electives | ` | | | | | | | | | | | | | | | | | | | | | | | | |
| | **6** | | Total | 0 | 0 | 0 | 0 | | Total | 0 | 0 | 0 | 0 | | Total | 0 | 0 | 0 | 0 | | Total | 0 | 0 | 0 | 0 |
| **Total** | **180** | | | **20** | **2** | **10** | **26** | | | **17** | **2** | **9** | **23** | | | **20** | **1** | **7** | **24** | | | **22** | **1** | **4** | **24** |
| | | | **Contact hours** | **32** | | | | | **Contact hours** | **28** | | | | | **Total contact hours** | **28** | | | | | **Total Contact hours** | **27** | | | |

FACULTY OF ENGINEERING AND TECHNOLOGY, SRM UNIVERSITY

DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

**B.TECH ELECTRONICS AND INSTRUMENTATION ENGINEERING CHOICE BASED FLEXIBLE CREDIT SYSTEM (CBFCS) Curriculum Under Regulations 2015 (For students admitted from 2015-16 onwards)**

| **L** | **Lecture Hours / Week** | **T** | **Tutorial Hours / Week** | **C Credits** | **P Practical Hours / Week** | **L** | **Laboratory Course** | **E** | **Elective Courses** | **J** | **Theory jointly with Lab** | **M** | **Course with Multidisciplinary content** |
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| | **Year 3** | | | | | | | | | | | | **Year 4** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1st Semester | | | | | | 2nd Semester | | | | | | 1st Semester | | | | | | 2nd Semester | | | |
| **Course Code** | **Course Title** | **L** | **T** | **P** | **C** | **Course Code** | **Course Title** | **L** | **T** | **P** | **C** | **Course Code** | **Course Title** | **L** | **T** | **P** | **C** | **Course Code** | **Course Title** | **L** | **T** | **P** | **C** |
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| 15PD301 | Communication and Reasoning Skills | 1 | 1 | 0 | 1 | 15PD302 | Quantitative Aptitude & Logical Reasoning –II | 1 | 1 | 0 | 1 | | | | | | | | | | | | |
| | Total | 1 | 1 | 0 | 1 | | Total | 1 | 1 | 0 | 1 | | Total | 0 | 0 | 0 | 0 | | Total | 0 | 0 | 0 | 0 |
| 15MA301 | Probability and Statistics | 4 | 0 | 0 | 4 | | | | | | | | | | | | | | | | | | |
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| | Total | 4 | 0 | 0 | 4 | | Total | 0 | 0 | 0 | 0 | | Total | 0 | 0 | 0 | 0 | | Total | 0 | 0 | 0 | 0 |
| 15EI301 | Discrete Signal Processing | 3 | 0 | 0 | 3 | | | | | | | | | | | | | | | | | | |
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| | Total | 3 | 0 | 0 | 3 | | Total | 0 | 0 | 0 | 0 | | Total | 0 | 0 | 0 | 0 | | Total | 0 | 0 | 0 | 0 |
| 15EI302 | Microcontroller based System Design | 3 | 0 | 0 | 3 | 15EI304 | Process Control | 3 | 0 | 0 | 3 | 15EI401 | PLC & DCS | 3 | 0 | 0 | 3 | | | | | | |
| 15EI303 | Control Systems Engineering | 3 | 0 | 0 | 3 | 15EI305 | Instrumentation System Design | 3 | 0 | 0 | 3 | 15EI402 | Computer Control of Process | 3 | 0 | 0 | 3 | | | | | | |
| 15EI302L | Microcontroller based System Design Laboratory | 0 | 0 | 2 | 1 | 15EI306 | Power Electronics and its Applications | 3 | 0 | 0 | 3 | 15EI403J | Image Processing | 2 | 0 | 2 | 3 | | | | | | |
| 15EI303L | Control Systems Engineering Laboratory | 0 | 0 | 2 | 1 | 15EI304L | Process Control laboratory | 0 | 0 | 2 | 1 | 15EI401L | Automation Laboratory | 0 | 0 | 2 | 1 | | | | | | |
| | | | | | | 15EI305L | Design Project Laboratory | 0 | 0 | 2 | 1 | | | | | | | | | | | | |
| | | | | | | 15EI307M | Multi-Disciplinary Design | 2 | 2 | 0 | 3 | | | | | | | | | | | | |
| | Total | 6 | 0 | 4 | 8 | | Total | 11 | 2 | 4 | 14 | | Total | 8 | 0 | 4 | 10 | | Total | 0 | 0 | 0 | 0 |
| | **Dept Elective-I** | **3** | **0** | **0** | **3** | | **Dept Elective-II** | **3** | **0** | **0** | **3** | | **Dept Elective-III** | **3** | **0** | **0** | **3** | | **Dept Elective-V** | **3** | **0** | **0** | **3** |
| | | | | | | | | | | | | | **Dept Elective-IV** | **3** | **0** | **0** | **3** | | **Dept Elective-VI** | **3** | **0** | **0** | **3** |
| | Total | 3 | 0 | 0 | 3 | | Total | 3 | 0 | 0 | 3 | | Total | 6 | 0 | 0 | 6 | | Total | 6 | 0 | 0 | 6 |
| 15EI390L | Industrial Training (To be done after IV semester) | 0 | 0 | 3 | 2 | 15EI376L / 15EI381L / 15EI386L / 15EI491L | Minor Project II / Seminar II / Massive Open Online Courses (MOOCS) II / Industry Module II | 0 | 0 | 3 | 2 | | | | | | | 15EI496L | Major Project | 0 | 0 | 24 | 12 |
| 15EI375L / 15EI380L / 15EI385L / 15EI490L | Minor Project I / Seminar I / Massive Open Online Courses (MOOCS) I / Industry Module I | 0 | 0 | 3 | 2 | | | | | | | | | | | | | | | | | | |
| | Total | 0 | 0 | 6 | 4 | | Total | 0 | 0 | 3 | 2 | | Total | 0 | 0 | 0 | 0 | | Total | 0 | 0 | 24 | 12 |
| | Open Elective I | 3 | 0 | 0 | 3 | | Open Elective II | 3 | 0 | 0 | 3 | | | | | | | | | | | | |
| | As per list / as taken by the student | | | | | | As per list / as taken by the student | | | | | | | | | | | | | | | | |
| | Total | 3 | 0 | 0 | 3 | | Total | 3 | 0 | 0 | 3 | | Total | 0 | 0 | 0 | 0 | | Total | 0 | 0 | 0 | 0 |
| | | **20** | **1** | **10** | **26** | | | **18** | **3** | **7** | **23** | | | **14** | **0** | **4** | **16** | | | **6** | **0** | **24** | **18** |
| | **Total Contact hours** | **31** | | | | | **Total contact hours** | **28** | | | | | **Total contact hours** | **18** | | | | | **Total contact hours** | **30** | | | |

**DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING**

**FACULTY OF ENGINEERING AND TECHNOLOGY, SRM UNIVERSITY**

**DEPARTMENT ELECTIVES FOR B.Tech EIE DEGREE PROGRAMME UNDER CHOICE BASED FLEXIBLE CREDIT SYSTEM (CBFCS)**

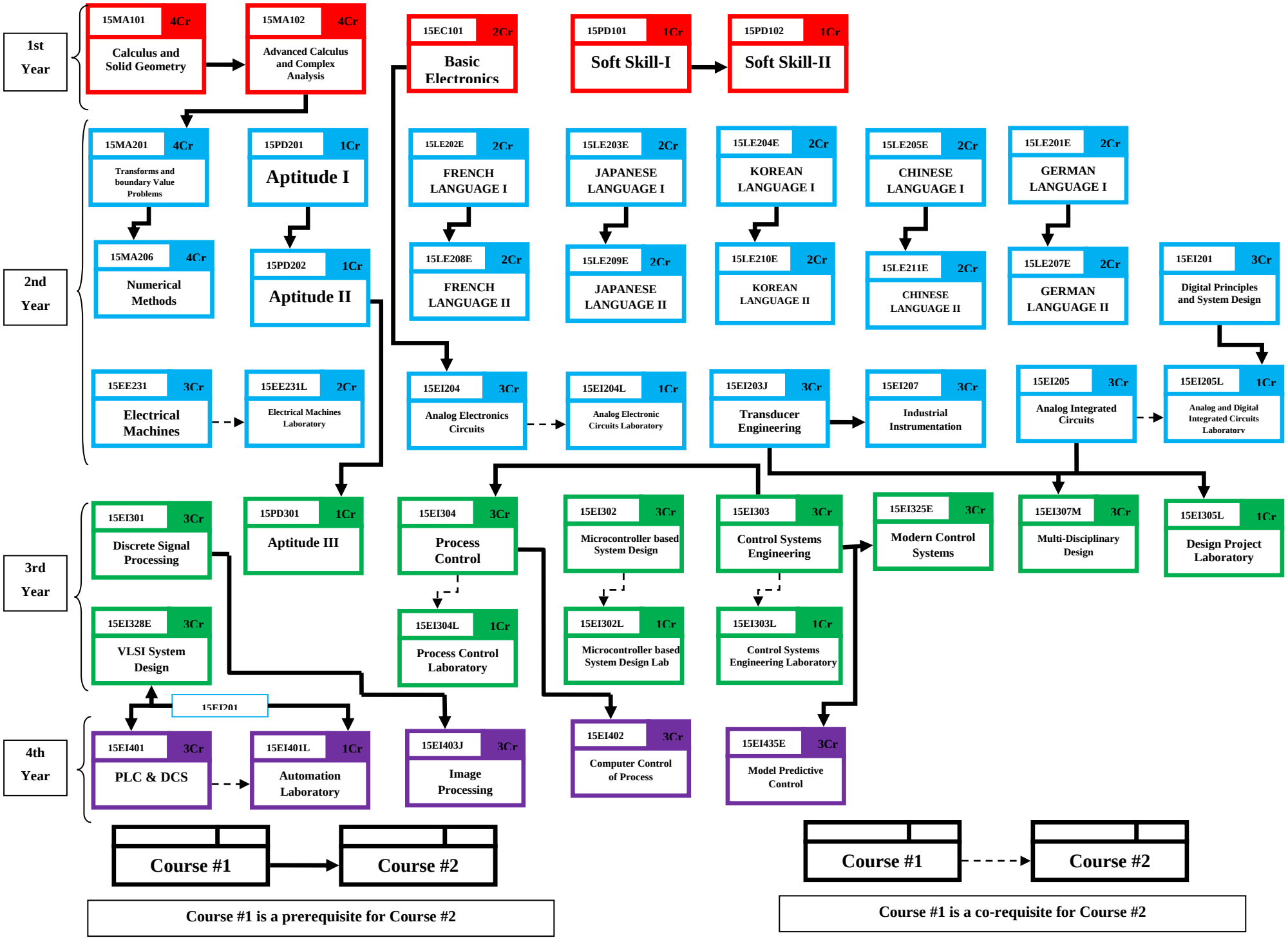
| Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|
| 15EI321E | Analytical Instrumentation | 3 | 0 | 0 | 3 |
| 15EI322E | Reliability and Safety Engineering | 3 | 0 | 0 | 3 |
| 15EI323E | Biomedical Instrumentation | 3 | 0 | 0 | 3 |
| 15ME315E | Fundamentals of Hydraulics and Pneumatics | 3 | 0 | 0 | 3 |
| 15EI325E | Modern Control Systmes | 3 | 0 | 0 | 3 |
| 15EI326E | Micro and Smart Systems | 3 | 0 | 0 | 3 |
| 15EI327E | Power plant Instrumentation | 3 | 0 | 0 | 3 |
| 15EI328E | VLSI System Design | 3 | 0 | 0 | 3 |
| 15NT318E | Fundamentals of Nano Electronics | 3 | 0 | 0 | 3 |
| 15EI421E | Wireless Sensor Networks | 3 | 0 | 0 | 3 |
| 15EI422E | Multi Sensor Data Fusion | 3 | 0 | 0 | 3 |
| 15EI423E | Bio-MEMS | 3 | 0 | 0 | 3 |
| 15MH413E | Robotics and Automation | 3 | 0 | 0 | 3 |
| 15EI425E | Applications of MEMS | 3 | 0 | 0 | 3 |
| 15EI426E | Non-Linear System | 3 | 0 | 0 | 3 |
| 15EI427E | Real Time Embedded System | 3 | 0 | 0 | 3 |
| 15EI428E | Automotive Systems | 3 | 0 | 0 | 3 |
| 15EI429E | Soft Computing | 3 | 0 | 0 | 3 |
| 15EI430E | Adaptive Control | 3 | 0 | 0 | 3 |
| 15EI431E | System Identification | 3 | 0 | 0 | 3 |
| 15EI432E | Instrumentation and Control in Iron and Steel Industries | 3 | 0 | 0 | 3 |
| 15EI433E | Instrumentation and Control in Petrochemical Industries | 3 | 0 | 0 | 3 |
| 15EI434E | Optimal Control | 3 | 0 | 0 | 3 |
| 15EI435E | Model Predictive Control | 3 | 0 | 0 | 3 |
| 15EI436E | Industrial Data Communication | 3 | 0 | 0 | 3 |

**COURSES CUSTOMIZED TO OTHER DEPARTMENT**

| Course Code | Course Title | L | T | P | C | Course Offered to |
|---|---|---|---|---|---|---|
| 15EI251 | Electronics and Instumentation | 3 | 0 | 0 | 3 | Mechanical, Nano |
| 15EI251L | Electronics and Instumentation Laboratory | 0 | 0 | 2 | 1 | Mechanical, Nano |

| Department of EIE | | | |
|---|---|---|---|
| **B. Tech Electronics and Instrumentation Engineering** | | | |
| **2015 -Curriculum** | | | |
| **Course Code** | **Course Title** | **Prerequisite course** | **Co requisite course** |
| 15PD102 | Soft Skill-II | 15PD101 | |
| 15MA102 | Advanced Calculus and Complex Analysis | 15MA101 | |
| 15MA201 | Transforms and boundary Value Problems | 15MA102 | |
| 15EE231L | Electrical Machines Laboratory | | 15EE231 |
| 15LE207E | GERMAN LANGUAGE II | 15LE201E | |
| 15LE208E | FRENCH LANGUAGE II | 15LE202E | |
| 15LE209E | JAPANESE LANGUAGE II | 15LE203E | |
| 15LE210E | KOREAN LANGUAGE II | 15LE204E | |
| 15LE211E | CHINESE LANGUAGE II | 15LE205E | |
| 15PD202 | Aptitude II | 15PD201 | |
| 15MA206 | Numerical Methods | 15MA201 | |
| 15EI204 | Analog Electronics Circuits | 15EC101 | |
| 15EI207 | Industrial Instrumentation | 15EI203J | |
| 15EI204L | Analog Electronic Circuits Laboratory | | 15EI204 |
| 15EI205L | Analog and Digital Integrated Circuits Laboratory | 15EI201 | 15EI205 |
| 15PD301 | Aptitude III | 15PD202 | |
| 15EI302L | Microcontroller based System Design Laboratory | - | 15EI302 |
| 15EI303L | Control Systems Engineering Laboratory | - | 15EI303 |
| 15EI304 | Process Control | 15EI303 | - |
| 15EI304L | Process Control laboratory | | 15EI304 |
| 15EI305L | Design Project Laboratory | 15EI205,15EI203J | - |
| 15EI307M | Multi-Disciplinary Design | 15EI203J,15EI205 | - |
| 15EI325E | Modern Control Systems | 15EI303 | - |
| 15EI328E | VLSI System Design | 15EI201 | - |
| 15EI401 | PLC & DCS | 15EI201 | - |
| 15EI402 | Computer Control of Process | 15EI304 | - |
| 15EI403J | Image Processing | 15EI301 | - |
| 15EI435E | Model Predictive Control | 15EI303 | - |
| 15EI401L | Automation Laboratory | 15EI201 | 15EI401 |

# B.Tech Electronics and Instrumentation Engineering
## Prerequisites and Co requisites flow chart
## 2015 – Curriculum



| 15EI201 | Digital Principles and System Design | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| *Co-requisite:* | NIL | | | | |
| *Prerequisite:* | NIL | | | | |
| *Data Book / Codes/Standards* | NIL | | | | |
| *Course Category* | P PROFESSIONAL CORE | ELECTRONICS ENGINEERING | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | |

| **PURPOSE** | To learn the basic methods for the design of digital circuits and provide the fundamental concepts used in the design of digital systems. |
|---|---|

| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Simplify the mathematical expressions using Boolean functions and simple problems. | a | | | | | | |
| 2. | Implement the combinational logic circuits | a | e | k | | | | |
| 3. | Design the various synchronous and asynchronous circuits. | a | b | | | | | |
| 4. | Understand the various memory devices | a | k | | | | | |
| 5. | Apply the circuits in real time application | k | | | | | | |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | **UNIT I: Number System & Minimization Techniques** | **9** | | | |
| 1. | Review of number system: Binary, Decimal, Octal Hexadecimal Binary Coded Decimal, 1's and 2's complements of Binary numbers,9's and 10's complements | 1 | C | 1 | 1,2 |
| 2. | Types and conversion :<br>Binary to Decimal, Octal , Hexadecimal<br>Decimal to Binary, Octal , Hexadecimal<br>Octal to Binary, Decimal , Hexadecimal<br>Hexadecimal to Binary, Octal, Decimal | 2 | C | 1 | 1,2 |
| 3. | Codes :Weighted binary codes BCD ,(8421)2421 Code<br>Non weighted code, Excess 3 code, Gray Codes, Conversion of Binary to gray and Gray to Binary code, Boolean algebra, Basic laws of Boolean Algebra De– Morgan's theorem | 2 | C | 1 | 1,2 |
| 4. | Switching functions and simplification using K Maps,<br>Quine Mc-Cluskey method. | 4 | C | 1 | 1,2 |
| | **UNIT II: Combinational Circuits** | **9** | | | |
| 5. | Design of logic gates, Design of Combinational circuits<br>Half adder, Full Adder, Half subtractor, Full subtractor, Parallel binary Adder, Subtractor, Serial Adder, BCD Adder | 3 | C,D | 2 | 1,2 |
| 6. | Comparators , 4-bit magnitude comparator, Code converters : BCD to binary Converter, Binary to Gray code converters<br>Gray to Binary Converters | 2 | C,D | 2 | 1,2 |
| 7. | Encoders, Decoders | 2 | C,D | 2 | 1,2 |
| 8. | Multiplexers, Demultiplexers | 2 | C,D | 2 | 1,2 |
| | **UNIT III: Synchronous and Asynchronous Sequential Circuit** | **9** | | | |
| 9. | Flip flops : SR Characteristic table and equation, D Characteristic table and equation, JK Characteristic table and equation, T Characteristic table and equation | 3 | D,I | 3 | 1,2 |
| 10. | Realization of one flip flop using other flip flops JK,SR,T,D | 2 | C,D,I | 3 | 1,2 |
| 11. | Counters, Up/Down counters, Modulo-n counter, Johnson counter Shift registers, serial in serial out, Parallel in parallel out | 1 | C,D | 3 | 1,2 |
| 12. | Design of synchronous and Asynchronous sequential circuits<br>State diagram, state reduction, state assignment, State minimization, Excitation table and maps, Circuit implementation | 3 | C, D,I | 3 | 1,2 |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | **UNIT IV: Memory Devices and Logic Families** | **9** | | | |
| 13. | Memory Organization, Capacity, Density, Signals and Basic Operations, Read, Write, Address, data Signals Memory Read, Write Cycle, Synchronous Burst SRAM, Dynamic RAM Burst, Distributed Refresh, Types of DRAMs, ROM , Mask ROM | 4 | C, D,I | 4 | 1,2 |
| 14. | First In-First Out (FIFO) Memory last in-first out (LIFO) memory Classification of memories - ROM RAM PROM – EPROM EEPROM, Digital logic families Logic and their characteristics TTL, Tristate gates, ECL, CMOS | 3 | C | 4 | 1,2 |
| 15. | PLA,PAL,PLD | 2 | D,I | 4 | 1,2 |
| | **UNIT V: Digital Application** | **9** | | | |
| 16. | Gate circuits, Game control circuits, Combinational circuit Odd prime number detector, Design of Now serving system | 3 | D,I | 5 | 6 |
| 17. | Event detector circuit, Fire place control circuits, Seven segment display decoder | 3 | D,I | 5 | 6 |
| 18. | Elevator Control System: Elevator State Diagram, State Table, Input and Output Signals, Input Latches, Traffic Signal Control System: Switching of Traffic Lights, Inputs and Outputs, State Machine | 3 | D,I | 5 | 6 |
| | **Total contact hours** | **45** | | | |

| **LEARNING RESOURCES** | |
|---|---|
| **Sl. No.** | **TEXT BOOKS** |
| 1. | Morris Mano M, "*Digital Logic and Computer Design*", 4th Edition Prentice Hall of India, 2002. |
| 2. | Floyd, "*Digital Fundamentals*", 8th Edition, Pearson Education, 2003. |
| | **REFERENCE BOOKS/OTHER READING MATERIAL** |
| 3. | Charles. H, Roth, "*Fundamentals Logic Design*", Jaico Publishing, 4th Edition, 2002 |
| 4. | John Yarbrough. M, "*Digital Logic, Application & Design*", 4th Edition, Thomson, 2002. |
| 5. | John Wakerly. F, "*Digital Design Principles and Practice*", 3rd Edition, Pearson Education, 2002. |
| 6. | forum.allaboutcircuits.com |

| **Course nature** | | | | **Theory** | | | |
|---|---|---|---|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | | | | | |
| **In-semester** | **Assessment tool** | Cycle test I | Cycle test II | Cycle Test III | Surprise Test | Quiz | **Total** |
| | **Weightage** | **10%** | **15%** | **15%** | **5%** | **5%** | **50%** |
| | | | | | **End semester examination Weightage:** | | **50%** |

| 15EI202 | Communication Engineering | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| *Co-requisite:* | NIL | | | | |
| *Prerequisite:* | NIL | | | | |
| *Data Book / Codes/Standards* | NIL | | | | |
| *Course Category* | P PROFESSIONAL CORE ELECTRONICS ENGINEERING | | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | |

| **PURPOSE** | To know about the basics of communication engineering such as analog modulation (AM, FM, Transmission, Reception), and pulse modulation methods. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Obtain the basic knowledge about the signals, analog and digital communication, noise. | a | | | | | | |
| 2. | Know the modulation technique of AM, FM and pulse modulation | a | b | c | | | | |
| 3. | Know the demodulation technique of AM,FM and Pulse modulation | a | b | e | | | | |
| 4. | Understand the different types of transmitter, receiver of AM, FM and PCM | a | b | | | | | |
| 5. | Obtain the knowledge of various wireless communication | a | | | | | | |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | **UNIT I:Basic Information Theory** | **9** | | | |
| 1. | Introduction to information messages & signals, Analog communication, Digital communication and Discrete communication | 2 | C | 1 | 1,2 |
| 2. | Atmospheric noise, thermal noise, white noise, shot noise, Noise figure and experimental determination of noise figure | 2 | C | 1 | 1,2 |
| 3. | Need for Modulation, Degree of modulation, Generation of AM, FM and PM waves | 2 | C | 1 | 1,2 |
| 4. | Introduction to pulse modulation, Types of Pulse modulations: PAM,PTM,PCM | 3 | C | 1 | 1,2 |
| | **UNIT II: Modulation Techniques** | **9** | | | |
| 5. | Modulation of double side band full carrier, Modulation of double side band suppressed carrier, Modulation of single side band suppressed carrier, Modulation of VSB | 4 | C,D | 2 | 1-5 |
| 6. | Narrow band FM and Wide band FM, Direct method of FM Modulators. | 2 | C,D | 2 | 1-5 |
| 7. | Generation and modulation of Pulse amplitude modulation, Pulse time modulation and Pulse Code modulation. | 3 | C,D | 2 | 1-5 |
| | **UNIT III: Demodulation Techniques** | **9** | | | |
| 8. | Demodulation of double side band full carrier: envelope detector, Demodulation of double side band suppressed carrier, Demodulation of single side band suppressed carrier, Demodulation of VSB. | 4 | C,D | 3 | 1-5 |
| 9. | FM Demodulators, Slope detector, Frequency discriminator, PLL. | 1 | C,D | 3 | 1-5 |
| 10. | Demodulation of Pulse amplitude modulation, Pulse Time modulation, Pulse code modulation. | 4 | C,D | 3 | 1-5 |
| | **UNIT IV: Transmitters & Receivers** | **9** | | | |
| 11. | AM Transmitters-Low level and High level transmitters, AM Receivers, TRF receiver and super-hetrodyne receiver. | 5 | C,D | 4 | 1-5 |
| 12. | FM Transmitters, FM Receivers, PCM transmitters and receiver, Time division multiplexing and Frequency division multiplexing. | 4 | C,D | 4 | 1-5 |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | **UNIT V: Applications** | **9** | | | |
| 13. | Wireless Networking, Wi MAX, Wireless devices, ZigBee, Examples of air Interface standard: GSM, IS-95 CDMA, Bluetooth Technology, Types of Wireless Data Transmission: Wireless Router, Wireless adapters, Microwave, Infrared (IR). | 5 | C | 5 | 5 |
| 14. | Types of Wireless Devices: Radio, Wireless Phones Serial Communication: RS-232, Bi-Directional Communications, Synchronous and Asynchronous Communications. | 4 | C | 5 | 5 |
| **Total contact hours** | | **45** | | | |

| **LEARNING RESOURCES** | |
|---|---|
| **Sl. No.** | **TEXT BOOKS** |
| 1. | Singh. R.P and Sapre. S.D, "*Analog and Digital Communication Systems*", McGraw-Hill Publishing Company Ltd., 3rd Edition , 2003. |
| 2. | Kennedy. G, "*Electronic Communication Systems*", McGraw-Hill, 4th Edition, 2003. |
| **REFERENCE BOOKS/OTHER READING MATERIAL** | |
| 3. | Haykins. S, "*Communication Systems*", 4th Edition, John Wiley Inc., 2000. |
| 4. | Roddy D. and Coolen J., *Electronic communications*, 4th Edition, Prentice Hall of India P. Ltd. 1987. |
| 5. | Deshpande, N.D, "*Communication Electronics*", Tata McGraw Hill Pub.1989. |
| 6. | K. Daniel Wong, "*Fundamentals of Wireless Communication Engineering Technologies*" John Wiley, 2012. |

| **Course nature** | | | | **Theory** | | | |
|---|---|---|---|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | | | | | |
| **In-semester** | **Assessment tool** | Cycle test I | Cycle test II | Cycle Test III | Surprise Test | Quiz | **Total** |
| | **Weightage** | **10%** | **15%** | **15%** | **5%** | **5%** | **50%** |
| **End semester examination Weightage:** | | | | | | | **50%** |

| 15EI203J | Transducer Engineering | | | L | T | P | C |
|---|---|---|---|---|---|---|---|
| | | | | 2 | 0 | 2 | 3 |
| *Co-requisite:* | NIL | | | | | | |
| *Prerequisite:* | NIL | | | | | | |
| *Data Book / Codes/Standards* | NIL | | | | | | |
| *Course Category* | P | PROFESSIONAL ENGINEERING | INSTRUMENTATION ENGINEERING | | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | | | |

| **PURPOSE** | To enable the students to select and design suitable instruments to meet the requirements of industrial applications and various transducers used for the measurement of various physical quantities |
|---|---|

| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Know the various types of error in instruments | a | e | k | | | | |
| 2. | Obtain the knowledge about various types of Sensors & Transducers and their working principle | b | | | | | | |
| 3. | Understand the various types of transducers like Resistive, Capacitive and Inductive | a | d | k | | | | |
| 4. | Learn some of the miscellaneous transducers | a | k | | | | | |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | **UNIT I: Measurements and Instrumentation of Transducers** | **6** | | | |
| 1. | General configuration and description of measuring Instruments | 3 | C | 1,2 | 1,2 |
| 2. | Basic method of measurement, Generalized scheme for measurement systems, Units and standards requirement of transducers. | 3 | C | 1 | 1,2 |
| 3. | Errors, Classification of errors, error analysis Statistical methods | 3 | C,D | 1 | 1,2 |
| | **UNIT II: Characteistics of Transducers** | **6** | | | |
| 4. | Static and dynamic characteristics of instrument systems Errors in Instrumentation system | 3 | C | 2 | 1,2 |
| 5. | Mathematical model of transducer | 3 | C | 2 | 1,2 |
| 6. | Active and passive transducers and their classification | 3 | C | 2 | 1,2 |
| | **UNIT III: Resistive Transducers** | **6** | | | |
| 7. | Potentiometer, Loading effect, Strain gauge, Theory, types, temperature compensation Applications | 3 | C | 3 | 1,2 |
| 8. | Torque measurement , Proving Ring , Load Cell, gyroscope | 3 | C | 3 | 1,2 |
| 9. | Resistance thermometer, Thermistors materials, Constructions, Characteristics, Hot wire anemometer | 3 | C | 3 | 1,2 |
| | **UNIT IV: Inductive And Capacitive Transducer** | **6** | | | |
| 10. | Self inductive transducer, Mutual inductive transducers, Linear Variable Differential Transformer(LVDT), Accelerometer RVDT | 3 | C | 3 | 1,2,4 |
| 11. | Synchros, Microsyn, Capacitive transducer | 3 | C | 3 | 1,2,4 |
| 12. | Variable Area Type, Variable Air Gap type, Variable Permittivity type, Capacitor microphone. | 3 | C | 3 | 1,2,4 |
| | **UNIT V: Miscelleaneous Transducers** | **6** | | | |
| 13. | Piezoelectric transducer, Hall Effect transducers, proximity sensors, Radiation sensors | 3 | C | 4 | 1,2,4 |
| 14. | Smart sensors Fiber optic sensors Biosensors | 3 | C | 4 | 1,2,4 |
| 15. | Film sensors MEMS & Nano sensor Digital transducers | 3 | C | 4 | 1,2,4 |
| | **Total contact hours** | **30** | | | |

| Sl. No. | Description of experiments | Contact hours | C-D I-O | IOs | Reference |
|---|---|---|---|---|---|
| 1. | Characteristics of Strain gauge | 3 | C,O | 3 | 1,2 |
| 2. | Characteristics of load cell | 3 | C,O | 3 | 1,2 |
| 3. | Characteristics of thermistor | 3 | C,O | 3 | 1,2 |
| 4. | Characteristics of RTD | 3 | C,O | 3 | 1,2 |
| 5. | Characteristics of Thermocouple | 3 | C,O | 3 | 1,2 |
| 6. | Loading effect of Potentiometer | 3 | C,O | 3 | 1,2 |
| 7. | Characteristics of Synchros | 3 | C,O | 4 | 1,2 |
| 8. | Characteristics of LVDT | 3 | C,O | 4 | 1,2 |
| 9. | Characteristics of Piezo-electric transducer | 3 | C,O | 4 | 1,2 |
| 10. | Characteristics of Hall-effect transducer | 3 | C,O | 4 | 1,2 |
| | **Total contact hours** | **30** | | | |

| **LEARNING RESOURCES** | |
|---|---|
| **Sl. No.** | **TEXT BOOKS** |
| 1. | Sawhney. A.K, "*A Course in Electrical and Electronics Measurements and Instrumentation*", 18th Edition, Dhanpat Rai& Company Private Limited, 2007. |
| 2. | Renganathan. S,"*Transducer Engineering*", 4th Edition Allied Publishers, Chennai, 2003. |
| | **REFERENCE BOOKS/OTHER READING MATERIAL** |
| 3. | Doebelin. E.A, "*Measurement Systems – Applications and Design*", Tata McGraw Hill, New York, 2000. |
| 4. | Patranabis. D, "*Sensors and Transducers*", 2nd Edition ,Prentice Hall of India, 1999. |
| 5. | John. P, Bentley, "*Principles of Measurement Systems*", 3rd Edition, Pearson Education, 2000. |
| 6. | Murthy.D.V.S, "*Transducers and Instrumentation*", 11th Edition Prentice Hall of India, 2005. |

| **Course nature** | | | | **Theory + Practical** | | | |
|---|---|---|---|---|---|---|---|
| **Assessment Method – Theory Component (Weightage 50%)** | | | | | | | |
| **In-semester** | **Assessment tool** | Cycle test I | Cycle test II | Cycle Test III | Surprise Test | Quiz | **Total** |
| | **Weightage** | **10%** | **15%** | **15%** | **5%** | **5%** | **50%** |
| | | | | | | **End semester examination Weightage :** | **50%** |
| | | | | | | | |
| **Assessment Method – Practical Component (Weightage 50%)** | | | | | | | |
| **In-semester** | **Assessment tool** | Experiments | Record | MCQ/Quiz/Viva Voce | Model examination | | **Total** |
| | **Weightage** | **40%** | **5%** | **5%** | **10%** | | **60%** |
| | | | | | | **End semester examination Weightage :** | **40%** |

