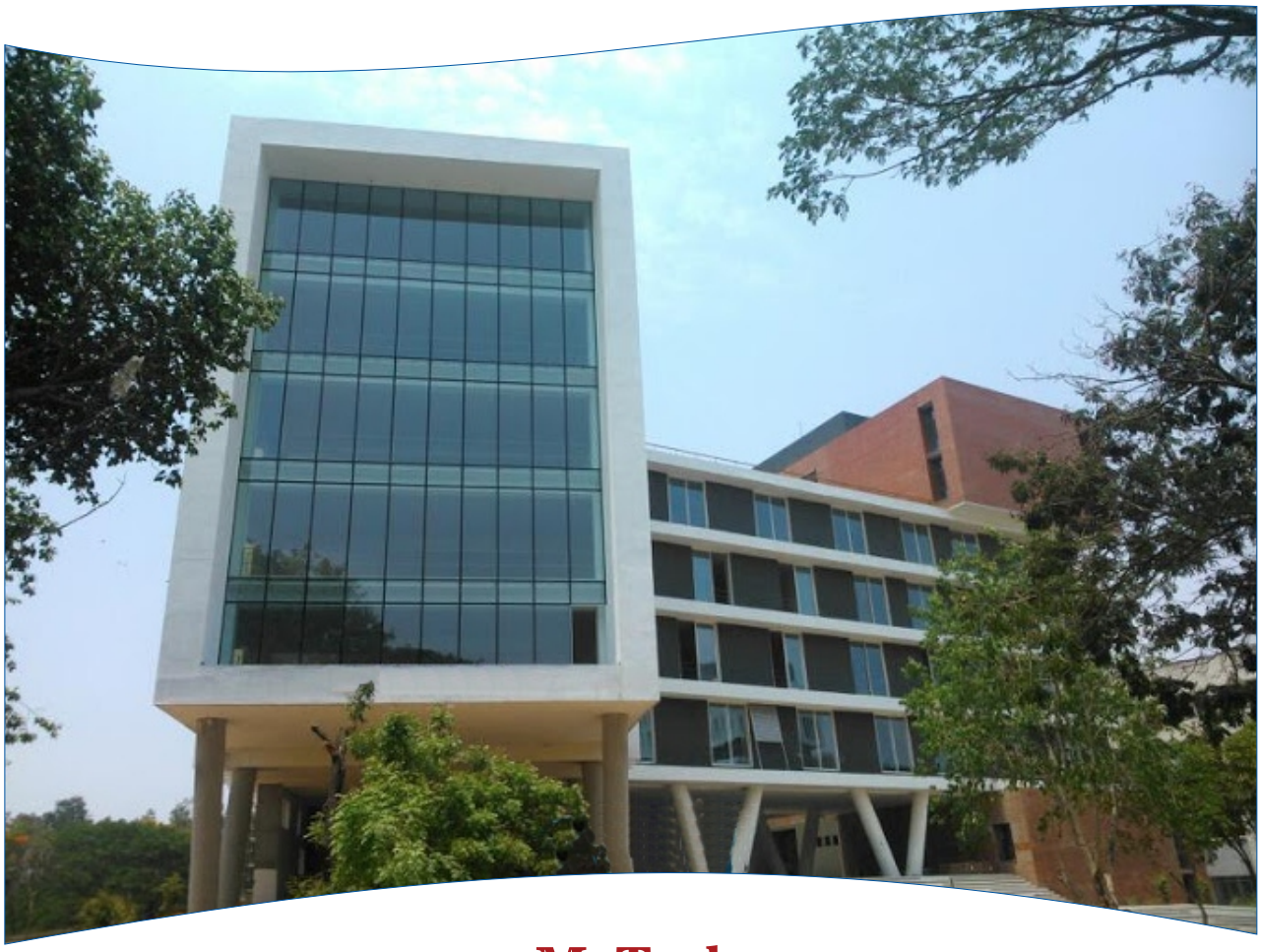
# CURRICULUM AND SYLLABI

## REGULATIONS - 2016

### (As approved by the 9th Academic Council)



## M. Tech.

## ELECTRONICS AND INSTRUMENTATION ENGINEERING


B.S.ABDUR RAHMAN UNIVERSITY

B.S. ABDUR RAHMAN INSTITUTE OF SCIENCE & TECHNOLOGY
(Estd. u/s 3 of the UGC Act, 1956)

(FORMERLY B.S. ABDUR RAHMAN CRESCENT ENGINEERING COLLEGE)
Rated with A Grade by National Assessment and Accreditation Council
**Seethakathi Estate, G.S.T. Road, Vandalur, Chennai - 600 048**
**www.bsauniv.ac.in**

# REGULATIONS, CURRICULUM AND SYLLABI

# M. Tech.
# ELECTRONICS AND INSTRUMENTATION ENGINEERING

**(As approved by the 9th Academic Council)**

***JULY 2016***

B.S.ABDUR RAHMAN UNIVERSITY
B.S. ABDUR RAHMAN INSTITUTE OF SCIENCE & TECHNOLOGY
(Estd. u/s 3 of the UGC Act, 1956)
(FORMERLY B.S. ABDUR RAHMAN CRESCENT ENGINEERING COLLEGE)
Rated with A Grade by National Assessment and Accreditation Council
**Seethakathi Estate, G.S.T. Road, Vandalur, Chennai - 600 048**
**www.bsauniv.ac.in**

# UNIVERSITY VISION AND MISSION

## VISION

B.S. Abdur Rahman Institute of Science and Technology aspires to be a leader in Education, Training and Research in Engineering, Science, Technology and Management and to play a vital role in the Socio-Economic progress of the Country.

## MISSION

- To blossom into an internationally renowned University
- To empower the youth through quality education and to provide professional leadership
- To achieve excellence in all its endeavors to face global challenges
- To provide excellent teaching and research ambience
- To network with global institutions of Excellence, Business, Industry and Research Organizations
- To contribute to the knowledge base through Scientific enquiry, Applied research and Innovation

# VISION AND MISSION OF THE DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

## VISION

The Department aspires to excel in providing quality education, training and research in the area of Electronics and Instrumentation Engineering to meet the industrial and societal needs.

## MISSION

- To provide quality education in the field of Electronics and Instrumentation Engineering by offering Under Graduate, Post Graduate and Doctoral Programs.
- To impart technical knowledge and hands on experience, leadership and managerial skills to meet the current industrial and societal needs.
- To enhance problem solving capabilities through design projects, internship and industrial projects.
- To maintain active linkages with industries and research institutions
- To develop analytical skills, leadership quality and team spirit through balanced curriculum and a judicial mix of co-curricular, extra-curricular and professional society activities.
- To enrich the knowledge and skills of faculty through continuous learning and active research.

# PROGRAMME EDUCATIONAL OBJECTIVES AND OUTCOMES

## PROGRAMME EDUCATIONAL OBJECTIVES

1. To provide advanced knowledge in the areas of Instrumentation, Control & Electronics and be aware of latest trends in the fields
2. To develop ability to design, implement and maintain the automation systems for the process industries
3. To develop skill by providing practical exposure in the areas of Electronics and Instrumentation Engineering, to interpret and evaluate the experimental results
4. To kindle interest in the development of innovative ideas in the real time problems related to electronics, Instrumentation and Control and take up projects to implement these ideas
5. To impart necessary managerial and soft skills required to face the challenges in process industries and software companies.
6. To inculcate sustained interest in the process of lifelong learning to keep abreast of new developments in the field of Electronics, Instrumentation and Control.

## PROGRAMME OUTCOME

1. Identify real-time problems in the areas of instrumentation, industrial automation & microelectronics and carryout industry standard project
2. Apply the in-depth knowledge gained in the areas of Electronics , Instrumentation and Process Control to find feasible and optimal solutions for industrial problems
3. Formulate/Select and apply relevant techniques, resources and Engineering & IT tools for the design of instrumentation systems for process modeling and control
4. Function actively and efficiently as a lead of different teams and multidisciplinary projects
5. Communicate effectively the engineering concepts and ideas with a wide range of engineering community and others, to understand and prepare reports, to make effective presentations and to frame instructions and guidelines.
6. Carry out the assigned task in the career with professional approach and ethical responsibility
7. Recognize the need for self and life-long learning keeping pace with technological changes.

# REGULATIONS – 2016
# FOR
# M. Tech. / MCA / M.Sc. DEGREE PROGRAMMES

## 1.0 PRELIMINARY DEFINITIONS AND NOMENCLATURE

In these Regulations, unless the context otherwise requires

i. **"Programme"** means a Post Graduate Degree Programme (M. Tech. / MCA / M.Sc.)

ii. **"Course"** means a theory or practical subject that is normally studied in a semester, like Applied Mathematics, Structural Dynamics, Computer Aided Design, etc.

iii. **"University"** means B.S. Abdur Rahman University, Chennai, 600048.

iv. **"Institution"** unless otherwise specifically mentioned as an autonomous or off campus institution means B.S. Abdur Rahman University.

v. **"Academic Council"** means the Academic Council, which is the apex body on all academic matters of this University

vi. **"Dean (Academic Affairs)"** means Dean (Academic Affairs) of B.S. Abdur Rahman University, who administers the academic matters.

vii. **"Dean (P.G. Studies)"** means Dean (P.G. Studies) of B.S. Abdur Rahman University who administers all P.G Programmes of the University in coordination with Dean (Academic Affairs)

viii. **"Dean (Student Affairs)"** means Dean (Student Affairs) of B.S. Abdur Rahman University, who looks after the welfare and discipline of the students.

ix. **"Controller of Examinations"** means the Controller of Examinations of B.S. Abdur Rahman University who is responsible for conduct of examinations and declaration of results.

## 2.0 PROGRAMMES OFFERED, MODE OF STUDY AND ADMISSION REQUIREMENTS

### 2.1 P.G. Programmes Offered

The various P.G. Programmes and their modes of study are as follows:

| Degree | Mode of Study |
|---|---|
| M. Tech. /M.C.A. / M.Sc. | Full Time & Part Time – Day / Evening / Weekends |

## 2.2 Modes of Study

### 2.2.1 Full-time

Students admitted under "Full-Time" shall be available in the Institution during the complete working hours for curricular, co-curricular and extra-curricular activities assigned to them.

**2.2.2** A full time student, who has completed all non-project courses desiring to do the Project work in part-time mode for valid reasons, shall apply to the Dean (Academic Affairs) through the Head of the Department. Permission may be granted based on merits of the case. Such conversion is not permitted in the middle of a semester.

### 2.2.3 Part-time

In this mode of study, the students are required to attend classes for the courses in the time slots selected by them, during the daytime (or) evenings (or) weekends.

## 2.3 Admission Requirements

**2.3.1** Students for admission to the first semester of the Master's Degree Programme shall be required to have passed the appropriate degree examination of this University as specified in the Table shown for eligible entry qualifications for admission to P.G. programmes or any other degree examination of any University or authority accepted by this University as equivalent thereto.