| 15EI204 | Analog Electronic Circuits | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| *Co-requisite:* | NIL | | | | |
| *Prerequisite:* | 15 EC101 | | | | |
| *Data Book / Codes/Standards* | NIL | | | | |
| *Course Category* | P PROFESSIONAL CORE | ELECTRONICS ENGINEERING | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | |

| **PURPOSE** | The aim of this course is to familiarize the student with the analysis and design of basic transistor amplifier circuits, tuned amplifiers, wave shaping, multi vibrator circuits ,voltage regulators and electronic circuit applications |
|---|---|

| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Learn the biasing methods and stabilization techniques of BJT and FET transistors. | a | b | | | | | |
| 2. | Understand the design and modeling of transistors and their use in tuned circuits. | a | c | | | | | |
| 3. | Analysis large signal power amplifiers and design wave shaping circuits and multi vibrators. | a | d | | | | | |
| 4. | Analyze many simple feedback amplifier circuits and to design LC Oscillators. | a | b | | | | | |
| 5. | Analyze and design voltage regulators and application based circuits. | a | c | | | | | |

| Session | Description of Topic | Conduct hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | **UNIT I : Transistor Biasing & Stabilization** | **9** | | | |
| 1. | BJT, Biasing, DC Load line, AC load line, Operating point | 2 | C | 1-4 | 1,2 |
| 2. | Fixed bias, Emitter stabilized network, Voltage Divider bias-Design of Bias circuit with emitter resistor Manometers | 2 | C,D | 1 | 1,2 |
| 3. | FET Biasing, Fixed Bias, Self- Bias, Voltage Divider Bias | 3 | C,D | 1 | 1,2 |
| 4. | Bias stabilization, Stability factor for BJT & FET amplifier | 2 | C,D | 1 | 1,2 |
| | **UNIT II :Design And Analysis Of Small Signal Amplifiers** | **9** | | | |
| 5. | Small signal analysis of BJT in configuration, CE amplifier, FET in C-MOS amplifier | 3 | C,D | 2 | 1,4 |
| 6. | Emitter coupled differential Amplifier Analysis, Const source and constant current bias circuits | 2 | C,D | 2 | 1,4 |
| 7. | Single tuned Amplifiers, Double tuned amplifiers | 2 | D,I | 2 | 1,4 |
| 8. | Stagger tuned amplifiers & their frequency response | 2 | D,I | 2 | 1,4 |
| | **UNIT III : Large Signal Amplifiers &Wave Shaping Circuits** | **9** | | | |
| 9. | Large signal Amplifiers: Classification of power amplifiers (Class A, B, AB, C&D) | 1 | C,D | 3 | 2,3 |
| 10. | Efficiency of class A, RC coupled and transformer Coupled class A amplifiers | 2 | C,D,I | 3 | 2,3 |
| 11. | Class B complementary-symmetry, push-pull power amplifiers, Calculation of power output, efficiency and power dissipation-Crossover distortion. | 2 | C,D | 3 | 2,3 |
| 12. | Wave shaping Circuits: RC Wave Shaping Circuits, Diode Clampers and Clippers | 2 | D,I | 3 | 2,3 |
| 13. | Multivibrator, Monostable, Astable and Bistable, Schmitt Triggers. | 2 | D,I | 3 | 2,3 |
| | **UNIT IV : Feedback And Oscillators Circuits** | **9** | | | |
| 14. | Feedback Amplifiers: Classification of feedback amplifiers, Effect of feedback on amplifier characteristics | 2 | C | 4 | 1,5 |
| 15. | Voltage series, shunt, current series, shunt feedback configurations | 2 | D | 4 | 1,5 |
| 16. | Emitter follower, Darlington amplifier | 1 | D | 4 | 1,5 |

| Session | Description of Topic | Conduct hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| 17. | Oscillators: Barkhausen criterion, Colpitts, Hartley and Crystal Oscillator | 2 | D | 4 | 1,5 |
| 18. | RC phase Shift Oscillator, Wein Bridge Oscillator and Quartz Oscillator. | 2 | D | 4 | 1,5 |
| | **UNIT V Amplifier Applications** | **9** | D | | |
| 19. | Voltage Regulators, line regulation, load regulation | 3 | D | 5 | 3 |
| 20. | Design of Series Voltage Regulator, Shunt Voltage Regulator Linear IC voltage regulators | 3 | D | 5 | 3 |
| 21. | JFET radio frequency amplifier, JFET Buffer, Power MOSFET Driver circuits. | 3 | D | 5 | 3 |
| | **Total contact hours** | **45** | | | |

| **LEARNING RESOURCES** | |
|---|---|
| **Sl. No.** | **TEXT BOOKS** |
| 1. | Robert L.Boylestad and Louis Nashesky, "*Electronic Devices and Circuit Theory*", 11th Edition, Pearson New International Edition, 2014. |
| 2. | David A. Bell, "*Electronic Devices and Circuits*", 5th Edition, Oxford University Press, 2008. |
| | **REFERENCE BOOKS/OTHER READING MATERIAL** |
| 3. | Robert T.Paynter, "*Introductory electronic Devices & circuits*", Pearson Education,6th Edition, 2008. |
| 4. | Milman. J and Halkias. C, Millman's, "*Integrated Electronics*", 2nd Edition, Tata McGraw Hill Ltd, 2009. |
| 5. | Thomas L.Floyd, "*Electronic Devices*", 9th Edition, Pearson Education, 2011. |

| **Course nature** | | | | **Theory** | | | |
|---|---|---|---|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | | | | | |
| **In-semester** | **Assessment tool** | Cycle test I | Cycle test II | Cycle Test III | Surprise Test | Quiz | **Total** |
| | **Weightage** | **10%** | **15%** | **15%** | **5%** | **5%** | **50%** |
| | | | | | | **End semester examination Weightage :** | **50%** |

| 15EI205 | Analog Integrated Circuits | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| *Co-requisite:* | NIL | | | | |
| *Prerequisite:* | NIL | | | | |
| *Data Book / Codes/Standards* | NIL | | | | |
| *Course Category* | P PROFESSIONAL CORE | ELECTRONICS ENGINEERING | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | |

| **PURPOSE** | To acquire analytical ability of the analog integrated circuits | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Learn the fundamentals of op-amp. | a | e | | | | | |
| 2. | Design waveform generator circuits. | a | | | | | | |
| 3. | Enhance their knowledge in filter designs. | a | b | | | | | |
| 4. | Familiarize themselves with the data conversion methods. | a | | | | | | |
| 5. | Expose to the concept of voltage regulation and timer. | a | e | | | | | |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | **UNIT 1: Op-Amp Fundamentals and Applications** | **9** | | | |
| 1. | Op-amp symbol, terminals, packages and specifications, Ideal op-amp & practical op-amp, Inverting and Non-inverting amplifiers | 2 | C,D | 1 | 1,2 |
| 2. | DC characteristics of op-amp | 2 | C | 1 | 1,2 |
| 3. | AC characteristics of op-amp | 1 | C | 1 | 1,2 |
| 4. | Summing amplifier, Difference amplifier, Voltage follower, Instrumentation amplifier | 2 | C,D | 1 | 1,2 |
| 5. | V to I and I to V converters, Precision rectifiers, Clipper Clamper | 2 | C | 1 | 1,2 |
| | **UNIT II: Waveform Generators** | **9** | | | |
| 6. | Differentiator, Integrator and Comparator Applications | 3 | C | 1,2 | 1 |
| 7. | Schmitt trigger circuit | 1 | C,D | 2 | 1 |
| 8. | Square, Saw-tooth, Triangular wave generators | 3 | C,D | 1,2 | 1 |
| 9. | RC Phase shift oscillator | 1 | C,D | 1,2 | 1 |
| 10. | Wien Bridge Oscillator | 1 | C,D | 1,2 | 1 |
| | **UNIT III: Active Filters &PLL** | **9** | | | |
| 11. | RC Active Filters: First, Second order Filters | 2 | C,D | 3 | 1,2 |
| 12. | LPF, HPF, BPF, BRF | 2 | C,D | 3 | 1,2 |
| 13. | Phase Locked Loop(PLL) and Functional diagram description | 3 | C,D | 3 | 1,2 |
| 14. | VCO | 1 | C | 3 | 1,2 |
| 15. | PLL applications | 1 | C | 3 | 1,2 |
| | **UNIT IV: Data Converters** | **9** | | | |
| 16. | Digital to Analog converter basic concepts Weighted resistor DAC, R-2R ladder DAC | 4 | C,D | 4 | 1,5 |
| 17. | Analog to Digital converter basic concepts, Flash type ADC, Ramp type ADC, Successive approximation Type ADC | 4 | C,D | 4 | 1,5 |
| 18. | Dual slope ADC | 1 | C,D | 4 | 1,5 |
| | **UNIT V: Voltage Regulators and Timers** | **9** | | | |
| 19. | Fixed voltage regulators, Adjustable voltage regulators, switching regulator | 3 | C | 5 | 1,5 |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| 20. | 723 general purpose voltage regulator | 3 | C | 5 | 1,5 |
| 21. | IC555 Timer Introduction | 2 | C | 5 | 1,5 |
| 22. | Monostable, Astable operation of Timer | 1 | C | 5 | 1,5 |
| | **Total contact hours** | **45** | | | |

| **LEARNING RESOURCES** | |
|---|---|
| **Sl. No.** | **TEXT BOOKS** |
| 1. | Roy choudhury and Shailjain, " *linear Integrated Circuits*",4th Edition, New Age, 2011 |
| 2. | RamakantA.Gayakwad, "*Op-Amps and Linear Integrated Circuits*", 4th Edition, Prentice Hall, 2002 |
| 3. | Robert F. Coughlin, Frederick F. Driscoll, "*Operational-Amplifiers and Linear Integrated Circuits*", 6th Edition, Prentice Hall, 2011 |
| | **REFERENCE BOOKS/OTHER READING MATERIAL** |
| 4. | Donald A. Neamen, "*Electronics Circuits Analysis and Design",* 3rd Edition, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2006 |
| 5. | Sergio Franco, "*Design with operational amplifier and analog integrated circuits*", McGraw Hill, 2002 |

| **Course nature** | | | | **Theory** | | | |
|---|---|---|---|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | | | | | |
| **In-semester** | **Assessment tool** | Cycle test I | Cycle test II | Cycle Test III | Surprise Test | Quiz | **Total** |
| | **Weightage** | **10%** | **15%** | **15%** | **5%** | **5%** | **50%** |
| | | | | | **End semester examination Weightage :** | | **50%** |

| 15EI206 | Measurements and Instrumentation | | | L | T | P | C |
|---|---|---|---|---|---|---|---|
| | | | | 3 | 0 | 0 | 3 |
| *Co-requisite:* | NIL | | | | | | |
| *Prerequisite:* | NIL | | | | | | |
| *Data Book / Codes/Standards* | NIL | | | | | | |
| *Course Category* | P | PROFESSIONAL CORE | INSTRUMENTAION ENGINEERING | | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | | | |

| **PURPOSE** | To enable the students to learn in detail about the various instruments available for measuring /monitoring electrical parameters encountered in domestic / industrial applications. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Understand the different principles and instruments adopted for measurement of current, voltage, power, energy etc. | a | b | e | | | | |
| 2. | Know different methods available for measurement of passive elements like resistance, inductance & capacitance. | a | b | e | k | | | |
| 3. | Solve problems in the various electrical parameter measurements. | a | b | e | | | | |
| 4. | Learn the storage of digital signal and analyzers for analyzing digital signal to provide with meaning full information. | a | b | e | k | | | |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | **UNIT I: Measurement of Current and Voltage** | **9** | | | |
| 1. | Classification of analog instruments, d'Arsonval Galvanometer, Vibration Galvanometer | 3 | C | 1 | 1-3 |
| 2. | PMMC instrument, Moving iron instrument | 2 | C | 1 | 1-3 |
| 3. | Dynamometer instrument, Induction type instrument | 2 | C | 1 | 1-3 |
| 4. | Extension of ranges, Calibration of ammeters, Calibration of voltmeters | 2 | C,D | 1 | 1-3 |
| | **UNIT II: Measurement of Power and Energy** | **9** | | | |
| 5. | Measurement of power using voltmeter ammeter method, Electrodynamic wattmeter, Power measurement in poly-phase systems | 4 | C | 1 | 1-3 |
| 6. | Single phase induction type energy meter, Poly phase induction type energy meter, Testing of energy meters | 3 | C,D | 1 | 1-3 |
| 7. | Calibration of wattmeter and energy meter | 2 | C,D | 1 | 1-3 |
| | **UNIT III: Measurement of Resistance and Impedance** | **9** | | | |
| 8. | Low resistance measurement using Kelvin's double bridge, Medium resistance measurement using Voltmeter Ammeter method, Wheatstone bridge method | 2 | C,D | 2,3 | 1-4 |
| 9. | High resistance measurement using Megger, Earth resistance measurement. | 1 | C,D | 2.3 | 1-4 |
| 10. | Introduction to A.C. bridges, Measurement of Self Inductance: Maxwell's Bridge and Anderson's bridge | 2 | C,D | 2,3 | 1-4 |
| 11. | Measurement of Capacitance: Schering's bridge, De-Sauty's bridge | 2 | C,D | 2,3 | 1-4 |
| 12. | Measurement of Mutual Inductance: Heaviside M.I. bridge Measurement of frequency using Wien's bridge. | 2 | C,D | 2,3 | 1-4 |
| | **UNIT IV: Oscilloscopes & Signal Generators** | **9** | | | |
| 13. | General purpose CRO, Sampling and storage scope | 2 | C | 4 | 1-5 |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| 14. | Digital Storage Oscilloscope, Signal and function generators | 3 | C | 4 | 1-5 |
| 15. | Pattern generator, Sweep generator, Noise generators, Digital voltmeter, Digital Multimeter. | 4 | C | 4 | 2,4 |
| | **UNIT V: Recording Devices And Wave Analysers** | **9** | C | | |
| 16. | X-Y recorder, Digital recording and data loggers | 2 | C | 4 | 1-5 |
| 17. | Basic wave analyzer, Frequency selective and heterodyne spectrum analyzer | 3 | C | 4 | 1-5 |
| 18. | Fundamental type harmonic distortion analyzers , Distortion factor meter, Q meter , Distortion analyzers using resonance bridge, Wien bridge | 4 | C | 4 | 1-5 |
| | **Total contact hours** | **45** | | | |

| **LEARNING RESOURCES** | |
|---|---|
| **Sl. No.** | **TEXT BOOKS** |
| 1. | Sawhney A.K**,** "*A Course in Electrical and Electronics Measurements and Instrumentation*", 18th Edition, Dhanpat Rai & Company Private Limited, 2007 |
| 2. | Kalsi.H.S,"*Electronic Instrumentation*", 2nd Edition, Tata McGraw Hill company, 2004. |
| | **REFERENCE BOOKS/OTHER READING MATERIAL** |
| 3. | Golding. E. W, and Widdis F.C, "*Electrical Measurements and Measuring Instruments"*, 5th Edition, A.H.Wheeler&Company, 2003. |
| 4. | Copper. W.D and Hlefrick.. A.D, "*Modern Electronic Instrumentation and Measurement Technique*", 5th Edition, Prentice Hall of India, 2002. |
| 5. | Bell, A.D., "*Electronic Instrumentation and Measurements*", 2nd Edition, Prentice Hall of India, New Delhi, 2003. |

| **Course nature** | | | | **Theory** | | | |
|---|---|---|---|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | | | | | |
| **In-semester** | **Assessment tool** | Cycle test I | Cycle test II | Cycle Test III | Surprise Test | Quiz | **Total** |
| | **Weightage** | **10%** | **15%** | **15%** | **5%** | **5%** | **50%** |
| **End semester examination Weightage :** | | | | | | | **50%** |

| 15EI207 | Industrial Instrumentation | | | L | T | P | C |
|---|---|---|---|---|---|---|---|
| | | | | 3 | 0 | 0 | 3 |
| *Co-requisite:* | NIL | | | | | | |
| *Prerequisite:* | 15EI203J | | | | | | |
| *Data Book / Codes/Standards* | NIL | | | | | | |
| *Course Category* | P | PROEFESSIONAL CORE | INSTRUMENTATION ENGINEERING | | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | | | |

| **PURPOSE** | To provide details on basic process parameters that is applied in most processing industries for both measurement and control applications. |
|---|---|

| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Provide sound knowledge about various techniques used for the measurement of industrial parameters. Exposure to torque, velocity measuring instruments. | a | | | | | | |
| 2. | Have an adequate knowledge about pressure transducers. | a | b | | | | | |
| 3. | Have an idea about the temperature measurements, calibration and temperature compensation used in Themocouple, Thermistor, Resistance temperature detector. | a | b | | | | | |
| 4. | Know about various flow and level measurement techniques adopted in industrial environment. | a | b | | | | | |
| 5. | Exposure to humidity measuring instruments. | a | b | | | | | |
| 6. | Know the application of various process parameters used in industries. | a | k | | | | | |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | **UNIT I: Introduction to Process Variable and Measuring Devices** | **9** | | | |
| 1. | Definitions of Process variable, Unit conversions and physical constants, Terristial constants and Properties of Water. | 1 | C | 1-5 | 1,2 |
| 2. | Fluid mechanics: Pressure, Hydraulic power system, Pneumatic Power system, Pascal's Principle and hydrostatic pressure, Review of RTD, Thermistor, Thermocouple. | 3 | C,D | 1-2 | 1-4 |
| 3. | Manometers, Buoyancy Principle Reynolds number, Nature of flow, Bernoulli's equation, venturi tube. | 2 | C,D | 4 | 1-4 |
| 4. | Speed: Measurement of speed, moving iron and moving coil Type, AC and DC Tacho generator, Stroboscope. Velocity sensor, Torque sensor | 2 | C,D | 1 | 1-6 |
| 5. | Torque: Measurement of torque, Inductive principle and Digital methods. | 1 | C | 1 | 1-6 |
| | **UNIT II : Pressure Measurement** | **9** | | | |
| 6. | Types of Pressure**,** Pressure measurement using Mano meters ,Errors in manometer, Electrical Pressure sensor: strain gauge, Differential capacitance sensor, Elastic type pressure measurement: Bourdon gauge, bellows, diaphragms, capacitance sensor | 4 | C,D | 1-2 | 1-5 |
| 7. | Measurement of vacuum pressure: McLeod gauge, Thermal conductivity gauge, Thermocouple type conductivity gauge.<br>Ionization gauges**:** Hot and cold cathode. | 3 | C,D | 2 | 1-5 |
| 8. | Differential pressure transmitters: Flapper nozzle. Measurement of flapper movement. Application consideration: Selection, installation and calibration. | 2 | C.D | 2 | 1-5 |
| | **UNIT III: Temperature Measurement** | **9** | | | |
| 9. | Temperature scales, Methods of Temperature measurement, Bi-metal temperature sensors, Filled-bulb temperature sensors<br>Electrical Type temperature Measurement : RTD, Temperature measurement change in physical properties, 3 wire and 4 wire RTD | 5 | C,D | 1-2 | 1-5 |

| | | | | | |
|---|---|---|---|---|---|
| 10. | Thermistor, Thermocouple, Laws of thermo couple. Reference junction compensation, Pyrometer: Radiation type Pyrometer, Optical type Pyrometer, Application consideration: selection, range, accuracy, thermal time constant, installation, calibration and protection. | 4 | C,D | 1-2 | 1-5 |
| | **UNIT IV: Flow Measurement** | **9** | | | |
| 11. | Variable head : orifice plate, Pitot tube, Variable area: Rota meter<br>Velocity based flow meter: Turbine flow meters, Magnetic flow meters, Ultrasonic flow meters. | 5 | C,D | 4 | 1-5 |
| 12. | Inertia-based (true mass) flow meters: Coriolis flow meters.<br>Thermal-based (mass) flow meters: Hot wire Anemometer.<br>Open channel flow measurement: weir-rectangular, v-notch, trapezoidal, Application consideration: Selection, installation and calibration. | 4 | C | 4 | 1-5 |
| | **UNIT V: Measurement Of Level, Humidity & Various Process Parameter Applications.** | **9** | | | |
| 13. | Methods of level measurement : Direct Measurement-Mechanical type Float, Magnetic float, Indirect measurement : Hydrostatic pressure , air purge system | 3 | C | 4 | 1-5 |
| 14. | Electrical type: Capacitive type level sensor. Echo- Ultrasonic level measurement. Measurement of Humidity: Humidity terms, Dry & wet bulb Psychro meters, Dew point hygrometer. | 4 | C,D | 4,5 | 1-5 |
| 15. | Application consideration: Selection, installation and calibration of level Measurement, Application of various Process parameters used in Paper industry, Mine, and Nuclear industry. | 2 | C | 4,6 | 8 |
| **Total contact hours** | | **45** | | | |

| **LEARNING RESOURCES** | |
|---|---|
| **Sl. No.** | **TEXT BOOKS** |
| 1. | Patranabis. D, "*Principles of Industrial Instrumentation*", Tata McGraw Hill, 3rd Edition, New Delhi, Reprint 2010. |
| 2. | Tony R. Kuphaldt, "*Lessons In Industrial Instrumentation* ", Version 0.2, 2008 |
| **REFERENCE BOOKS/OTHER READING MATERIAL** | |
| 3. | Dunn, William C; "*Fundamentals of Industrial Instrumentation and Process control*", McGrawHill, 1st Edition Professional, 2005. |
| 4. | Singh S. K., "*Industrial Instrumentation & Control*", Tata McGraw Hill, 3rd Edition, Reprint 2009. |
| 5. | Krishnaswamy K.&Vijayachitra S., "*Industrial Instrumentation*", New age International, 3rd Edition, Reprint 2008. |
| 6. | Jain R.K., "Mechanical and Industrial Measurements", Hanna Publishers, 3rd Edition, Delhi 1999. |
| 7. | Liptak B.G., "*Instrument Engineers Handbook (Measurement)",* Chilton Book Co., McGrawHill publishing Ltd., 4th Edition, 1999. |
| 8. | Liptak B.G., "*Instrumentation in the Processing industries VI Engineers Handbook* ", Chilton publisher, 3rd Edition 2001. |
| 9. | A.K. Sawhney , "*A course in Electrical and Electronic Measurements and Instrumentation*", Dhanpatrai Co., 19th Revised edition-2011. |

| **Course nature** | | | | **Theory** | | | |
|---|---|---|---|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | | | | | |
| **In-semester** | **Assessment tool** | Cycle test I | Cycle test II | Cycle Test III | Surprise Test | Quiz | **Total** |
| | **Weightage** | **10%** | **15%** | **15%** | **5%** | **5%** | **50%** |
| **End semester examination Weightage :** | | | | | | | **50%** |

| 15EI204L | Analog Electronic Circuits Laboratory | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 2 | 1 |
| *Co-requisite:* | 15EI204 | | | | |
| *Prerequisite:* | NIL | | | | |
| *Data Book / Codes/Standards* | NIL | | | | |
| *Course Category* | P PROFESSIONAL CORE | ELECTRONICS ENGINEERING | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | |

| **PURPOSE** | The aim of this course is to familiarize the student with the analysis and design of basic transistor amplifier circuits, tuned amplifiers, wave shaping, multi vibrator circuits, voltage regulators and electronic circuit applications |
|---|---|

| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Know the design procedure of various electronic circuit configurations. | a | e | | | | | |
| 2. | Have an idea about the frequency response of amplifiers | a | c | | | | | |
| 3. | Have a clear understanding of operation of oscillators and power supplies | a | d | | | | | |

| Session | Description of Topic | Conduct hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| 1. | Series and Shunt feedback amplifiers | 3 | C | 1 | 1,2 |
| 2. | Design of Wein bridge oscillator | 3 | C | 3 | 1,2 |
| 3. | Design of transistor RC phase shift oscillator | 3 | C,D | 3 | 1,2 |
| 4. | Design of LC–Hartley and Colpitt oscillator | 3 | C,D | 3 | 1,2 |
| 5. | Integrators and Differentiators | 3 | C,D | 2 | 1,2 |
| 6. | Clippers and Clampers | 3 | C,D | 3 | 1,2 |
| 7. | Darlington Emitter follower | 3 | C,D | 2 | 1,2 |
| 8. | Complementary Symmetry Push-pull amplifier | 3 | D,I | 3 | 1,2 |
| 9. | Design of Monostable Multivibrator | 3 | D,I | 2,3 | 1,2 |
| 10. | Design of Bistable Multivibrator | **3** | D,I | 2,3 | 1,2 |
| | **Total contact hours** | **30** | | | |

| **LEARNING RESOURCES** | |
|---|---|
| **Sl. No.** | **REFERENCE BOOKS** |
| 1. | *Analog Electronic circuits Laboratory Manual* |
| 2. | David A. Bell, "*Electronic Devices and Circuits*", 5th Edition, Oxford University Press, 2008. |

| **Course nature** | | | | **Practical** | | | |
|---|---|---|---|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | | | | | |
| **In-semester** | **Assessment tool** | Experiments | Record | MCQ/Quiz/Viva Voce | Model examination | **Total** | Experiments |
| | **Weightage** | **40%** | **5%** | **5%** | **10%** | **60%** | **40%** |
| | | | | | **End semester examination Weightage :** | | **40%** |

| 15EI205L | Analog and Digital Integrated Circuits Laboratory | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 2 | 1 |
| *Co-requisite:* | 15EI205 | | | | |
| *Prerequisite:* | 15EI201 | | | | |
| *Data Book / Codes/Standards* | NIL | | | | |
| *Course Category* | P PROFESSIONAL CORE | ELECTRONICS ENGINEERING | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | |

| **PURPOSE** | To study various Analog, digital & Linear Integrated Circuits used in Simple System Configuration. |
|---|---|

| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Enable the students to understand the various types of combinational circuits | a | | | | | | |
| 2. | Understand the various types of sequential circuits | b | | | | | | |
| 3. | Study the Operational amplifier characteristics and applications | b | | | | | | |
| 4. | Design and verify waveform generator circuits and filter circuits | a | e | | | | | |

| Sl. No. | Description of experiments | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| 1. | Implementation and testing of code converters. | 3 | C | 1 | 1 |
| 2. | Implementation and testing of multiplexers &demultiplexer | 3 | D | 2 | 1 |
| 3. | Implementation of 4-Bit shift registers using flip flops | 3 | D | 1 | 1 |
| 4. | Implementation and testing of counters using flip flops | 3 | C | 4 | 1,2 |
| 5. | Design and implementation of 3-bit synchronous up/down counter | 3 | C, D | 4 | 1,2 |
| 6. | Verification of Mathematical Applications of OP-AMP | 3 | C,I,O | 1 | 1,2 |
| 7. | Verification of Characteristics of μA741 | 3 | C,I,O | 1,4 | 1,2 |
| 8. | Design and testing of first order Low Pass and High Pass Active filters | 3 | D,I,O | 2 | 1,2 |
| 9. | Design and testing of Phase shift Oscillators and Wein bridge oscillators | 3 | D,I,O | 2,3 | 1,2 |
| 10. | Design and testing of Monostable and Astable Multivibrator using NE555 TIMER | 3 | D | 4 | 1,2 |
| | Total contact hours | 30 | | | |

| **LEARNING RESOURCES** | |
|---|---|
| **Sl. No.** | **REFERENCES** |
| 1. | Laboratory Manual |
| 2. | Roy Choudhury. D and Shail. B. Jain, "*Linear Integrated Circuits*", New Age International 4th Edition, 2011. |
| 3. | Gayakwad. R.A, "*Op-amps & Linear Integrated Circuits*", Pearson education, 4th Edition, 2015. |

| **Course nature** | **Practical** |
|---|---|

**Assessment Method (Weightage 100%)**

| **In-semester** | **Assessment tool** | Experiments | Record | MCQ/Quiz/Viva Voce | Model examination | **Total** |
|---|---|---|---|---|---|---|
| | **Weightage** | **40%** | **5%** | **5%** | **10%** | **60%** |
| | | | | **End semester examination Weightage :** | | **40%** |

| 15EI301 | Discrete Signal Processing | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| *Co-requisite:* | NIL | | | | |
| *Prerequisite:* | NIL | | | | |
| *Data Book / Codes/Standards* | NIL | | | | |
| *Course Category* | E ENGINEERING SCIENCES | ELECTRONICS ENGINEERING | | | |
| *Course designed by* | Department of Electronics and Instrumentation | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | |

| **PURPOSE** | The purpose of this course is to introduce students to the basics of Signals and Systems, Discrete Signal Processing. The main objective of this subject is to help students to design the digital filters and understand about the architecture of the DSP processor |
|---|---|

| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Understand the basics of Signals and Systems | a | b | f | | | | |
| 2. | Learn the various transform techniques applicable to signals and systems | a | c | f | | | | |
| 3. | Design and implement digital IIR and FIR filters | a | c | f | | | | |
| 4. | Learn the DSP Processor and its applications | d | k | | | | | |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | **UNIT I: Basics of Signals and Systems** | **9** | | | |
| 1. | Introduction to Signals, systems and signal processing; | 1 | C | 1-4 | 1-4 |
| 2. | Classification of signals | 4 | C | 1 | 1-4 |
| 3. | Classification of system | 4 | C,D | 1 | 1 |
| | **UNIT II: Analysis of Discrete Time Signals** | **9** | | | |
| 4. | Z-transform &Properties, Inverse Z-transform | 3 | C,D | 2 | 1,2 |
| 5. | Decimation in time and Decimation in frequency FFT algorithm | 2 | C,D | 2 | 1,2 |
| 6. | Computing inverse DFT using FFT | 2 | C,D | 2 | 1,2 |
| 7. | Discrete Fourier Transform (DFT),DTFT and properties | 2 | C,D | 2 | 1,2 |
| | **UNIT III : Design of Digital FIR Filters** | **9** | | | |
| 8. | Basic elements of Digital Signal Processing, Frequency selective filters | 1 | C | 3 | 1,2,4 |
| 9. | Design of digital FIR filters using Fourier series method | 3 | C,D | 3 | 1,2,4 |
| 10. | Design of digital FIR filters Using Windowing Techniques | 4 | C,D | 3 | 1,2,4 |
| | **UNIT IV: Design of Digital IIR Filters** | **9** | | | |
| 11. | Review of analog filters ,Design of digital IIR filters using Butterworth Filter | 3 | C,D | 3 | 1,2,4 |
| 12. | Design of digital IIR filters using Chebyshev approximations | 2 | C,D | 3 | 1,2,4 |
| 13. | Design of digital IIR filters using Bilinear transformation method, Impulse Invariant transformation method. | 4 | C,D | 3 | 1,2,4 |
| | **UNIT V: Digital Signal Processor and Applications** | **9** | | | |
| 14. | TMS320C54X,Architecture,Addressing Modes | 5 | C,D | 5 | 3,5 |
| 15. | Application of DSP in Image processing | 2 | C | 2 | 5 |
| 16. | Application of DSP in Radar system. | 2 | C | 2 | 5 |
| | **Total contact hours** | **45** | | | |

| LEARNING RESOURCES | |
|---|---|
| **Sl. No.** | **TEXT BOOKS** |
| 1. | John G Proakis and Manolakis, " *Digital Signal Processing Principles, Algorithm and Applications*", Pearson, 4th Edition, 2007 |
| | **REFERENCE BOOKS/OTHER READING MATERIAL** |
| 2. | Alan V. Oppenheim, Ronald Schaffer W., *Discrete Time Signal Processing*, PHI, 1989 |
| 3. | Mithra, S.K., "*Digital Signal Processing: A Computer Based Approach*", 3rd Edition, 2005. |
| 4. | Johny R. Johnson, "*Introduction to Digital Signal Processing"*, PHI. DSP Processor TMS320 Manual 1989 |
| 5. | www.elsevier.com |

| **Course nature** | | | | **Theory** | | | |
|---|---|---|---|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | | | | | |
| **In-semester** | **Assessment tool** | Cycle test I | Cycle test II | Cycle Test III | Surprise Test | Quiz | **Total** |
| | **Weightage** | **10%** | **15%** | **15%** | **5%** | **5%** | **50%** |
| | | | | | **End semester examination Weightage :** | | **50%** |

| 15EI302 | Microcontroller based System Design | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| *Co-requisite:* | NIL | | | | |
| *Prerequisite:* | NIL | | | | |
| *Data Book / Codes/Standards* | NIL | | | | |
| *Course Category* | P PROFESSIONAL CORE | ELECTRONICS ENGINEERING | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | |

| **PURPOSE** | The purpose of this course is to enable the students to understand the basic concepts of microprocessors, microcontrollers and to implementing real time applications. |
|---|---|

| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Understand the concepts of Microprocessors and programming them. | a | b | d | | | | |
| 2. | Understand the concepts of Microcontrollers and programming them. | a | c | d | | | | |
| 3. | Appreciate the advantages in using RISC microprocessors microcontrollers in engineering applications | a | b | c | d | | | |
| 4. | Understand various interfacing circuits necessary for various applications. | a | b | c | d | e | | |
| 5. | Understand the real time application approach using microcontrollers | a | b | c | d | e | k | |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | **UNIT I: 8086 Microprocessor** | **9** | | | |
| 1. | Introduction to microprocessors and microcontrollers, Evolution and history of microprocessors | 1 | C | 1,2 | 1,4,5 |
| 2. | 8086 Register organization, Signal description, Minimum Mode, Maximum mode operations | 3 | C | 1,5 | 1,4,5 |
| 3. | Interrupts, Addressing modes | 1 | C | 1,5 | 1,4,5 |
| 4. | Instruction set, programming | 4 | C,I | 1,5 | 1,4,5 |
| | **UNIT II: Interfacing Concepts and Devices** | **9** | | | |
| 5. | Memory and I/O interfacing with 8086 | 3 | C,D,I | 4,5 | 1,4,5 |
| 6. | Programmable DMA Controller (8257),Programmable Peripheral Interface (8255), Programmable Interval Timer (8254) | 3 | C | 4,5 | 1,4,5 |
| 7. | Programmable Communication Interface (8251A) Programmable Keyboard and Display Controller (8279) Programmable Interrupt Controller(8259A) | 3 | C | 4,5 | 1,4,5 |
| | **UNIT III :8051 Microcontroller** | **9** | | | |
| 8. | Register Set, Architecture of 8051 microcontroller | 2 | C | 2,5 | 1,3 |
| 9. | I/O and memory addressing, Interrupts, Addressing modes. | 3 | C | 2,5 | 1,3 |
| 10. | Instruction set, Programming | 4 | C,I | 2,5 | 1,3 |
| | **UNIT IV: Introduction to Arm Core Processors** | **9** | | | |
| 11. | Introduction to RISC design and ARM design, The ARM Cortex M0 (nuvoTon- Nu-LB-LUC140)architecture | 1 | C | 2,3,5 | 2,6,7 |
| 12. | Register organization, current program status register, pipelining, executions, ARM processor families, Interrupts and vector table | 2 | C | 2,3,5 | 2,6,7 |
| 13. | Instruction Set | 3 | C,I | 2,3,5 | 2,6,7 |
| 14. | The thumb instruction set | 2 | C,I | 2,3,5 | 2,6,7 |
| 15. | Basic ARM ALP | 1 | C,I | 2,3,5 | 2,6,7 |
| | **UNIT V: Applications Using 8051 Microcontroller and Arm Processor** | **9** | | | |
| 16. | List of microcontrollers in use and Selection criteria of Right Microcontroller For a Project | 1 | C,D,I | 5 | 1,3 |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| 17. | Interfacing of pushbutton switches and LED'S using 8051, Traffic light control system using 8051, Temperature control system using 8051, Interfacing stepper motor using 8051, Interfacing Matrix key board, Interfacing DC motors/servo motors using 8051 | 3 | C,D,I | 5 | 1,3 |
| 18. | LCD Display using 8051/ Nu-LB-NUC140 controller Interfacing of seven segment display, A/D and D/A interfacing using Nu-LB-NUC140 controller | 5 | C,D,I | 5 | 1,2,3,6,7 |
| | **Total contact hours** | **45** | | | |

| **LEARNING RESOURCES** | |
|---|---|
| **Sl. No.** | **TEXT BOOKS** |
| 1. | N. Senthil Kumar, M. Saravanan and S. Jeevananthan, "*Microprocessors and Microcontrollers*", Oxford Publishers,2010. |
| 2. | Andrew N. Sloss, Dominic Symes, Chris Wright and John Rayfield, "*ARM System Developer's Guide*, Designing and Optimizing System Software", Elsevier, 2004. |
| | **REFERENCE BOOKS/OTHER READING MATERIAL** |
| 3. | Muhammad Ali Mazidi and Janice Gillispie Mazidi, "The 8051 - *Microcontroller and Embedded systems*", 7th Edition, Pearson Education, 2004. |
| 4. | Doughlas.V.Hall, "*Microprocessor and Interfacing: Programming and Hardware*", Revised 2nd edition, McGraw Hill, 1992. |
| 5. | Ray.A.K and Bhurchandi.K.M, "*Advanced Microprocessors and Peripherals – Architectures, Programming and Interfacing*", Tata McGraw Hill, 2002 Reprint. |
| 6. | David Seal, "*ARM Architecture Reference Manual*", Pearson Education, 2007. |
| 7. | nuvoTon Cortex M0 (Nu-LB-NUC100/140) *Driver and Processor Reference Manual*; www.nuvoton.com |

| **Course nature** | | | | **Theory** | | | |
|---|---|---|---|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | | | | | |
| **In-semester** | **Assessment tool** | Cycle test I | Cycle test II | Cycle Test III | Surprise Test | Quiz | **Total** |
| | **Weightage** | **10%** | **15%** | **15%** | **5%** | **5%** | **50%** |
| | | | | | **End semester examination Weightage :** | | **50%** |

| 15EI303 | Control Systems Engineering | | | L | T | P | C |
|---|---|---|---|---|---|---|---|
| | | | | 3 | 0 | 0 | 3 |
| *Co-requisite:* | NIL | | | | | | |
| *Prerequisite:* | NIL | | | | | | |
| *Data Book / Codes/Standards* | NIL | | | | | | |
| *Course Category* | P | PROFESSIONAL CORE | CONTROL SYSTEMS ENGINEERING | | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | | | |

| **PURPOSE** | To acquire analytical ability in solving mathematical problems as applied to the respective branches of Engineering. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Understand the importance of systems and various types of control systems. | a | | | | | | |
| 2. | Describe the various time domain and frequency domain tools for analysis. | a | b | | | | | |
| 3. | Describe the methods to analyze the stability of systems. | a | b | | | | | |
| 4. | Design and implement controllers for real time applications. | a | b | c | d | e | k | |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | **UNIT I: Transfer Function** | **9** | | | |
| 1. | Open and Closed Loop control systems, Feed forward and Feedback Systems. | 1 | C | 1 | 1-4 |
| 2. | Mathematical modeling of Mechanical Translational system and Rotational system, Conversions of Mechanical system to Electrical system. | 4 | C,D | 1 | 1-4 |
| 3. | Transfer function using Block diagram reduction technique and Signal flow graph, Block diagram to signal flow graph conversions | 4 | C,D | 1 | 1-4 |
| | **UNIT II: Time Domain Analysis** | **9** | | | 1-4 |
| 4. | Transfer function of First order system using Step, Ramp, Impulse and Parabolic signal. | 2 | C | 1,2 | 1-4 |
| 5. | Transfer function of Second order system, over damped system, Undamped, critically damped and under damped system using Step Input. | 3 | C,D | 1,2 | 1-4 |
| 6. | Transient and Steady state response, Steady state error analysis, Static error constant and Generalized Error Coefficient of control systems. | 4 | C,D,I | 1,2 | 1-4 |
| | **UNIT III: Stability Analysis** | **9** | | | 1-4 |
| 7. | Stability analysis using Routh's Hurwitz criterion. | 3 | C,D | 1,3 | 1-4 |
| 8. | Root locus plots of typical systems, Root locus analysis. | 6 | C,D,I | 1,3 | 1-4 |
| | **UNIT IV: Frequency Domain Analysis** | **9** | | | 1-4 |
| 9. | Introduction to Frequency domain analysis and its types | 1 | C | 1,2 | 1-4 |
| 10. | Magnitude and phase plots of typical systems using Bode plot and its analysis | 4 | C,D,I | 1,2 | 1-4 |
| 11. | Analysis using Polar plots and Nyquist Stability criterion | 4 | C,D,I | 1,2 | 1-4 |
| | **UNIT V: Design of Control Systems** | **9** | | | 1-4 |
| 12. | Design Specification, controller configurations, ON-OFF controller, PID controllers. | 3 | C,D | 1-4 | 1-4 |
| 13. | Design of speed control system for DC motor | 3 | D | 1-4 | 5 |
| 14. | Design of control system for Twin Rotor Multi input Multi output System(TRMS) with one degree of freedom | 3 | D | 1-4 | 6 |
| | **Total contact hours** | **45** | | | |

| LEARNING RESOURCES | |
|---|---|
| **Sl. No.** | **TEXT BOOKS** |
| 1. | Nagrath I J and Gopal .M., "*Control Systems Engineering*", Anshan Pub, 2008. |
| 2. | Benjamin C Kuo, " *Automatic Control System*", 9th edition, John Wiley & Sons, 2010. |
| | **REFERENCE BOOKS/OTHER READING MATERIAL** |
| 3. | Katsuhiko Ogata, "*Modern Control Engineering*" ,5th edition, Prentice Hall of India Private Ltd, New Delhi, 2009. |
| 4. | Richard .C. Dorf and Robert.H.Bishop, "*Modern Control System Engineering*", Pearson Education (US), United States, 2010 |
| 5. | Guoshinghuang, "*PC – based PID speed control in DC Motor*", IEEE, ISBN-978-1-4244-1723-0,2008, |
| 6. | "*Control of Twin Rotor MIMO System (TRMS) Using PID Controller*", International Journal of Advance Engineering and Research Development, ISSN:2348-6406, 2015 |

| **Course nature** | | | | **Theory** | | | |
|---|---|---|---|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | | | | | |
| **In-semester** | **Assessment tool** | Cycle test I | Cycle test II | Cycle Test III | Surprise Test | Quiz | **Total** |
| | **Weightage** | **10%** | **15%** | **15%** | **5%** | **5%** | **50%** |
| | | | | | **End semester examination Weightage :** | | **50%** |

| 15EI302L | Microcontroller based System Design Laboratory | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 2 | 1 |
| *Co-requisite:* | 15EI302 | | | | |
| *Prerequisite:* | NIL | | | | |
| *Data Book / Codes/Standards* | NIL | | | | |
| *Course Category* | P PROFESSIONAL CORE | ELECTRONICS ENGINEERING | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | |

| **PURPOSE** | To develop skills in programming and interfacing applications of microprocessors and microcontrollers |
|---|---|

| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Improve their ability in their programming skills. | b | | | | | | |
| 2. | Equip themselves familiar with interfacing concepts of microprocessors | b | c | d | | | | |
| 3. | Equip themselves familiar with interfacing concepts of microcontrollers | b | c | d | | | | |

| Sl. No. | Description of experiments | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | **General Purpose Programming Exercises Using 8086** | | | | |
| 1. | Addition, Subtraction, Multiplication and Division | 3 | C,I | 1,2 | 1,2 |
| 2. | Finding the maximum value in an array. | 3 | C,I | 1,2 | 1,2 |
| 3. | Sorting of data. | 1 | C,I | 1,2 | 1,2 |
| 4. | BCD-to-Hex conversion and Hex-to-BCD conversion. | 3 | C,I | 1,2 | 1,2 |
| 5. | Block data transfer (forward and reverse) | 2 | C,I | 1,2 | 1,2 |
| | **Interfacing with Application Boards (8051, Arm Cortex M0 {Nu-Lb-Nuc140})** | | | | |
| 6. | Traffic light control using 8051 | 3 | C,D,I | 1,3 | 1,3 |
| 7. | Stepper motor control using 8051 controller | 3 | C,D,I | 1,3 | 1,3 |
| 8. | Temperature control system using 8051 | 3 | C,D,I | 1,3 | 1,3 |
| 9. | LCD Display using 8051/ Nu-LB-NUC140 controller | 3 | C,D,I | 1,3 | 1,3 |
| 10. | 8 bit ADC and 8 bit DAC. using nuvoTon (NUC140) board | 3 | C,D,I | 1,3 | 1,3 |
| 11. | Seven segment display using nuvoTon (NUC140) board | 3 | C,D,I | 1,3 | 1,3 |
| | **Total contact hours** | **30** | | | |

| **LEARNING RESOURCES** | |
|---|---|
| **Sl. No.** | **REFERENCES** |
| 1. | Laboratory Manual |
| 2. | N. Senthil Kumar, M. Saravanan and S. Jeevananthan, "Microprocessors *and Microcontrollers*", Oxford Publishers,2010. |
| 3. | *nuvoTon Cortex M0 (Nu-LB-NUC100/140) Driver and Processor Reference Manual*; www.nuvoton.com |

| **Course nature** | | | | **Practical** | | |
|---|---|---|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | | | | |
| **In-semester** | **Assessment tool** | Experiments | Record | MCQ/Quiz/Viva Voce | Model examination | **Total** |
| | **Weightage** | **40%** | **5%** | **5%** | **10%** | **60%** |
| | | | | **End semester examination Weightage :** | | **40%** |

| 15EI303L | Control Systems Engineering Laboratory | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 2 | 1 |
| *Co-requisite:* | 15EI303 | | | | |
| *Prerequisite:* | NIL | | | | |
| *Data Book / Codes/Standards* | NIL | | | | |
| *Course Category* | P PROFESSIONAL CORE | CONTROL ENGINEERING | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | |

| **PURPOSE** | To apply the concepts of control system and design and verify using software tools | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Analyze the first and second order systems using time domain analysis. | a | b | | | | | |
| 2. | Analyze the first and second order systems using frequency domain analysis. | a | b | | | | | |
| 3. | Design PID controller | a | b | c | e | k | | |
| 4. | Design and Implement PID controller for any applications. | a | b | c | e | k | | |

| Sl. No. | Description of experiments | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| 1. | a) Step, ramp and Impulse response of first order systems.<br>b) Step, ramp and Impulse response of second order systems. | 3 | C,I | 1 | 1 |
| 2. | Identification of damping in second order systems. | 3 | C,I | 1 | 1 |
| 3. | Time domain analysis for second order systems | 3 | C,I | 1 | 1 |
| 4. | Stability analysis of linear systems using Routh-Hurwitz method | 3 | C,I | 1 | 1 |
| 5. | Stability analysis of linear systems using Root Locus. | 3 | C,I | 1 | 1 |
| 6. | Frequency response analysis using Bode Plot. | 3 | C,I | 2 | 1 |
| 7. | Frequency response analysis using Polar Plot | 3 | C,I | 2 | 1 |
| 8. | Design of PID Controller for first order and second order systems. | 3 | C,D,I,O | 3 | 1 |
| 9. | Design of PID Controller for speed control of DC Motor System. | 3 | C,D,I,O | 3 | 2 |
| 10. | Design of PID Based controller for Twin Rotor Multi Input Multi Output System. | 3 | C,D,I,O | 3 | 3 |
| | **Total contact hours** | **30** | | | |

| **LEARNING RESOURCES** | |
|---|---|
| **Sl. No.** | **REFERENCES** |
| 1. | LAB manual |
| 2. | Guoshinghuang, "*PC – based PID speed control in DC Motor*", IEEE, ISBN-978-1-4244-1723-0,2008. |
| 3. | "*Control of Twin Rotor MIMO System (TRMS) Using PID Controller*", International Journal of Advance Engineering and Research Development, ISSN:2348-6406, 2015. |

| **Course nature** | | **Practical** | | | | |
|---|---|---|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | | | | |
| **In-semester** | **Assessment tool** | Experiments | Record | MCQ/Quiz/Viva Voce | Model examination | **Total** |
| | **Weightage** | **40%** | **5%** | **5%** | **10%** | **60%** |
| | | | | **End semester examination Weightage :** | | **40%** |

| 15EI375L | Minor Project I | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 2 |
| *Co-requisite:* | NIL | | | | |
| *Prerequisite:* | NIL | | | | |
| *Data Book / Codes/Standards* | NIL | | | | |
| *Course Category* | P PROFESSIONAL | | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | |

| **PURPOSE** | To obtain hands-on experience in converting a small novel idea / technique into a working model / prototype involving multi-disciplinary skills and / or knowledge and working in at team. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Conceptualize a novel idea / technique into a product | c | | | | | | |
| 2. | Think in terms of multi-disciplinary environment | | d | | | | | |
| 3. | Understand the management techniques of implementing a project | | | | k | | | |
| 4. | Take on the challenges of teamwork, prepare a presentation in a professional manner, and document all aspects of design work. | | | g | | | | |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | An Multidisciplinary project to be taken up by a team of maximum of ten students. Development of prototype product, a 3D model, simulation, blueprint for a larger project and any other development work are permitted. The contribution of the individuals in the project should be clearly brought out. A combined report is to be submitted. A presentation is to be made for the reviewers on the work done by the candidate. | | C,D,I | 1,2,3,4 | |
| | **Total contact hours** | | | | |

| **Course nature** | | **Project – 100% internal continuous assessment** | |
|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | |
| **In-semester** | **Assessment tool** | Refer the table | **Total** |
| | **Weightage** | Refer the table below | **100%** |
| **End semester examination Weightage :** | | | **0%** |

| Assessment component | Expected outcome | Evaluators | Criteria or basis | Marks |
|---|---|---|---|---|
| Project proposal (Review – I) | A short presentation to be delivered on:<br>• A brief, descriptive project title (2-4 words). This is critical!<br>• The 3 nearest competitors (existing solutions) and price.<br>• Team members name, phone number, email, department/degree program, and year.<br>• A description of the product opportunity that has been identified. To include: Documentation of the market need, shortcomings of existing competitive products, and definition of the target market and its size.<br>• Proposed supervisor / guide | Panel of reviewers | Viability / feasibility of the project<br>Extent of preliminary work done. | **0** |

| Assessment component | Expected outcome | Evaluators | Criteria or basis | Marks |
|---|---|---|---|---|
| Review II | • Mission Statement / Techniques<br>• Concept Sketches, Design Specifications / Modules & Techniques along with System architecture<br>• Coding | Panel of reviewers | Originality, Multi-disciplinary component, clarity of idea and presentation, team work, handling Q&A. | **20** |
| Review III | • Final Concept and Model / Algorithm/ Technique<br>• Drawings, Plans / programme output<br>• Financial Model / costing<br>• Prototype / Coding<br>• Final Presentation and Demonstration | Panel of reviewers | Originality, Multi-disciplinary component, clarity of idea and presentation, team work, handling Q&A. | **50** |
| Final technical Report | A good technical report | Supervisor / Guide | Regularity, systematic progress, extent of work and quality of work | **30** |
| | | | **Total** | **100** |

| 15EI380L | Seminar I | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 2 |
| *Co-requisite:* | NIL | | | | |
| *Prerequisite:* | NIL | | | | |
| *Data Book / Codes/Standards* | NIL | | | | |
| *Course Category* | P PROFESSIONAL | | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | |

| **PURPOSE** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Understand the research methodology adopted by various researchers | h | i | j | | | | |
| 2. | Mathematically model a problem, critically analyse it and adopt strategies to solve | b | c | e | | | | |
| 3. | Understand and present a well documented research | e | g | | | | | |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | **Guidelines for conducting 15EI380L Seminar for B.Tech**<br>1. Upon registering for the course the student must identify a sub-domain of the degree specialization that is of interest to the student and start collecting research papers as many as possible.<br>2. After collecting sufficient number of research papers the student must peruse all the papers, meet the course faculty and discuss on the salient aspects of each and every paper.<br>3. The course faculty, after discussion with the student will approve TWO research papers that is appropriate for presentation.<br>4. The student must collect additional relevant reference materials to supplement and compliment the two research papers and start preparing the presentation.<br>5. Each student must present a 15-minute presentation on each of the approved research paper to the panel of evaluators.<br>6. The presenter must present one research paper within the first half of the semester (6 weeks) and another research paper in the next half of the semester (6 weeks) as per the schedule.<br>7. All other students registered for the course will form the audience.<br>8. The audience as well as the evaluators will probe the student with appropriate questions and solicit response from the presenter.<br>9. The presentation will be evaluated against 7 to 8 assessment criteria by 4 to 5 evaluators.<br>10. The score obtained through the presentations of TWO research papers will be converted to appropriate percentage of marks.<br>This course is 100% internal continuous assessment. | | C,D | 1,2,3,4 | |
| | **Total contact hours** | **30** | | | |

| 15EI 385L | Massive Open Online Courses (MOOCS) I | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 2 |
| *Co-requisite:* | NIL | | | | |
| *Prerequisite:* | NIL | | | | |
| *Data Book / Codes/Standards* | NIL | | | | |
| *Course Category* | P PROFESSIONAL | | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | |

| **PURPOSE** | To offer students the opportunity to study with the world's best universities by integrating select MOOCs in a regular degree programme and providing students full credit transfer, as per university regulations, if they earn a "Verified / Completion Certificate" and take a proctored examination through a secure, physical testing center. |
|---|---|

| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Apply the concepts, theories, laws, technologies learnt herein to provide engineering solutions. | f | h | i | j | | | |

| **Course nature** | | **Online - 100% internal continuous assessment.** | | | | |
|---|---|---|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | | | | |
| **In-semester** | **Assessment tool** | Quiz | Assignment | Non-proctored / Unsupervised Tests | Proctored / Supervised Test | **Total** |
| | **Weightage** | **25%** | **25%** | **10%** | **40%** | **100%** |
| **End semester examination Weightage :** | | | | | | **0%** |

**Registration process, Assessment and Credit Transfer:**

1. Students can register for courses offered by approved global MOOCs platforms like edX, Coursera or Universities with which SRM partners specifically for MOOCs.
2. Annually, each department must officially announce, to the students as well as to the Controller of Examinations, the list of courses that will be recognized and accepted for credit transfer.
3. The department must also officially announce / appoint one or more faculty coordinator(s) for advising the students attached to them, monitoring their progress and assist the department in proctoring the tests, uploading the marks / grades, and collecting and submitting the graded certificate(s) to the CoE, within the stipulated timeframe.
4. Student who desires to pursue a course, from the above department-approved list, through MOOCs must register for that course during the course registration process of the Faculty of Engineering and Technology, SRM University.
5. The maximum credit limits for course registration at SRM will include the MOOCs course registered.
6. The student must periodically submit the marks / grades obtained in various quizzes, assignments, tests etc immediately to the Faculty Advisor or the Course Coordinator for uploading in the university's academic module.
7. The student must take the final test as a Proctored / Supervised test in the university campus.
8. The student must submit the "Certificate of Completion" as well as the final overall Marks and / or Grade within the stipulated time for effecting the grade conversion and credit transfer, as per the regulations. It is solely the responsibility of the individual student to fulfil the above conditions to earn the credits.

The attendance for this course, for the purpose of awarding attendance grade, will be considered 100% , if the credits are transferred, after satisfying the above (1) to (7) norms; else if the credits are not transferred or transferable, the attendance will be considered as ZERO.

| 15EI390L | Industrial Training | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 2 |
| *Co-requisite:* | NIL | | | | |
| *Prerequisite:* | NIL | | | | |
| *Data Book / Codes/Standards* | NIL | | | | |
| *Course Category* | P PROFESSIONAL CORE | | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | |

| **PURPOSE** | To provide short-term work experience in an Industry/ Company/ Organization | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Get an inside view of an industry and organization/company | | | | j | | | |
| 2. | Gain valuable skills and knowledge | | | | j | | | |
| 3. | Make professional connections and enhance networking | f | g | | | | | |
| 4. | Get experience in a field to allow the student to make a career transition | | | i | | | | |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | 1. It is mandatory for every student to undergo this course.<br>2. Every student is expected to spend a minimum of 15-days in an Industry/ Company/ Organization, during the summer vacation.<br>3. The type of industry must be NOT below the Medium Scale category in his / her domain of the degree programme.<br>4. The student must submit the "Training Completion Certificate" issued by the industry / company / Organization as well as a technical report not exceeding 15 pages, within the stipulated time to be eligible for making a presentation before the committee constituted by the department.<br>5. The committee will then assess the student based on the report submitted and the presentation made.<br>6. Marks will be awarded out of maximum 100.<br>7. Appropriate grades will be assigned as per the regulations.<br>8. Only if a student gets a minimum of pass grade, appropriate credit will be transferred towards the degree requirements, as per the regulations.<br>9. It is solely the responsibility of the individual student to fulfill the above conditions to earn the credits.<br>10. The attendance for this course, for the purpose of awarding attendance grade, will be considered 100%, if the credits are transferred, after satisfying the above (1) to (8) norms; else if the credits are not transferred or transferable, the attendance will be considered as ZERO.<br>11. The committee must recommend redoing the course, if it collectively concludes, based on the assessment made from the report and presentations submitted by the student, that either the level of training received or the skill and / or knowledge gained is NOT satisfactory. | | D, I,O | 1,2,3,4 | |
| | **Total contact hours** | | | | |

| **Course nature** | | **Training – 100% internal continuous assessment** | | |
|---|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | | |
| **In-semester** | **Assessment tool** | **Presentation** | **Report** | **Total** |
| | **Weightage** | **80%** | **20%** | **100%** |
| **End semester examination Weightage :** | | | | **0%** |

| 15EI490L | Industry Module I | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 2 |
| *Co-requisite:* | NIL | | | | |
| *Prerequisite:* | NIL | | | | |
| *Data Book / Codes/Standards* | NIL | | | | |
| *Course Category* | P PROFESSIONAL | | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | |

**PURPOSE**

| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Obtain an insight into the current industrial trends and practices | | | j | | | | |
| 2. | Obtain an insight into the technologies adopted by industries | | | j | | | | |
| 3. | Obtain an insight into the technical problems encountered by the industries and the scope for providing solutions. | | h | | | | | |
| 4. | Network with industry | g | | | | | | |

| Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|
| 1. The department will identify and shortlist few emerging topics that are trending in industry.<br>2. The department will identify experts from industry who are willing to deliver modules on the shortlisted topics.<br>3. The identified expert will assist the department in formulating the course content to be delivered as a 30-hour module, prepare lectures notes, ppt, handouts and other learning materials.<br>4. The department will arrange to get the necessary approvals for offering the course, from the university's statutory academic bodies well before the actual offering.<br>5. The department must officially announce, to the students as well as to the Controller of Examinations, the list of courses that will be offered as industry module.<br>6. The department must also officially announce / appoint one or more faculty coordinator(s) for advising the students attached to them, monitoring their progress and assist the department in proctoring/supervising/assessment the quizzes, assignments, tests etc, uploading the marks, attendance etc, within the stipulated timeframe.<br>7. The Student who desires to pursue a course, from the above department-approved list, must register for that course during the course registration process of the Faculty of Engineering and Technology, SRM University.<br>8. The maximum credit limits for course registration at SRM will include the Industry Module also.<br>9. All academic requirements of a professional course like minimum attendance, assessment methods, discipline etc will be applicable for this Industry Module.<br>10. The course will be conducted on week ends or beyond the college regular working hours. | | C,D,I,O | 1,2,3,4 | |
| **Total contact hours** | **30** | | | |

| **Course nature** | | **100% internal continuous assessment.** | | | | | |
|---|---|---|---|---|---|---|---|
| **Assessment Method – Theory Component (Weightage 50%)** | | | | | | | |
| **In-semester** | **Assessment tool** | Cycle test I | Cycle test II | Cycle Test III | Surprise Test | Quiz | **Total** |
| | **Weightage** | **10%** | **15%** | **15%** | **5%** | **5%** | **50%** |
| **End semester examination Weightage** | | | | | | | **50%** |

| 15EI304 | Process Control | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| *Co-requisite:* | NIL | | | | |
| *Prerequisite:* | 15EI303 | | | | |
| *Data Book / Codes/Standards* | NIL | | | | |
| *Course Category* | P PROFESSIONAL CORE | CONTROL ENGINEERING | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | |

| **PURPOSE** | To enable the students to learn the basic concepts of process control and to develop sufficient knowledge of the various control actions and design of controllers used to control any process. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Learn mathematical modeling of various processes, basic control actions and characteristics of different types of controllers | a | d | | | | | |
| 2. | Select ,design and tune a controller to suit a particular process | c | e | h | | | | |
| 3. | Study and design about the characteristics of final control elements | a | c | h | | | | |
| 4. | Learn about the control schemes applied to various processes | c | d | e | | | | |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | **UNIT I:Introduction to Process Control** | **9** | | | |
| 1. | Need for process control, Hardware elements of a process control system | 1 | C | 1 | 1,2 |
| 2. | Need for Mathematical modeling, Mathematical model of level, pressure ,thermal processes | 4 | C,D | 1 | 1,5 |
| 3. | Servo and regulator operation, Batch & Continuous process, Concept of self regulation, Dead time, Degrees of freedom | 4 | C | 1 | 1,2,4 |
| | **UNIT II: Various Controllers and its Characteristics** | **9** | | | |
| 4. | Basic control actions, Characteristics of ON- OFF, Single speed floating controllers | 2 | C | 1 | 1,2 |
| 5. | Proportional, integral and derivative control modes, P+I, P+D and P+I+D control modes, pneumatic and electronic controllers to realize various control actions. Response of P, PI and PID controllers to various type of error signals. | 4 | C,D | 1 | 2 |
| 6. | Reset Wind-up and prevention, Derivative and Proportional kick, Bumpless transfer, Selection of a controller for a particular process | 3 | C,D | 1 | 1,2 |
| | **UNIT III: Controller Design** | **9** | | | |
| 7. | Need for controller tuning ,Evaluation criteria, Quarter Decay Ratio, IAE, ISE and ITAE, Optimum controller tuning using Evaluation criteria | 3 | C,D | 1,2 | 4,6 |
| 8. | Tuning of PID controllers using Process reaction curve method, Damped oscillation method and Z-N tuning method. | 6 | C,D | 1,2 | 4,6 |
| | **UNIT IV: Final Control Elements** | **9** | | | |
| 9. | I/P, P/I converters, Pneumatic and electric actuators | 3 | C | 1,3 | 3,4 |
| 10. | Types of control valves , Valve positioner and its importance , Inherent and Installed characteristics of control valve | 4 | C | 1,3 | 3,4 |
| 11. | Control valve sizing , Cavitation and flashing, selection criteria | 2 | C,D | 1,3 | 3,4 |
| | **UNIT V:Advanced Control Methods** | **9** | | | |
| 12. | Cascade control , Feed forward control ,Ratio Control, Inferential control , Split range control | 3 | C | 1,4 | 1,4 |
| 13. | Discussion of recent research paper on applications with controller tuning techniques | 3 | D | 1,4 | 7 |
| 14. | Discussion of recent research paper on industrial applications with advanced control schemes | 3 | D | 1,4 | 8 |
| | **Total contact hours** | **45** | | | |

| LEARNING RESOURCES | |
|---|---|
| **Sl. No.** | **TEXT BOOKS** |
| 1. | Stephanopoulos. G, "*Chemical Process Control - An Introduction to Theory and Practice*", Prentice Hall of India, 2005. |
| 2. | Johnson .C.D, "*Process Control Instrument Technology*", Prentice Hall Inc., 2004. |
| | **REFERENCE BOOKS/OTHER READING MATERIAL** |
| 3. | Harriott .P, "*Process Control*", Tata McGraw Hill, 2005. |
| 4. | Bequette. B.W, "*Process Control Modeling, Design and Simulation*", Prentice Hall of India, 2004. |
| 5. | Eckman. D.P., "*Automatic Process Control*", Wiley Eastern Ltd., New Delhi, 1993. |
| 6. | Coughanowr, D.R, "*Process Systems Analysis and Control*", McGraw –Hill International Edition, 2004 |
| 7. | A.Fatoni,J.Sila,I.Arifin, "*Comparative study of parallel and cascade configuration supervisory predictive controller for water level control system with delay time". Journal of mathematics*,2016 |
| 8. | J Zhu,WGui,HXu,CYang,"*Combined fuzzy based feedforward and bubble size distribution based feedback control for reagent dosage in copper roughing process*", Journal of process control,2016 |

| **Course nature** | | | | **Theory** | | | |
|---|---|---|---|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | | | | | |
| **In-semester** | **Assessment tool** | Cycle test I | Cycle test II | Cycle Test III | Surprise Test | Quiz | **Total** |
| | **Weightage** | **10%** | **15%** | **15%** | **5%** | **5%** | **50%** |
| | | | | | | **End semester examination Weightage :** | **50%** |

| 15EI305 | Instrumentation System Design | | | L | T | P | C |
|---|---|---|---|---|---|---|---|
| | | | | 3 | 0 | 0 | 3 |
| *Co-requisite:* | NIL | | | | | | |
| *Prerequisite:* | NIL | | | | | | |
| *Data Book / Codes/Standards* | NIL | | | | | | |
| *Course Category* | P | PROFESSIONAL CORE | INSTRUMENTATION ENGINEERING | | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | | | |

| **PURPOSE** | To familiarize with various instrumentation related topics and acquire analytical ability in understanding various measurement systems. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Learn the basics of transducers and different characteristics. | a | | | | | | |
| 2. | Understand measurement of various parameters. | a | e | | | | | |
| 3. | Learn the design of signal conditioning elements. | a | b | c | | | | |
| 4. | Familiarize with design considerations of final control element. | a | b | c | k | | | |
| 5. | Study the basics of computer based control | a | b | c | k | | | |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | **UNIT I: Design Of Transducers** | **9** | | | |
| 1. | Static Characteristics: systematic characteristics, statistical characteristics, calibration | 2 | C | 1 | 1,3 |
| 2. | Dynamic characteristics of measurement systems | 2 | C | 1 | 1,3 |
| 3. | General block diagram analysis of measurement systems and classification of transducers | 1 | C | 1 | 1,3 |
| 4. | Time and frequency response of first order system for step, ramp, impulse, parabola, sinusoidal inputs | 2 | C,D | 1 | 1,3 |
| 5. | Time and frequency response of second order system for step, ramp, impulse, parabola, sinusoidal inputs | 2 | C,D | 1 | 1,3 |
| | **UNIT II: Measurement Of Various Parameters** | **9** | | | |
| 6. | Measurement of Pressure | 2 | C | 2 | 1,3 |
| 7. | Measurement of Temperature | 2 | C | 2 | 1,3 |
| 8. | Measurement of Flow and Level | 2 | C | 2 | 1,3 |
| 9. | Measurement of Level | 1 | C | 2 | 1,3 |
| 10. | Measurement of Humidity and pH | 2 | C | | 1,3 |
| | **UNIT III: Design Of Signal Conditioning Circuits** | **9** | | | |
| 11. | Design of V/I Converter and I/V Converter | 1 | C,D | 4 | 1,3 |
| 12. | Analog and Digital filter design | 4 | C,D,I | 4 | 1,3 |
| 13. | Signal conditioning circuit for Temperature measurement and Cold Junction Compensation | 2 | C,D | 4 | 1,3 |
| 14. | Digital Signal conditioning | 2 | C,D | 4 | 1 |
| | **UNIT IV: Design Of Final Control Element** | **9** | | | |
| 15. | Pneumatic systems: Flapper nozzle amplifier and its characteristics, pneumatic actuators | 3 | C | 4 | 2,3 |
| 16. | Electrical actuators: solenoids, d.c and a.c. servomotors, principle of stepper motors, | 5 | C | 4 | 2,3 |
| 17. | Hydraulic actuators | 1 | C | 4 | 2,3 |
| | **UNIT V: Computer Based Control** | **9** | | | |
| 18. | Digital applications, Hardware configurations | 3 | C | 4 | 1 |
| 19. | Software requirements | 3 | C | 4 | 1 |
| 20. | Data logging, Data-Acquisition System, Supervisory control | 3 | C | 5 | 1 |
| | **Total contact hours** | **45** | | | |

| LEARNING RESOURCES | |
|---|---|
| **Sl. No.** | **TEXT BOOKS** |
| 1. | C. D. Johnson, "*Process Control Instrumentation Technology*", 8th Edition, Prentice Hall, 2015. |
| 2. | J.P. Bentley, "*Principles of Measurement Systems*", Pearson Education ,2015. |
| | **REFERENCE BOOKS/OTHER READING MATERIAL** |
| 3. | A.K. Ghosh, "*Introduction to Measurement and Instrumentation*", PHI Learning ,2012. |
| 4. | E.O. Doebelin, "*Measurement Systems Application and Design*", 5th edition McGraw Hill Publication, 2008. |

| **Course nature** | | | | **Theory** | | | |
|---|---|---|---|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | | | | | |
| **In-semester** | **Assessment tool** | Cycle test I | Cycle test II | Cycle Test III | Surprise Test | Quiz | **Total** |
| | **Weightage** | **10%** | **15%** | **15%** | **5%** | **5%** | **50%** |
| **End semester examination Weightage :** | | | | | | | **50%** |

| 15EI306 | Power Electronics and its Applications | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| *Co-requisite:* | NIL | | | | |
| *Prerequisite:* | NIL | | | | |
| *Data Book / Codes/Standards* | NIL | | | | |
| *Course Category* | P PROFESSIONAL CORE | ELECTRONICS ENGINEERING | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | |

| **PURPOSE** | To know about the basics power semi conductor devices and implementation in various power converter applications. |
|---|---|

| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Know the operation of power semi conductor devices. | a | e | | | | | |
| 2. | Know the triggering and commutation techniques used in SCR. | a | b | e | | | | |
| 3. | Obtain the knowledge about different controlled rectifier method. | a | b | c | | | | |
| 4. | Obtain the knowledge about different types of inverter and chopper | a | b | e | | | | |
| 5. | Know the design and selection of drives in industrial applications. | a | | | | | | |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | **UNIT I: Power Semiconductor Devices** | **9** | | | |
| 1. | Introduction to power semiconductor devices, types of power electronics converters. | 1 | C | 1 | 1-2 |
| 2. | Power diodes and its type, power transistor and power MOSFET's and IGBT | 4 | C | 1 | 1-2 |
| 3. | Characteristics of Thyristors, two transistor model of thyristor. | 2 | C | 1 | 1-4 |
| 4. | Thyristor ratings and its protection, series and parallel operation of thyristor. | 2 | C,D | 1 | 1-6 |
| | **UNIT II: Triggering and Communication Circuits** | **9** | | | |
| 5. | Thyristor triggering circuits with R, RL, RC, Single pulse and train of pulses, triggering with microprocessor | 4 | C,D | 2 | 2-5 |
| 6. | Commutation techniques, natural commutation, forced commutation, types of commutation. | 2 | C,D | 2 | 2-5 |
| 7. | Class A, Class B, Class C, Class D & Class E Commutation | 3 | C.D | 2 | 1-5 |
| | **UNIT III: Converters** | **9** | | | |
| 8. | Concepts of Electric Drives, Selection of Motor & Motor rating, Single phase half controlled rectifiers and single phase fully controlled rectifiers with DC motor load. | 4 | C,D | 3 | 1-5 |
| 9. | Three phase- half controlled rectifiers and Three phase-fully controlled rectifiers with DC motor load, Effect of source inductance. | 3 | C,D | 3 | 1-5 |
| 10. | Dual converters, Step up cycloconverter and Step down Cyclo converter. | 2 | C,D | 3 | 1-5 |
| | **UNIT IV: Inverters And Choppers** | **9** | | | |
| 11. | Voltage source series inverters, Voltage source parallel inverters, Voltage source bridge inverters-180 mode and 120 modes, PWM inverters-Induction Motor Drives | 5 | C,D | 4 | 1-6 |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| 12. | DC chopper - step up chopper and step down chopper, Single and Multi-Quadrant Operation with DC Motor Load, Voltage commutated chopper, Load commutated chopper, Current commutated chopper. | 4 | C,D | 4 | 1-6 |
| | **UNIT V: TYPICAL APPLICATION** | **9** | | | |
| 13. | Control of DC and AC drives, Uninterrupted Power Supply (UPS).Switched Mode Power Supply, Active Power Line Conditioner | 5 | C,I | 5 | 2-6 |
| 14. | Electronic Ballast, Stepper and switched reluctance motor drive, AC voltage regulators, Induction Heating. | 4 | C,I | 5 | 2-6 |
| **Total contact hours** | | **45** | | | |

| **LEARNING RESOURCES** | |
|---|---|
| **Sl. No.** | **TEXT BOOKS** |
| 1. | Ned Mohan, Tore M. Undeland and William P. Robbins, "*Power Electronics Converter*s, Applications and Design", John Wiley and Sons,Third Edition, 2002. |
| 2. | Bimbhra P. S, "*Power Electronics*", Khanna Publishers, Fifth Edition, 2012. |
| **REFERENCE BOOKS/OTHER READING MATERIAL** | |
| 3. | G. K. Dubey, S. R. Doradla, A. Joshi and R. M. K. Sinha, "*Thyristorised Power Controllers*", New Age International Publishers, First Edition, Reprint 2005. |
| 4. | Singh. M .D, Khanchandani. K.B, "*Power Electronics*", Tata McGraw-Hill, Second Edition, 2008. |
| 5. | Williams. B.W, "*Power Electronics: Devices, Drivers, Applications and Passive Components*", Macmillan,Second Edition, Reprint 2007. |
| 6. | Muhammad. H, Rashid, "*Power Electronics Handbook*", Third edition, 2011. |

| **Course nature** | | | | **Theory** | | | |
|---|---|---|---|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | | | | | |
| **In-semester** | **Assessment tool** | Cycle test I | Cycle test II | Cycle Test III | Surprise Test | Quiz | **Total** |
| | **Weightage** | **10%** | **15%** | **15%** | **5%** | **5%** | **50%** |
| **End semester examination Weightage :** | | | | | | | **50%** |

| 15EI304L | Process Control Laboratory | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 2 | 1 |
| *Co-requisite:* | 15EI304 | | | | |
| *Prerequisite:* | NIL | | | | |
| *Data Book / Codes/Standards* | NIL | | | | |
| *Course Category* | P PROFESSIONAL CORE | CONTROL ENGINEERING | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | |

| **PURPOSE** | To enable the students to understand the fundamentals of process control, types of processes, characteristics of different types of controllers for controlling a process and process automation | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Explain the characteristics and significance of Final Control Element | a | b | | | | | |
| 2. | Design and implement controllers for various processes | a | b | c | e | k | | |
| 3. | Tune the controller and improve the performance of the process | a | b | c | e | k | | |
| 4. | Design and control complex systems | a | b | c | e | k | | |

| Session | Description of experiments | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| 1. | Characteristic of I/P and P/I converters | 3 | C,I,O | 1 | 1,2,3 |
| 2. | Characteristic of various type of control valves | 3 | C,I,O | 1 | 1,3 |
| 3. | Characteristic of control valve with and without positioner | 3 | C,I,O | 1 | 1,2,3 |
| 4. | Design of ON/OFF, PI and PID controller for the pressure process | 3 | C,D,I,O | 2 | 1,2,3 |
| 5. | Design of ON/OFF, PI and PID controller for the level process | 3 | C,D,I,O | 2 | 1,2,3 |
| 6. | Design of ON/OFF, PI and PID controller for the flow process | 3 | C,D,I,O | 2 | 1,2,3 |
| 7. | Design of ON/OFF, PI and PID controller for the temperature process | 3 | C,D,I,O | 2 | 1,2,3 |
| 8. | Tuning of controllers | 3 | C,D,I,O | 3 | 1,2,3 |
| 9. | Study of complex control system | 3 | C,D,I,O | 4 | 1,2,3 |
| 10. | Responses of different order processes with and without transportation lag | 3 | C,D,I,O | 4 | 1,2,3 |
| | **Total contact hours** | **30** | | | |

| **LEARNING RESOURCES** | |
|---|---|
| **Sl. No.** | **REFERENCES** |
| 1. | Laboratory Manual |
| 2. | Johnson .C.D, "*Process Control Instrument Technology*", Prentice Hall Inc., 2004. |
| 3. | Bequette. B.W, "*Process Control Modeling, Design and Simulation*", Prentice Hall ofIndia, 2004. |

| **Course nature** | | | **Practical** | | | |
|---|---|---|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | | | | |
| **In-semester** | **Assessment tool** | Experiments | Record | MCQ/Quiz/Viva Voce | Model examination | **Total** |
| | **Weightage** | **40%** | **5%** | **5%** | **10%** | **60%** |
| | | | | **End semester examination Weightage :** | | **40%** |

| 15EI305L | Design Project Laboratory | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 2 | 1 |
| *Co-requisite:* | NIL | | | | |
| *Prerequisite:* | 15EI205,15EI203J | | | | |
| *Data Book / Codes/Standards* | NIL | | | | |
| *Course Category* | P PROFESSIONAL CORE | ELECTRONICS ENGINEERING | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | |

| **PURPOSE** | To develop skills in designing and conducting experiments related to applications of principles of physics in engineering | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Develop their ability in designing of basic electronic circuits | a | b | c | k | | | |
| 2. | Familiarize with the concepts of automation and its concepts | a | b | c | d | k | | |

| Sl. No. | Description of experiments | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| 1. | Design of regulated power supply | 2 | D,I | 1 | 1,2 |
| 2. | Instrumentation amplifier | 2 | C,D | 1 | 1,2 |
| 3. | Design of filters: LPF, HPF, BPF and BRF | 4 | D | 1 | 1,2 |
| 4. | I to V and V to I Convertor | 2 | D | 1 | 1,2 |
| 5. | Design of Oscillator | 2 | D | 1 | 1,2 |
| 6. | Design of digital clock | 3 | D,I | 1,2 | 1 |
| 7. | Speed control of motor | 3 | D,I | 1,2 | 1 |
| 8. | Automatic Water level control | 3 | D,I | 1,2 | 1 |
| 9. | Automatic head light (low/ high beam) control | 3 | D,I | 1,2 | 1 |
| 10. | Home automation | 6 | D,I | 1,2 | 1 |
| | **Total contact hours** | **30** | | | |

| **LEARNING RESOURCES** | |
|---|---|
| **Sl. No.** | **REFERENCES** |
| 1. | Laboratory Manual |
| 2. | Roy choudhury and shailjain, "*linear Integrated Circuits*",4th edition, New Age, 2011. |

| **Course nature** | | | | **Practical** | | |
|---|---|---|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | | | | |
| **In-semester** | **Assessment tool** | Experiments | Record | MCQ/Quiz/Viva Voce | Model examination | **Total** |
| | **Weightage** | **40%** | **5%** | **5%** | **10%** | **60%** |
| | | | | **End semester examination Weightage :** | | **40%** |

| 15EI307M | Multi-Disciplinary Design | L | T | P | C |
|---|---|---|---|---|---|
| | | 2 | 2 | 0 | 3 |
| *Co-requisite:* | NIL | | | | |
| *Prerequisite:* | 15EI203J, 15EI205 | | | | |
| *Data Book / Codes/Standards* | NIL | | | | |
| *Course Category* | P PROFESSIONAL CORE | | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | |

| **PURPOSE** | Students of any specialization at an undergraduate level learn courses related to various sub-domains (Multi-disciplinary) of their specialization individually. They are not exposed to understanding how the various multi-disciplinary fields interact and integrate in real life situations. It is very common that an expert in a particular domain models and designs systems or products oblivious of the impact of other subsystems. This lack of multi-disciplinary thinking is very blatantly visible when the students take up their major project during their final year. This course aims to develop appropriate skills on systemic thinking on how to identify and formulate a problem, decompose the problem into smaller elements, conceptualize the design, evaluate the conceptual design by using scientific, engineering and managerial tools, select, analyze and interpret the data, consideration of safety, socio-politico-cultural, risks and hazards, disposal, regional and national laws, costing and financial model and undertake documentation and finally presentation. |
|---|---|

| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Subdivide a complex system into smaller disciplinary models, manage their interfaces and reintegrate them into an overall system model | a | c | e | f | i | | |
| 2. | Rationalize a system architecture or product design problem by selecting appropriate design variables, parameters and constraints | a | c | e | f | i | | |
| 3. | Design for value and quantitatively assess the expected lifecycle cost of a new system or product | a | c | e | f | i | | |
| 4. | Take on the challenges of teamwork, prepare a presentation in a professional manner, and document all aspects of design work. | a | c | e | f | i | | |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| 1 | Introduction: Facilitating Multidisciplinary Projects | | C,D,I,O | 1,2,3,4 | 1-6 |
| 2 | Identifying and formulating a problem | | | | |
| 3 | System Modelling | | | | |
| 4 | Thinking perspectives: Decomposition–Composition Thinking Hierarchical Thinking, Organizational Thinking, Life-Cycle Thinking, Safety Thinking, Risk Thinking, Socio-politico-cultural thinking, Environment thinking | | | | |
| 5 | Decomposing a system – Identifying the major sub-systems | | | | |
| 6 | Mathematical Modeling and Governing equations for each sub systems | | | | |
| 7 | Objectives, Constraints and Design Variables | | | | |
| 8 | Conceptual Design | | | | |
| 9 | Collaborative Design – Disciplinary teams satisfy the local constraints while trying to match the global constraints set by the project coordinator. | | | | |
| 10 | Tools for modeling, designing, analysis, data interpretation, decision making etc | | | | |
| 11 | Design Analysis, evaluation and selection | | | | |
| 12 | Costing and Financial model | | | | |
| 13 | Documentation, reviewing and presentation | | | | |
| | **Total contact hours** | **60** | | | |

| LEARNING RESOURCES | |
|---|---|
| **Sl. No.** | **REFERENCES** |
| 1. | G.Maarten Bonnema, Karel T. Veenvliet, Jan F. Broenink, "*Systems Design and Engineering: Facilitating Multidisciplinary Development Projects*", December 15, 2015, CRC Press, ISBN 9781498751261 |
| 2. | Ina Wagner , Tone Bratteteig, Dagny Stuedahl, "*Exploring Digital Design-Multi-Disciplinary Design Practices*", Springer-Verlag London, 2010, ISSN:1431-1496 |
| 3. | Sawhney. A.K**,** "*A Course in Electrical and Electronics Measurements and Instrumentation*", 18th Edition, DhanpatRai& Company Private Limited, 2007. |
| 4. | Nagrath I J and Gopal.M.,"*Control Systems Engineering*", Anshan Pub,2008. |
| 5. | Benjamin C Kuo, "Automatic *Control System*", 9th edition, John Wiley&sons,2010. |
| 6. | Doebelin. E.A, "*Measurement Systems – Applications and Design*", Tata McGraw Hill,New York, 2000. |

| **Course nature** | | | | **Predominantly Practice complimented by theory** | | |
|---|---|---|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | | | | |
| **In-semester** | **Assessment tool** | Review 1 | Review 2 | Review 3 | Review 4 | **Total** |
| | **Weightage** | **10%** | **25%** | **25%** | **40%** | **100%** |
| **End semester examination Weightage :** | | | | | | **0%** |

**Pedagogy:**

Theme or major/broad domains will be announced by the department every semester. Multi-disciplinary designs will be made by the students in groups (group size may be decided by the course coordinator), with the topic of interest falling within the theme or major/broad domains as announced by the department, applying any combinations of the disciplines in engineering. 3D modelling and / or simulation must be used to validate the design.

In a combination of lecture and hands-on experiences, students must be exposed to understand and analyse engineering designs (or products) and systems, their realization process and project management. Analysis of the design criteria for safety, ergonomics, environment, life cycle cost and sociological impact is to be covered. Periodic oral and written status reports are required. The course culminates in a comprehensive written report and oral presentation. If required guest lecturers from industry experts from the sub-domains may be arranged to provide an outside perspective and show how the system design is being handled by the industry. The Conceive Design Implement Operate (CDIO) principles must be taught to the students.

A full-scale fabrication is not within the purview /scope of this course. Of course this design, if scalable and approved by the department, can be extended as the major project work

This course is 100% internal continuous assessment.

| 15EI376L | Minor Project II | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 2 |
| *Co-requisite:* | NIL | | | | |
| *Prerequisite:* | NIL | | | | |
| *Data Book / Codes/Standards* | NIL | | | | |
| *Course Category* | P PROFESSIONAL | | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | |

| **PURPOSE** | To obtain hands-on experience in converting a small novel idea / technique into a working model / prototype involving multi-disciplinary skills and / or knowledge and working in at team. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Conceptualise a novel idea / technique into a product | c | | | | | | |
| 2. | Think in terms of multi-disciplinary environment | | d | | | | | |
| 3. | Understand the management techniques of implementing a project | | | | k | | | |
| 4. | Take on the challenges of teamwork, prepare a presentation in a professional manner, and document all aspects of design work. | | | g | | | | |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | A Multidisciplinary project to be taken up by a team of maximum of ten students. Development of prototype product, a 3D model, simulation, blueprint for a larger project and any other development work are permitted. The contribution of the individuals in the project should be clearly brought out. A combined report is to be submitted. A presentation is to be made for the reviewers on the work done by the candidate. | | C,D,I | 1,2,3,4 | |
| | **Total contact hours** | | | | |

| **Course nature** | | **Project – 100% internal continuous assessment** | |
|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | |
| **In-semester** | **Assessment tool** | Refer the table | **Total** |
| | **Weightage** | Refer the table below | **100%** |
| **End semester examination Weightage :** | | | **0%** |

| Assessment component | Expected outcome | Evaluators | Criteria or basis | Marks |
|---|---|---|---|---|
| Project proposal (Review – I) | A short presentation to be delivered on:<br>• A brief, descriptive project title (2-4 words). This is critical!<br>• The 3 nearest competitors (existing solutions) and price.<br>• Team members name, phone number, email, department/degree program, and year.<br>• A description of the product opportunity that has been identified. To include: Documentation of the market need, shortcomings of existing competitive products, and definition of the target market and its size.<br>• Proposed supervisor / guide | Panel of reviewers | Viability / feasibility of the project Extent of preliminary work done. | **0** |

| Assessment component | Expected outcome | Evaluators | Criteria or basis | Marks |
|---|---|---|---|---|
| Review II | • Mission Statement / Techniques<br>• Concept Sketches, Design Specifications / Modules & Techniques along with System architecture<br>• Coding | Panel of reviewers | Originality, Multi-disciplinary component, clarity of idea and presentation, team work, handling Q&A. | **20** |
| Review III | • Final Concept and Model / Algorithm/ Technique<br>• Drawings, Plans / programme output<br>• Financial Model / costing<br>• Prototype / Coding<br>• Final Presentation and Demonstration | Panel of reviewers | Originality, Multi-disciplinary component, clarity of idea and presentation, team work, handling Q&A. | **50** |
| Final technical Report | A good technical report | Supervisor / Guide | Regularity, systematic progress, extent of work and quality of work | **30** |
| | | | **Total** | **100** |

| 15EI381L | Seminar II | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 2 |
| *Co-requisite:* | NIL | | | | |
| *Prerequisite:* | NIL | | | | |
| *Data Book / Codes/Standards* | NIL | | | | |
| *Course Category* | P PROFESSIONAL | | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | |

| **PURPOSE** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Understand the research methodology adopted by various researchers | h | i | j | | | | |
| 2. | Mathematically model a problem, critically analyse it and adopt strategies to solve | b | c | e | | | | |
| 3. | Understand and present a well documented research | e | g | | | | | |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | **Guidelines for conducting 15EI380L Seminar for B.Tech**<br>1. Upon registering for the course the student must identify a sub-domain of the degree specialization that is of interest to the student and start collecting research papers as many as possible.<br>2. After collecting sufficient number of research papers the student must peruse all the papers, meet the course faculty and discuss on the salient aspects of each and every paper.<br>3. The course faculty, after discussion with the student will approve TWO research papers that is appropriate for presentation.<br>4. The student must collect additional relevant reference materials to supplement and compliment the two research papers and start preparing the presentation.<br>5. Each student must present a 15-minute presentation on each of the approved research paper to the panel of evaluators.<br>6. The presenter must present one research paper within the first half of the semester (6 weeks) and another research paper in the next half of the semester (6 weeks) as per the schedule.<br>7. All other students registered for the course will form the audience.<br>8. The audience as well as the evaluators will probe the student with appropriate questions and solicit response from the presenter.<br>9. The presentation will be evaluated against 7 to 8 assessment criteria by 4 to 5 evaluators.<br>10. The score obtained through the presentations of TWO research papers will be converted to appropriate percentage of marks.<br>This course is 100% internal continuous assessment. | | C,D | 1,2,3,4 | |
| | **Total contact hours** | **30** | | | |

| 15EI 386L | Massive Open Online Courses (MOOCS) II | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 2 |
| *Co-requisite:* | NIL | | | | |
| *Prerequisite:* | NIL | | | | |
| *Data Book / Codes/Standards* | NIL | | | | |
| *Course Category* | P PROFESSIONAL | | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | |

| **PURPOSE** | To offer students the opportunity to study with the world's best universities by integrating select MOOCs in a regular degree programme and providing students full credit transfer, as per university regulations, if they earn a "Verified / Completion Certificate" and take a proctored examination through a secure, physical testing center. |
|---|---|

| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| At the end of the course, student will be able | | | | | | | | |
| 1. | To apply the concepts, theories, laws, technologies learnt herein to provide engineering solutions. | f | h | i | j | | | |

| **Course nature** | | **Online - 100% internal continuous assessment.** | | | | |
|---|---|---|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | | | | |
| **In-semester** | **Assessment tool** | Quiz | Assignment | Non-proctored / Unsupervised Tests | Proctored / Supervised Test | **Total** |
| | **Weightage** | **25%** | **25%** | **10%** | **40%** | **100%** |
| | | | | **End semester examination Weightage :** | | **0%** |

**Registration process, Assessment and Credit Transfer:**

1. Students can register for courses offered by approved global MOOCs platforms like edX, Coursera or Universities with which SRM partners specifically for MOOCs.
2. Annually, each department must officially announce, to the students as well as to the Controller of Examinations, the list of courses that will be recognised and accepted for credit transfer.
3. The department must also officially announce / appoint one or more faculty coordinator(s) for advising the students attached to them, monitoring their progress and assist the department in proctoring the tests, uploading the marks / grades, and collecting and submitting the graded certificate(s) to the CoE, within the stipulated timeframe.
4. Student who desires to pursue a course, from the above department-approved list, through MOOCs must register for that course during the course registration process of the Faculty of Engineering and Technology, SRM University.
5. The maximum credit limits for course registration at SRM will include the MOOCs course registered.
6. The student must periodically submit the marks / grades obtained in various quizzes, assignments, tests etc immediately to the Faculty Advisor or the Course Coordinator for uploading in the university's academic module.
7. The student must take the final test as a Proctored / Supervised test in the university campus.
8. The student must submit the "Certificate of Completion" as well as the final overall Marks and / or Grade within the stipulated time for effecting the grade conversion and credit transfer, as per the regulations. It is solely the responsibility of the individual student to fulfil the above conditions to earn the credits.

The attendance for this course, for the purpose of awarding attendance grade, will be considered 100% , if the credits are transferred, after satisfying the above (1) to (7) norms; else if the credits are not transferred or transferable, the attendance will be considered as ZERO.

| 15EI491L | Industry Module II | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 2 |
| *Co-requisite:* | NIL | | | | |
| *Prerequisite:* | NIL | | | | |
| *Data Book / Codes/Standards* | NIL | | | | |
| *Course Category* | P PROFESSIONAL | | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | |

**PURPOSE**

| INSTRUCTIONAL OBJECTIVES | | STUDENT OUTCOMES | | | | | | |
|---|---|---|---|---|---|---|---|---|
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Obtain an insight into the current industrial trends and practices | | | j | | | | |
| 2. | Obtain an insight into the technologies adopted by industries | | | j | | | | |
| 3. | Obtain an insight into the technical problems encountered by the industries and the scope for providing solutions. | | h | | | | | |
| 4. | Network with industry | g | | | | | | |

| Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|
| 1. The department will identify and shortlist few emerging topics that are trending in industry.<br>2. The department will identify experts from industry who are willing to deliver modules on the shortlisted topics.<br>3. The identified expert will assist the department in formulating the course content to be delivered as a 30-hour module, prepare lectures notes, ppt, handouts and other learning materials.<br>4. The department will arrange to get the necessary approvals for offering the course, from the university's statutory academic bodies well before the actual offering.<br>5. The department must officially announce, to the students as well as to the Controller of Examinations, the list of courses that will be offered as industry module.<br>6. The department must also officially announce / appoint one or more faculty coordinator(s) for advising the students attached to them, monitoring their progress and assist the department in proctoring/supervising/assessment the quizzes, assignments, tests etc, uploading the marks, attendance etc, within the stipulated timeframe.<br>7. The Student who desires to pursue a course, from the above department-approved list, must register for that course during the course registration process of the Faculty of Engineering and Technology, SRM University.<br>8. The maximum credit limits for course registration at SRM will include the Industry Module also.<br>9. All academic requirements of a professional course like minimum attendance, assessment methods, discipline etc will be applicable for this Industry Module.<br>10. The course will be conducted on week ends or beyond the college regular working hours. | | C,D,I,O | 1,2,3,4 | |
| **Total contact hours** | **30** | | | |

| **Course nature** | | **100% internal continuous assessment.** | | | | | |
|---|---|---|---|---|---|---|---|
| **Assessment Method – Theory Component (Weightage 50%)** | | | | | | | |
| **In-semester** | **Assessment tool** | Cycle test I | Cycle test II | Cycle Test III | Surprise Test | Quiz | **Total** |
| | **Weightage** | **10%** | **15%** | **15%** | **5%** | **5%** | **50%** |
| | | | | | **End semester examination Weightage** | | **50%** |

| 15EI401 | PLC & DCS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| *Co-requisite:* | NIL | | | | |
| *Prerequisite:* | 15EI201 | | | | |
| *Data Book / Codes/Standards* | NIL | | | | |
| *Course Category* | P PROFESSIONAL CORE | AUTOMATION ENGINEERING | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | |

| **PURPOSE** | This course introduces the student to practical methods of automatic control of machines, processes and systems. Also the student will learn the PLC programming fundamentals and some knowledge in DCS and SCADA which are used in process automation industries. |
|---|---|

| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Understand the need for automation in process industries and to learn about PLC. | a | b | c | | | | |
| 2. | Learn the programming languages of PLC. | a | b | c | d | e | k | |
| 3. | Get an exposure to SCADA | a | b | c | d | e | | |
| 4. | Learn about industrial DCS and its applications. | a | b | c | d | e | k | |
| 5. | Have an exposure about communication networks. | a | b | c | | | | |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | **UNIT I: Programmable Logic Controller Basics** | **9** | | | |
| 1. | Overview of PLC systems, parts of PLC, Input / Output modules, power supplies and isolators | 4 | C | 1 | 1,2,4 |
| 2. | Architecture of a PLC, Input/output devices: switches, sensors, Relays, transducers, seal-in circuits. | 3 | C, D | 1 | 1,2,4 |
| 3. | Fundamental PLC wiring diagram | 2 | C,D | 1 | 1,2,4 |
| | **UNIT II: Programming of PLC** | **9** | | | |
| 4. | Fundamentals of logic, Program scan, Relay logic, PLC programming languages | 4 | C, D | 2 | 1,2,4 |
| 5. | Functional blocks: timers, counters, math instructions, data manipulation instructions | 3 | C,D | 2 | 1,2,4 |
| 6. | Requirement of communication networks for PLC, PLC to PC Communication to computer. | 2 | C | 2 | 1,2,4 |
| | **UNIT III:SCADA** | **9** | | | |
| 7. | Elements of SCADA system, History of SCADA, Remote Terminal Unit | 4 | C | 3 | 5 |
| 8. | Discrete control, Analog control, Master Terminal Unit, Operator interface | 5 | C | 3 | 5 |
| | **UNIT IV: Distributed Control System** | **9** | | | |
| 9. | Evolution, Different architectures, Local Control Unit | 3 | C | 4 | 3 |
| 10. | Display unit, Operator Interface, Engineering Interface | 3 | C | 4 | 3 |
| 11. | DCS Applications in Power plant, Iron plant, Steel plant, Cement plant. | 3 | C | 4 | 3 |
| | **UNIT V: HART and Field Bus** | **9** | | | |
| 12. | Introduction, Evolution of signal standards, HART communication protocol, communication modes. | 3 | C | 5 | 6 |
| 13. | HART networks, HART commands, HART and OSI model | 3 | C | 5 | 6 |
| 14. | Field bus, architecture, basic requirements of field bus standard, field bus topology, interoperability, interchangeability. | 3 | C | 5 | 6 |
| | **Total contact hours** | **45** | | | |

| LEARNING RESOURCES | |
|---|---|
| **Sl. No.** | **TEXT BOOKS** |
| 1. | Frank Petruzella. D, "*Programmable Logic Controllers*", Tata McGraw Hill Third Edition, 2010. |
| 2. | Bolton. W, "*Programmable Logic Controllers*" Fifth Edition, Elsevier Newnes, 2009. |
| 3. | Michael Lucas, "*Distributed Control Systems*", Van Nostrand Reinhold Co., 1986. |
| | **REFERENCE BOOKS/OTHER READING MATERIAL** |
| 4. | John W. Webb, Ronald A. Reis, "*Programmable Logic Controllers": Principles and Applications*, Prentice Hall, 2003. |
| 5. | Stuart Boyer A, "*SCADA*: *Supervisory control and data Acquisition*", Fourth Edition, ISA-The Instrumentation, Systems, and Automation Society,2010. |
| 6. | Deon Reynders, "*Practical Industrial data communication*" First Edition, Butterworth-Heinemann, 2005. |

| **Course nature** | | | | **Theory** | | | |
|---|---|---|---|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | | | | | |
| **In-semester** | **Assessment tool** | Cycle test I | Cycle test II | Cycle Test III | Surprise Test | Quiz | **Total** |
| | **Weightage** | **10%** | **15%** | **15%** | **5%** | **5%** | **50%** |
| | | | | | | **End semester examination Weightage :** | **50%** |

| 15EI402 | Computer Control of Process | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| *Co-requisite:* | NIL | | | | |
| *Prerequisite:* | 15EI304 | | | | |
| *Data Book / Codes/Standards* | NIL | | | | |
| *Course Category* | P PROFESSIONAL CORE | CONTROL ENGINEERING | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | |

| **PURPOSE** | To introduce the knowledge on the principle of sampled data control system. To impart the ideas of system modeling and identification of process | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Understand the basics of discrete data systems. | e | | | | | | |
| 2. | Learn the computer as controller in digital control system. | a | c | | | | | |
| 3. | Understand the control algorithm and its implementation. | a | c | | | | | |
| 4. | Have knowledge in modeling and identification of process. | a | b | c | | | | |
| 5. | Acquire a knowledge in Multiloop control system. | a | b | | | | | |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | **UNIT I: Analysis of Discrete Data System** | **9** | | | |
| 1. | State-space representation of discrete data systems | 1 | C,D | 1 | 3 |
| 2. | Selection of sampling process, Selection of sampling period | 1 | C | 1 | 1 |
| 3. | Review of Z transform | 1 | C,D | 1 | 1 |
| 4. | Modified Z transform | 3 | C,D | 1 | 2 |
| 5. | Pulse transfer function | 2 | C,D | 1 | 2 |
| 6. | Stability of discrete data system, Schurcohn method. | 1 | C,D | 1 | 2 |
| | **UNIT II: Computer as Controller** | **9** | | | |
| 7. | Basic building blocks of computer control system and Data loggers | 2 | C | 2 | 2 |
| 8. | Data acquisition systems , supervisory control , SCADA ,Direct digital control | 2 | C | 2 | 4,5 |
| 9. | Implementation of digital controllers , temperature control , position control and stepper motor | 3 | C | 2 | 3 |
| 10. | Case study : Design of computerized multi loop controller | 2 | C,D,I | 2 | 6 |
| | **UNIT III: Design of Digital Controller** | **9** | | | |
| 11. | Digital PID , Position and velocity form | 1 | C,D | 3 | 1 |
| 12. | Deadbeat's algorithm | 2 | C,D,I | 3 | 1,2 |
| 13. | Dahlin's algorithm | 2 | C,D,I | 3 | 1,2 |
| 14. | Kalman's algorithm | 2 | C,D,I | 3 | 1,2 |
| 15. | Pole placement controller | 1 | C,D,I | 3 | 1 |
| 16. | Predictive controller | 1 | C,D | 3 | 1 |
| | **UNIT IV: System Identification** | **9** | | | |
| 17. | Non Parametric methods : Transient Analysis , Frequency analysis , correlation analysis ,Spectral analysis | 5 | C,D | 4 | 2, 5 |
| 18. | Parametric methods : Least square method , Recursive least square method | 4 | C,D | 4 | 2, 5 |
| | **UNIT V: Multi Loop Regulatory Control** | **9** | | | |
| 19. | Multi-loop Control , Introduction | 1 | C,D | 5 | 1 |
| 20. | Process Interaction , Pairing of Inputs and outputs | 2 | C,D | 5 | 1 |
| 21. | The Relative Gain Array (RGA) | 3 | C,D,I | 5 | 1 |
| 22. | Multi loop PID Controller , Decoupler | 3 | C,D,I | 5 | 1 |
| | **Total contact hours** | **45** | | | |

| LEARNING RESOURCES | |
|---|---|
| **Sl. No.** | **TEXT BOOKS** |
| 1. | Stephanopoulos, G., "*Chemical Process Control -An Introduction to Theory and Practice*", Prentice Hall of India, 3rd Edition , 2005. |
| 2. | Deshpande. Pm,and Ash, "*Elements of Computer Control System*" ISA Press, USA, 2nd Edition 1998. |
| | **REFERENCE BOOKS/OTHER READING MATERIAL** |
| 3. | Gopal, M., "*Digital Control and State Variable Methods*", Tata McGraw Hill, 3rd Edition, 2003. |
| 4. | Bequette,B.W., "*Process Control Modeling, Design and Simulation*", Prentice Hall of India, 2004 |
| 5. | Seborg, D.E., Edgar,T.F. and Mellichamp, D.A., "*Process Dynamics and Control*", Wiley John, 3rd Edition , 2010. |
| 6. | www.researchgate.net/.../242817466 |

| **Course nature** | | | | **Theory** | | | |
|---|---|---|---|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | | | | | |
| **In-semester** | **Assessment tool** | Cycle test I | Cycle test II | Cycle Test III | Surprise Test | Quiz | **Total** |
| | **Weightage** | **10%** | **15%** | **15%** | **5%** | **5%** | **50%** |
| | | | | | **End semester examination Weightage :** | | **50%** |

| 15EI403J | Image Processing | L | T | P | C |
|---|---|---|---|---|---|
| | | 2 | 0 | 2 | 3 |
| *Co-requisite:* | NIL | | | | |
| *Prerequisite:* | 15EI301 | | | | |
| *Data Book / Codes/Standards* | NIL | | | | |
| *Course Category* | P PROFESSIONAL CORE | ELECTRONICS ENGINEERING | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | |

| **PURPOSE** | The purpose of this course is to introduce the basic concept and methodologies for digital image processing | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Study the image fundamentals, mathematical transforms necessary for image processing. | a | b | d | k | | | |
| 2. | About the various techniques of image enhancement, reconstruction, compression and segmentation. | a | b | h | | | | |
| 3. | Know sampling and reconstruction procedures | a | b | e | | | | |
| 4. | Design image processing systems | a | | | | | | |

| Session | Description of Topic (Theory) | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | **UNIT I: Fundamentals of Dip** | **6** | | | |
| 1. | Origin of digital Image Processing, Components of Image processing system | 1 | | 1 | 1,2 |
| 2. | Elements of visual perception, Image sampling and quantization | 2 | C | 1 | 1,3,4 |
| 3. | Basic relationship between pixels, properties of human eye | 1 | C,D | 1 | 1,3,4 |
| 4. | Image representation. | 2 | C,D | 1 | 1 |
| | **UNIT II: Image Transformations** | **6** | | | |
| 5. | Basic geometric transformations, Introduction to Fourier Transform and DFT | 2 | C | 2 | 1,3 |
| 6. | Properties of 2D Fourier Transform, FFT | 1 | C,D | 2 | 1,3 |
| 7. | Separable Image Transforms, Walsh Hadamard | 1 | D | 2 | 1 |
| 8. | Discrete Cosine Transform, Haar, KL transforms. | 2 | C,D | 2 | 1 |
| | **UNIT III: Image Enhancement** | **6** | | | |
| 9. | Spatial Domain methods: Basic grey level transformation, Histogram equalization, Enhancement using Arithmetic/logical operations | 2 | | 2,3 | 1,2 |
| 10. | Spatial filtering: Smoothing, sharpening filters, Laplacian filters | 2 | C,D,I | 2,3 | 1,2 |
| 11. | Frequency domain filters Smoothing, Sharpening filters, Homomorphic filtering. | 2 | C,D | 2,3 | 1,2 |
| | **UNIT IV: Image Restoration** | **6** | | | |
| 12. | Model of Image Degradation/Restoration process, Noise models, Restoration in the presence of Noise, Spatial filtering | 1 | C,I | 4 | 1,2,3 |
| 13. | Periodic Noise reduction by Frequency, Domain Filtering, Inverse filtering | 2 | D,I | 4 | 1,2,3 |
| 14. | Least mean square filtering, Constrained least mean square filtering | 3 | D,I | 4 | 1,2,3 |
| | **UNIT V: Image Compression and Segmentation** | **6** | | | |
| 15. | Lossless compression: Variable length coding, LZW coding DPCM | 3 | D,I | 4 | 1,3,4 |
| 16. | Lossy Compression: Transform coding, Wavelet coding, Basics of Image compression standards: JPEG, MPEG Edge detection | 3 | C | 4 | 1,3,4 |

| Session | Description of Topic (Theory) | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | **Total contact hours** | **30** | | | |

| Session | Description of experiments | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| 1. | Display of Gray scale Images. | 3 | I | 1-4 | 1,2 |
| 2. | Histogram Equalization. | 3 | C | 1 | 1,2 |
| 3. | Design of Non-linear Filtering. | 3 | D | 1 | 1,3 |
| 4. | Determination of Edge detection using Operators. | 3 | C,I | 1,3,4 | 1 |
| 5. | 2-D DFT and DCT. | 3 | C,D | 1,3 | 1 |
| 6. | Filtering in frequency domain. | 3 | C | 3,4 | 1 |
| 7. | Display of colour images. | 3 | D,I | 3,4 | 1 |
| 8. | Conversion between colour spaces. | 3 | I | 3,4 | 1,3,4 |
| 9. | DWT of images. | 3 | I | 4 | 1,4,2 |
| 10. | Segmentation using watershed transform. | 3 | I | 4 | 1 |
| | **Total contact hours** | **30** | | | |

| **LEARNING RESOURCES** | |
|---|---|
| **Sl. No.** | **TEXT BOOKS** |
| 1. | Rafael.C,Gonzalez, Richard E Woods, "*Digital Image Processing*",3rdEdition, Pearson India, 2013. |
| 2. | Jain A.K, "*Fundamentals of Digital Image Processing*", 4th Edition, Prentice hall of India, 2004. |
| | **REFERENCE BOOKS/OTHER READING MATERIAL** |
| 3. | B.Chanda, D. DuttaMajumder, "*Digital Image Processing and Analysis*", 2ndEdition, Phi learning, 2011. |
| 4. | William K Pratt, "*Digital Image Processing*", 4th Edition, Wiley, 2012. |

| **Course nature** | | | | **Theory + Practical** | | | |
|---|---|---|---|---|---|---|---|
| **Assessment Method – Theory Component (Weightage 50%)** | | | | | | | |
| **In-semester** | **Assessment tool** | Cycle test I | Cycle test II | Cycle Test III | Surprise Test | Quiz | **Total** |
| | **Weightage** | **10%** | **15%** | **15%** | **5%** | **5%** | **50%** |
| | | | | | | **End semester examination Weightage :** | **50%** |
| | | | | | | | |
| **Assessment Method – Practical Component (Weightage 50%)** | | | | | | | |
| **In-semester** | **Assessment tool** | Experiments | Record | MCQ/Quiz/Viva Voce | Model examination | | **Total** |
| | **Weightage** | **40%** | **5%** | **5%** | **10%** | | **60%** |
| | | | | | | **End semester examination Weightage :** | **40%** |

| 15EI401L | Automation Laboratory | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 2 | 1 |
| *Co-requisite:* | 15EI401 | | | | |
| *Prerequisite:* | 15EI201 | | | | |
| *Data Book / Codes/Standards* | NIL | | | | |
| *Course Category* | P PROFESSIONAL CORE | AUTOMATION ENGINEERING | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | |

| **PURPOSE** | This course introduces the student to practical methods of automatic control of machines, processes and systems. Also the student will learn the PLC programming for various real time process applications and some knowledge in SCADA which are used in process automation industries. |
|---|---|

| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Implement control system using PLC in process automation | a | b | c | d | e | | |
| 2. | Gain knowledge in SCADA used in process automation | a | b | c | d | e | | |

| Session. | Description of experiments | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| 1. | Study of PLC | 3 | C,D,I | 1 | 1,2 |
| 2. | Implementation of Code converters | 3 | D,I | 1 | 1,2 |
| 3. | Traffic light control system | 3 | D,I,O | 1 | 1,2 |
| 4. | Water level control system | 3 | D,I,O | 1 | 1,2 |
| 5. | Material handling system | 3 | D,I,O | 1 | 1,2 |
| 6. | Bottle filling system | 3 | D,I,O | 1 | 1,2 |
| 7. | Sequential operation of motor | 3 | D,I,O | 1 | 1,2 |
| 8. | Star to delta starter | 3 | D,I,O | 1 | 1,2 |
| 9. | DC motor speed control system | 2 | D,I,O | 1 | 1,2 |
| 10. | Temperature control system | 2 | D,I,O | 1 | 1,2 |
| 11. | Implementation of PLC programming through SCADA | 2 | D,I,O | 2 | 1,2 |
| | **Total contact hours** | **30** | | | |

| **LEARNING RESOURCES** | |
|---|---|
| **Sl. No.** | **REFERENCES** |
| 1. | Laboratory Manual |
| 2. | Frank. D, Petruzella, "*Programmable Logic Controllers",* Tata McGraw Hill, Third Edition-2010. |

| **Course nature** | | | | **Practical** | | |
|---|---|---|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | | | | |
| **In-semester** | **Assessment tool** | Experiments | Record | MCQ/Quiz/Viva Voce | Model examination | **Total** |
| | **Weightage** | **40%** | **5%** | **5%** | **10%** | **60%** |
| | | | | **End semester examination Weightage :** | | **40%** |

| 15EI496L | Major Project | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 24 | 12 |
| *Co-requisite:* | NIL | | | | |
| *Prerequisite:* | NIL | | | | |
| *Data Book / Codes/Standards* | NIL | | | | |
| *Course Category* | P PROFESSIONAL CORE | | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | |

| **PURPOSE** | The Major Project experience is the culminating academic endeavor of students who earn a degree in their Undergraduate Programs. The project provides students with the opportunity to explore a problem or issue of particular personal or professional interest and to address that problem or issue through focused study and applied research under the direction of a faculty member. The project demonstrates the student's ability to synthesize and apply the knowledge and skills acquired in his/her academic program to real-world issues and problems. This final project affirms students' ability to think critically and creatively, to solve practical problems, to make reasoned and ethical decisions, and to communicate effectively. |
|---|---|

| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Provide students with the opportunity to apply the knowledge and skills acquired in their courses to a specific problem or issue. | a | c | | e | f | | i |
| 2. | Allow students to extend their academic experience into areas of personal interest, working with new ideas, issues, organizations, and individuals. | a | c | | e | f | | i |
| 3. | Encourage students to think critically and creatively about academic, professional, or social issues and to further develop their analytical and ethical leadership skills necessary to address and help solve these issues. | a | c | | e | f | h | i |
| 4. | Provide students with the opportunity to refine research skills and demonstrate their proficiency in written and/or oral communication skills. | a | c | | e | f | g | i |
| 5. | Take on the challenges of teamwork, prepare a presentation in a professional manner, and document all aspects of design work. | | | d | | | g | |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | 1. The Major project is a major component of our engineering curriculum: it is the culmination of the program of study enabling the students to showcase the knowledge and the skills they have acquired during the previous four years, design a product/service of significance, and solve an open-ended problem in engineering.<br>2. Each student must register to the project course related to his or her program<br>3. Major Project course consists of one semester and would be allowed to register only during the final year of study.<br>4. The Major Project may be initiated during the pre-final semester but will be assessed and credits transferred only during the last semester of study, upon completion of all other degree requirements. Generally the undergraduate major project is a team based one.<br>5. Each team in the major project course will consist of maximum of 5 students.<br>6. Each project will be assigned a faculty, who will act as | | C,D,I,O | 1,2,3,4,5 | |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | the supervisor.<br>7. The project shall be driven by realistic constraints like that related to economic, environmental, social, political, ethical, health & safety, manufacturability and sustainability.<br>8. Each group must document and implement a management structure. Group leadership roles must be clearly identified including who has responsibility for monitoring project deliverables and group coordination. | | | | |
| | 9. A group project may be interdisciplinary, with students enrolled in different engineering degrees, or in Engineering plus other faculties such as Management, Medical and Health Sciences, Science and Humanities.<br>10. Each student team is expected to maintain a log book that would normally be used to serve as a record of the way in which the project progressed during the course of the session.<br>11. Salient points discussed at meetings with the supervisor (i.e., suggestions for further meetings, changes to experimental procedures) should be recorded by the student in order to provide a basis for subsequent work.<br>12. The logbook may be formally assessed;<br>13. The contribution of each individual team member will be clearly identified and the weightage of this component will be explicitly considered while assessing the work done.<br>14. A project report is to be submitted on the topic which will be evaluated during the final review.<br>15. Assessment components will be as spelt out in the regulations.<br>16. The department will announce a marking scheme for awarding marks for the different sections of the report.<br>17. The project report must possess substantial technical depth and require the students to exercise analytical, evaluation and design skills at the appropriate level. | | | | |
| | **Total contact hours** | | | | |

| **Course nature** | | **Project – 100 % Internal continuous Assessment** | | | |
|---|---|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | | | |
| **In-semester** | **Assessment tool** | Review 1 | Review 2 | **Review 3** | **Total** |
| | **Weightage** | **10%** | **15%** | **20%** | **45%** |
| **End semester examination** | **Assessment Tool** | **Project Report** | **Viva Voce** | | |
| | **Weightage :** | **25%** | **30%** | | **55%** |

| 15EI321E | Analytical Instrumentation | | | L | T | P | C |
|---|---|---|---|---|---|---|---|
| | | | | 3 | 0 | 0 | 3 |
| *Co-requisite:* | NIL | | | | | | |
| *Prerequisite:* | NIL | | | | | | |
| *Data Book / Codes/Standards* | NIL | | | | | | |
| *Course Category* | P | PROFESSIONAL ELECTIVE | INSTUMENTATION ENGINEERING | | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | | | |

| **PURPOSE** | The course is designed to equip the students with an adequate knowledge of a number of analytical tools which are useful for clinical analysis in hospitals, drugs and pharmaceutical laboratories and above all for environmental pollution monitoring and control. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Apply the principles and theory of instrumental analysis. | a | c | | | | | |
| 2. | Understand the operation, maintenance, and calibration of Chemical analysis instruments**.** | a | b | e | | | | |
| 3. | Understand important methods of analysis of industrial gases and radio chemical methods of analysis. | a | b | c | | | | |
| 4. | Develop skill for preventive maintenance and repairs of sophisticated instruments. | a | e | | | | | |
| 5. | Understand the concept of Analytical Instruments. | a | e | | | | | |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | **UNIT I : Instrumental Analysis** | **9** | | | |
| 1. | Introduction, Chemical instrumental analysis, classification | 1 | C | 1-4 | 1-2 |
| 2. | Spectral, electro analytical and separative methods | 2 | C | 1-2 | 1,4 |
| 3. | Instrumental methods of analysis, basic components and their classification | 2 | C | 1-3 | 1,3,4 |
| 4. | Sampling systems, ion selective electrodes, conductivity meters, pH meters | 4 | C | 1-3 | 1,2,5 |
| | **UNIT II : Dissolved Component and Gas Analysis** | **9** | | | |
| 5. | Dissolved oxygen analyser, sodium analyser, silica analyser | 3 | C | 1-4 | 1,2,4 |
| 6. | Moisture measurement, Oxygen analyser, CO monitor, $NO_2$ analyser | 2 | C | 1-3 | 1,5 |
| 7. | $H_2S$ analyser, dust and smoke measurement | 2 | C | 1-3 | 1,2,5 |
| 8. | Thermal conductivity type, thermal analyser, industrial analysers. | 2 | C | 1-3 | 1,3 |
| | **UNIT III :Chromatography** | **9** | | | |
| 9. | Gas chromatography | 1 | C | 1-3 | 2,3,4 |
| 10. | Liquid chromatography | 1 | C | 1-3 | 1,3,5 |
| 11. | Principles, types and applications | 3 | C | 1-3 | 1,2,5 |
| 12. | High pressure liquid chromatography | 2 | C | 1-3 | 1,2 |
| 13. | Detectors | 2 | C | 1-3 | 1,2 |
| | **UNIT IV** : **Spectrophotometer and Flame Photometer** | **9** | | | |
| 14. | Spectral methods of analysis, Beer's law UV, visible spectrophotometers | 1 | C | 1-3 | 1,3,4 |
| 15. | Single beam and double beam instruments, source and detectors | 2 | C | 1-3 | 2,4,5 |
| 16. | IR spectrophotometers, sources and detectors | 2 | C | 1-3 | 3,4,5 |
| 17. | FTIR spectrometers, atomic absorption spectrophotometer | 2 | C | 1-3 | 1,3,4 |
| 18. | Flame emission spectrophotometers, Flame Photometry, applications | 2 | C | 1-3 | 1,4,5 |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | **UNIT V: Nuclear Magnetic Resonance and Radiation Techniques** | **9** | | | |
| 19. | NMR spectrometers and its applications | 1 | C | 1-4 | 1,3,5 |
| 20. | Application of mass spectrophotometers, nuclear radiation detectors | 4 | C | 1-3 | 1,2,5 |
| 21. | Application of GM counter, proportional counter, solid state detectors, scintillation counter | 3 | C | 1-3 | 1,2,5 |
| 22. | Application of X- ray spectroscopy | 1 | C | 1-5 | 1.3.4 |
| | **Total contact hours** | **45** | | | |

| **LEARNING RESOURCES** | |
|---|---|
| **Sl. No.** | **TEXT BOOKS** |
| 1. | Khandpur. R.S, "*Handbook of Analytical Instruments*", Tata McGraw Hill publishing Co. Ltd., 2003. |
| 2. | Bella. G, Liptak,*"Process Measurement and analysis"*., CRC press LLC.,2003. |
| | **REFERENCE BOOKS/OTHER READING MATERIAL** |
| 3. | Francis Rousseau and Annick Rouesssac*"Chemical analysis Modern Instrumentation Methods and Techniques*", John wiley& sons Ltd., 2007. |
| 4. | James W.Robinson ,"*Undergraduate Instrumental Analysis*", Marcel Dekker.,2005. |
| 5. | Dwayne Heard, *"Analytical Techniques for atmospheric measurement*", Blackwell Publishing, 2006. |

| **Course nature** | | | | **Theory** | | | |
|---|---|---|---|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | | | | | |
| **In-semester** | **Assessment tool** | Cycle test I | Cycle test II | Cycle Test III | Surprise Test | Quiz | **Total** |
| | **Weightage** | **10%** | **15%** | **15%** | **5%** | **5%** | **50%** |
| | | | | | **End semester examination Weightage :** | | **50%** |

| 15EI322E | Reliability and Safety Engineering | | | L | T | P | C |
|---|---|---|---|---|---|---|---|
| | | | | 3 | 0 | 0 | 3 |
| *Co-requisite:* | NIL | | | | | | |
| *Prerequisite:* | NIL | | | | | | |
| *Data Book / Codes/Standards* | NIL | | | | | | |
| *Course Category* | P | PROFESSIONAL ELECTIVE | INSTRUMENTATION ENGINEERING | | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | | | |

| **PURPOSE** | To introduce the student to the basic concepts of reliability and safety engineering. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Apply the concepts of reliability in engineering aspects. | c | h | | | | | |
| 2. | Know the failure modes in industry operation. | c | h | | | | | |
| 3. | Understand maintainability and safety aspects. | c | h | | | | | |
| 4. | Know the responsibilities and safety rules to be followed in process industries. | c | h | | | | | |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | **UNIT I: Reliability** | **9** | | | |
| 1. | Definition and basic concepts, block diagrams, failure data, failure modes | 5 | C | 1,2 | 1,2 |
| 2. | Reliability in terms of hazard rates and failure density function, Hazard models and 'bath-tub' curve. | 4 | C | 1,2 | 1,2 |
| | **UNIT II: Maintainability** | **9** | | | |
| 3. | Maintainability: Definition, basic concepts, relationship between reliability, maintainability and availability | 3 | C | 3 | 1,2 |
| 4. | Corrective maintenance time distributions and maintainability demonstration. | 3 | C | 3 | 1,2 |
| 5. | Design considerations for maintainability, Availability and reliability relationship | 3 | C | 3 | 1,2 |
| | **UNIT III: Safety** | **9** | | | |
| 6. | Causes of failure and unreliability, measurement and prediction of human reliability, human reliability and operator training. | 3 | C | 3 | 3 |
| 7. | Safety margins in critical devices, Origins of consumerism and importance of product knowledge. | 3 | C | 3 | 3 |
| 8. | Product safety, product liability and product safety improvement program. | 3 | C | 3 | |
| | **UNIT IV: Storage of Hazardous Chemical Rules** | **9** | | | |
| 9. | Definitions - duties of authorities, responsibilities of occupier, notification of major accidents, information to be furnished. | 5 | C | 4 | 6 |
| 10. | Preparation of offsite and onsite plans, list of hazardous and toxic chemicals, safety reports, safety data sheets. | 4 | C | 4 | 6 |
| | **UNIT V : Other Acts and Rules** | **9** | | | |
| 11. | Indian Boiler Act 1923, static and mobile pressure vessel rules (SMPV), motor vehicle rules. | 3 | C | 4 | 4 |
| 12. | Mines act 1952, workman compensation act, rules – electricity act and rules, hazardous wastes (management and handling) rules 1989. | 2 | C | 4 | 5 |
| 13. | Petroleum rules, Gas cylinder rules, Explosives Act 1983, Pesticides Act. | 2 | C | 4 | 5 |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| 14. | Occupational Safety and Health act of USA (The Williames-Steiger Act of 1970) – Health and safety work act (HASAWA 1974, UK) – OSHAS 18000 – ISO 14000 – American National Standards Institute (ANSI). | 2 | C | 4 | 7,8 |
| | **Total contact hours** | **45** | | | |

| **LEARNING RESOURCES** | |
|---|---|
| **Sl. No.** | **TEXT BOOKS** |
| 1. | Govil, A.K., "*Reliability Engineering*", Tata McGraw -Hill, New Delhi,1983 |
| 2. | Srinath L.S, "*Reliability Engineering*", Affiliated East-West Press Pvt. Ltd, New Delhi, 1998. |
| 3. | Sinha and Kale, "*Introduction to Life-Testing*", Wiley Eastern, New Delhi, 1992 |
| | **REFERENCE BOOKS/OTHER READING MATERIAL** |
| 4. | The Indian boilers act 1923, Commercial Law Publishers (India) Pvt. Ltd., Allahabad |
| 5. | The Mines Act 1952, Commercial Law Publishers (India) Pvt. Ltd., Allahabad. |
| 6. | The manufacture, storage and import of hazardous chemical rules 1989, Madras Book Agency. |
| 7. | www.osha.gov/pls/oshaweb/ |
| 8. | www.hse.gov.uk/legislation/hswa.htm |

| **Course nature** | | | | **Theory** | | | |
|---|---|---|---|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | | | | | |
| **In-semester** | **Assessment tool** | Cycle test I | Cycle test II | Cycle Test III | Surprise Test | Quiz | **Total** |
| | **Weightage** | **10%** | **15%** | **15%** | **5%** | **5%** | **50%** |
| | | | | | | **End semester examination Weightage :** | **50%** |

| 15EI323E | Biomedical Instrumentation | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| *Co-requisite:* | NIL | | | | |
| *Prerequisite:* | NIL | | | | |
| *Data Book / Codes/Standards* | NIL | | | | |
| *Course Category* | P PROFESSIONAL ELECTIVE | INSTRUMENTATION ENGINEERING | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | |

| **PURPOSE** | To educate students on the various physiological systems of the human body and to provide an exposure to the instruments used in various departments and laboratories of a hospital. |
|---|---|

| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Understand the physical foundations of biological systems and the various electrodes used in medical field. | a | | | | | | |
| 2. | Have a detailed understanding about the various electro physiological measurements in the human body. | a | | | | | | |
| 3. | Gain knowledge on the measurement of non-electrical parameter in the human body. | a | k | | | | | |
| 4. | Understand the basic concepts of various medical imaging techniques and their applications. | h | | k | | | | |
| 5. | Understand medical assisting and therapy equipments. | h | | k | | | | |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | **UNIT I: Physiology and Transducers** | **9** | | | |
| 1. | Man instrument system, Problems encountered in measuring a living system , Transducers for biomedical applications | 1 | C | 1 | 1,2 |
| 2. | Cell and its structure, Resting and action potential, Propagation of action potentials, The heart and cardiovascular system, Electrophysiology of cardiovascular system, Physiology of the respiratory system, Nervous system | 6 | C | 1 | 1 |
| 3. | Electrode theory, Biopotential electrodes. | 2 | C | 1 | 1,2 |
| | **UNIT II: Electro Physiological Measurement** | **9** | | | |
| 4. | Lead system, recording methods and Typical waveforms of ECG, Vector cardiography, EEG | 5 | C,D | 1,2 | 1,2,3 |
| 5. | Lead system, recording methods and Typical waveforms of EMG, ERG, EOG. | 4 | C,D | 1,2 | 2 |
| | **UNIT III: Non- Electrical Parameter Measurements** | **9** | | | |
| 6. | Measurement of blood pressure, blood flow and cardiac output, Plethysmography | 4 | C | 1,3 | 1,2,3 |
| 7. | Measurement of heart sounds, Gas analysers, Blood gas analysers, Oximeters. | 5 | C | 1,3 | 1,2,3 |
| | **UNIT IV: Medical Imaging and Telemetry** | **9** | | | |
| 8. | X-ray machine , Echocardiography ,Computer tomography | 4 | C | 1,4 | 1,2 |
| 9. | MRI ,Diagnostic ultrasound, PET ,SPECT | 3 | C | 1,4 | 1,2 |
| 10. | Electrical impedance tomography, Thermography, Biotelemetry. | 2 | C | 1,4 | 1,2 |
| | **UNIT V:Assisting and Therapeutic Device** | **9** | | | |
| 11. | Pacemakers, Defibrillators, Ventilator | 4 | C | 1,5 | 1,2 |
| 12. | Heart lung machine, Kidney machine, Diathermy , Endoscopes, Lasers in biomedicine | 3 | C | 1,5 | 2 |
| 13. | Discussion of recent research papers on biomedical instruments | 3 | C | | 4 |
| | **Total contact hours** | **45** | | | |

| LEARNING RESOURCES | |
|---|---|
| **Sl. No.** | **TEXT BOOKS** |
| 1. | Leslie Cromwell, Fred. J, Weibell and Erich A. Pleiffer, "*Biomedical Instrumentation and Measurements*", 2nd edition, Prentice Hall of India, 2004. |
| 2. | Kandpur. R.S, "*Handbook of Biomedical Instrumentation*", 2nd edition, Tata McGraw Hill, 2011. |
| | **REFERENCE BOOKS/OTHER READING MATERIAL** |
| 3. | John .G, Webster, Editor, "*Medical Instrumentation, Application and Design*", John Wiley and Sons Inc, 2009. |
| 4. | MorelliS,SalernoS,Ahmed H, PiscioneriA,DeBartolo L, "*Recent Strategies Combining Biomaterials and Stem Cells for Bone, Liver and Skin Regeneration*",Current Stem Cell Research & Therapy ,2016. |

| **Course nature** | | | | **Theory** | | | |
|---|---|---|---|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | | | | | |
| **In-semester** | **Assessment tool** | Cycle test I | Cycle test II | Cycle Test III | Surprise Test | Quiz | **Total** |
| | **Weightage** | **10%** | **15%** | **15%** | **5%** | **5%** | **50%** |
| | | | | | **End semester examination Weightage :** | | **50%** |

| 15EI325E | Modern Control Systems | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| *Co-requisite:* | NIL | | | | |
| *Prerequisite:* | 15EI303 | | | | |
| *Data Book / Codes/Standards* | NIL | | | | |
| *Course Category* | P PROFESSIONAL ELECTIVE | CONTROL ENGINEERING | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | |

| **PURPOSE** | To gain knowledge in compensator and controller design, state variable analysis, non-linear systems and optimal control. |
|---|---|

| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Design cascade compensators in time domain and design PID controllers in time domain and frequency domain | a | b | | | | | |
| 2. | Understand and develop state space model for different systems | a | e | | | | | |
| 3. | Analyze the controllability and observability of a system and to design controllers and observers. | a | e | c | | | | |
| 4. | Giveabasicknowledgeinnon-linearityandmethodstofindthestabilityof non-linear systems | a | e | | | | | |
| 5. | Understand the need of optimality and solving problems | a | e | | | | | |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | **UNIT I: Linear Control Design** | **9** | | | |
| 1. | Design Specifications ,compensator configuration(Series) | 1 | C | 1 | 1,2 |
| 2. | Design of cascade and feedback compensators (lag, Lead) by using time domain and frequency domain. | 4 | C,D,I | 1 | 1,2 |
| 3. | Introduction of PID controllers and design PD, PI, PID controllers using time and frequency domain methods. | 4 | C,D | 1 | 1,2 |
| | **UNIT II: State Space Analysis** | **9** | | | |
| 4. | Introduction, Concepts of State, State variable and State space model | 1 | C | 2 | 1,2,3,4, |
| 5. | State space representation of linear continuous time systems using physical variables, phase variables and canonical variables. | 5 | C,D | 2 | 1,2,3 |
| 6. | Computation of state transition matrix. | 3 | D | 2 | 1,2,3 |
| | **UNIT III: Controllability and Observability** | **9** | | | |
| 7. | Concepts of Controllability and Observability | 4 | C | 3 | 1,3 |
| 8. | Control System Design Via Pole Placement by state feedback | 2 | C,D | 3 | 1,3 |
| 9. | State Observers | 3 | C,D | 3 | 1,3 |
| | **UNIT IV: Non Linear Control** | **9** | | | |
| 10. | Introduction, Properties, Common physical non linear ties | 1 | C | 4 | 1,2,4,5 |
| 11. | Describing function of Dead zone, Relay, saturation non-linearties | 4 | D | 4 | 1,2,4 |
| 12. | Stability analysis of non linear systems using Phase Trajectories. | 4 | C,D | 4 | 1,2,4 |
| | **UNIT V: Applications** | **9** | | | |
| 13. | State space Modeling of Inverted Pendulum, Mechanical systems | 3 | D | 5 | 1,3 |
| 14. | State space Modeling of Electrical Systems | 3 | C,D | 5 | 1,3 |
| 15. | State space Modeling of Field and Armature controlled DC Motor | 3 | C,D | 5 | 1,3 |
| | **Total contact hours** | **45** | | | |

| LEARNING RESOURCES | |
|---|---|
| **Sl. No.** | **TEXT BOOKS** |
| 1. | Gopal. M, "*Modern Control System theory"*, New age international (P) ltd, 2012. |
| 2. | Nagrath. I.J, and Gopal. M, "*Control Systems Engineering"*, Anshan Pub, 2008. |
| | **REFERENCE BOOKS/OTHER READING MATERIAL** |
| 3. | Katsuhiko Ogata, "*Modern Control Engineering"*- 5th Edition, Prentice Hall of India Private Ltd, New Delhi, 2009. |
| 4. | Richard.C, Dorfand Robert.H.Bishop, "*Modern Control System Engineering"*, Pearson Education (US), United States, 2010. |
| 5. | K.M.Soni, P.M.Tiwari and Ayushi Sharma, "*Advanced Control Systems"*, S.K.Kataria& Sons Publishers (P) Ltd, 2008. |

| **Course nature** | | | | **Theory** | | | |
|---|---|---|---|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | | | | | |
| **In-semester** | **Assessment tool** | Cycle test I | Cycle test II | Cycle Test III | Surprise Test | Quiz | **Total** |
| | **Weightage** | **10%** | **15%** | **15%** | **5%** | **5%** | **50%** |
| **End semester examination Weightage :** | | | | | | | **50%** |

| 15EI326E | Micro and Smart Systems | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| *Co-requisite:* | NIL | | | | |
| *Prerequisite:* | NIL | | | | |
| *Data Book / Codes/Standards* | NIL | | | | |
| *Course Category* | P PROFESSIONAL ELECTIVE | ELECTRONICS ENGINEERING | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | |

| **PURPOSE** | To acquire knowledge on the design, fabrication and appreciate the multi-disciplinary aspects of MEMS | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Appreciate the fundamental concepts in MEMS technology | a | | | | | | |
| 2. | Understand the fabrication and machining techniques of MEMS devices | a | c | | | | | |
| 3. | Familiarize with the concept of packaging techniques of MEMS devices | a | d | | | | | |
| 4. | Design and Simulate simple structures using MEMS software | a | b | | | | | |
| 5. | Analyze recent trends and developments in MEMS technology | a | | | | | | |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | **UNIT I: INTRODUCTION** | **9** | | | |
| 1. | Introduction to MEMS and Brief recap of Macro devices | 1 | C | 1 | 1 |
| 2. | MEMS evolution and products, Microelectronics and scaling laws, Chemical, Biomedical, Piezoelectric type of Micro sensors, Thermal, SMA, Piezoelectric and electro static type Micro actuators Piezoelectric Micro actuators, | 4 | C | 1 | 1 |
| 3. | Chemical and mechanical properties of Si compounds, GaAs and Quartz | 2 | C | 1 | 1 |
| 4. | Chemical and mechanical properties of Polymers and Piezoelectric materials | 2 | C | 1 | 1 |
| | **UNIT II: MICRO FABRICATION** | 9 | | | |
| 5. | Process Description, implementation, merits and demerits of Photolithography, Ion implantation and Diffusion | 3 | C | 2 | 1,2 |
| 6. | Process Description, Implementation, merits and demerits of PVD and Sputtering PVD, Sputtering, | 1 | C | 2 | 1,2 |
| 7. | CVD and its types, Oxidation, Dry and Wet Etching | 2 | C | 2 | 1,2 |
| 8. | Bulk MMC, Surface MMC, LIGA | 3 | C | 2 | 1,2 |
| | **UNIT III: MSD AND PACKAGING** | **9** | | | |
| 9. | Process Design, Electro-mechanical design-,Thermo-electric design, CAD | 4 | C | 3 | 1,3 |
| 10. | Die, Device, System Level packaging requirements | 1 | C | 3 | 1,3 |
| 11. | Types of bonding, Types of Sealing | 3 | C | 3 | 1,3 |
| 12. | Selection of packaging materials and requirements | 1 | C | 3 | 1,3 |
| | **UNIT IV: FINITE ELEMENT ANALYSIS** | **9** | | | |
| 13. | Finite element analysis, Introduction | 1 | C,I | 4 | 1,2 |
| 14. | Intro to simulation, Design of cantilever Si die design for Pressure sensor- Loading & stress analysis | 5 | D,I | 4 | 1 |
| 15. | Case study on strain sensor, Temperature sensors, Humidity sensors | 3 | D,I | 4 | 4 |
| | **UNIT V: RECENT TRENDS AND APPLICATIONS** | **9** | | | |
| 16. | MEMS Sensors in micro Satellites | 1 | C,I | 5 | 4 |
| 17. | Air bag deployment in automotive, Lab on chip, Bio MEMS, Micro mirrors Paper MEMS | 4 | C,I | 5 | 4 |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| 18. | Micro power generators, MEMS for military and security applications, IR and gas sensors | 4 | C,I | 5 | 4 |
| | **Total contact hours** | **45** | | | |

| LEARNING RESOURCES | |
|---|---|
| **Sl. No.** | **TEXT BOOKS** |
| 1. | Tai ran Tsu, *"MEMS and Microsystems Design and Manufacture"*, TATA McGraw Hill,2nd edition,2002 |
| 2. | Mark Madou, "*Fundamentals of Micro fabrication"*, Taylor & Francis group,2nd edition, 2002 |
| | **REFERENCE BOOKS/OTHER READING MATERIAL** |
| 3. | Tai-Ran Hsu , "*MEMS and Microsystems: design , manufacture, and nano scale engineering*", 2nd Edition, John Wiley & Sons, Inc,, Hoboken, New Jersey, 2008 |
| 4. | Julian Gardener, Vijay Varadhan, Osama, "*Micro sensors, MEMS, and Smart Device",* Wiley and Sons, 1st Edition,2007 |
| 5. | www.mhme.com/engcs/mech/hsu |

| **Course nature** | | | | **Theory** | | | |
|---|---|---|---|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | | | | | |
| **In-semester** | **Assessment tool** | Cycle test I | Cycle test II | Cycle Test III | Surprise Test | Quiz | **Total** |
| | **Weightage** | **10%** | **15%** | **15%** | **5%** | **5%** | **50%** |
| | | | | | | **End semester examination Weightage :** | **50%** |

| 15EI327E | Power Plant Instrumentation | | | L | T | P | C |
|---|---|---|---|---|---|---|---|
| | | | | 3 | 0 | 0 | 3 |
| *Co-requisite:* | NIL | | | | | | |
| *Prerequisite:* | NIL | | | | | | |
| *Data Book / Codes/Standards* | NIL | | | | | | |
| *Course Category* | P | PROFESSIONAL ELECTIVE | INSTRUMENTATION ENGINEERING | | | | |
| *Course designed by* | Department of Electronics and Instrumentation | | | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | | | |

| **PURPOSE** | To acquire knowledge about sub systems in power plants, control of different parameters and upcoming technologies in power generation. |
|---|---|

| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Familiarize about different power generation process. | a | | | | | | |
| 2. | Understand and learn the different principles and instruments adopted for measurement of electrical and non electrical parameter. | a | c | | | | | |
| 3. | Analysis important parameter for monitoring and controlling in power plant | a | | | | | | |
| 4. | Understand different control loops in boilers | a | | | | | | |
| 5. | Get the knowledge about modern techniques used to obtain maximum efficiency | a | | | | | | |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | **UNIT I:Methods of Power Generation** | **9** | | | |
| 1. | Methods of power generation and basic building blocks for hydro, thermal, nuclear power. | 4 | C | 1 | 1,2 |
| 2. | Basic building blocks for solar and wind power | 2 | C | 1 | 1,2 |
| 3. | Importance of instrumentations in power generation | 1 | C | 1 | 1,2 |
| 4. | Details of boiler processes, P&I diagram of boiler | 2 | C,D | 1 | 1,2,3 |
| | **UNIT II: Measurements in Power Plants** | **9** | | | |
| 5. | Electrical measurements current, voltage, power, frequency, power factor | 2 | C | 2 | 1,2 |
| 6. | Non electrical parameter measurement ,correction factor for steam temp, steam pressure | 1 | C | 2 | 1,2 |
| 7. | Level measurement, radiations detector, smoke density measurement, dust monitor | 3 | C | 2 | 1,2 |
| 8. | Speed vibration, shell temperature monitoring & control, steam pressure control, lubricant temp control of turbines. | 3 | C | 2 | 1,2 |
| | **UNIT III: Analyzers in Power Plants** | **9** | | | |
| 9. | Introduction to analyzers, Flue gas oxygen analyzer , analysis of impurities in feed water and steam | 3 | C | 3 | 1,2 |
| 10. | Dissolved oxygen analyzer, chromatography | 3 | C | 3 | 1,2 |
| 11. | pH Meter, Fuel analyzer, pollution monitoring instruments. | 3 | C | 3 | 1,2 |
| | **UNIT IV: Control Loops in Boiler** | **9** | | | |
| 12. | Combustion Control, air/fuel ratio control, furnace draft control, drum level control | 3 | C | 4 | 1 |
| 13. | Main steam and reheat steam temp control, super heater control, attemperator, deaerator control | 4 | C,D | 4 | 1 |
| 14. | Distributed control system in power plants, interlocks in boiler operation. | 2 | C,D | 4 | 1 |
| | **UNIT V: Case Study** | **9** | | | |
| 15. | Spherical micro solar cells, Wing wave technology | 3 | C | 5 | 5,6 |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| 16. | Tree shaped wind turbines, dual rotor technology for wind turbines | 4 | C | 5 | 7,8 |
| 17. | Prototype Fast Breeder Reactor, Fast breeder reactor | 2 | C | 5 | 9 |
| | **Total contact hours** | **45** | | | |

| **LEARNING RESOURCES** | |
|---|---|
| **Sl. No.** | **TEXT BOOKS** |
| 1. | Liptak B.G., "*Instrumentation in Process Industries"*, Chilton, 1973 |
| | **REFERENCE BOOKS/OTHER READING MATERIAL** |
| 2. | Krishnaswamy.K, "*Power plant Instrumentation"*- second edition, PHI Learning Pvt. Ltd., 2011. |
| 3. | Sam .G.Duke low, "*The Control of boilers"* , instrument Society of America,1991 |
| 4. | *Modern Power Station Practice*, Vol.6, Instrumentation, Controls and Testing, Pergamon Press, Oxford, 1971. |
| 5. | » Spherical Cells Promise To Expand Applications for Solar Power |
| 6. | » Spherical Solar Cells Solve Issue of 3-D Sunlight Reception |
| 7. | http://ieeexplore.ieee.org/xpl/freeabs_all.jsp?arnumber=6404785&abstractAccess=no&userType=inst |
| 8. | http://www.dailymail.co.uk/sciencetech/article-3450924/The-wind-turbine-backyard-Wind-Tree-uses-tiny-blades-generate-electricity-light-breezes.html |
| 9. | http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.551.552&rep=rep1&type=pdf |

| **Course nature** | | | | **Theory** | | | |
|---|---|---|---|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | | | | | |
| **In-semester** | **Assessment tool** | Cycle test I | Cycle test II | Cycle Test III | Surprise Test | Quiz | **Total** |
| | **Weightage** | **10%** | **15%** | **15%** | **5%** | **5%** | **50%** |
| | | | | | | **End semester examination Weightage :** | **50%** |

| 15EI328E | VLSI System Design | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| *Co-requisite:* | NIL | | | | |
| *Prerequisite:* | 15EI201 | | | | |
| *Data Book / Codes/Standards* | NIL | | | | |
| *Course Category* | P PROFESSIONAL ELECTIVE | ELECTRONICS ENGINEERING | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | |

| **PURPOSE** | The purpose of this course is to develop a basic idea about the VLSI technology for the engineering graduates by learning the concepts of Integrated Circuit design and testing. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Learn the MOS Process Technology | a | b | d | k | | | |
| 2. | Rightly apply the concepts in real time applications and to explain the recent developments in the present area. | a | b | h | | | | |
| 3. | Learn the concepts of modeling a digital system using Hardware Description Language. | a | b | e | | | | |
| 4. | Give basic knowledge of ASIC internals | a | | | | | | |
| 5. | Impart knowledge on ASIC types and tools used in the design. | a | | | | | | |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | **UNIT I: Introduction to MOS Technology** | **9** | | | |
| 1. | Basic MOS transistors: Symbols, Enhancement mode, Depletion mode transistor operation | 2 | C,D | 1 | 1,3,4,5 |
| 2. | Basic Electrical Properties of MOS and BICMOS Circuits | 3 | C | 1 | 1,3 |
| 3. | An overview of Silicon Semiconductor technology: NMOS fabrication, CMOS fabrication: n-well, p-well, Twin tub, interconnects | 3 | C,D | 1 | 1,3 |
| 4. | Bipolar transistors, Latch up and prevention. | 1 | C | 1 | 1,3,4,5 |
| | **UNIT II: MOS Circuit Design Process** | **9** | | | |
| 5. | CMOS inverter DC characteristic, Determination of pull up to pull down ratio | 2 | C,D | 1 | 1,4,5 |
| 6. | Transmission gate NMOS and CMOS inverter, Pass transistor | 2 | D | 2,1 | 1,4,3 |
| 7. | Design of logic gates and Flip flops using CPTL, Switch logic networks | 2 | C,D,I | 2 | 1,3,4,5 |
| 8. | Stick diagrams for logic gates, Design rules and layout | 3 | C,D | 2 | 1,4,3 |
| | **UNIT III: CMOS Subsystem Design** | **9** | | | |
| 9. | Alternative Gate Circuits | 1 | C | 3 | 1,3,4 |
| 10. | Design of different types of Adders: Manchester carry chain adder, Carry Look Ahead, Carry Select Adder, Carry skip adder | 2 | C,D,I | 3 | 1,3 |
| 11. | Design of different types of multipliers: Braun array, Baugh - Wooley Array, Wallace tree multiplier, Systolic array multiplier | 3 | C,D | 3 | 1,3 |
| 12. | Latches and Flip flops | 2 | C,I | 3 | 1,3 |
| 13. | Barrel shifters, Memory Structures | 1 | D | 3 | 1 |
| | **UNIT IV: ASIC** | **9** | | | |
| 14. | Introduction, Types of ASIC, Design Flow of VLSI | 2 | C | 4 | 1,2,3 |
| 15. | Types of Simulation, Programmable ASIC | 2 | D,I | 4 | 1,2,3 |
| 16. | Floor Planning | 2 | D,I | 4 | 2 |
| 17. | Placement | 1 | D | 4 | 2 |
| 18. | Partitioning and Routing | 2 | C | 4 | 2 |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | **UNIT V: VHDL** | **9** | | | |
| 19. | Program Structure, Types and Constants, functions and Procedures | 2 | D,I | 5 | 1,3,6 |
| 20. | Libraries and Packages, Structural Design Elements | 3 | C,I | 5 | 1,3,6 |
| 21. | Dataflow design Elements, Behavioral design Elements | 2 | C,I | 5 | 1,3,6 |
| 22. | Time Dimension and Simulation, Synthesis | 2 | C,D,I | 5 | 6 |
| | **Total contact hours** | **45** | | | |

| **LEARNING RESOURCES** | |
|---|---|
| **Sl. No.** | **TEXT BOOKS** |
| 1. | Douglas Pucknell, "*Basic VLSI Design Systems and Circuits*", Prentice Hall PTR, 2005. |
| 2. | Michael John Sabestian Smith, "*Application Specific Integrated circuits*", Addison Wesley, 1st Edition, 1997. |
| | **REFERENCE BOOKS/OTHER READING MATERIAL** |
| 3. | Wayne Wolf, "*Modern VLSI Design (System on Silicon)",* Prentice Hall PTR, 2008. |
| 4. | Neil Weste& Kamran Eshrangian, "*Principles of CMOS VLSI Design*", AddisonWesley, 2nd Edition, 1998. |
| 5. | Jacob Baker, Harry, David E. Boyce, "*CMOS Circuit Design, Layout andSimulation*", Prentice Hall India, 1998. |
| 6. | Bhasker. J,"*A VHDL Primer*", Pearson Education, Third Edition, 1999. |
| 7. | John Wakerly, "*Digital Design Principles & Practices*", 3rdEdition, PearsonEducation, 2002. |

| **Course nature** | | | | **Theory** | | |
|---|---|---|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | | | | |
| **In-semester** | **Assessment tool** | Cycle test I | Cycle test II | Cycle Test III | Surprise Test | **Total** |
| | **Weightage** | **10%** | **10%** | **20%** | **5%** | **50%** |
| **End semester examination Weightage :** | | | | | | **50%** |

| 15EI421E | Wireless Sensor Networks | | | L | T | P | C |
|---|---|---|---|---|---|---|---|
| | | | | 3 | 0 | 0 | 3 |
| *Co-requisite:* | NIL | | | | | | |
| *Prerequisite:* | NIL | | | | | | |
| *Data Book / Codes/Standards* | NIL | | | | | | |
| *Course Category* | P | PROFESSIONAL ELECTIVE | ELECTRONICS ENGINEERING | | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | | | |

| **PURPOSE** | To study the fundamentals of sensor networks and the several issues in the layers. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Understand basic sensor network concepts | a | c | | | | | |
| 2. | Know physical layer issues, medium Access control Protocol | a | c | | | | | |
| 3. | Comprehend network layer characteristics and protocols | a | c | | | | | |
| 4. | Understand transport layer issues and protocol | a | c | | | | | |
| 5. | Understand the network management and Middleware services | a | | | | | | |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | **UNIT I :Introduction To Wireless Sensor Networks** | **9** | | | |
| 1. | Challenges for wireless sensor networks, Comparison of sensor network with ad hoc network | 2 | C | 1-4 | 1 |
| 2. | Single node architecture –Hardware components, energy consumption of sensor nodes | 2 | C | 1 | 1 |
| 3. | Network architecture , Sensor network scenarios, types of sources and sinks, single hop versus multi-hop networks, multiple sinks and sources, design principles | 3 | C | 1 | 1 |
| 4. | Development of wireless sensor networks– WINS, µAMPS Underwater Acoustic and Deep space networks. | 2 | C | 1 | 1 |
| | **UNIT II: Physical Layer** | **9** | | | |
| 5. | Wireless channel and communication fundamentals | 1 | C | 2 | 2 |
| 6. | 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, | 4 | C | 2 | 2,4 |
| 7. | Physical layer and transceiver design consideration in wireless sensor networks, Energy usage profile, choice of modulation, Power Management | 4 | C | 2 | 2 , 4 |
| | **UNIT III: Data Link Layer** | **9** | | | |
| 8. | MAC protocols , fundamentals of wireless MAC protocols, low duty cycle protocols and wakeup concepts | 4 | C | 4 | 2 , 4 |
| 9. | Contention, based protocols, Schedule, based protocols, Link Layer protocols ,fundamentals task and requirements ,error control ,framing, link management | 5 | C | 4 | 2 , 4 |
| | **UNIT IV: Network Layer** | **9** | | | |
| 10. | Gossiping and agent-based uni cast forwarding , Energy-efficient unicast, | 2 | C | 4 | 2 , 4 |
| 11. | Broadcast and multicast, geographic routing, mobile. | 3 | C | 4 | 2 , 4 |
| 12. | Data, centric and content, based networking ,Data ,centric routing, Data aggregation, Data, centric storage, Higher layer design issues | 3 | C | 4 | 2 , 4 |

| | | | | | |
|---|---|---|---|---|---|
| | **UNIT V: Case Study** | **9** | | | |
| 13. | Target detection tracking, Habitat monitoring, Environmental disaster monitoring, Practical implementation issues, | 4 | C | 4 | 2,4 |
| 14. | Low rate WPAN, Sensor Network Platforms and tools, Sensor node hardware, Node-level software platforms, node, level simulators. | 5 | C | 4 | 2,4 |
| | **Total contact hours** | **45** | | | |

| **LEARNING RESOURCES** | |
|---|---|
| **Sl. No.** | **TEXT BOOKS** |
| 1. | Fengzhao, Leonidas guibas, "*Wireless Sensor Networks: an information processing approach*", Elsivier publication, 2004. |
| 2. | C.S.Raghavendra Krishna, M.Sivalingam and Taribznati, "*Wireless Sensor Networks",* Springer publication, 2004. |
| | **REFERENCE BOOKS/OTHER READING MATERIAL** |
| 3. | Edgar H .Callaway "*Wireless Sensor Networks : Architecture and protocol*", CRC press |
| 4. | Holger Karl , Andreas willig ,John wiley,"*Protocol and Architecture for Wireless Sensor Networks*", publication, Jan 2006. |
| 5. | I.F. Akyildiz, W. Su, Sankarasubramaniam, E. Cayirci, "*Wireless sensor networks: a survey*", Computer Networks, Elsevier, 2002, 394 - 422. |

| **Course nature** | | | | **Theory** | | | |
|---|---|---|---|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | | | | | |
| **In-semester** | **Assessment tool** | Cycle test I | Cycle test II | Cycle Test III | Surprise Test | Quiz | **Total** |
| | **Weightage** | **10%** | **15%** | **15%** | **5%** | **5%** | **50%** |
| | | | | | | **End semester examination Weightage :** | **50%** |

| 15EI422E | Multi Sensor Data Fusion | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| *Co-requisite:* | NIL | | | | |
| *Prerequisite:* | NIL | | | | |
| *Data Book / Codes/Standards* | NIL | | | | |
| *Course Category* | P PROFESSIONAL ELECTIVE | INSTUMENTATION ENGINEERING | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | |

| **PURPOSE** | To understand the concept of sensors and multiple sensors and the inter face hierarchy using mathematical tools. To estimate the performance of practical filters. |
|---|---|

| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| At the end of the course, student will be able to | | a | c | | | | | |
| 1. | Understand the concept of sensors, architecture, mathematical tools. | a | b | c | e | | | |
| 2. | Understand the algorithms for multi sensor data fusion. | a | b | | | | | |
| 3. | Understand the practical Filter. | a | | | | | | |
| 4. | Understand the performance of data structures. | a | c | | | | | |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | **UNITI : Multi Sensor Data Fusion** | **9** | | | |
| 1. | Introduction, sensors and sensor data , Use of multiple Sensors, Fusion applications | 1 | C | 1-4 | 1, 2 |
| 2. | The inference hierarchy, output data, Data fusion model. | 2 | C | 1-2 | 1, 2, 3 |
| 3. | Architectural concepts and issues, Benefits of data fusion | 2 | C,D | 1-3 | 1,2 |
| 4. | Mathematical tools used: Algorithms, co-ordinate transformations rigid body motion, Dependability and Markov chains, Meta – heuristics. | 4 | C,D,I | 1-3 | 1,2,3 |
| | **UNIT II : Taxonomy Of Algorithms** | **9** | | | |
| 5. | Taxonomy of algorithms for multi sensor data fusion | 3 | C,D | 2,3 | 1,2,3 |
| 6. | Data association | 3 | C,D | 1 | 1,2,4 |
| 7. | Identity declaration. | 4 | D,I | 1-2 | 1,2,3 |
| | **UNIT III :Kalman Filtering And Estimation** | **9** | | | |
| 8. | Estimation: Kalman filtering | 1 | C,D,I | 1-3 | 1, 2, 3 |
| 9. | Practical aspects of Kalman filtering extended Kalman filters. | 3 | C,D,I | 1-3 | 1,2,4 |
| 10. | Decision levels identify fusion | 3 | C,D | 1-3 | 1,2,4 |
| 11. | Knowledge based approaches. | 2 | C | 1-3 | 1,2,4 |
| | **UNIT IV: Data Fusion And Estimation** | **9** | | | |
| 12. | Data information filter, extended information filter | 1 | C | 1-4 | 1,3,4 |
| 13. | Decentralized and scalable decentralized estimation | 2 | D,I | 1-3 | 1, 2, 3 |
| 14. | Sensor fusion and approximate agreement | 2 | D,I | 1-3 | 1, 2, 3 |
| 15. | Optimal sensor fusion using range trees recursively | 2 | C,D,I | 1-2 | 1, 2,3 |
| 16. | Distributed dynamic sensor fusion | 2 | C,D | 1-2 | 1, 2, 3 |
| | **UNIT V : Application Of Data Fusion System** | **9** | | | |
| 17. | High performance data structures: Tessellated, trees, graphs and function | 1 | D,I | 1-2 | 1,3, 4 |
| 18. | Representing ranges and uncertainty in data structures | 4 | C | 1-3 | 1, 3, 4 |
| 19. | Designing optimal sensor systems within dependability bounds | 4 | C | 1-3 | 1, 2, 3 |
| 20. | Implementing data fusion system | 1 | C,I | 1-4 | 1, 3, 4 |
| | **Total contact hours** | **45** | | | |

| LEARNING RESOURCES | |
|---|---|
| **Sl. No.** | **TEXT BOOKS** |
| 1. | David L. Hall, "*Mathematical techniques in Multisensor data fusion*", Artech House, Boston, 1992. |
| 2. | R.R. Brooks and S.S. Iyengar, "*Multisensor Fusion: Fundamentals and Applications with Software*", Prentice Hall Inc., New Jersey, 1998. |
| | **REFERENCE BOOKS/OTHER READING MATERIAL** |
| 3. | Arthur Gelb, "*Applied Optimal Estimation"*, The M.I.T. Press, 1982. |
| 4. | James V. Candy, *"Signal Processing: The Model Based Approach"*, McGraw–Hill Book Company, 1987. |

| **Course nature** | | | | **Theory** | | | |
|---|---|---|---|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | | | | | |
| In-semester | Assessment tool | Cycle test I | Cycle test II | Cycle Test III | Surprise Test | Quiz | Total |
| | Weightage | 10% | 15% | 15% | 5% | 5% | 50% |
| | | | | | | End semester examination Weightage : | 50% |

| 15EI423E | Bio-MEMS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| *Co-requisite:* | NIL | | | | |
| *Prerequisite:* | NIL | | | | |
| *Data Book / Codes/Standards* | NIL | | | | |
| *Course Category* | P PROFESSIONAL ELECTIVE | ELECTRONICS ENGINEERING | | | |
| *Course designed by* | Department of Electronics & Instrumentation Engineering | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | |

| **PURPOSE** | To acquire in depth knowledge in the working, design, fabrication of MEMS devices in Bio and Medical Applications. |
|---|---|

| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Understand the basic concept of silicon fabrication | a | d | | | | | |
| 2. | Design of the micro devices for medical applications | a | c | d | k | | | |
| 3. | Design of lab on chip | a | c | d | k | | | |
| 4. | Design of micro sensors for detection and application in medical field. | a | c | d | k | | | |
| 5. | Expose to the concept of current trend in the technologies and advancements | a | d | | | | | |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | **UNIT I: Introduction to BIOMEMS** | **9** | | | |
| 1. | Bio-MEMS, Biocompatibility | 1 | C | 1 | 1 |
| 2. | Silicon Micro Fabrication | 4 | C | 1 | 1 |
| 3. | Soft Fabrication Techniques | 3 | C | 1 | 1 |
| 4. | Polymer Materials | 1 | C | | 1 |
| | **UNIT II: Microfluidic Principles** | **9** | | | 1 |
| 5. | Introduction, Transport processes, Electrokinetic phenomena | 3 | C | 1,2 | 1 |
| 6. | Micro valves | 2 | C,D,I | 1,2 | 1 |
| 7. | Micro mixers | 2 | C,D,I | 1,2 | 1 |
| 8. | Micro pumps | 2 | C,D,I | 1,2 | 1 |
| | **UNIT III: Micro actuators and Drug Delivery** | **9** | | | |
| 9. | Introduction, Activation Methods | 4 | C,D | 1,3 | 1 |
| 10. | Micro actuators for microfluidics | 1 | C,D,I | 1,3 | 1 |
| 11. | Equivalent circuit representation | 1 | C,D,I | 1,3 | 1 |
| 12. | Drug Delivery | 3 | C,D,I | 1,3 | 1 |
| | **UNIT IV: Micro-Total-Analysis System** | **9** | | | |
| 13. | Lab on chip | 1 | C,D,I | 1,4 | 1 |
| 14. | Capillary Electrophoresis Arrays, Cell, Molecule and particle handling | 2 | C,D,I | 1,4 | 1 |
| 15. | Surface modification, micro spheres, cell-based bio-assay system | 3 | C,D,I | 1,4 | 1 |
| 16. | Detection and Measurement Methods | 3 | C,D | | 1 |
| | **UNIT V: Emerging BIOMEMS Technologies** | **9** | | | |
| 17. | Minimally invasive surgery, POC diagnosis, Cardiovascular | 3 | C | 5 | 1 |
| 18. | Diabetes, endoscopy, neuro sciences, oncology | 4 | C | 5 | 1 |
| 19. | Ophthalmology, dermabrasion | 2 | C | 5 | 1 |
| | **Total contact hours** | **45** | | | |

| LEARNING RESOURCES | |
|---|---|
| **Sl. No.** | **TEXT BOOKS** |
| 1. | Steven S. Saliterman," *Fundamentals of BioMEMS and Medical Microdevices*", SPIE Press, 2006 |
| | **REFERENCE BOOKS/OTHER READING MATERIAL** |
| 2. | Gregory Kovacs, "*Micro machined Transducers*", Tata McGraw Hill,1998 |
| 3. | Stephen D.Senturia, "*Microsystems Design*",Springer,2001 |
| 4. | Tai - Rai Hsu, "*MEMS and Microsystems: Design and Manufacturing*", Tata MC Graw Hill, Edition 2002 |
| 5. | Chang Liu, "*Foundations of MEMS*",Pearson,2012 |
| 6. | Deepak Uttamchandani,"*Handbook of MEMS for wireless and mobile applications*", Woodhead Publishing,2013 |
| 7. | Marc J.Madou,"*Fundamentals of Microfabrication*", CRC Press; 3rd edition,2011 |

| **Course nature** | | | | **Theory** | | | |
|---|---|---|---|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | | | | | |
| **In-semester** | **Assessment tool** | Cycle test I | Cycle test II | Cycle Test III | Surprise Test | Quiz | **Total** |
| | **Weightage** | **10%** | **15%** | **15%** | **5%** | **5%** | **50%** |
| **End semester examination Weightage :** | | | | | | | **50%** |

| 15EI425E | Applications of MEMS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| *Co-requisite:* | NIL | | | | |
| *Prerequisite:* | NIL | | | | |
| *Data Book / Codes/Standards* | NIL | | | | |
| *Course Category* | P PROFESSIONAL ELECTIVE | ELECTRONICS ENGINEERING | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | |

| **PURPOSE** | To acquire in depth knowledge in the working, design, fabrication of MEMS devices in various fields. |
|---|---|

| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Understand the basic concept of fabrication | a | | d | | | | |
| 2. | Design of the micro devices for sensing and actuating applications | a | c | d | k | | | |
| 3. | Design of devices for microfluidic applications | a | c | d | k | | | |
| 4. | Design of sensors for RF MEMS application | a | c | d | k | | | |
| 5. | Expose to the concept of current trend in the technologies and advancements | a | | d | | | | |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | **UNIT I: Introduction To MEMS** | **9** | | | |
| 1. | Basic road map, Benefits of Miniaturization & Scaling | 1 | C | 1 | 1 |
| 2. | Materials, Basic Fabrication Process | 2 | C | 1 | 1 |
| 3. | Lithography, Pattern Transfer | 3 | C | 1 | 1 |
| 4. | Various deposition Techniques | 3 | C | 1 | 1 |
| | **UNIT II: Sensing & Actuation** | **9** | | | |
| 5. | Introduction, Electrostatic Sensing & Actuation | 3 | C,D,I | 1,2 | 1 |
| 6. | Thermal Sensing & Actuation | 2 | C,D,I | 1,2 | 1 |
| 7. | Pizeoresistive Sensors | 2 | C,D,I | 1,2 | 1 |
| 8. | Pizeoelectric Sensing & Actuation | 2 | C,D,I | 1,2 | 1 |
| | **UNIT III: Micro Fluidics Applications** | **9** | | | |
| 9. | Introduction, Reynolds Number & Viscosity | 1 | C,I | 1,3 | 1 |
| 10. | Methods of fluid movement in channels, Pressure driven flow | 3 | C,I | 1,3 | 1 |
| 11. | Electro kinetics flow, Electrophoresis &Dielectrophoresis | 3 | C,I | 1,3 | 1 |
| 12. | Design – Channels | 1 | C,D,I | 1,3 | 1 |
| 13. | Valves | 1 | C,D,I | 1,3 | 1 |
| | **UNIT IV: RF MEMS Application** | **9** | | | |
| 14. | Introduction, Switches, Varactors | 3 | C,D,I | 1,4 | 2 |
| 15. | Antenna, Reliability | 2 | C,D,I | 1,4 | 2 |
| 16. | Applications – intra ocular, Drug Delivery, Automotive | 4 | C,D,I | 1,4 | 2 |
| | **UNIT V: Case Studies** | **9** | | | |
| 17. | BP – Sensor, Microphone, Acceleration Sensor | 3 | C,D | 5 | 4,5,6 |
| 18. | Gyroscope, Optical sensors, Micro Pump, Micro Motors | 4 | C,D | 5 | 4,5,6 |
| 19. | Gear Trains, Inertial Sensors | 2 | C,D | 5 | 4,5,6 |
| | **Total contact hours** | **45** | | | |

| LEARNING RESOURCES | |
|---|---|
| **Sl. No.** | **TEXT BOOKS** |
| 1. | Chang Liu, "*Foundations of MEMS*",Pearson,2012 |
| 2. | Deepak Uttamchandani,"*Handbook of MEMS for wireless and mobile applications*", Woodhead Publishing, 2013. |
| 3. | Marc J.Madou,"*Fundamentals of Microfabrication*",CRC Press; 3rd Edition, 2011 |
| | **REFERENCE BOOKS/OTHER READING MATERIAL** |
| 4. | Gregory Kovacs, *"Micro machined Transducers*", Tata McGraw Hill,1998 |
| 5. | Stephen D.Senturia, "*Microsystems Design*", Springer, 2001 |
| 6. | Tai - Rai Hsu, "*MEMS and Microsystems: Design and Manufacturing*", Tata Mc Graw Hill, 2002. |

| **Course nature** | | | | **Theory** | | | |
|---|---|---|---|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | | | | | |
| **In-semester** | **Assessment tool** | Cycle test I | Cycle test II | Cycle Test III | Surprise Test | Quiz | **Total** |
| | **Weightage** | **10%** | **15%** | **15%** | **5%** | **5%** | **50%** |
| | | | | | **End semester examination Weightage :** | | **50%** |

| 15EI426E | Non-Linear System | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| *Co-requisite:* | NIL | | | | |
| *Prerequisite:* | NIL | | | | |
| *Data Book / Codes/Standards* | NIL | | | | |
| *Course Category* | P PROFESSIONAL ELECTIVE | CONTROL ENGINEERING | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | |

| **PURPOSE** | Nonlinear control deals with the analysis and control of systems that are non linear, time-varying, or both. To investigate how non linear systems can be analyzed swell as controlled. |
|---|---|

| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Understand the concepts of Non linear Systems | a | e | | | | | |
| 2. | Design describing function of Non linear Systems | a | e | | | | | |
| 3. | Design non linear control systems using phase plane analysis. | a | e | | | | | |
| 4. | Design stability of non linear system | a | e | | | | | |
| 5. | Design non linear control system design | a | e | | | | | |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | **UNIT I: Linear and Non Linear Systems** | **7** | | | |
| 1. | Introduction of linear and non linear systems, Non linear system behavior, Common nonlinearities in Control systems. | 2 | C | 1 | 1,2 |
| 2. | Autonomy, analysis and design methods of Non-linear control systems. | 4 | C,D, | 1 | 1,2 |
| 3. | Common physical non linear ties, characteristics | 1 | C,D | 1 | 1,2 |
| | **UNIT II: Describing Function** | **9** | | | |
| 4. | Describing function fundamentals, Describing functions of common non linear ties. | 2 | C | 2 | 1,3,4, |
| 5. | Dead zone and saturation non linearity, Relay, Backlash, | 4 | C,D | 2 | 1,2,3 |
| 6. | Describing function analysis of nonlinear systems: Existence and stability of limit cycles. | 3 | D | 2 | 1,2,3 |
| | **UNIT III: Phase Plane Analysis** | **9** | | | |
| 7. | Singular points- Construction of phase plane using isoclines, and delta methods. | 5 | C,D | 3 | 1,3 |
| 8. | Existence of limit cycles: Poincare index and Bendixon theorems, Stability. | 4 | C,D | 3 | 1,3 |
| | **UNIT IV: LYAPUNOV Stability Theorem** | **10** | | | |
| 9. | Concepts of stability, Linearization and Local Stability, Liapunov's Direct method. | 5 | C | 4 | 1,2,4 |
| 10. | Kravsovski's Method, Variable Gradient Method. | 5 | D | 4 | 1,2,4 |
| | **UNIT V: Nonlinear Control Systems Design and Applications** | **10** | | | |
| 11. | Method of feedback Linearization, Mathematical tools. | 3 | D | 5 | 1,3,4 |
| 12. | Input- state Linearization of SISO systems, Input output Linearization of SISO Systems. | 3 | C,D | 5 | 1,3,4 |
| 13. | Basic concepts of variable structure systems and design. | 2 | C,D | 5 | 1,3,4 |
| 14. | Sliding surfaces, Conditions for existence of sliding regions- Case study. | 2 | C,D | | 1,3,4 |
| | **Total contact hours** | **45** | | | |

| LEARNING RESOURCES | |
|---|---|
| **Sl. No.** | **TEXT BOOKS** |
| 1. | Jean Jacques Slotine and WeipingLi, "*Applied Non linear Control*", Prentice HallInc., 2000. |
| 2. | Zoran Vukic, Ljubomir Kuljaca, Dali Donlagic and Sejid Tesnjak, "*Nonlinear Control Systems*", Marcel Dekker, Inc, 2003. |
| | **REFERENCE BOOKS/OTHER READING MATERIAL** |
| 3. | Shankar Sastry, "*Nonlinear systems: Analysis, Stability and Control*", Springer-Verlag, Newyork, Inc, 2003. |
| 4. | Horacio J.Marquez, "*Non linear Control Systems: Analysis and Design*", John Wiley & Sons Inc, 2003. |

| **Course nature** | | | | **Theory** | | | |
|---|---|---|---|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | | | | | |
| **In-semester** | **Assessment tool** | Cycle test I | Cycle test II | Cycle Test III | Surprise Test | Quiz | **Total** |
| | **Weightage** | **10%** | **15%** | **15%** | **5%** | **5%** | **50%** |
| | | | | | **End semester examination Weightage :** | | **50%** |

| 15EI427E | Real Time Embedded System | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| *Co-requisite:* | NIL | | | | |
| *Prerequisite:* | NIL | | | | |
| *Data Book / Codes/Standards* | NIL | | | | |
| *Course Category* | P PROFESSIONAL ELECTIVE | ELECTRONICS ENGINEERING | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | |

| **PURPOSE** | To enable the students to understand the basic concepts of microcontrollers and Embedded systems to implement in real time applications. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Derive the ability to design and implement any microcontroller based system after undergoing this course. | b | c | d | | | | |
| 2. | Familiar in the architecture and instruction set of the following microcontrollers Renesas R8C and Texas MSP430 microcontrollers. | b | c | | | | | |
| 3. | Appreciate the advantages in using RISC microprocessors / microcontrollers in engineering applications | b | c | | | | | |
| 4. | Understand the concepts of Microcontrollers and programming them. | b | c | d | | | | |
| 5. | Understand the real time application approach using microcontrollers | c | d | | | | | |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | **UNIT I: Review of Embedded Hardware** | **9** | | | |
| 1. | Introduction to Embedded systems, Microprocessors, Buses Interrupts | 2 | C | 1,4 | 1,3,4,5,6,7 |
| 2. | Microprocessor Architecture, Interrupts Basics, Shared-Data Problem, Interrupt Latency, Examples of Embedded System. | 3 | C | 1,4 | 1,3,4,5,6,7 |
| 3. | RISC Vs CISC, RISC properties and evolution, Advanced RISC microcontrollers, PIC 8-bit microcontrollers | 4 | C | 3,4 | 1,2,3,4,5 |
| | **UNIT II: R8C 16-BIT Microcontroller** | **9** | | | |
| 4. | The R8CArchitecture, CPU Registers, On-Chip Peripherals | 2 | C | 2,4 | 1,3,4,5 |
| 5. | Instruction Set | 4 | C,I | 2,3,4 | 1,3,4,5 |
| 6. | R8C Tiny Development Tools, ADC, PWM, UART, Timer Interrupts, System design using R8C Microcontroller. | 3 | C,I | 2,3,4 | 1,3,4,5 |
| | **UNIT III: MSP430 16 - BIT Microcontroller** | **9** | | | |
| 7. | The MSP430 Architecture, CPU Registers, On-Chip Peripherals | 2 | C | 2,4 | 1,3,4,5 |
| 8. | Instruction Set | 4 | C,I | 2,4 | 1,3,4,5 |
| 9. | MSP430Development Tools, ADC, PWM, UART, Timer Interrupts, System design using MSP430Microcontroller. | 3 | C,I | 2,4 | 1,3,4,5 |
| | **UNIT IV: Embedded Software Development** | **9** | | | |
| 10. | Cross development tools, Debugging techniques | 3 | C | 4,5 | 1,3,4,5 |
| 11. | Real-time Operating System | 3 | C,I | 4,5 | 1,3,4,5 |
| 12. | Memory Management, Scheduling techniques | 3 | C | 4,5 | 1,3,4,5 |
| | **UNIT V: System Development** | **9** | | | |
| 13. | Microcontroller based System Design, Peripheral Interfacing, Inter-Integrated Circuit Protocol for RTC, EEPROM, ADC/DAC, CAN BUS interfacing | 4 | C,I | 4,5 | 1,3,4,5 |
| 14. | Application in Instrumentation engineering, Robotics and control engineering | 5 | C,I | 4,5 | 1,3,4,5 |
| | **Total contact hours** | **45** | | | |

| LEARNING RESOURCES | |
|---|---|
| **Sl. No.** | **TEXT BOOKS** |
| 1. | Julio Sanchez Maria P.Canton, "*Microcontroller Programming"*: The microchip PIC, CRC Press, Taylor & Francis Group, 2007. |
| 2. | Andrew N. Sloss, Dominic Symes, Chris Wright and John Rayfield, "*ARM System Developer's Guide*, Designing and Optimizing System Software", Elsevier, 2004. |
| | **REFERENCE BOOKS/OTHER READING MATERIAL** |
| 3. | D. E. Simon, "*An Embedded Software Primer",* Addison-Wesley, 1999. |
| 4. | Wayne Wolf, "Computers as Components: *Principles of Embedded Computing System Design*", Morgan Kaufman Publishers, 2006. |
| 5. | John H.Davis , "MSP 430 *Micro controller basics", Elsevier*, 2008. |
| 6. | Doughlas.V.Hall, "*Microprocessor and Interfacing*: Programming and Hardware", Revised 2nd edition, McGraw Hill, 1992. |
| 7. | Ray.K and Bhurchandi.K.M, "*Advanced Microprocessors and Peripherals – Architectures, Programming and Interfacing*", Tata McGraw Hill, 2002 Reprint. |

| **Course nature** | | | | **Theory** | | | |
|---|---|---|---|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | | | | | |
| **In-semester** | **Assessment tool** | Cycle test I | Cycle test II | Cycle Test III | Surprise Test | Quiz | **Total** |
| | **Weightage** | **10%** | **15%** | **15%** | **5%** | **5%** | **50%** |
| | | | | | **End semester examination Weightage :** | | **50%** |

| 15EI428E | Automotive Systems | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| *Co-requisite:* | NIL | | | | |
| *Prerequisite:* | NIL | | | | |
| *Data Book / Codes/Standards* | NIL | | | | |
| *Course Category* | P PROFESSIONAL ELECTIVE | ELECTRONICS ENGINEERING | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | |

| **PURPOSE** | To understand the extent and nature of electronic circuitry in automotive systems including monitoring and control circuits for engines, emission control system, ignition systems, fuel systems including carbureted and fuel injected. Applications of sensors on automotive systems measurement for better insight into the course. |
|---|---|

| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Understand the automotive domain and electronic systems in it. | a | d | f | | | | |
| 2. | Understand the effect of electromagnetic interference. | a | c | e | | | | |
| 3. | Identify the sensor and actuator technologies involved in a car. | a | c | h | | | | |
| 4. | Analyze the various electrical systems and electronics involved in it for upgraded operation. | a | c | d | e | h | | |
| 5. | Update his/her knowledge with new systems on safety, security and body of a car. | a | c | d | e | h | | |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | **UNIT I: Fundamentals Of Automotive Electronics** | **9** | | | |
| 1. | Introduction to Automotive Electronics, Shop safety | 2 | C | 1 | 1,3 |
| 2. | Multiplexed Networking | 2 | C | 1 | 1,3 |
| 3. | Electromagnetic Interference and Electromagnetic Compatibility | 2 | C | 2 | 1,3 |
| 4. | Use of Diagnostic Equipment, Case study 1 | 3 | C | 1 | 1,3,4 |
| | **UNIT II: Automotive Sensors and Actuators** | **9** | | | |
| 5. | Vehicle Body Sensors | 2 | C | 3 | 1,5,7,8,9 |
| 6. | Power Train Sensors | 2 | C | 3 | 1,5,7,8,9 |
| 7. | Chassis Sensors | 2 | C | 3 | 1,5,7,8,9 |
| 8. | Automotive Actuator Technologies | 3 | C | 3 | 1,5,7,8,9 |
| | **UNIT III: Engine Systems** | **9** | | | |
| 9. | Starting Systems, Advanced starting technology | 2 | C | 3,4 | 1,3 |
| 10. | Charging systems, Advanced charging system technology | 2 | C | 3,4 | 1,3 |
| 11. | Ignition Systems, Advanced Ignition system technology | 3 | C | 3,4 | 1,3 |
| 12. | Fuel Injection systems, Advanced Fuel Injection technology | 2 | C | 3,4 | 1,3 |
| | **UNIT IV: Safety and Security Systems** | **9** | | | |
| 13. | Tire pressure monitoring systems, Two wheeler and Four wheeler security systems, Anti-lock braking system, Traction Control System | 2 | C | 3,4,5 | 1,2,3,5,6,7 |
| 14. | Adaptive Cruise Control, Parking guide systems, Air Bag System, Reversible Seat Belt Pre-tensioner, Electronic Power Steering systems | 4 | C | 3,4,5 | 1,2,3,5,6,7 |
| 15. | Collision Avoidance System, Case study 2 | 3 | C | 3,4,5 | 1-7 |
| | **UNIT V: Body Electronics** | **9** | | | |
| 16. | Power Windows, Central Locking System, Power Seat, Automatic Wiper systems | 3 | C | 3,4,5 | 1,2,3,5,6,7 |
| 17. | Electronic Vehicle Immobiliser, AntiTheft Alarm System, Computer Controlled Air Conditioning Systems, On Board Diagnostics | 3 | C | 3,4,5 | 1,2,3,5,6,7 |
| 18. | Smart Window Lift Control Module, Roof Control Module, Case study 3 | 3 | C | 3,4,5 | 1-7 |
| | **Total contact hours** | **45** | | | |

| LEARNING RESOURCES | |
|---|---|
| **Sl. No.** | **TEXT BOOKS** |
| 1. | Tom Denton, "*Automotive Electricals / Electronics System and Components"*, 3rd Edition,2004. |
| 2. | BOSCH, "*Automotive Electrics, Automotive Electronics: Systems & Components*, BOSCH", 4th Edition, 2005. |
| 3. | Jack Erjavec," *A Systems Approach to Automotive Technology*" Cengage Learning, 2009. |
| 4. | Edited by Ronald K.Jurgen, "*Automotive Electronics Reliability* "Vol.2 , SAE International, 2010 |
| | **REFERENCE BOOKS/OTHER READING MATERIAL** |
| 5. | Robert Bosch Gmbh, "*Automotive Electricals Electronics System and Components"*, 4th Edition, 2004. |
| 6. | Robert Bosch *, "Automotive Hand Book"*, Bently Publishers, 1997. |
| 7. | BOSCH., "*Automotive Sensors"*, 2002 |
| 8. | Ernest O. Doebelin, "*Measurement Systems – Application and Design"*, ,McGraw-Hill, 4th Edition 2000 |
| 9. | Ronald K. Jurgen, "*Sensors and Transducers*", SAE, 2nd Edition, 2003. |

| **Course nature** | | | | **Theory** | | | |
|---|---|---|---|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | | | | | |
| **In-semester** | **Assessment tool** | Cycle test I | Cycle test II | Cycle Test III | Surprise Test | Quiz | **Total** |
| | **Weightage** | **10%** | **15%** | **15%** | **5%** | **5%** | **50%** |
| | | | | | **End semester examination Weightage :** | | **50%** |

| 15EI429E | Soft Computing | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| *Co-requisite:* | NIL | | | | |
| *Prerequisite:* | NIL | | | | |
| *Data Book / Codes/Standards* | NIL | | | | |
| *Course Category* | P PROFESSIONAL ELECTIVE | CONTROL ENGINEERING | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | |

| **PURPOSE** | To gain knowledge in artificial networks for developing Engineering control strategies. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Understand the concept of artificial techniques for design of controllers. | a | d | | | | | |
| 2. | Improve the controller design by enhancing the performance of output. | c | | | | | | |
| 3. | Work with imprecise/ uncertain solution data for solving problems. | d | h | | | | | |
| 4. | Optimize the performance of control design. | e | f | | | | | |
| 5. | Apply the knowledge of artificial control tools to any control application.(FLC and Neural toolbox) | b | k | | | | | |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | **UNIT I: Artificial Neural Networks** | **9** | | | |
| 1. | Biological Neuron and Introduction to ANN, Classification of Networks. | 1 | C | 1 | 1 |
| 2. | Learning algorithms, Different network architectures | 1 | C | 1 | 1 |
| 3. | Linear separability, weights, activation function, bias and threshold. | 1 | C | 1 | 1 |
| 4. | McCulloch Pitt neuron, Hebb net algorithm, Perceptron learning convergence | 3 | C,D | 2 | 1 |
| 5. | Back propagation network, Hopfield Networks and Networks based on competition. | 3 | C,D | 2 | 1 |
| | **UNIT II: Fuzzy Logic Controller** | **9** | | | |
| 6. | Fuzzy sets, Basic definition and terminology, Crisp set Vs, Fuzzy set. | 1 | C | 3 | 2 |
| 7. | Fuzzy block diagram, Member Function Formulation and Parameterization | 3 | C | 1 | 2 |
| 8. | Fuzzy relations. Fuzzy If, then Rules and Fuzzy reasoning, Fuzzy Inference system | 3 | C | 1 | 2 |
| 9. | Fuzzy cardinality, Numerical in Fuzzy operation. | 2 | CD | 4 | 2 |
| | **UNIT III: Genetic Algorithm** | **9** | | | |
| 10. | Basic concepts of GA, GA adaptation to computing and GA terminologies. | 2 | C | 1 | 3,4 |
| 11. | Gradient and non, gradient search algorithms, GA operators. | 2 | C | 1 | 3,4 |
| 12. | Simulated Annealing, Random Search, Downhill Simplex Search. | 3 | D | 4 | 4 |
| 13. | Particle Swarm Optimization, Ant Colony and Tabu search techniques | 2 | I | 4 | 4 |
| | **UNIT IV: Integrated Artificial Systems** | **9** | | | |
| 14. | Adaptive Neuro Fuzzy Inference system (ANFIS) | 3 | C,D | 4,5 | 1,2 |
| 15. | Basic understanding of Fuzzy- Neural modeling | 3 | C,D | 4,5 | 1,2 |
| 16. | Fuzzy- GA systems | 3 | C,D | 4,5 | 2-4 |
| | **UNIT V: Control Application Of Artificial Techniques In Real Time Systems** | **9** | | | |
| 17. | Neural Network Control for a Coupled Tank Process | 2 | D, I | 1-5 | 7 |
| 18. | Fuzzy Logic Controller for Inverted Pendulum | 2 | D, I | 1-5 | 7 |
| 19. | GA application to Power System Optimization Problems | 2 | D, I | 1-5 | 7 |
| 20. | Journal papers on PSO and ANFIS techniques. | 3 | D, I | 1-5 | 7 |
| | **Total contact hours** | **45** | | | |

| LEARNING RESOURCES | |
|---|---|
| **Sl. No.** | **TEXT BOOKS** |
| 1. | Laurance Fausett, *"Fundamentals of Neural Networks"*, Pearson Education, 2004 |
| 2. | Timothy J. Ross, "*Fuzzy Logic with Engineering Applications"*, McGraw Hill, 1997 |
| 3. | Rajsekhar and Pai, "*Neural Networks, Fuzzy logic and Genetic Algorithm: Synthetic and Applications*", Pearson Education |
| | **REFERENCE BOOKS/OTHER READING MATERIAL** |
| 4. | David E.Goldberg, "*Genetic Algorithms in Search, Optimization, and Machine Learning*", Pearson Education, 2009. |
| 5. | R.Eberhart, P.Simpson and R.Dobbins, "*Computational Intelligence - PC Tools*", AP Professional, Boston, 1996. |
| 6. | AmitKonar, "*Artificial Intelligence and Soft Computing Behaviour and Cognitive model of the human brain*", CRC Press, 2008. |
| 7. | http://ip-science.thomsonreuters.com/mjl/publist_sciex.pdf |

| **Course nature** | | | | **Theory** | | | |
|---|---|---|---|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | | | | | |
| In-semester | Assessment tool | Cycle test I | Cycle test II | Cycle Test III | Surprise Test | Quiz | Total |
| | Weightage | 10% | 15% | 15% | 5% | 5% | 50% |
| **End semester examination Weightage :** | | | | | | | **50%** |

| 15EI430E | Adaptive Control | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| *Co-requisite:* | NIL | | | | |
| *Prerequisite:* | NIL | | | | |
| *Data Book / Codes/Standards* | NIL | | | | |
| *Course Category* | P PROFESSIONAL ELECTIVE | CONTROL ENGINEERING | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | |

| **PURPOSE** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Give an introduction and Overview of the theoretical approach in adaptive control. | a | b | | | | | |
| 2. | Have an adequate knowledge in adaptive control design, analysis, and application of a wide variety of algorithms. | a | b | | | | | |
| 3. | Give the knowledge on implementation of adaptive controllers in real time processes. | a | c | k | | | | |
| 4. | Introduce the student in research in adaptive control that can be used to manage dynamical systems with unknown parameters. | e | k | | | | | |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | **UNIT I: Introduction** | **9** | | | |
| 1. | Introduction to Adaptive Control, Linear Feedback, effects of process variations, adaptive schemes and related adaptive control problem. | 1 | C | 1 | 1 |
| 2. | Real Time parameter estimation, Least squares and regression models, Estimating parameters in dynamic systems, simulation of recursive estimation. | 2 | C | 1 | 1 |
| 3. | Deterministic Self tuning regulators, Pole placement design, Direct and Indirect self-tuning regulators, Stochastic and Predictive self-tuning regulators. | 3 | C | 1 | 1 |
| 4. | Unification of Direct self-tuning Regulators, Linear Quadratic STR, Adaptive Predictive Control. | 3 | C | 1,2 | 1 |
| | **UNIT II: Model Reference Adaptive Systems** | **9** | | | |
| 5. | Introduction, MIT rule, Determination of Adaptive gain. | 2 | C,D | 1,2 | 1 |
| 6. | Lyapunov Theory, Design of MRAS using Lyapunov Theory, BIBO Systems | 3 | C,D | 1,2 | 1 |
| 7. | Relations between MRAS and STR, Non- linear systems. | 2 | C,D | 1,2 | 1 |
| 8. | Non- linear Dynamics, adaptation of feed forward gain, Stability of direct Discrete time algorithms. | 2 | C,D | 1,2 | 1 |
| | **UNIT III : Auto Tuning, Gain Scheduling and Robust Controller** | **9** | | | |
| 9. | Introduction to auto- tuning, PID control, Auto- tuning techniques. | 1 | C,I | 2,3 | 1,2 |
| 10. | Transient response methods in auto tuning, Methods based on Relay feedbacks, Relay Oscillations. | 2 | C,I | 3 | 1,2 |
| 11. | Introduction and Principle of Gain Scheduling, Design of gain schedule controllers, Non-linear transformations in gain scheduling | 3 | C | 3 | 1,2 |
| 12. | Robust high gain feedback control, self oscillating adaptive systems, Variable structure systems. | 3 | C,I | 3 | 1,2 |
| | **UNIT IV: Practical Issues In Design Of Adaptive Control Systems** | **9** | | | |
| 13. | Introduction to controller implementation and controller design. | 2 | D,O | 3,4 | 1 |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| 14. | Solving the Diophantine equation, Estimator implementation, Square root algorithm. | 4 | D,O | 3,4 | 1 |
| 15. | Interaction of Estimator and Control, Prototype algorithm, Operational issues. | 3 | D,O | 3,4 | 1 |
| | **UNIT V: Applications** | **9** | | | |
| 16. | Journal Papers in Model Reference adaptive systems and Self tuning Controller Design | 3 | I,O | 1-4 | 3,4 |
| 17. | Journal Papers in Non linear Transformations, Application of Auto, tuning techniques, Methods based on Relay feedback Practical Issues. and implementation | 3 | I,O | 1-4 | 3,4 |
| 18. | Chemical Reactor Control, Temperature Control in a Distillation Column. | 3 | I,O | 1-4 | 3,4 |
| | **Total contact hours** | **45** | | | |

| **LEARNING RESOURCES** | |
|---|---|
| **Sl. No.** | **TEXT BOOKS** |
| 1. | Astrom& Bjorn Wittenmark, "*Adaptive Control"*, Addison Wesley- 2nd edition. |
| 2. | S.Sastry&M.Bodson,"*Adaptive Control: Stability, Convergence, and Robustness"*, Prentice Hall- 2011. |
| | **REFERENCE BOOKS/OTHER READING MATERIAL** |
| 3. | Ljung.L, "*System Identification*: *Theory for the User*", Prentice Hall- 2nd edition. |
| 4. | http://ip-science.thomsonreuters.com/mjl/publist_sciex.pdf |

| **Course nature** | | | | **Theory** | | | |
|---|---|---|---|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | | | | | |
| In-semester | Assessment tool | Cycle test I | Cycle test II | Cycle Test III | Surprise Test | Quiz | Total |
| | Weightage | 10% | 15% | 15% | 5% | 5% | 50% |
| End semester examination Weightage : | | | | | | | 50% |

| 15EI431E | System Identification | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| *Co-requisite:* | NIL | | | | |
| *Prerequisite:* | NIL | | | | |
| *Data Book / Codes/Standards* | NIL | | | | |
| *Course Category* | P PROFESSIONAL ELECTIVE | CONTROL ENGINEERING | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | |

| **PURPOSE** | To acquire knowledge about different systems, system identification techniques, and adaptive control policies and applications. |
|---|---|

| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Familiarize various model structures for system identification | a | b | | | | | |
| 2. | Acquire knowledge on control of discrete time system models | a | c | e | | | | |
| 3. | Analyze the concept of recursive plant model identification in open-loop and closed loop. | a | | | | | | |
| 4. | Understand different control policies of adaptive control | a | b | c | | | | |
| 5. | Get knowledge on the practical aspects of system identification and control | a | | | | | | |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | **UNIT I: Models for Identification** | **9** | | | |
| 1. | Introduction of different systems | 1 | C | 1 | 1-3 |
| 2. | Models of LTI systems: Linear Models, State space Models, OE model, Model sets, Structures and Identifiability | 3 | C | 1 | 1-4 |
| 3. | Models for Time-varying and Non-linear systems: Models with Nonlinearities , Non-linear state-space models | 3 | C,D | 1 | 3,4 |
| 4. | Black box models, Fuzzy models | 2 | C,D | 1 | 3,4 |
| | **UNIT II: Discrete Time System Models For Control** | **9** | | | |
| 5. | ARX models, bilinear parametric models | 2 | C | 2 | 3,4 |
| 6. | ARMAX models, NARMAX models | 2 | C,D | 2 | 3,4 |
| 7. | Hammerstein models, Wienner model | 2 | D | 2 | 3,4 |
| 8. | Linear and non-linear model structure selection, Selection of pseudo random binary sequence. | 3 | D | 2 | 3,4 |
| | **UNIT III: Recursive Plant Model Identification In Open-Loop** | **9** | | | |
| 9. | Identification methods - least squares, recursive least squares, extended least squares, generalized least squares | 6 | C | 3 | 1,2 |
| 10. | Maximum likelihood method - model validation identified in open-loop | 2 | C,D | 3 | 1,2 |
| 11. | Model order selection | 1 | C | 3 | 1,2 |
| | **UNIT IV: Recursive Plant Model Identification In Closed-Loop** | **9** | | | |
| 12. | Identification methods : closed loop output error algorithms | 2 | D | 3 | 1,2 |
| 13. | Filtered closed-loop error algorithms, filtered open-loop identification algorithms | 4 | C | 3 | 1-4 |
| 14. | Model validation identified in closed-loop | 2 | C,D | 3 | 1-4 |
| 15. | Comparative evaluation of various algorithms. | 1 | C,D | 3 | 1-4 |
| | **UNIT V: Practical Aspects Of System Identification And Control** | **9** | | | |
| 16. | Selection of input signals, offline and online identification. | 3 | C | 4 | 4 |
| 17. | Comparison of parameter estimation methods, model order testing and verification, Inverted Pendulum, Robot arm | 3 | C,D | 4 | 5 |
| 18. | Process control application - heat exchanger, Distillation column. | 3 | C | 4 | 5 |
| | **Total contact hours** | **45** | | | |

| LEARNING RESOURCES | |
|---|---|
| **Sl. No.** | **TEXT BOOKS** |
| 1. | W.D.T. Davies, "*System Identification for self adaptive control"*, Wiley – Inderscience, 1970. |
| | **REFERENCE BOOKS/OTHER READING MATERIAL** |
| 2. | Lennart Ljung, "*System Identification"*, PTR Prentice Hall, Englewood Cliff, New Jersey, 1987. |
| 3. | R. Iserman, "*Practical aspects of process identification, International federation of automatic control"*, Pergamon Press Ltd., Automatica, Vol 16, pp 575 – 585. |
| 4. | Katsuhiko Ogato,"*Modern Control Engineering*", Prentice Hall of India, 4th Edition, 2003. |
| 5. | S. Bittanti, L. Piroddi, "*Nonlinear identification and control of a heat exchanger: A neural network approach"***,** Journal of the Franklin Institute**,** Volume 334, Issue 1, January 1997, pp 135–153. |

| **Course nature** | | | | **Theory** | | | |
|---|---|---|---|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | | | | | |
| **In-semester** | **Assessment tool** | Cycle test I | Cycle test II | Cycle Test III | Surprise Test | Quiz | **Total** |
| | **Weightage** | **10%** | **15%** | **15%** | **5%** | **5%** | **50%** |
| | | | | | | **End semester examination Weightage :** | **50%** |

| 15EI432E | Instrumentation and Control in Iron and Steel Industries | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| *Co-requisite:* | NIL | | | | |
| *Prerequisite:* | NIL | | | | |
| *Data Book / Codes/Standards* | NIL | | | | |
| *Course Category* | E PROFESSIONAL ELECTIVE | CONTROL ENGINEERING | | | |
| *Course designed by* | Department of Electronics and Instrumentation | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | |

| **PURPOSE** | To provide a window of applications of instrumentation and automation in processing industries to students with specialization in Instrumentation Engineering |
|---|---|

| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Have an in-depth understanding of the various unit operations in the industry | c | i | | | | | |
| 2. | Find the appropriate sensors and transducers for various measurements | d | | | | | | |
| 3. | Evolve the appropriate controls and schematics for specific applications | d | e | | | | | |
| 4. | Appreciate the role of Instrumentation Engineer in such industries | h | | | | | | |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | **UNIT 1: Process Involved In Iron And Steel Industry** | **9** | | | |
| 1. | History of steel making | 1 | C | 1 | 1-4 |
| 2. | Description of the process, Raw material preparation, Iron making Blast furnaces | 4 | C,D | 1 | 1-4 |
| 3. | Raw Steel making, The basic oxygen Furnace, The Electric Furnace | 4 | C | 1 | 1 |
| | **UNIT II: Casting And Rolling Of Steel** | **9** | | | |
| 4. | Quality of steel, Casting of steel | 2 | C | 1 | 1,2 |
| 5. | Rolling Process, Primary Rolling | 3 | C | 1 | 1,2 |
| 6. | Cold Rolling and Finishing, Supporting Facilities | 4 | C | 1 | 1,2 |
| | **UNIT III : Measurement In The Iron And Steel Industry** | **9** | | | |
| 7. | Study of various process measurement - Level Measurement, Pressure Sensors, Density Measurement, Temperature Measurement, Flow Measurement, Weight Measurement, Shape and thickness Measurement | 6 | C | 2 | 1 |
| 8. | Analyzers in the Iron and Steel Industry, Oxygen Analyzer | 2 | C | 2-3 | 1 |
| 9. | Valves in the Iron and Steel Industry | 1 | C | 1 | 1 |
| | **UNIT IV: Special Applications For Controls** | **9** | | | |
| 10. | Typical Control system in the Iron and Steel Industry: Blast Furnace stove Combustion Control system, Gas And Water Controls in BOF Furnaces | 5 | C | 3 | 1 |
| 11. | Control system involved in level measurement, Strand Casting mold Level Control, Ingot Weight Measuring System | 3 | C | 3 | 1,2 |
| 12. | Waste Water Treatment, Chemical Rinse Treatment Plant | 1 | C | 3,4 | 1 |
| | **UNIT V:Computer Applications** | **9** | | | |
| 13. | Evolution of computer applications in the industry | 3 | C | 4 | 1 |
| 14. | Model calculating and data logging applied to Steel Making | 1 | C | 4 | 1 |
| 15. | Steel rolling mill Control | 1 | C | 1,3 | 1 |
| 16. | Annealing process control, Computer Controlled Batch Annealing | 1 | C | 1,3 | 1 |
| 17. | Utilities management with computer system | 1 | C | 1,3 | 1 |
| 18. | Case study on iron and steel manufacturing process. | 2 | C | 4 | 5 |
| | **Total contact hours** | **45** | | | |

| LEARNING RESOURCES | |
|---|---|
| **Sl. No.** | **TEXT BOOKS** |
| 1. | Liptak, Bela G, "*Instrumentation in the Processing Industries"*, Chilton Publishers, 1973. |
| | **REFERENCE BOOKS/OTHER READING MATERIAL** |
| 2. | Considine D. M.," *Process/Industrial Instruments and control Handbook"*, McGraw Hill, 4th Edition 1993. |
| 3. | SeropeKalpakjian, "*Manufacturing Engineering and Technology"*, Addison Wesley Publishing Company, Massachusetts, 3rd Edition, 1995. |
| 4. | Robert H. Perry, D.W. Green and J.O. Maloney, Perry's "*Chemical Engineers Handbook"*, McGraw Hill Inc, New York, 7th Edition, 1998. |
| 5. | www.journals.elsevier.com |

| **Course nature** | | | | **Theory** | | | |
|---|---|---|---|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | | | | | |
| **In-semester** | **Assessment tool** | Cycle test I | Cycle test II | Cycle Test III | Surprise Test | Quiz | **Total** |
| | **Weightage** | **10%** | **15%** | **15%** | **5%** | **5%** | **50%** |
| | | | | | | **End semester examination Weightage :** | **50%** |

| 15EI433E | Instrumentation and Control in Petrochemical Industries | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| *Co-requisite:* | NIL | | | | |
| *Prerequisite:* | NIL | | | | |
| *Data Book / Codes/Standards* | NIL | | | | |
| *Course Category* | P PROFESSIONAL ELECTIVE | CONTROL ENGINEERING | | | |
| *Course designed by* | Department of Electronics & Instrumentation Engineering | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | |

| **PURPOSE** | To learn the complete operation of Petrochemical Industries and acquire the understanding of control reactors & control of pumps. |
|---|---|

| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Acquire knowledge of various equipments involved in the petrochemical industries. | a | c | | | | | |
| 2. | Understand the control of Distillation Column, Reactor, Heat exchangers, Evaporators. | a | b | | | | | |
| 3. | Learn performance of control of various pumps. | a | c | | | | | |
| 4. | Understand the real time application of petrochemical industries | a | c | | | | | |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | **UNIT I: Introduction To Petroleum** | **9** | | | |
| 1. | Petroleum Exploration, Production and Refining | 2 | C | 1 | 1 |
| 2. | Refining, Refining Capacity in India, Consumption of Petroleum products in India. | 1 | C | 1 | 1 |
| 3. | Constituents of Crude Oil | 2 | C | 1 | 1 |
| 4. | P & I diagram of petroleum refinery | 1 | C | 1 | 1 |
| 5. | Atmospheric Distillation of Crude oil, Vacuum Distillation process, Thermal Conversion process | 3 | C | 1 | 1 |
| | **UNIT II: Computer as Controller** | **9** | | | |
| 6. | Temperature Control, Pressure control, Feed control of distillation control | 1 | C | 2 | 2 |
| 7. | Reflux Control, Reboiler Control | 1 | C | 2 | 2,4 |
| 8. | Temperature Control, Pressure Control of chemical reactors | 2 | C | 2 | 2 , 4 |
| 9. | Control of Dryers: Batch Dryers, Atmospheric and Vacuum; Continuous Dryers. | 3 | C | 2 | 2 , 4 |
| 10. | Evaporators- Types of Evaporators | 2 | C | 2 | 2 , 4 |
| | **UNIT III: Control of Heat Exchanger** | **9** | | | |
| 11. | variables and Degrees of freedom, Liquid to Liquid Heat Exchangers | 3 | C | 2 | 2 , 4 |
| 12. | Steam Heaters, Condensers, Reboilers and Vaporizers, Cascade Control, Feed forward Control. | 6 | C | 2 | 2 , 4 |
| | **UNIT IV: Control of Pumps** | **9** | | | |
| 13. | Centrifugal pump- On-Off level control, Pressure control, Flow control, Throttling control. | 2 | C | 3 | 2 , 4 |
| 14. | Rotary pumps - On-Off pressure control, Reciprocating Pumps- On-Off control and Throttling control. | 3 | C | 3 | 2 , 4 |
| 15. | Effluent and Water Treatment Control- Chemical Oxidation, chemical Reduction | 3 | C | 3 | |
| | **UNIT V: Computer Applications In Industry** | **9** | | | |
| 16. | Review of data logging, SCADA, DDC and DCS | 3 | C | 4 | 5 |
| 17. | Case study: Water treatment control using SCADA | 2 | C | 4 | 5 |
| 18. | Case study: Control of chemical reactor using SCADA | 2 | C | 4 | 5 |
| 19. | Case Study: Boiler control | 2 | C | 4 | 5 |
| | **Total contact hours** | **45** | | | |

| LEARNING RESOURCES | |
|---|---|
| **Sl. No.** | **TEXT BOOKS** |
| 1. | Dr. Ram Prasad, "*Petroleum Refining Technology"*, Khanna Publisher, 1st Edition, 2000 |
| 2. | Liptak B.G., "*Instrumentation in Process Industries"*, Chilton Book Company, 1973 |
| | **REFERENCE BOOKS/OTHER READING MATERIAL** |
| 3. | Considine M. and Ross S.D., "*Handbook of Applied Instrumentation"*, McGraw Hill, 1962 |
| 4. | Liptak B.G., "*Instrument Engineers Handbook"*, Volume II., 1989 |
| 5. | www.wseas.us |

| **Course nature** | | | | **Theory** | | | |
|---|---|---|---|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | | | | | |
| **In-semester** | **Assessment tool** | Cycle test I | Cycle test II | Cycle Test III | Surprise Test | Quiz | **Total** |
| | **Weightage** | **10%** | **15%** | **15%** | **5%** | **5%** | **50%** |
| | | | | | **End semester examination Weightage :** | | **50%** |

| 15EI434E | Optimal Control | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

| | | | |
|---|---|---|---|
| *Co-requisite:* | NIL | | |
| *Prerequisite:* | NIL` | | |
| *Data Book / Codes/Standards* | NIL | | |
| *Course Category* | P | PROFESSIONAL ELECTIVE | CONTROL ENGINEERING |
| *Course designed by* | Department of Electronics and Instrumentation | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | |

| | |
|---|---|
| **PURPOSE** | To acquire analytical ability in solving mathematical problems as applied to the respective branches of Engineering. |

| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Formulate the optimal control problems, Parameter optimization versus path optimization | a | d | | | | | |
| 2. | Understand the Path optimization subject to constraints, Weak and strong extrema | a | d | e | | | | |
| 3. | Understand the Optimal control with state and control constraints, Time-optimal control | a | b | c | | | | |
| 4. | Understand the Linear quadratic optimal control problems | a | b | d | e | | | |
| 5. | Analyze the Dynamic programming in optimal control | c | d | i | | | | |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | **UNIT I: Basics of Optimization** | **9** | | | |
| 1 | Introduction to optimization | 1 | C | 1-4 | 1-5 |
| 2 | Formulation of optimal control problems | 2 | C | 1 | 1-5 |
| 3 | Parameter optimization versus path optimization | 2 | C,D | 1 | 1-5 |
| 4 | Local and global optima; general conditions on existence and uniqueness | 2 | C,D | 1 | 1-5 |
| 5 | Some basic facts from finite, dimensional optimization | 2 | C | | 1-5 |
| | **UNIT II: Calculus of Variations** | **9** | | | |
| 6 | Fundamental concepts | 2 | C | 2 | 2,3 |
| 7 | Extreme functional involving single and several independent functions | 2 | C,D | 2 | 2,3 |
| 8 | Piecewise smooth extremals | 2 | D,I | 2 | 2,3 |
| 9 | Constrained extrema | 3 | C | | 2,3 |
| | **UNIT III: Variational Approach to Optimal Problems** | **9** | | | |
| 10 | The Hamiltonian, Terminal constraints, Splines, Terminal manifolds, Free final times | 2 | C,D,I | 3 | 2,3,4 |
| 11 | Min-time and bang, bang control, Pontryagin's maximum principle | 2 | C,D | 3 | 2,3,4 |
| 12 | Control and state constraints, Time-optimal control, Singular solutions | 2 | C,I | 3 | 2,3,4 |
| 13 | Minimum control effort problems. | 3 | C,I | | 2,3,4 |
| | **UNIT IV: Linear Quadratic Gaussian (LQG) Problems** | **9** | | | |
| 14 | Quadratic optimal Control problems, steady state quadratic Optimal Control, Quadratic optimal control of servo systems. | 3 | C | 4 | 2,3 |
| 15 | Linear optimal regulator problem, Matrix Riccati equation and solution method, choice of weighting matrices | 3 | D,I | 4 | 1,2,3 |
| 16 | Steady state properties of optimal regulators, Linear tracking problem | 3 | D,I | 4 | 1,2,3 |
| | **UNIT V:Dynamic Programming** | **9** | | | |
| 17 | Principle of optimality , recurrence relation of dynamic programming for optimal control problem ,computational procedure for solving optimal control problems | 3 | D,I | 2,5 | 1,2,4 |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| 18 | characteristics of dynamic programming solution, dynamic programming application to discrete and continuous systems, Hamilton Jacobi Bellman equation | 3 | C | 3,5 | 1,2,4 |
| 19 | Numerical Techniques: Numerical solution of two-point boundary value problem and Fletcher Powell method, solution of Ricatti equation by iterative method | 3 | C | 3,5 | 1,2,4 |
| | **Total contact hours** | **45** | | | |

| **LEARNING RESOURCES** | |
|---|---|
| **Sl. No.** | **TEXT BOOKS** |
| 1. | Donald E. Kirk, "*Optimal Control Theory – An introduction* ", Pearson Education, 1970. |
| 2. | M. Gopal, "*Modern Control System Theory*", New Age International Ltd., 2002. |
| | **REFERENCE BOOKS/OTHER READING MATERIAL** |
| 3. | B. Sarkar, "*Control System Design – The Optimal Approach"*, Wheeler Publishing, New Delhi, 1997. |
| 4. | KeminZbou, J.C. Doyle, *"Robust & Optimal Control"*, Pearson Education, 1996. |
| 5. | A. E. Bryson ,"*Applied Optimal Control: Optimization, Estimation and Control***"** CRC Press, 1975 |
| 6. | Katruhiko Ogata, "*Modern Control Engineering"*, Prentice Hall of India Ltd,2016 |
| 7. | Sage A.P. and White CC, "*Optimum System Control"*, Prentice Hall, New Jersey, 1977. |

| **Course nature** | | | | **Theory** | | | |
|---|---|---|---|---|---|---|---|
| **Assessment Method – Theory Component (Weightage 50%)** | | | | | | | |
| **In-semester** | **Assessment tool** | Cycle test I | Cycle test II | Cycle Test III | Surprise Test | Quiz | **Total** |
| | **Weightage** | **10%** | **15%** | **15%** | **5%** | **5%** | **50%** |
| **End semester examination Weightage :** | | | | | | | **50%** |

| 15EI435E | Model Predictive Control | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| *Co-requisite:* | NIL | | | | |
| *Prerequisite:* | 15EI303 | | | | |
| *Data Book / Codes/Standards* | NIL | | | | |
| *Course Category* | P PROFESSIONAL ELECTIVE | CONTROL ENGINEERING | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | |

| **PURPOSE** | To acquire ability of designing control solutions based on the analysis of the system stability status. |
|---|---|

| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Understand the basics of Model based Predictive Control | a | | | | | | |
| 2. | Know the different types of control methodologies available. | a | e | | | | | |
| 3. | Design SISO based model predictive control schemes | a | b | e | | | | |
| 4. | Implement generalized predictive control in various processes. | a | | | | | | |
| 5. | Learn different applications of model predictive control. | a | d | e | | | | |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | **UNIT I: Introduction** | **9** | | | |
| 1. | Introduction to Model Predictive Control | 1 | C | 1 | 1,2,4 |
| 2. | Time Delay Systems, Smith Predictor Method | 2 | C | 1 | 1,2,4 |
| 3. | Description on MPC Elements | 2 | C | 1 | 1,2,4 |
| 4. | Types of MPC algorithms and its review | 3 | C | 1 | 1,2,4 |
| 5. | State space formulation | 1 | C | 1 | 1,2,4 |
| | **UNIT II: Model Predictive Control Schemes** | **9** | | | |
| 6. | Dynamic Matrix Control: Prediction, Measurable Disturbances, Control Algorithm | 4 | C,D | 1,2 | 1,2,4 |
| 7. | Model Algorithmic Control: Process Model, Prediction, Control Law | 4 | C,D | 1,2 | 1,2,4 |
| 8. | Case Study 1: Water heater Control using Dynamic Matrix Control | 1 | D | 1,2,5 | 1,2,4 |
| | **UNIT III: Generalized Predictive Control** | **9** | | | |
| 9. | Formulation of Generalized Predictive Control | 3 | C,D | 2,4 | 1,2,3,4 |
| 10. | Role of T and P Polynomials | 2 | C | 2,4 | 1,2,3,4 |
| 11. | Application of different Predictors in GPC | 1 | C,I | 2,4 | 1,2,3,4 |
| 12. | Constrained Receding Horizon Predictive Control, Stable GPC | 3 | C,D | 2,4 | 1,2,3,4 |
| | **UNIT IV: Implementation Of GPC** | **9** | | | |
| 13. | The Dead Time Multiple of the Sampling Time Case | 4 | C,D | 2,4,5 | 1 |
| 14. | GPC in Integration Processes | 3 | C,D | 2,4,5 | 1 |
| 15. | Stability Robustness Analysis | 2 | C | 2,4,5 | 1,2,4 |
| | **UNIT V: Applications** | **9** | | | |
| 16. | Pilot Plant, Plant description, plant control: Flow, Temperature, Level | 5 | C | 2,5 | 1 |
| 17. | Mobile robot: Prediction Model, Parameterization of desired path, Control development | 3 | C | 2,5 | 1 |
| 18. | Case study 1 and Case study 2 | 1 | C | 2,5 | 6,7 |
| | **Total contact hours** | **45** | | | |

| LEARNING RESOURCES | |
|---|---|
| **Sl. No.** | **TEXT BOOKS** |
| 1. | E.F.Camacho and C.Bordons, "*Model Predictive Control,* Springer – Verlag", ISBN 3-540-76241-8, Second edition, 2007 |
| 2. | R.Soeterboek,"*Predictive Control – A Unified Approach"* , Prentice Hall International Series on Systems and Control Engineering, ISBN 0-13-678350-3, 1992 |
| | **REFERENCE BOOKS/OTHER READING MATERIAL** |
| 3. | M.Mahfouf and D.A.Linkens, "*Generalised Predictive Control and Bioengineering"*, Taylor and Francis, ISBN 0-7484-0597-6, 1998. |
| 4. | J.A.Rossiter, "*Model based predictive control: A practical approach"*, CRC Press, 2003. |
| 5. | Garcia, C.E, Prett, D.M, and Morari, M., "*Model Predictive Control: Theory and Practice, a survey"*, Automatica, 25, p335 – 348, 1989 |
| 6. | N. Danesh Pour, A. Montazeri, J. Poshtan and M.R. Jahed Motlahgh, "*Two Case Studies for Applying Model Predictive Controllers on Chemical Processes",* 33rd Annual Conference of the IEEE Industrial Electronics Society (IECON), p580-585, 2007 |
| 7. | B. V. Anarase , B. J. Parvat , C. B. Kadu, "*Design of Model Predictive Control for Non Linear Process",* Volume 6, Issue 1,International Journal of Emerging Technology and Advanced Engineering, p304 - 314, 2016 |

| **Course nature** | | | | **Theory** | | | |
|---|---|---|---|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | | | | | |
| **In-semester** | **Assessment tool** | Cycle test I | Cycle test II | Cycle Test III | Surprise Test | Quiz | **Total** |
| | **Weightage** | **10%** | **15%** | **15%** | **5%** | **5%** | **50%** |
| | | | | | **End semester examination Weightage :** | | **50%** |

| 15EI436E | Industrial Data Communication | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| *Co-requisite:* | NIL | | | | |
| *Prerequisite:* | NIL | | | | |
| *Data Book / Codes/Standards* | NIL | | | | |
| *Course Category* | P PROFESSIONAL ELECTIVE | ELECTRONICS ENGINEERING | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | |

| **PURPOSE** | To acquire knowledge about various data communication modes, techniques and protocols required in industrial data communication. |
|---|---|

| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Understand technology of data networks. | a | e | k | | | | |
| 2. | Learn the basic of internetworking. | a | c | e | k | | | |
| 3 | Have adequate knowledge in various communication protocol. | a | e | k | | | | |
| 4 | Do secured industrial data communication. | a | e | k | | | | |
| 5 | Learn about IEEE standards in industrial communication. | a | b | c | h | | | |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | **UNIT I: Introduction To Data Communication** | **9** | | | |
| 1. | Introduction, OSI reference model, Systems engineering approach, State transition structure, Detailed design | 2 | C,D | 1 | 2 |
| 2. | Media, Physical connections, Protocols, Noise, Cable spacing, Ingress protection. | 2 | C | 1,2 | 2 |
| 3. | Introduction, Evolution of industrial control process | 1 | C | 1 | 1 |
| 4. | Communication interface, serial and parallel, communication mode, simplex, half and full duplex | 2 | C | 1,2 | 1 |
| 5. | LAN standards for open LAN, bridges, routers, gateways. | 2 | C | 1,2 | 1 |
| | **UNIT II: Industrial Networks** | **9** | | | |
| 6. | Network requirements, OSI implementation. | 2 | C,D | 1,2,3 | 1 |
| 7. | Enterprise network: types of networks, LAN architecture, topology | 2 | C | 1,2 | 5,6 |
| 8. | Transmission media: Cable Characteristics, Cable selection, unshielded twisted pair cable, shielded twisted pair cable, Coaxial cables, Fiber optics, wireless media. | 2 | C | 1,2 | 2 |
| 9. | Physical and logical media access and arbitration methods, token passing, ring, bus master slave, peer-peer, network and transport layer services. | 2 | C | 1,2 | 5,6 |
| 10. | Real time implications, Session, presentation and application layers | 1 | C,I | 1,3 | 5,6 |
| | **UNIT III: Open Control Networks & Hart** | **9** | | | |
| 11. | RS232, RS422, EIA 485, Ethernet, General Purpose Instrument Bus, specifications. | 3 | C | 1,2,4 | 2 |
| 12. | MODBUS plus, data highway plus. | 2 | C | 1,2,4 | 2 |
| 13. | HART, Architecture, physical, data link, application layer. | 2 | C | 1,3 | 2 |
| 14. | Communication technique, normal and burst mode of communication, troubleshooting benefits of HART. | 2 | C,I | 1,5 | 2 |
| | **UNIT IV: Network Types** | **9** | | | |
| 15. | Sensor level network: AS-i, CAN, Devicenet, lnterbus and LON | 3 | C | 1,4 | 1 |
| 16. | Device network: Foundation Fieldbus H1, H2, HART, PROFIBUS-PA | 3 | C | 1,4 | 1 |
| 17. | Control network: BACnet, Control Net, FF-HSE, PROFIBUS-DP, Ethernet TCP/IP. | 3 | C | 1,4 | 1 |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | **UNIT V: Foundation Field Bus & Wireless Communication** | **9** | | | |
| 18. | Fieldbus requirement, features, advantages, field bus components, types, Architecture | 3 | C | 1,4 | 1 |
| 19. | System and network management, wiring, segment functionality checking, installation in safe and hazardous area and troubleshooting. | 2 | C | 1,5 | 1 |
| 20. | Wireless communication, Satellite systems, Wireless LANs, Radio and wireless communication, Wi-Fi | 2 | C | 1,6,7 | 1 |
| 21. | GSM, GPRS and VSAT, comparison, limitations and characteristics | 2 | C | 1,2 | 1 |
| | **Total contact hours** | **45** | | | |

| **LEARNING RESOURCES** | |
|---|---|
| **Sl. No.** | **TEXT BOOKS** |
| 1. | Lawrence M Thompson, "*Industrial data Communication",5th* Edition, Instrument Socitey of America, 2014. |
| 2. | Dcou Reynders, Steve Mackay, Edwin Wright, "*Practical Industrial Data Communications",* 1st Edition elsevier, *2005.* |
| | **REFERENCE BOOKS/OTHER READING MATERIAL** |
| 3. | Daniel T Miklovic, "*Real time control network",* ISA 1993. |
| 4. | Bela G Liptak, "*Process software and digital networks",* 4th Edition, CRC press, 2007. |
| 5. | Andrew S. Tanenbaum, "*Computer Networks",* 5th Edition, PHI/Pearson Education.2010. |
| 6. | Behrouz A. Forouzan, "*Data Communications and Networking",* 2nd update Edition, Tata McGraw Hill Publishing Company, New Delhi, 2012. |
| 7. | Douglas E. Comer, "*Computer Networks and Internets",* 6th Edition, Pearson Education Asia, 5th Indian reprint, 2014. |

| **Course nature** | | | | **Theory** | | | |
|---|---|---|---|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | | | | | |
| **In-semester** | **Assessment tool** | Cycle test I | Cycle test II | Cycle Test III | Surprise Test | Quiz | **Total** |
| | **Weightage** | **10%** | **15%** | **15%** | **5%** | **5%** | **50%** |
| | | | | | | **End semester examination Weightage :** | **50%** |

| 15EI251 | Electronics and Instrumentation | | | L | T | P | C |
|---|---|---|---|---|---|---|---|
| | | | | 3 | 0 | 0 | 3 |
| *Co-requisite:* | NIL | | | | | | |
| *Prerequisite:* | NIL | | | | | | |
| *Data Book / Codes/Standards* | NIL | | | | | | |
| *Course Category* | E | ENGINEERING SCIENCES | ELECTRONICS ENGINEERING | | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | | | |

| **PURPOSE** | The aim of the course is to familiarize the student with the principle of operation, capabilities and limitation of Electronics and Instrumentation so that he will be able to use this knowledge effectively. |
|---|---|

| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| At the end of the course, student will be able to | | | | | | | | |
| 1. | Design rectifiers and voltage stabilizer circuits | a | b | e | | | | |
| 2. | Analyze various biasing methods of Transistor | a | | | | | | |
| 3. | Know the usage of Semiconductor Devices for high power applications | a | b | e | | | | |
| 4. | Understand the Basic of Measurement System | a | | | | | | |
| 5. | Use of Primary sensing element and Signal Conditioning unit | a | e | | | | | |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| | **UNIT 1 Semiconductor Diode** | **9** | | | |
| 1. | Semiconductor diode – crystal diode as a rectifier – equivalent circuit of a crystal diode | 2 | C,D | 1 | 1,3 |
| 2. | Half wave rectifier – efficiency of half wave rectifier | 2 | C | 1 | 1,3 |
| 3. | Full wave rectifier – center tap full wave rectifier | 1 | C,D | 1 | 1,3 |
| 4. | Full wave bridge rectifier – efficiency of full wave bridge rectifier | 2 | C,D | 1 | 1,3 |
| 5. | Zener diode – equivalent circuit of zener diode – zener diode as a voltage regulator | 2 | C | 1 | 1,3 |
| | **UNIT II: Transistor and Its Biasing** | **9** | | | |
| 6. | Transistor symbols – transistor as an amplifier – connections | 2 | C | 2 | 1,3 |
| 7. | CB, CE and CC characteristics – comparison of transistor connections | 2 | C | 2 | 1,3 |
| 8. | Transistor as an amplifier in CE arrangement – transistor load line analysis – operating point | 2 | C,D | 2 | 1,3 |
| 9. | CE Circuit - performance of transistor amplifier - cut off and saturation points | 2 | C | 2 | 1,3 |
| 10. | Transistor biasing: methods of transistor biasing - base resistor method - biasing with feedback resistor - voltage divider bias method . | 1 | C,D | 2 | 1,3 |
| | **UNIT III: FET, SCR and UJT** | **9** | | | |
| 11. | Types of field effect transistor - JFET - working principles of JFET | 2 | C | 3 | 1,5 |
| 12. | JFET as an amplifier and its output characteristics - JFET applications | 2 | C | 3 | 1,5 |
| 13. | MOSFET working principle - SCR - equivalent circuit and V-I characteristics. scr as a half wave and full wave rectifier | 3 | C | 3 | 1,5 |
| 14. | Application of SCR - TRIAC and DIAC characteristics and its applications, UJT - equivalent circuit of a UJT and its characteristics - tutorial | 2 | C | 3 | 1,5 |
| | **UNIT IV: Measurement System** | **9** | | | |
| 15. | Measurements and its significance, methods of measurements, classification of instruments and application | 4 | C | 4 | 2,8 |

| Session | Description of Topic | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| 16. | Elements of a generalized measurement system, static and dynamic characteristics of an instruments, Errors in measurement systems - units, system, dimension and standards | 5 | C,D | 4 | 2,8 |
| | **UNIT V: Primary Sensing Elements And Signal Conditioning** | **9** | | | |
| 17. | Introduction - transducers - advantage of electric transducers, classification based upon principle of transduction | 3 | C | 5 | 2,8 |
| 18. | Primary and secondary transducer, passive and active transducers, analog and digital transducers, transducers and inverse transducers and examples for each. Characteristics and choice of transducers | 3 | C | 5 | 2,8 |
| 19. | Input transfer and output characteristics and its application. operational amplifier, Characteristics of operational amplifier, basic filters, A/D converters. simple types | 3 | C | 5 | 2,8 |
| | **Total contact hours** | **45** | | | |

| **LEARNING RESOURCES** | |
|---|---|
| **Sl. No.** | **TEXT BOOKS** |
| 1. | Mehta.V.K, and Rohit Metha, "*Principles of Electronics"*, S.Chand & Company Ltd., First Edition, 2010. |
| 2. | Sawhney.A.K, "*A Course in Electrical and Electronic Measurement and Instrumentation"*, Dhanpat Rai Sons, New Delhi, 2012. |
| | **REFERENCE BOOKS/OTHER READING MATERIAL** |
| 3. | Millman and Halkias, "*Electronic devices and Circuits"*, Tata McGraw Hill International Edition, 2010 |
| 4. | Mithal.G.K, "*Electronic Devices and Circuits"*, Khanna Publishers, New Delhi,2008 |
| 5. | Salivahanan.S, Sureshkumar.N, and Vallavaraj.A, "*Electronic Devices and Circuits"*, Tata McGraw - Hill, New Delhi, 2011. |
| 6. | Sze.S.M, "*Semiconductor Devices - Physics and Technology"*, 2nd Edition, John Wiley & Sons, New York, 2006. |
| 7. | Ben G. Streetman and Sanjay Banerjee, "*Solid State Electronic Devices"*, Pearson Education, 2009. |
| 8. | Ernest O. Doebelin, "*Measurement Systems - Application and Design"*, Tata McGraw-Hill, New Delhi, 2011. |

| **Course nature** | | | | **Theory** | | | |
|---|---|---|---|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | | | | | |
| **In-semester** | **Assessment tool** | Cycle test I | Cycle test II | Cycle Test III | Surprise Test | Quiz | **Total** |
| | **Weightage** | **10%** | **15%** | **15%** | **5%** | **5%** | **50%** |
| | | | | | **End semester examination Weightage :** | | **50%** |

| 15EI251L | Electronics and Instrumentation Laboratory | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 2 | 1 |
| *Co-requisite:* | 15EI251 | | | | |
| *Prerequisite:* | NIL | | | | |
| *Data Book / Codes/Standards* | NIL | | | | |
| *Course Category* | E ENGINEERING SCIENCES | ELECTRONICS ENGINEERING | | | |
| *Course designed by* | Department of Electronics and Instrumentation Engineering | | | | |
| *Approval* | 32nd Academic Council Meeting held on 23rd July, 2016 | | | | |

| **PURPOSE** | To develop skills in designing and conducting experiments related to applications of principles of physics in engineering | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **INSTRUCTIONAL OBJECTIVES** | | **STUDENT OUTCOMES** | | | | | | |
| At the end of the course, student will be able to | | | | | | | | |
| 1 | Familiarize with the concepts and working of basic electronic components | a | b | k | | | | |
| 2 | Understand the concepts of sensors | a | b | k | | | | |

| Sl. No. | Description of experiments | Contact hours | C-D-I-O | IOs | Reference |
|---|---|---|---|---|---|
| 1. | Characteristics of semiconductor diode & Zener diode | 2 | D,I | 1 | 1,2 |
| 2. | Characteristics of BJT in CE & CB Configuration | 2 | C,D | 1 | 1,2 |
| 3. | Characteristics of FET | 2 | D | 1 | 1,2 |
| 4. | Characteristics of SCR | 2 | D | 1 | 1,2 |
| 5. | Characteristics of DIAC & UJT | 2 | D | 1 | 1,2 |
| 6. | Characteristics of RTD | 2 | D,I | 2 | 1,3 |
| 7. | Characteristics of thermistor | 2 | D,I | 2 | 1,3 |
| 8. | Characteristics of thermocouple | 2 | D,I | 2 | 1,3 |
| 9. | Characteristics of load cell | 2 | D,I | 2 | 1,3 |
| 10. | Characteristics of strain gauge | 2 | D,I | 2 | 1,3 |
| | **Total contact hours (including demo and repeat labs)** | **30** | | | |

| **LEARNING RESOURCES** | |
|---|---|
| **Sl. No.** | **REFERENCES** |
| 1. | Laboratory Manual |
| 2. | VK Mehtha , " *Principles of Electronics*", S Chand; 7th Revised edition edition , 2005 |
| 3. | A.K. Sawhney, Puneet Sawhney, "*Electrical Electronic Measurement and Instrumentation*", Dhanpat Rai & Co, 2013 |

| **Course nature** | | | | **Practical** | | |
|---|---|---|---|---|---|---|
| **Assessment Method (Weightage 100%)** | | | | | | |
| **In-semester** | **Assessment tool** | Experiments | Record | MCQ/Quiz/Viva Voce | Model examination | **Total** |
| | **Weightage** | **40%** | **5%** | **5%** | **10%** | **60%** |
| | | | | | **End semester examination Weightage :** | **40%** |