**2.3.2** Eligibility conditions for admission such as class obtained, number of attempts in the qualifying examination and physical fitness will be as prescribed by this Institution from time to time.

**2.3.3** All part-time students should satisfy other conditions regarding experience, sponsorship etc., which may be prescribed by this Institution from time to time.

**2.3.4** Student eligible for admission to M.C.A under lateral entry scheme shall be required to have passed three year degree in B.Sc (Computer Science) / B.C.A / B.Sc (Information Technology)

## 3.0 DURATION AND STRUCTURE OF THE P.G. PROGRAMME

**3.1** The minimum and maximum period for completion of the P.G. Programmes are given below:

| Programme | Min. No. of Semesters | Max. No. of Semesters |
|---|---|---|
| M. Tech. (Full Time) | 4 | 8 |
| M. Tech. (Part Time) | 6 | 12 |
| M.C.A. (Full Time) | 6 | 12 |
| M.C.A. (Part Time) | 9 | 18 |
| M.C.A. (Full Time) – (Lateral Entry) | 4 | 8 |
| M.C.A. (Part Time) – (Lateral Entry) | 6 | 12 |
| M.Sc. (Full Time) | 4 | 8 |
| M. Sc. (Part Time) | 6 | 12 |

**3.2** The PG. programmes consist of the following components as prescribed in the respective curriculum

i. Core courses
ii. General Elective courses
iii. Professional Elective courses
iv. Project work / thesis / dissertation
v. Laboratory Courses
vi. Case studies
vii. Seminars
viii. Mini Project
ix. Industrial Internship

**3.3** The curriculum and syllabi of all PG. programmes shall be approved by the Academic Council of this University.

**3.4** The minimum number of credits to be earned for the successful completion of the programme shall be specified in the curriculum of the respective specialization of the P.G. programme.

**3.5** Each academic semester shall normally comprise of 80 working days. Semester-end examinations will follow immediately after the last working day.

## ELIGIBLE ENTRY QUALIFICATIONS FOR ADMISSION TO P.G. PROGRAMMES

| Sl. No. | Name of the Department | P.G. Programmes offered | Qualifications for admission |
|---|---|---|---|
| 01 | Civil Engineering | M. Tech. (Structural Engineering) | B.E / B. Tech. (Civil Engineering) / (Structural Engineering) |
| | | M. Tech. (Construction Engineering and Project Management) | |
| 02 | Mechanical Engineering | M. Tech. (Manufacturing Engineering) | B.E. / B. Tech. (Mechanical / Auto / Manufacturing / Production / Industrial / Mechatronics / Metallurgy / Aerospace /Aeronautical / Material Science / Marine Engineering) |
| | | M. Tech. (CAD/CAM) | |
| 03 | Polymer Engineering | M. Tech. (Polymer Technology) | B. E. / B. Tech. Mechanical / Production /Polymer Science or Engg or Tech / Rubber Tech / M.Sc (Polymer Sc./ Chemistry Appl. Chemistry) |
| 04 | Electrical and Electronics Engineering | M. Tech. (Power Systems Engg) | B.E / B.Tech (EEE / ECE / E&I / I&C / Electronics / Instrumentation) |
| | | M. Tech. (Power Electronics & Drives) | B.E / B.Tech (EEE / ECE / E&I / I&C / Electronics / Instrumentation) |
| 05 | Electronics and Communication Engineering | M. Tech. (Communication Systems) | B.E / B.Tech (EEE/ ECE / E&I / I&C / Electronics / Instrumentation) |
| | | M. Tech. (VLSI and Embedded Systems) | B.E. / B. Tech. (ECE / Electronics / E&I / I&C / EEE) |
| 06 | ECE Department jointly with Physics Dept. | M. Tech. (Optoelectronics and Laser Technology) | B.E. / B. Tech. (ECE / EEE / Electronics / EIE / ICE) M.Sc (Physics / Materials Science / Electronics / Photonics) |
| 07 | Electronics and Instrumentation Engineering | M. Tech. (Electronics and Instrumentation Engineering) | B.E. / B. Tech. (EIE / ICE / Electronics / ECE / EEE) |

| Sl. No. | Name of the Department | P.G. Programmes offered | Qualifications for admission |
|---|---|---|---|
| 08 | Computer Science and Engineering | M. Tech. (Computer Science and Engineering) | B.E. / B. Tech. (CSE / IT / ECE / EEE / EIE / ICE / Electronics / MCA) |
| | | M. Tech. (Software Engineering) | B.E. / B. Tech. (CSE / IT) MCA |
| | | M. Tech. (Network Security) | B.E. / B. Tech. (CSE / IT / ECE / EEE / EIE / ICE / Electronics / MCA) |
| | | M. Tech. (Computer Science and Engineering with specialization in Big Data Analytics) | B.E. / B. Tech. (CSE / IT / ECE / EEE / EIE / ICE / Electronics / MCA) |
| 09 | Information Technology | M. Tech. (Information Technology) | B.E / B. Tech. (IT / CSE / ECE / EEE / EIE / ICE / Electronics) MCA |
| | | M. Tech. (Information Security & Digital Forensics) | B.E / B. Tech. (IT / CSE / ECE / EEE / EIE / ICE / Electronics) MCA |
| 10 | Computer Applications | M.C.A. | Bachelor Degree in any discipline with Mathematics as one of the subjects (or) Mathematics at +2 level |
| | | M.C.A. – (Lateral Entry) | B.Sc Computer Science / B.Sc Information Technology / B.C.A |
| | | M. Tech. (Systems Engineering and Operations Research) | BE / B. Tech. (Any Branch) or M.Sc., (Maths / Physics / Statistics / CS / IT / SE) or M.C.A. |
| | | M. Tech. (Data & Storage Management | BE / B. Tech. (Any Branch) or M.Sc., (Maths / Physics / Statistics / CS / IT / SE) or M.C.A. |
| 11 | Mathematics | M.Sc. (Actuarial Science) | Any Degree with Mathematics / Statistics as one of the subjects of study. |
| | | M.Sc. Mathematics | B.Sc. (Mathematics) |
| 12 | Physics | M.Sc.(Physics) | B.Sc.(Physics / Applied Science / Electronics / Electronics Science / Electronics & Instrumentation) |
| | | M.Sc. (Material Science) | B.Sc.(Physics / Applied Science / Electronics / Electronics |

| Sl. No. | Name of the Department | P.G. Programmes offered | Qualifications for admission |
|---|---|---|---|
| | | | Science / Electronics & Instrumentation) |
| 13 | Chemistry | M.Sc.(Chemistry) | B.Sc (Chemistry / Applied Science) |
| 14 | Life Sciences | M.Sc. Molecular Biology & Biochemistry | B.Sc. in any branch of Life Sciences |
| | | M.Sc. Genetics | B.Sc. in any branch of Life Sciences |
| | | M.Sc. Biotechnology | B.Sc. in any branch of Life Sciences |
| | | M.Sc. Microbiology | B.Sc. in any branch of Life Sciences |
| | | M.Sc. Bioscience | B.Sc. in any branch of Life Sciences |
| | | M. Tech. Biotechnology | B. Tech. (Biotechnology / Chemical Engineering) / M.Sc. in any branch of Life Sciences |

**3.6** The curriculum of PG programmes shall be so designed that the minimum prescribed credits required for the award of the degree shall be within the limits specified below:

| Programme | Minimum prescribed credits |
|---|---|
| M. Tech. | 73 |
| M.C.A. | 120 |
| M.Sc. | 72 |

**3.7** Credits will be assigned to the courses for all P.G. programmes as given below:

- One credit for one lecture period per week (or) 15 periods per semester
- One credit for one tutorial period per week
- One credit each for seminar/practical session/project of two or three periods per week
- One credit for two weeks of industrial internship
- One credit for 15 periods of lecture (can even be spread over a short span of time)

**3.8** The number of credits registered by a student in non-project semester and project semester should be within the range specified below:

| P.G. Programme | Full Time | | Part Time | |
|---|---|---|---|---|
| | Non-project Semester | Project semester | Non-project Semester | Project semester |
| M. Tech. | 9 to 28 | 12 to 28 | 6 to 12 | 12 to 28 |
| M.C.A. | 9 to 29 | 12 to 29 | 6 to 12 | 12 to 29 |
| M.Sc. | 9 to 25 | 12 to 20 | 6 to 12 | 12 to 20 |

**3.9** The student may choose a course prescribed in the curriculum from any department depending on his / her convenient time slot. All attendance will be maintained course-wise only.

**3.10** The electives from the curriculum are to be chosen with the approval of the Head of the Department.

**3.11** A student may be permitted by the Head of the Department to choose electives from other PG programmes either within the Department or from other Departments up to a maximum of nine credits during the period of his/her study, with the approval of the Head of the Departments offering such courses.

**3.12** To help the students to take up special research areas in their project work and to enable the department to introduce courses in latest/emerging areas in the curriculum, "Special Electives" may be offered. A student may be permitted to register for a "Special Elective" up to a maximum of three credits during the period of his/her study, provided the syllabus of this course is recommended by the Head of the Department and approved by the Chairman, Academic Council before the commencement of the semester, in which the special elective course is offered. Subsequently, such course shall be ratified by the Board of Studies and Academic Council.

**3.13** The medium of instruction, examination, seminar and project/thesis/ dissertation reports will be English.

**3.14** Industrial internship, if specified in the curriculum shall be of not less than two weeks duration and shall be organized by the Head of the Department.

**3.15 Project Work / Thesis / Dissertation**

**3.15.1** Project work / Thesis / Dissertation shall be carried out under the supervision of a Faculty member in the concerned Department.

**3.15.2** A student may however, in certain cases, be permitted to work for the project in an Industrial/Research Organization, on the recommendation of the Head of the Department. In such cases, the project work shall be jointly

supervised by a faculty of the Department and an Engineer / Scientist from the organization and the student shall be instructed to meet the faculty periodically and to attend the review committee meetings for evaluating the progress.

**3.15.3** Project work / Thesis / Dissertation (Phase - II in the case of M. Tech.) shall be pursued for a minimum of 16 weeks during the final semester, following the preliminary work carried out in Phase-1 during the previous semester.

**3.15.4** The Project Report/Thesis / Dissertation report / Drawings prepared according to approved guidelines and duly signed by the supervisor(s) and the Head of the Department shall be submitted to the concerned department.

**3.15.5** The deadline for submission of final Project Report / Thesis / Dissertation is within 30 calendar days from the last working day of the semester in which Project / Thesis / Dissertation is done.

**3.15.6** If a student fails to submit the Project Report / Thesis / Dissertation on or before the specified deadline he / she is deemed to have not completed the Project Work / Thesis / dissertation and shall re-register the same in a subsequent semester.

## 4.0 CLASS ADVISOR AND FACULTY ADVISOR

### 4.1 Class Advisor

A faculty member will be nominated by the HOD as Class Advisor for the whole class.

He / she is responsible for maintaining the academic, curricular and co-curricular records of all students throughout their period of study.

### 4.2 Faculty Advisor

To help the students in planning their courses of study and for general counseling on the academic programme, the Head of the Department of the students will attach a certain number of students to a faculty member of the department who shall function as Faculty Advisor for the students throughout their period of study. Such Faculty Advisor shall offer advice to the students on academic and personal matters and guide the students in taking up courses for registration and enrolment every semester.

## 5.0 CLASS COMMITTEE

**5.1** Every class of the PG Programme will have a Class Committee constituted by the Head of the Department as follows:

i. Teachers of all courses of the programme

ii. One senior faculty preferably not offering courses for the class, as

Chairperson.

iii. Minimum two students of the class, nominated by the Head of the Department.

iv. Class Advisor / Faculty Advisor of the class - Ex-Officio Member

v. Professor in-charge of the PG Programme - Ex-Officio Member.

**5.2** The Class Committee shall be constituted by the respective Head of the Department of the students.

**5.3** The basic responsibilities of the Class Committee are to review periodically the progress of the classes to discuss problems concerning curriculum and syllabi and the conduct of classes. The type of assessment for the course will be decided by the teacher in consultation with the Class Committee and will be announced to the students at the beginning of the semester. Each Class Committee will communicate its recommendations to the Head of the Department and Dean (Academic Affairs). The class committee, **without the student members,** will also be responsible for finalization of the semester results and award of grades.

**5.4** The Class Committee is required to meet at least thrice in a semester, first within a week of the commencement of the semester, second, after the first assessment and the third, after the semester-end examination to finalize the grades.

## 6.0 COURSE COMMITTEE

Each common theory course offered to more than one group of students shall have a “Course Committee” comprising all the teachers teaching the common course with one of them nominated as Course coordinator. The nomination of the Course coordinator shall be made by the Head of the Department / Dean (Academic Affairs) depending upon whether all the teachers teaching the common course belong to a single department or to several departments. The Course Committee shall meet as often as possible and ensure uniform evaluation of the tests and arrive at a common scheme of evaluation for the tests. Wherever it is feasible, the Course Committee may also prepare a common question paper for the test(s).

## 7.0 REGISTRATION AND ENROLMENT

**7.1** For the first semester every student has to register for the courses within one week from the commencement of the semester

**7.2** For the subsequent semesters registration for the courses will be done by the student one week before the last working day of the previous semester. The curriculum gives details of the core and elective courses, project and

seminar to be taken in different semester with the number of credits. The student should consult his/her Faculty Advisor for the choice of courses. The Registration form shall be filled in and signed by the student and the Faculty Advisor.

**7.3** From the second semester onwards all students shall pay the prescribed fees and enroll on a specified day at the beginning of a semester.

**7.4** A student will become eligible for enrolment only if he/she satisfies clause 9 and in addition he/she is not debarred from enrolment by a disciplinary action of the Institution. At the time of enrolment a student can drop a course registered earlier and also substitute it by another course for valid reasons with the consent of the Faculty Advisor. Late enrolment will be permitted on payment of a prescribed fine up to two weeks from the date of commencement of the semester.

**7.5** Withdrawal from a course registered is permitted up to one week from the date of the completion of the first assessment test.

**7.6** Change of a course within a period of 15 days from the commencement of the course, with the approval of Dean (Academic Affairs), on the recommendation of the HOD, is permitted.

**7.7** Courses withdrawn will have to be taken when they are offered next if they belong to the list of core courses.

**7.8** A student undergoing a full time PG Programme should have enrolled for all preceding semesters before registering for a particular semester

**7.9** A student undergoing the P.G. programme in Part Time mode can choose not to register for any course in a particular semester with written approval from the head of the department. However the total duration for the completion of the programme shall not exceed the prescribed maximum number of semesters (vide clause 3.1)

## 8.0 TEMPORARY BREAK OF STUDY FROM THE PROGRAMME

A student may be permitted by the Dean (Academic Affairs) to avail temporary break of study from the programme up to a maximum of two semesters for reasons of ill health or other valid grounds. Such student has to rejoin only in the same semester from where he left. However the total duration for completion of the programme shall not exceed the prescribed maximum number of semesters (vide clause 3.1).

## 9.0 MINIMUM REQUIREMENTS TO REGISTER FOR PROJECT / THESIS / DISSERTATION

**9.1** A student is permitted to register for project semester, if he/she has earned the minimum number of credits specified below:

| Programme | Minimum No. of credits to be earned to enroll for project semester |
|---|---|
| M. Tech. (Full time / Part time) | 18 |
| M.C.A. (Full time / Part time) | 45 |
| M.C.A. (Full time / Part time) – (Lateral Entry) | 22 |
| M.Sc.(Full time / Part time) | 18 |

**9.2** If the student has not earned minimum number of credits specified, he/she has to earn the required credits, at least to the extent of minimum credits specified in clause 9.1 and then register for the project semester.

## 10.0 DISCIPLINE

**10.1** Every student is required to observe discipline and decorous behavior both inside and outside the campus and not to indulge in any activity, which will tend to bring down the prestige of the Institution.

**10.2** Any act of indiscipline of a student reported to the Head of the Institution will be referred to a Discipline and Welfare Committee for taking appropriate action.

## 11.0 ATTENDANCE

**11.1** Attendance rules for all Full Time Programme and Part time Programmes are given in the following sub-clause.

**11.2** Ideally every student is expected to attend all classes and earn 100% attendance in the contact periods of every course, subject to a maximum relaxation of 25% for genuine reasons like on medical grounds, representing the University in approved events etc., to become eligible to appear for the semester-end examination in that course, failing which the student shall be awarded "I" grade in that course. If the course is a core course, the student should register for and repeat the course when it is offered next. If the course is an elective, either he/she can register and repeat the same elective or can register for a new elective.

**11.3** The students of Full Time mode of study, who have not attended a single hour in all courses in a semester and awarded ‘I’ grade are not permitted to

write the examination and also not permitted move to next higher semester. Such students should repeat all the courses of the semester in the next Academic year.

## 12.0 SUMMER TERM COURSES

**12.1** Summer term courses may be offered by a department on the recommendation of the Departmental Consultative Committee and approved by the Dean (Academic Affairs). No student should register for more than three courses during a summer term.

**12.2** Summer term courses will be announced by the Head of the department at the end of the even semester before the commencement of the end semester examinations. A student will have to register within the time stipulated in the announcement. A student has to pay the fees as stipulated in the announcement.

**12.3** The number of contact hours and the assessment procedure for any course during summer term will be the same as those during regular semesters.

Students with U grades will have the option either to write semester end arrears exam or to redo the courses during summer / regular semesters, if they wish to improve their continuous assessment marks subject to the approval of the Head of the department.

**12.4** Withdrawal from a summer term course is not permitted. No substitute examination will be conducted for the summer term courses.

**12.5** The summer term courses are not applicable for the students of Part Time mode.

## 13.0 ASSESSMENTS AND EXAMINATIONS

**13.1** The following rule shall apply to all the PG programmes (M. Tech. / M.C.A. / M.Sc.)

For lecture-based courses, normally a minimum of two assessments will be made during the semester. The assessments may be combination of tests and assignments. The assessment procedure as decided in the Class Committee will be announced to the students right from the beginning of the semester by the course teacher.

**13.2** There shall be one examination of three hours duration, at the end of the semester.

**13.3** In one (or) two credit courses that are not spread over the entire semester, the evaluation will be conducted at the completion of the course itself. Anyhow approval for the same is to be obtained from the HoD and the Dean of Academic Affairs.

**13.4** The evaluation of the Project work will be based on the project report and a Viva-Voce Examination by a team consisting of the supervisor concerned, an Internal Examiner and External Examiner to be appointed by the Controller of Examinations.

**13.5** At the end of industrial internship, the student shall submit a certificate from the organization and also a brief report. The evaluation will be made based on this report and a Viva-Voce Examination, conducted internally by a Departmental Committee constituted by the Head of the Department.

## 14.0 WEIGHTAGES

**14.1** The following shall be the weightages for different courses:

**i) Lecture based course**

| | |
|---|---|
| Two continuous assessments | 50% |
| Semester-end examination | 50% |

**ii) Laboratory based courses**

| | |
|---|---|
| Laboratory work assessment | 75% |
| Semester-end examination | 25% |

**iii) Project work**

| | |
|---|---|
| Periodic reviews | 50% |
| Evaluation of Project Report by | |
| External Examiner | 20% |
| Viva-Voce Examination | 30% |

**14.2** Appearing for semester end examination for each course (Theory and Practical) is mandatory and a student should secure a minimum of 40% marks in semester end examination for the successful completion of the course.

**14.3** The markings for all tests, tutorial, assignments (if any), laboratory work and examinations will be on absolute basis. The final percentage of marks is calculated in each course as per the weightages given in clause 13.1.

## 15.0 SUBSTITUTE EXAMINATION

**15.1** A student who has missed for genuine reasons any one of the three assessments including semester-end examination of a course may be permitted to write a substitute examination. However, permission to take up a substitute examination will be given under exceptional circumstances, such as accident or admissions to a hospital due to illness, etc.

**15.2** A student who misses any assessment in a course shall apply in a prescribed form to the Dean (Academic Affairs) through the Head of the department within a week from the date of missed assessment. However

the substitute tests and examination for a course will be conducted within two weeks after the last day of the semester-end examinations.

## 16.0 COURSEWISE GRADING OF STUDENTS AND LETTER GRADES

**16.1** Based on the semester performance, each student is awarded a final letter grade at the end of the semester in each course. The letter grades and the corresponding grade points are as follows, but grading has to be relative grading

| Letter grade | Grade points |
|---|---|
| S | 10 |
| A | 9 |
| B | 8 |
| C | 7 |
| D | 6 |
| E | 5 |
| U | 0 |
| W | - |
| I | - |
| AB | - |

- Flexible range grading system will be adopted
- **“W”** denotes withdrawal from the course.
- **"I"** denotes inadequate attendance and hence prevention from semester-end examination
- **"U"** denotes unsuccessful performance in a course.
- **“AB”** denotes absent for the semester end examination

**16.2** A student is considered to have completed a course successfully if he / she secure five grade points or higher. A letter grade ‘U’ in any course implies unsuccessful performance in that course.

**16.3** A course successfully completed cannot be repeated for any reason.

## 17.0 AWARD OF LETTER GRADE

**17.1** A final meeting of the Class Committee without the student member(s) will be convened within ten days after the last day of the semester end examination. The letter grades to be awarded to the students for different courses will be finalized at the meeting.

**17.2** After finalization of the grades at the class committee meeting the Chairman will forward the results to the Controller of Examinations, with copies to Head of the Department and Dean (Academic Affairs).

## 18.0 DECLARATION OF RESULTS

**18.1** After finalization by the Class Committee as per clause 16.1 the Letter grades awarded to the students in the each course shall be announced on the departmental notice board after duly approved by the Controller of Examinations.

**18.2** In case any student feels aggrieved about the results, he/she can apply for revaluation after paying the prescribed fee for the purpose, within one week from the announcement of results.

A committee will be constituted by the concerned Head of the Department comprising of the Chairperson of the concerned Class Committee (Convener), the teacher concerned and a teacher of the department who is knowledgeable in the concerned course. If the Committee finds that the case is genuine, it may jointly revalue the answer script and forward the revised marks to the Controller of Examinations with full justification for the revision, if any.

**18.3** The “U” and “AB” grade once awarded stays in the grade sheet of the students and is not deleted when he/she completes the course successfully later. The grade acquired by the student later will be indicated in the grade sheet of the appropriate semester.

## 19.0 COURSE REPETITION AND ARREARS EXAMINATION

**19.1** A student should register to re-do a core course wherein "I" or "W" grade is awarded. If the student is awarded "I" or "W" grade in an elective course either the same elective course may be repeated or a new elective course may be taken.

**19.2** A student who is awarded “U” or “AB” grade in a course shall write the semester-end examination as arrear examination, at the end of the next semester, along with the regular examinations of next semester courses.

**19.3** A student who is awarded “U” or “AB” grade in a course will have the option of either to write semester end arrear examination at the end of the subsequent semesters, or to redo the course whenever the course is offered. Marks earned during the redo period in the continuous assessment for the course, will be used for grading along with the marks earned in the end-semester (re-do) examination.

**19.4** If any student obtained "U" or "AB" grade, the marks earned during the redo period for the continuous assessment for that course will be considered for further appearance as arrears.

**19.5** If a student with "U" or "AB" grade prefers to redo any particular course fails to earn the minimum 75% attendance while doing that course, then he/she will not be permitted to write the semester end examination and his / her earlier 'U' grade and continuous assessment marks shall continue.

## 20.0 GRADE SHEET

**20.1** The grade sheet issued at the end of the semester to each student will contain the following:

(i) the credits for each course registered for that semester.

(ii) the performance in each course by the letter grade obtained.

(iii) the total credits earned in that semester.

(iv) the Grade Point Average (GPA) of all the courses registered for that semester and the Cumulative Grade Point Average (CGPA) of all the courses taken up to that semester.

**20.2** The GPA will be calculated according to the formula

$$GPA = \frac{\sum_{i=1}^{n}(C_i)(GP_i)}{\sum_{i=1}^{n}(C_i)}$$

where n = number of courses

where $C_i$ is the number of credits assigned for $i^{th}$ course

$GP_i$ - Grade point obtained in the $i^{th}$ course

for the cumulative grade point average (CGPA) a similar formula is used except that the sum is over all the courses taken in all the semesters completed up to the point of time.

'I' and 'W' grades will be excluded for GPA calculations.

'U', 'AB' 'I' and 'W' grades will be excluded for CGPA calculations.

**20.3** Classification of the award of degree will be as follows:

**20.3.1** For students under full time mode of study

| CGPA | Classification |
|---|---|
| 8.50 and above, having completed all courses in first appearance | First class with Distinction |
| 6.50 and above, having completed within a period of 2 semesters beyond the programme period | First Class |
| All others | Second Class |

However, to be eligible for First Class with Distinction, a student should not have obtained U or I grade in any course during his/her study and should have completed the PG Programme within a minimum period covered by the minimum duration (clause 3.1) plus authorized break of study, if any (clause 8). To be eligible for First Class, a student should have passed the examination in all courses within the specified minimum number of semesters reckoned from his/her commencement of study plus two semesters. For this purpose, the authorized break of study will not be counted. The students who do not satisfy the above two conditions will be classified as second class. For the purpose of classification, the CGPA will be rounded to two decimal places. For the purpose of comparison of performance of students and ranking, CGPA will be considered up to three decimal places.

**20.3.2** For students under part time mode of study

| CGPA | Classification |
|---|---|
| 8.50 and above, having completed all courses in first appearance | First class with Distinction |
| 6.50 and above | First Class |
| All others | Second Class |

For the purpose of classification, the CGPA will be rounded to two decimal places.

## 21.0 ELIGIBILITY FOR THE AWARD OF THE MASTERS DEGREE

**21.1** A student shall be declared to be eligible for the award of the Masters Degree, if he/she has:

i) successfully acquired the required credits as specified in the Curriculum corresponding to his/her programme within the stipulated time,

ii) no disciplinary action is pending against him/her.

**21.2** The award of the degree must be approved by the University.

## 22.0 POWER TO MODIFY

Notwithstanding all that have been stated above, the Academic Council has the right to modify any of the above regulations from time to time.

# CURRICULUM & SYLLABI FOR
# M. Tech (Electronics and Instrumentation Engineering)

## CURRICULUM
## (FOUR SEMESTERS / FULL TIME)

| S. No | Course Code | Course Name | L | T | P | C |
|---|---|---|---|---|---|---|
| | | **Semester I** | | | | |
| 1 | MAC6184 | Probability, Matrix Theory And Linear Programming | **3** | **1** | **0** | **4** |
| 2 | EEC6101 | System Theory | **3** | **0** | **0** | **3** |
| 3 | EIC6101 | Microcontroller based system design | **3** | **0** | **0** | **3** |
| 4 | EIC6102 | Frequency based Control System | **3** | **0** | **2** | **4** |
| 5 | EIC6103 | Applied Industrial Instrumentation | **3** | **0** | **0** | **3** |
| 6 | | Professional Elective | | | | **2/3** |
| | | **Total Credit** | | | | **19/20** |
| | | **Semester II** | | | | |
| 1 | GEC6201 | Research Methodology for Engineers | **3** | **0** | **0** | **3** |
| 2 | EIC6211 | Advanced Process Control | **3** | **0** | **2** | **4** |
| 3 | EIC6212 | Industrial Automation using PLC, SCADA and DCS | **3** | **0** | **2** | **4** |
| 4 | | Professional Elective (min credit of 9) | | | | **9** |
| 5 | EIC6213 | Mini project/Seminar | **0** | **0** | **2** | **1** |
| | | **Total Credit** | | | | **21** |
| | | **Semester III** | | | | |
| 1 | | Professional Elective | | | | **7/6** |
| 2 | | General Elective (min credit of 3) | | | | **3** |
| 3 | EIC7102 | Industry Internship | **0** | **0** | **#** | **1** |
| 4 | EIC7101 | Project Phase I | **0** | **0** | **12** | **6*** |
| | | **Total Credit** | | | | **17/16** |

# - Two week summer internship

| S. No | Course Code | Course Name | L | T | P | C |
|---|---|---|---|---|---|---|
| | | **Semester IV** | | | | |
| 1 | EIC7101 | Project Phase II | **0** | **0** | **36** | **18** |
| | | Total Credit (semester IV) | | | | **18** |

*Credit for Project Phase I to be accounted along with Project work phase II in IV semester

**Value added course by industrial person / Academician with 1 credit

**Grand Total of Credits** **75**

# LIST OF PROFESSIONAL ELECTIVES

| S. No | Course Code | Course Name | L | T | P | C |
|---|---|---|---|---|---|---|
| | | **Professional Elective (Semester 1 Electives) (2/3 credits)** | | | | |
| 1. | EICY101 | Piping & Instrumentation for Process Industries | **2** | **0** | **0** | **2** |
| 2. | EICY102 | Applied soft computing techniques for Process Modeling, Control and Optimization | **2** | **0** | **2** | **3** |
| 3. | EICY103 | Instrumentation System Design | **2** | **0** | **2** | **3** |
| | | **Professional Elective - (Semester 2 Electives) (9 credits)** | | | | |
| 1 | EICY201 | System Identification and Modeling | **2** | **0** | **2** | **3** |
| 2 | EICY202 | Adaptive Control | **3** | **0** | **0** | **3** |
| 3 | EICY203 | Optimal Control | **3** | **0** | **0** | **3** |
| 4 | EICY204 | Virtual Instrumentation | **2** | **0** | **2** | **3** |
| 5 | EICY205 | Advanced Fibre optics and Laser Instrumentation | **3** | **0** | **0** | **3** |
| 6 | EICY206 | Applied Biomedical Instrumentation | **3** | **0** | **0** | **3** |
| 7 | ECCY001 | Digital Image Processing | **3** | **0** | **0** | **3** |
| 8 | ECC6104 | Advanced Digital Signal Processing | **3** | **1** | **0** | **4** |
| 9 | ECCY022 | Speech and Audio Signal Processing | **3** | **0** | **0** | **3** |
| 10 | ECCY016 | Network Security | **3** | **0** | **0** | **3** |
| 11 | MACY081 | Signal Processing Techniques | **3** | **1** | **0** | **4** |
| 12 | ECCY050 | MEMS System Design | **3** | **0** | **0** | **3** |
| | | **Professional Elective (Semester 3 Electives) (7/6 credits)** | | | | |
| 1 | EICY130 | Fault Tolerant Control | **3** | **0** | **0** | **3** |
| 2 | EICY131 | Robotics and Automation | **3** | **0** | **0** | **3** |
| 3 | EICY132 | Instrumentation in Power Plant | **3** | **0** | **0** | **3** |
| 4 | EICY133 | Instrumentation in Petrochemical Industry | **3** | **0** | **0** | **3** |
| 5 | EICY134 | Value Added Course | **1** | **0** | **0** | **1** |
| 6 | ECCY025 | Wireless Communication | **3** | **0** | **0** | **3** |
| 7 | ECCY011 | Medical Image Processing | **3** | **0** | **0** | **3** |
| 8 | ECCY026 | Wireless sensor Networks | **3** | **0** | **0** | **3** |
| 9 | EEC6128 | Embedded and Advanced Control of Electric Drives | **3** | **0** | **2** | **4** |
| 10 | EEC6235 | Solid State AC and DC Drives | **3** | **0** | **0** | **3** |
| 11 | EECY047 | Special Electrical Machines and Controllers | **3** | **0** | **0** | **3** |

# GENERAL ELECTIVES FOR M.TECH PROGRAMMES

| Sl. No. | Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|---|
| 1 | GECY101 | Project Management | **3** | **0** | **0** | **3** |
| 2 | GECY102 | Society, Technology & Sustainability | **3** | **0** | **0** | **3** |
| 3 | GECY103 | Artificial Intelligence | **3** | **0** | **0** | **3** |
| 4 | GECY104 | Green Computing | **3** | **0** | **0** | **3** |
| 5 | GECY105 | Gaming Design | **3** | **0** | **0** | **3** |
| 6 | GECY106 | Social Computing | **3** | **0** | **0** | **3** |
| 7 | GECY107 | Soft Computing | **3** | **0** | **0** | **3** |
| 8 | GECY108 | Embedded System Programming | **3** | **0** | **0** | **3** |
| 9 | GECY109 | Principles of Sustainable Development | **3** | **0** | **0** | **3** |
| 10 | GECY110 | Quantitative Techniques in Management | **3** | **0** | **0** | **3** |
| 11 | GECY111 | Programming using MATLAB & SIMULINK | **1** | **0** | **2** | **2** |
| 12 | GECY112 | JAVA Programming | **1** | **0** | **2** | **2** |
| 13 | GECY113 | PYTHON Programming | **1** | **0** | **2** | **2** |
| 14 | GECY114 | Intellectual Property Rights | **1** | **0** | **0** | **1** |

# SEMESTER I

| | | L | T | P | C |
|---|---|---|---|---|---|
| **MAC6184** | **PROBABILITY, MATRIX THEORY AND LINEAR PROGRAMMING** | **3** | **1** | **0** | **4** |

**OBJECTIVE:**

The aim of this course is to

- provide a comprehensive introduction to the probability distributions used in engineering.
- familiarize students with advanced matrix theory and variational problems.
- expose the students to Operations Research using concepts of linear programming.

**MODULE I PROBABILITY DISTRIBUTIONS 10+03**

Axioms of probability – addition and multiplication theorem – conditional probability – total probability – random variables - moments – moments generating functions and their properties- Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

**MODULE II TWO DIMENSIONAL RANDOM VARIABLES 08+03**

Joint distributions - marginal and conditional distributions - functions of random variables - covariance - correlation and regression - Central limit theorem.

**MODULE III ADVANCED MATRIX THEORY 09+03**

Matrix norms - singular value decomposition - QR algorithm - pseudo inverse - least square approximations.

**MODULE IV LINEAR PROGRAMMING 10+03**

Formation - graphical method - simplex method - Big-M method - Two Phase method - transportation and assignment problems.

**MODULE V CALCULUS OF VARIATIONS 08+03**

Variation and its properties – Euler's equation – functional dependant on first and higher order derivatives – functional dependant on functions of several independent variables – variational problems with moving boundaries – isoperimetric problems – Ritz and Kantorovich methods.

**L – 45; T – 15; Total – 60**

**TEXT BOOKS:**

1. S.M.Ross, “A First Course in Probability”, 9th edition, Pearson Education, 2013.
2. Lewis.D.W., “Matrix Theory”, Allied Publishers, Chennai, 1995.
3. Taha, H.A., “Operations Research - An Introduction '', 10th edition, Pearson Prentice Hall, 2016.
4. A.S. Gupta, “Calculus of variations with applications”, PHI Pvt. Ltd, New Delhi, 2011.

**REFERENCES:**

1. H. Cramer., “Random Variables and Probability Distributions”, Cambridge University Press (2004).
2. Roger A. Horn, Charles R. Johnson, “Matrix Analysis”, Cambridge University Press; 2nd edition (2012).
3. Robert.J.Vanderbei., “Linear Programming: Foundations and Extensions”, Springer US(2014).
4. David. J. Rader., “Deterministic Operations Research”, Wiley (2010).
5. Elsgolts, “Differential Equations and Calculus of Variations", University Press of the Pacific (2003).

**OUTCOME:**

At the end of the course students will be able to

- Solve problems using concept of standard, discrete and continuous distributions.
- Solve problems using one dimensional and two dimensional random variables.
- Find eigenvalues and eigen vectors of a higher order matrix.
- Solve problems of linear programming.
- Solve problems of calculus of variations by direct methods and using Euler’s formulae.

**EEC6101 SYSTEM THEORY**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To provide knowledge on state space approach, state feedback controllers and observers for different processes.
- To enhance knowledge on stability analysis of multivariable processes.
- To introduce nonlinear systems and its linearization methods.
- To evaluate Stability of Linear and Non Linear Systems.

**MODULE I STATE SPACE APPROACH 08**

Introduction to State Space Approach - System representation in state variable form – State transition equation – Methods of computing the state transition matrix.

**MODULE II STATE FEEDBACK CONTROL AND STATE ESTIMATOR 08**

Stability analysis - Controllability and Observability of linear time invariant systems - State Feedback – Output Feedback – Pole placement technique – Full order and Reduced Order Observers.

**MODULE III STABILITY FOR LINEAR SYSTEMS 08**

Introduction – Equilibrium points – Stability in the sense of Lyapunov - BIBO Stability – Stability of LTI systems – The direct method of Lyapunov and the Linear continuous time autonomous systems – Popov Stability Criterion.

**MODULE IV NON-LINEAR SYSTEMS 06**

Types of Non-Linearity – Typical Examples – Phase plane analysis (analytical and graphical methods) – Limit cycles – Equivalent Linearization.

**MODULE V STABILITY FOR NON-LINEAR SYSTEMS 08**

Equilibrium stability of non linear continuous time autonomous systems – Finding Lyapunov functions for nonlinear continuous time autonomous systems – Krasovskii and variable gradient method.

**MODULE VI STABILITY FOR NON-LINEAR SYSTEMS USING DESCRIBING FUNCTION 07**

Describing Function Analysis for Non Linear Systems, Describing Functions for different non-linear elements- backlash, deadzone, saturation and hysteresis

**Total Hours: 45**

**REFERENCES:**


- M.Gopal, “Modern Control System Theory”, New Age International, 2005.
- K.Ogata, “Modern Control Engineering”, Prentice Hall of India, 2010.
- John .S.Bay, “Fundamentals of Linear State Space Systems”, Tata McGraw– Hill, 1999.
- Z.Bubnicki, “Modern Control Theory”, Springer, 2005.


**OUTCOMES:**

At the end of the course, the students will have knowledge and achieve skills on the following:

- Implement state space approach for the process and obtain the solution.
- Design state feedback controller and observer.
- Perform stability analysis of the system using conventional mathematical approach
- Ability to analyze complex systems using mathematical models.
- Ability to analyze the stability of Linear Systems using Lyapnov and Popov Stability Criterions
- Ability to analyze the stability of Non-Linear Systems using novel techniques.

| EIC 6101 | MICROCONTROLLER BASED SYSTEM DESIGN | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To expose the students to the fundamentals of embedded Programming
- To provide knowledge about the architectures and features of various microcontrollers
- To impart knowledge about both hardware and software aspects of integrating digital devices into microcontroller based systems.
- To understand the concepts of algorithm development and programming on software tools and microcontrollers with peripheral interfaces.
- To design embedded system for real time applications.

**MODULE I INTRODUCTION TO EMBEDDED SYSTEM 09**

Microprocessor and Microcontroller architecture, Comparison, Advantages and applications of each Harvard and Von Neumann architecture, RISC and CISC comparison, Definition of embedded system and its characteristics. Role of microcontroller in embedded System. Study of RS232, RS 485, I2C, SPI protocols. Serial communications, Memory,Software and hardware tools for development of microcontroller based system.

**MODULE II PIC MICROCONTROLLER 09**

Introduction to PIC Microcontroller, PIC16F877A Architecture and Instruction Set, Memory Organization, I/O Ports and SFRs, Interrupts, Timers and ADC, addressing modes – instruction set – PIC programming in Assembly & C.

**MODULE III AVR MICROCONTROLLER 09**

Overview of AVR family, AVR family Categories and importance (AT mega / X mega). AVR Microcontroller architecture, Register, AVR status register, ROM space and other hardware modules, AT mega 32 pin configuration & function of each pin. AVR Assembly Language Programming, Timers, Interrupts.

**MODULE IV LPC 2148 MICROCONTROLELR 09**

LPC2148 ARM 7 microcontroller, Features of LPC2148, Block diagram of LPC2148, Pin diagram of LPC2148, Architectural overview, On-chip flash program memory, On-chip static RAM. System control, Timers, ADC, DAC, UART.

**MODULE V CASE STUDIES 09**

Home security system, Smart card application, Design of DAS system, Design of Digital Multimeter, Stepper motor control, Design of DC Motor control using PWM, Line Following Robotic Circuit using AT Mega 8 Microcontroller.

**Total Hours:45 hours**

**TEXT BOOKS:**

1. "The PIC Microcontroller and Embedded systems – Using Assembly and C for PIC18," Muhammad Ali Mazidi, Rolin D. McKinlay, and Danny Causey, Prentice Hall, 2013
2. The AVR Microcontroller and Embedded Systems Using Assembly and C, By Muhammad Ali Mazidi, Sarmad Naimi and Sepehr Naimi, Pearson Education, 2011.
3. Programming and Customizing the AVR Microcontroller, By Dhananjay Gadre, McGraw Hill Education,2008
4. Lyla B Das," Embedded Systems-An Integrated Approach", Pearson 2013

**REFERENCE BOOKS:**

1. Rajkamal, 'Embedded system-Architecture, Programming, Design', TMH, 2011.
2. Peckol, "Embedded system Design", John Wiley & Sons, 2010
3. Microcontrollers, Principles and Applications – Ajit pal – PHI Ltd., - 2011.

**OUTCOMES:**

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

- Compare microprocessor and microcontroller and analyze the tools in an embedded system
- Distinguish the architecture of three microcontroller's namely PIC, AVR microcontrollers.
- Interface PIC, AVR microcontrollers to various peripheral devices such as ADC, DAC, Motor, LCD etc.
- Develop the programming skills with simple arithmetic and control instructions for PIC, AVR microcontrollers
- Design and implement microcontroller based embedded system for the selected industrial projects.

| EIC6102 | FREQUENCY BASED CONTROL SYSTEM | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 4 |

**OBJECTIVES:**

- To review the methods of stability analysis of systems
- To enhance knowledge on frequency domain based controller design
- To provide in depth knowledge on the synthesis of linear time invariant controllers for linear systems
- To introduce the concept of fractional calculus for control applications
- To impart knowledge on fractional order controller design

**MODULE I BASICS OF FEEDBACK CONTROL SYSTEMS 07**

**Theory**

Introduction – Basic frequency domain characteristics- Stability analysis using Bode plot - Nichol's charts – Closed loop specification – Performance limitations of NMP/Unstable systems.

**Practical 04**

Modeling of a process, stability analysis using Bode Plot, Nichol's chart using Matlab and Labview

**MODULE II CONTROLLER DESIGN USING FREQUENCY RESPONSE PLOTS 08**

**Theory**

Frequency response plots - reshaping the Bode plot – compensator design using bode plot – Lag, Lead, Lag-Lead design – Frequency domain analysis and its applications - Quantitative Feedback Theory – Quantitaive Feedback ApplicationsLoop shaping

**Practical 04**

Reshaping the Bode plot, Compensator design and Loop shaping using Matlab

**MODULE III CONTROLLER DESIGN USING QUANTITATIVE FEEDBACK THEORY 12**

**Theory**

Quantitative feedback theory – Overview, Design objective, control system performance specifications, Insight to QFT techniques – Open Loop Plant, Closed Loop formulation, Insight to the use of Nichols Chart in the QFT – MISO Analog Control System – Design Procedure Outline : LTI plant models, performance specifications, plant templates, stability bound, tracking bounds, disturbance bounds, Loop shaping, design of prefilter, Design Example.

**Practical** **10**

Controller design, tuning and simulation using QFT toolbox

**MODULE IV FRACTIONAL ORDER SYSTEM** **09**

**Theory**

Fractional-order Calculus and Its Computations – Frequency and Time Domain Analysis of Fractional-Order Linear Systems - Filter Approximations to Fractional-Order Differentiations – Model reduction Techniques for Fractional Order Systems.

**Practical** **06**

Fractional order modeling and control using Matlab for process setups

**MODULE V FRACTIONAL ORDER CONTROLLER DESIGN** **09**

**Theory**

Design of fractional order PI, PD, PID controller for first order plus dead time process - using graphical method, analytical method & optimization techniques - tuning of fractional order lead-lag compensators.

**Practical** **06**

Fractional order controller design and simulation using Matlab

**L: 45, P:30, Total :60**

**TEXT BOOK:**

1. Oded Yaniv, 'Quantitative feedback theory for linear and non-linear systems', Kluwer Academic publishers, 1999.
2. M.Gopal, 'Control systems, principles and design' fourth edition, Tata McGraw Hill publishers pvt ltd, 2014
3. Monje, C.A., Chen, Y., Vinagre, B.M., Xue, D., Feliu-Batlle, V.,' Fractional-order Systems and Controls Fundamentals and Applications', Springer-Verlag London, 2010.

**OUTCOMES:**

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

- Analyze the techniques used for estimating the stability of systems
- Design controllers/compensators using frequency domain approach
- Synthesize linear time invariant controllers for linear systems
- Analyze fractional order system in frequency and time domains
- Design of fractional order controllers using different techniques

| EIC6103 | APPLIED INDUSTRIAL INSTRUMENTATION | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To review the various techniques used for the measurement of primary industrial parameters like flow, level, temperature and pressure.
- To provide knowledge about the important parameters to be monitored and analyzed in Thermal power Plant
- To give an exposure on the important parameters to be monitored and analyzed in Petrochemical Industry
- To impart knowledge about the hazardous zone classification and intrinsic safety techniques to the adapted in industries.
- To introduce special purpose instruments like Nuclear radiation detection techniques, fibre optic sensors, Instrumentation for NDT applications etc

**MODULE I REVIEW OF INDUSTRIAL INSTRUMENTATION 10**

Overview of Measurement of Flow, level, Temperature, Pressure, Viscosity, Humidity, Force, Torque and Acceleration, Intelligent Sensors and its Interfaces with Process controllers and PLC, Process Analysers ( Toxic,Combustible, Gas Detectors, Flame scanners)

**MODULE II MEASUREMENT IN THERMAL POWER PLANT 10**

Selection and Installation of instruments used for the Measurement of fuel flow, Air flow, Drum level, Steam pressure, Steam temperature – Feed water quality measurement Flue gas Oxygen Analyzers- pH measurement – Pollution monitoring instruments

**MODULE III MEASUREMENT IN PETROLEUM REFINERY 10**

Flow, Level, Temperature and Pressure measurement in Distillation. Pyrolysis, catalytic cracking and reforming process-Hydrocarbon analyzers, oil in water analysers - sulphur in oil Analyzer- Selection and maintenance of measuring instruments

**MODULE IV INSTRUMENTATION FOR INDUSTRIAL SAFETY 05**

Area Classification - Electrical and Intrinsic Safety - Explosion Suppression and Deluge systems - Conservation and emergency vents - Flame, fire and smoke detectors - Leak Detectors - Intrinsic Safety.

Process Industry Practices : Field Insts, Estimation, Control Panel, Analyser Housing, Inst Air, Electrical interfaces, Selection, Inst Tools, cabels/wires, Value proposition, Installation Support, Safety Systems, Project Documentation

**MODULE V SPECIAL PURPOSE INSTRUMENTATION 10**

Detection of Nuclear Radiation – Corrosion monitoring – Fibre optic sensors - smart transmitters and wireless transmitters – Instrumentation for NDT applications - Instrumentation for energy conservation and management - Image based measurements.

**Total Hours: 45**

**TEXT BOOKS:**

1. B.G.Liptak, “Instrumentation Engineers Handbook (Process Measurement & Analysis)”, Fourth Edition, Chilton Book Co, 2003.
2. K.Krishnaswamy and M.Ponnibala, “Power Plant Instrumentation”, PHI Learning Pvt Ltd, 2013. 25
3. John G Webster, “The Measurement, Instrumentation, and Sensors Handbook”, CRC and IEEE Press, 1999.

**REFERENCE BOOKS:**

1. Håvard Devold, “Oil and Gas Production Handbook - An Introduction to Oil and Gas Production”, ABB ATPA oil and gas, 2006.
2. M.Arumugam, “Optical Fibre Communication and Sensors”, Anuradha Agencies, 2002.
3. Paul E. Mix, “Introduction to Nondestructive Testing”, John Wiley and Sons, 2005.

**OUTCOMES:**

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

- select suitable measuring instruments for real time industrial applications
- select and install various measuring instruments used in thermal power plants and petroleum industries
- Analyze industrial safety measures and select appropriate techniques to provide intrinsic safety
- Adapt industrial practices for instrument housing, electrical interfaces, and installation support
- Apply the special purpose instruments for NDT, energy conservation and management.

# SEMESTER II

| GEC6201 | RESEARCH METHODOLOGY FOR ENGINEERS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To provide a perspective on research to the scholars
- To educate on the research conceptions for designing the research
- To impart knowledge on statistical techniques for hypothesis construction
- To gain knowledge on methods of data analysis and interpretation
- To learn about the effective communication of research finding

**MODULE I RESEARCH PROBLEM FORMULATION 07**

Research – Objectives**:** – types, Research process, Solving engineering problems, Identification of research topic, Formulation of research problem, Literature survey and review.

**MODULE II HYPOTHESIS FORMULATION 08**

Research design – meaning and need – basic concepts, Different research designs, Experimental design – principle – important experimental designs, Design of experimental setup, Mathematical modeling, Simulation – validation and experimentation, Dimensional analysis and similitude.

**MODULE III STATISTICAL TECHNIQUES 12**

Statistics in research – concept of probability – popular distributions –Hypothesis testing- sample design- Design of experiments – factorial designs -– orthogonal arrays- ANOM - ANOVA - Multivariate analysis - Use of optimization techniques – traditional methods – evolutionary optimization techniques –Transportation model.

**MODULE IV STATISTICAL ANALYSIS OF DATA 10**

Research Data analysis – interpretation of results – correlation with scientific facts- Accuracy and precision – error analysis, limitations - Curve fitting, Correlation and regression.

**MODULE V RESEARCH REPORT 08**

Purpose of written report – audience, synopsis writing, preparing papers for International journals, Thesis writing – organization of contents – style of writing –

graphs and charts – referencing, Oral presentation and defence, Ethics in research, Patenting, Intellectual Property Rights.

**Total Hours: 45**

**REFERENCES:**


1. Ganesan R., Research Methodology for Engineers, MJP Publishers, Chennai, 2011.
2. Ernest O., Doebelin, Engineering Experimentation: planning, execution, reporting, McGraw Hill International edition, 1995.
3. George E. Dieter., Engineering Design, McGraw Hill – International edition, 2000.
4. Madhav S. Phadke, Quality Engineering using Robust Design, Printice Hall, Englewood Cliffs, New Jersey, 1989.
5. Kothari C.R., Research Methodology – Methods and Techniques, New Age International (P) Ltd, New Delhi, 2003.
6. Kalyanmoy Deb., “Genetic Algorithms for optimization”, KanGAL report, No.2001002.
7. Holeman, J.P., Experimental methods for Engineers, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 2007.
8. Govt. of India, Intellectual Property Laws; Acts, Rules & Regulations, Universal Law Publishing Co. Pvt. Ltd., New Delhi 2010.
9. University of New South Wales, “How to write a Ph.D. Thesis” Sydney, Australia, Science @ Unsw.
10. Shannon. R.E., System Simulation: the art and science, Printice Hall Inc, Englewood Cliffs, N.J.1995.
11. Scheffer. R.L. and James T. Mc Clave, Probability and Statistics for Engineers, PWS – Kent Publishers Co., Boston, USA, 1990.


**OUTCOMES:**

Students should be able to

- Formulate the research problem
- Design and Analyse the research methodology
- Construct and optimize the research hypothesis
- Analyse and interpret the data
- Report the research findings

| EIC6211 | ADVANCED PROCESS CONTROL | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 4 |

**OBJECTIVES:**

- To review the various processes and basic control schemes used for linear processes
- To determine the multivariable models for the Single Input Single Output, Multi Input Single Output, Single Input Multi Output and Multi Input and Multi Output systems.
- To analyse the interaction among the loops in the MIMO system
- To design and develop the multiloop and multivariable control schemes
- To model and control time varying and nonlinear systems

**MODULE I REVIEW OF PROCESS CONTROL 09+06**

Need for process control –Continuous and batch processes – Self regulation – Servo and regulatory operations – Interacting and non-interacting systems – Degrees of freedom - Linearization of nonlinear systems- Mathematical model of Level and Thermal processes – Lumped and Distributed parameter models - ON-OFF, P, P+I, P+D and P+I+D control - Controller Tuning:- Process reaction curve method, Continuous cycling method and Damped oscillation method

**MODULE II MULTIVARIABLE SYSTEMS 09+06**

**Theory**

Introduction to Multivariable systems -Transfer Matrix Representation -State Space representation - Poles and Zeros of MIMO System - Multivariable frequency response analysis - Directions in Multivariable systems - Singular Value Decomposition - Demonstration of Multivariable Systems analysis

**Practicals**

Differential equation modelling using matlab and simulink, determination of State space around an operating condition, Computation of Transfer Function Matrix, SVD computation, Frequency analysis using Matlab.

**MODULE III MULTI-LOOP REGULATORY CONTROL 09+06**

**Theory**

Introduction to Multi Loop Control - Process Interaction, Pairing of Inputs and Outputs - Relative Gain Array (RGA) – Properties and Application of RGA - Multi Loop PID Controller - Biggest Log Modulus Tuning Method - Decoupling Control - LQG Control - RGA for Non-Square Plant

**Practicals**

Computation of RGA, simulation of multiloop PID controller, Implementation of Decouplers, LQG design for a process

**MODULE IV MULTIVARIABLE REGULATORY CONTROL 09+06**

**Theory**

Introduction to Multivariable Control - Multivariable PID Controller - Multivariable IMC, Multivariable Dynamic Matrix Controller - Multivariable Model Predictive Control - Generalized Predictive Controller - Multiple Model based Predictive Controller - Constrained Model Predictive Controller - Implementation Issues

**Practicals**

Multivariable PID controller, Multivariable Dynamic Matrix controller simulation, multivariable IMC simulation

**MODULE V CONTROL OF TIME VARYING AND NONLINEAR SYSTEMS 09+06**

**Theory**

Model for Time varying systems - Models for Nonlinear Systems - Real time parameter estimation - Gain Scheduling Adaptive Control - Deterministic Self tuning controller - Model Reference Adaptive controller - Nonlinear PID Controller - Hammerstein and Wiener Systems

**Practicals**

Simulation of time varying process and analysis, Self tuning regulator design and simulation, Gain scheduler for control of a nonlinear process

**SAMPLE CASE STUDIES**

Students will be asked to select a case study given below or any other process of their choice. He/She has to do the advanced control schemes which will suit their process and demonstrate.

Control Schemes for Distillation Column, CSTR, Bioreactor, Three Tank System, Quadruple Tank System, pH process control system, Polymerization Reactor Automation

**L: 45, P: 30, Total :60**

**TEXT BOOK:**

1. Thomas E. Merlin,"Process Control – Designing Processes and Control Systems for Dynamic Performance", McGraw Hill, Inc., 2000.

**REFERENCE BOOKS:**

1. Bequette B.W, “Process Control Modeling, Design and Simulation”, Prentice Hall of India, 2004
2. Stephanopoulous. G., “Chemical Process Control – An Introduction to Theory and Practice”, Prentice Hall of India, 2008
3. Seborg D.E., Edgar T.F. and Mellichamp D.A., “Process Dynamics and Control”, Wiley John and Sons, 3rd Edition, 2010.
4. Coughanowr. D.R., “Process Systems Analysis and Control”, McGraw Hill,
5. Third Edition, 2009.
6. E. Ikonen and K. Najim, “Advanced Process Identification and Control”, Marcel Dekker, Inc New York, 2002.
7. P. Albertos and S. Antonio, “Multivariabl control Systems: An Engineering Approach”, Springer Verilog, 2004.
8. Sigurd Skogestad, Iam Postlethwaite, “Multivariable Feedback Control: Analysis and Design”, John Wiley and Sons, ‘Second Edition’, 2005.

**OUTCOMES:**

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

- Identify real world industrial or biomedical process and carry out dynamic performance analysis
- Perform interaction study in multivariable process and select the control scheme to be used
- Devise the process model of a multivariable system and apply multiloop and multivariable control
- Design and simulate the control scheme and evaluate the servo-regulatory response
- Model the time varying, nonlinear systems and perform control for the same

| EIC6212 | INDUSTRIAL AUTOMATION USING PLC, SCADA AND DCS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 4 |

**OBJECTIVES:**

- To provide in depth knowledge about PLC hardware and its programming
- To train the students to take up industrial applications and solve it using PLC
- To provide basic knowledge in the architecture and local control unit of distributed control system
- To give adequate knowledge about hardware, interfaces used in DCS and communication protocols
- To impart skill in developing data acquisition and supervisory control

**MODULE I PROGRAMMABLE LOGIC CONTROLLER: HARDWARE AND BASIC OPERATIONS 09+06**

Hard relay logic, Evolution of Programmable logic controller (PLC), Hardware Components of PLC: Input/Output modules, power supplies, isolators, CPU, memory and programming devices. Generic Control system Architecture and IO Assignments, General PLC programming procedures, Developing fundamental ladder logic programs (as per IEC61131) for Boolean operations, PLC basic functions : Register basics, timer functions, counter functions.

**Practical:** Development of Ladder program for simple on-off applications, Development of Ladder program for Timing and counting applications.

**MODULE II PROGRAMMABLE LOGIC CONTROLLERS : ADVANCED OPERATIONS, INSTALLATIONS AND TROUBLESHOOTING 09+06**

Developing program control instructions, data manipulation instructions, math instructions, sequencer and shift register instructions, Functional block diagram, Analog control using PLC (PID control configuration, PLC installations and troubleshooting.

**Practical:** Development of FBD in PLC, Automatic control of level using PLC, Automatic control of temperature using PLC, Control of pressure loop using PLC.

**MODULE III DISTRIBUTED CONTROL SYSTEM 09+06**

Introduction to Distributed control system, DCS architectures, Comparison, Local Control Unit, Process interfacing issues, Operator interfaces - Low level and high level operator interfaces - Operator displays - Engineering interfaces - Low level and high level engineering interfaces, Latest trends and developments.

**Practical:** Configuring Screens and Graphics (DCS), Tag Assignments to Field Devices in DCS, DCS based PID control for level loop.

**MODULE IV DATA ACQUISITION SYSTEMS 09+06**

Computers in Process control – Data Loggers – Data acquisition systems (DAS) – Alarms – Direct Digital Control (DDC) - Characteristics of digital data – Controller software – Computer Process interface for Data Acquisition and control – Supervisory Digital Control (SCADA) -introduction and brief history of SCADA – SCADA Hardware and software.

**Practical:** Programming of HMI interfacing with PLC, Communicate PLC with SCADA

**MODULE V COMMUNICATIONS IN DCS 09+06**

Introduction - Evolution of signal standard - HART communication protocol - communication modes - HART networks - HART commands - HART field controller implementation - HART and OSI model - Field bus – Introduction Profibus, Modbus - Foundation field bus - General field bus architecture – basic requirement - basic requirements of field bus standard - field bus topology. Introduction to AS-Interface (As-i), Device net and Industrial Ethernet.

**L: 45, P: 30 Total: 60**

**REFERENCES:**

1. W. Bolton, "Programmable Logic Controllers", published by Elsevier Newnes 4th edition, Copyright @2006.
2. Webb, John W., Reis, Ronald A. “Programmable Logic Controllers: Principles and Applications”, 5th edition, Published by Prentice Hall College Div, 2002.
3. Clarke, G., Reynders, D. and Wright, E., "Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems", Newnes, 1st Edition, 2004.
4. Petrezeulla, Programmable Controllers, Mc-Graw Hill, 1989.5TH edition, 2016.
5. Michael P.Lucas, Distributed Control System, Van Nastrand Reinhold Company, New York, 1986.

**OUTCOMES:**

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

- Analyze the hardware components of PLC and its programming languages
- Develop programs for the use of PLC in industrial application
- Analyze the different architecture and interfaces of DCS
- Design and develop supervisory control and data acquisition system for given application
- Apply the various communication protocols in process industries

# ELECTIVE COURSES

**Professional Elective (Semester 1) (2/3 credits)**

| | | L | T | P | C |
|---|---|---|---|---|---|
| **EICY 101** | **PIPING AND INSTRUMENTATION FOR PROCESS INDUSTRIES** | **2** | **0** | **0** | **2** |

**OBJECTIVES:**

- To provide in depth knowledge on piping and instrumentation
- Learn about detail engineering and P & ID
- Other discipline support to Instrumentation
- How to do the Installation and commissioning
- Learn about calibration and fault finding

**MODULE I DESCRIPTION OF PROCESS PLANT 05**

General Project Cycle, Plant description, feed, component and Areas of plant, Plant layout, Plant location, accessibility, Marketing and Sales.

**MODULE II PIPING AND INSTRUMENTATION DIAGRAM PREPARATION 05**

Main description of a plant, P & ID Symbols, line numbering, line schedule P& ID development, various stages of P & ID, Process flow scheme plant legend finalization.

**MODULE III SYSTEM DESIGN AND DETAIL ENGINEERING 05**

Major Discipline involvement and Inter discipline Interaction, Major Instrumentation and Control Systems – Development Phase – Instrument List, I / O Count, Specification Sheets, Instrument Installation, Control Philosophy, Detail Engineering.

**MODULE IV BOILER CONTROL-II 05**

Plot plan, Piping, equipment plan, Electrical area classification, Fire Hazardous classification, Control Network architecture.

**MODULE V ANALYSERS – FLUE GAS ANALYSIS 10**

i. Dearator in Boiler and associated Instrumentation.
ii. Turbine monitoring – speed, vibrations, Lubricant oil temperature control systems how it functions.
iii. Boiler Drum Level Pressure compensation.
iv. Control of distillation column and instruments designed for Level, Pressure, flow etc.
v. Detailed study of intrinsic safety of Instruments.

**Total hours: 30**

**REFERENCE:**

1. Duncan C. Richardson, Plant Equipment and Maintenance Engineering Handbook, McGraw-Hill Education: New York, Chicago, San Francisco, Athens, London, Madrid, Mexico City, Milan, New Delhi, Singapore, Sydney, Toronto, 2014 McGraw-Hill Education.
2. Gabriel Salvendy, Handbook of Industrial Engineering – Technology and operations management, John Wiley & Sons, 2001.
3. Robert C Rosaler, Standard Handbook of Plant Engineering, McGraw-Hill third edition, 2004.
4. R.Keith Mobley, Plant Engineer's Handbook, Technology and Engineering, 2001.

**OUTCOMES:**

- System testing and startup
- Development of correct P & IDs
- Install and commissioning of new plants
- Apply piping and Instrumentation in design and maintenance of process Industry
- Understanding area classification

| EICY102 | APPLIED SOFT COMPUTING TECHNIQUES FOR PROCESS MODELING, CONTROL AND OPTIMIZATION | L | T | P | C |
|---|---|---|---|---|---|
| | | 2 | 0 | 2 | 3 |

**OBJECTIVES:**

- To expose the students to the basic concepts of neural networks, fuzzy logic and evolutionary algorithms
- To foster their abilities in designing and implementing soft computing based solutions for real-world problems in modeling and control
- To familiarize the Neural Network, Fuzzy Logic, Adaptive Neuro Fuzzy Inference System toolbox to the students
- To facilitate the student to optimize the model and controller parameters using Evolutionary and swarm intelligence techniques

**MODULE I REVIEW OF NEURAL NETWORK AND FUZZY LOGIC 06+06**

**Theory**

Introduction to Neural network - Biological Neuron - Artificial neuron — Activation functions — Network Architecture — Learning Process — Single Layer Perception — Limitations — Multi Layer Perception —Back propagation algorithm — RNN — Reinforcement learning — Discrete time hop field networks RBF — ART, SVM.

Fuzzy set theory — Fuzzy sets — Operation on Fuzzy sets — Fuzzy relations — Fuzzy membership functions — Fuzzy conditional statements — Fuzzy rules – MAMDANI – TAKAGI SUGENO.

**Practicals**

Familiarization of Neural Network Control Tool Box and Fuzzy Logic Tool Box

**MODULE II NEURAL NETWORKS FOR MODELING AND CONTROL 06+06**

**Theory**

Modeling of non linear systems using ANN- NARX,NNSS, NARMAX – Generation of training data - Model validation- Control of non linear system using ANN

**Practicals**

NARX, NNSS, NARMAX modeling using Neural Network toolbox

**MODULE III FUZZY LOGIC FOR MODELING AND CONTROL 06+06**

**Theory**

Modeling of non linear systems using fuzzy models (Mamdani and Sugeno) – TSK model - Fuzzy Logic controller – Adaptive fuzzy systems- Gain scheduling using Fuzzy Logic

**Practicals**

Modeling and Gain Scheduling of Nonlinear process using Fuzzy toolbox

**MODULE IV HEURISTIC OPTIMIZATION ALGORITHMS AND HYBRID CONTROL SCHEMES 06+06**

**Theory**

Particle Swarm Optimization – Ant colony optimization-Introduction to Evolutionary Algorithm — Optimization of membership function and rule base using Genetic Algorithm — Adaptive Neuro Fuzzy Inference Systems(ANFIS)

**Practicals**

Optimization of benchmark optimization problems using swarm intelligence and evolutionary algorithms in MATLAB

**MODULE V OPTIMAL IDENTIFICATION AND PARAMETER OPTIMIZATION USING EVOLUTIONARY AND SWARM INTELLIGENCE TECHNIQUES 06+06**

**Theory**

Process identification, PID controller parameter optimization, State feedback controller parameter optimization of process loops using evolutionary optimization techniques and swarm intelligence technique

**Practicals**

Optimal process modeling, controller parameter optimization, state feedback using soft computing techniques in MATLAB

**L: 30; P: 30; Total Hours: 45**

**TEXT BOOKS:**

1. Laurence Fausett, Fundamentals of Neural Networks, Prentice Hall, Englewood cliffs, N.J., 1992.
2. Jacek M.Zurada, Introduction to Artificial Neural Systems, Jaico Publishing House, Mumbai, 1997.
3. Timothy J.Ross, Fuzzy Logic with Engineering Applications, McGraw Hill Inc., 1997.

**REFERENCES:**

1. Freeman Neural network : Algorithms Applications and Programming Techniques,1991

2. Goldberg, Genetic Algorithm in Search, Optimization, and Machine Learning, Addison Wesley Publishing Company, Inc. 1989.
3. Tsoukalas L.H., and Robert E.Uhrig, Fuzzy and Neural approach in Engineering, John Wiley and Sons, 1997.
4. Millon W.T., Sutton R.S., and Webrose P.J., Neural Networks for control, MIT Press, 1992.
5. MATLAB Neural Network Tool Box, mathworks publications, 2011.
6. MATLAB Fuzzy Logic Tool Box Manual mathworks publications, 2011.
7. R. Eberhart, P.simpson and R.Dobbins,Computional Intelligence PC Tools, AP Professional, Boston, 1996.

**OUTCOMES:**

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

- Identify and analyze soft computing techniques and their roles in building intelligent machines.
- Recognize the feasibility of applying a soft computing methodology for modeling and control
- Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems.
- Effectively use existing software tools to solve problems using a soft computing approach.
- Evaluate and compare solutions of engineering problems various soft computing approaches
- Optimize the performance using Evolutionary and swarm intelligence techniques.

**EIC Y103 INSTRUMENTATION SYSTEM DESIGN**

| L | T | P | C |
|---|---|---|---|
| 2 | 0 | 2 | 3 |

**OBJECTIVES:**

- To provide knowledge in amplifier and filter circuits.
- To learn about transmitters, data loggers and annunciators.
- To get knowledge in design of controllers
- To enhance knowledge on selection of control valves and flow meters.

**MODULE I DESIGN OF SIGNAL CONDITIONING CIRCUITS 07+05**

Design of V/I Converter and I/V Converter- Design of first and second order analog and digital filters– Signal conditioning circuit for pH measurement –Design of Instrumentation amplifiers – Signal Conditioning circuit for strain gauge circuits – Thermocouple compensation circuits- Cold Junction Compensation – Thermocouple Linearization.

**Practical:** Design of instrumentation amplifiers, Design of active filters, Design of V/I and I/V converters, Design of linearising circuit and cold – junction compensation circuit for thermocouples.

**MODULE II DESIGN OF TRANSMITTERS 07+04**

Design of Transmitters for RTD &Thermocouple Instruments – Design of transmitters for Pressure measurement - Capacitance based Level Transmitter – Air purge flow measurement -Smart Flow Transmitters.

**Practical:**

Design of signal conditioning circuits for strain gauge and RTD, Measurement of level using capacitance method.

**MODULE III DESIGN OF DATA LOGGER AND PID CONTROLLER 08+03**

Design of ON / OFF Controller using Linear Integrated Circuits- Electronic PID Controller –Digital PID Controller design – Microcontroller based Data Logger – PC based Data Acquisition Cards (NI DAQ mx)

**Practical:** Design of on-off controller, PID controllers using operational amplifier, Design of digital PID using Matlab/simulink.

**MODULE IV ORIFICE AND CONTROL VALVE SIZING 08+03**

Orifice Sizing: - Liquid, Gas and steam services - Control Valves – Valve body:- Commercial valve bodies – Control valve sizing – Liquid, Gas and steam services – Cavitation and flashing –Selection criteria – Rotameter Design.

**Practical:** Determine the coefficient of discharge using orifice plate, study of flow-lift characteristics of control valve.

**L: 30, P:15, Total :45**

**TEXT BOOKS:**

1. B. G. Liptak, “Instrument Engineers Handbook”, Vol. I and II, 3rd edition, Chilton and Book Company, 2010.
2. D. M. Considine, “Process/Industrial Instruments and Control Handbook”, 4th Edition, McGraw-Hill Inc., 1999.
3. C. D. Johnson, “Process Control Instrumentation Technology”, 4th Edition, PHI, 2005.

**REFERENCES:**

1. Andrew and Williams, “Applied Instrumentation in Process Industries”, Vol. I, II, III, IV, Gulf Publishing Company, 1979.
2. John P. Bentley, “Principles of Measurement Systems”, Addison-Wesley publication, 1999.
3. T.R.Padmanabhan, “Industrial Instrumentation: Principles and Design”, Springer-Verlag Publications, 1999.
4. B. C. Nakra and K. K. Choudhari, “Instrumentation: Measurement and Analysis”, Tata McGraw Hill pub, 2008.

**OUTCOMES:**

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

- Design amplifiers and filters circuits for any requirement
- Design signal conditioning circuits for transmitters
- Design the suitable controllers for various process
- Select the suitable control valves for process

## PROFESSIONAL ELECTIVE (SEMESTER II) (9 CREDITS)

| EICY201 | SYSTEM IDENTIFICATION AND MODELING | L | T | P | C |
|---|---|---|---|---|---|
| | | 2 | 0 | 2 | 3 |

**OBJECTIVES:**

- To introduce various model structures for system identification
- To impart knowledge on parametric and non-parametric identification
- To introduce non-linear identification and model validation techniques
- To illustrate the identification techniques through case studies

**MODULE I MODELS FOR IDENTIFICATION 12**

**Theory**

Introduction - Need for modeling. Types of models: On the basis of their information source for development: first principle models, empirical models. On the basis of mathematical property: linear and non linear, deterministic and probabilistic, static and dynamic, lumped and distributed models. On the basis of transparency: white-box, black box models with examples

**Practical**

Empirical models using real time data for linear and non linear systems

**MODULE II NON-PARAMETRIC AND PARAMETRIC IDENTIFICATION 09**

**Theory**

Transient response and Correlation Analysis – Frequency response analysis – Spectral Analysis – Least Square – Recursive Least Square –Forgetting factor-Maximum Likelihood – Instrumental Variable methods.

**Practical**

Identification using time domain and frequency domain analysis

**MODULE III NON-LINEAR IDENTIFICATION AND MODEL VALIDATION 12**

**Theory**

Open and closed loop identification: Approaches – Direct and indirect identification –Joint input-output identification – Non-linear system identification – Wiener models –Power series expansions - State estimation techniques – Non linear identification using Neural Network and Fuzzy Logic-Model validation and verification

**Practical**

Neural and fuzzy modeling and model validation using Matlab

**MODULE IV CASE STUDIES 12**

**Theory**

Development of detailed mathematical model of Inverted Pendulum, heat exchanger, Distillation column and continuous stirred tank reactor

**Practical**

Mathematical model of Inverted Pendulum, heat exchanger, Distillation column and continuous stirred tank reactor using Matlab (any 2)

**L:30; P:15;Total Hours : 45**

**TEXT BOOKS:**

1. Soderstorm.T and Petre stioca, System Identification, Prentice Hall International (UK) Ltd. 1989

**REFERENCE BOOKS:**

1. Ljung, “System Identification Theory for the User”, PHI, 1999.
2. William S.Levine, “Control Systems Advanced Methods, the Control Handbook, CRC Press, 2011.

**OUTCOMES:**

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

- Compare the different types of models used for describing systems
- Estimate system parameters using parametric and non-parametric identification approaches
- Analyze the techniques used for identification of nonlinear systems
- Validate the developed models for linear and nonlinear systems with real time data
- Implement the modeling and simulation for selected processes used in industry

**EICY202 ADAPTIVE CONTROL**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To provide knowledge on parametric and nonparametric identification of system.
- To impart knowledge on adaptive control techniques.
- To enhance knowledge on the implementation issues and practical consideration by investigating the adaptive schemes

**MODULE I INTRODUCTION 09**

Introduction to adaptive control - Effects of process variations – Adaptive control schemes – Adaptive control problem – Applications – Real time parameter estimation - Estimating parameters in dynamical system

**MODULE II PARAMETRIC AND NON-PARAMETRIC IDENTIFICATION 04**

Non-parametric identification: Step response method – Impulse response method – Frequency response method. Parameter identification: ARX – ARMAX – ARIMAX – Least square estimation – Recursive least square estimation – Extended least square estimation – Maximum likelihood estimation

**MODULE III SELF-TUNING REGULATOR 09**

Deterministic in-direct self-tuning regulators – Deterministic direct self-tuning regulators – Stochastic self-tuning regulators – Linear Quadratic STR – Adaptive Predictive Control.

**MODULE IV MODEL REFERENCE ADAPTIVE 09**

The MIT rule – Lyapunov theory – Design of model reference adaptive controller using MIT rule and Lyapunov theory – Relation between model reference adaptive controller and self-tuning regulator

**MODULE V AUTOTUNING AND GAIN SCHEDULER 09**

Design of gain scheduling controller - Auto-tuning of PID controller : Relay Feedback test, parameter estimation using autotuning

**CASE STUDIES 05**

Application of adaptive control in distillation column, Continuous Stirred Tank Reactor, Heat exchanger and variable area tank system.

**Total Hours: 45**

**TEXT BOOKS:**

1. Karl J. Astrom & Bjorn Wittenmark, “Adaptive Control”, (Pearson Education, Singapore), Second Edition, 2003.
2. Landau, I.D., Lozano, R., M'Saad, M., Karimi, A., “Adaptive Control: Algorithms, Analysis and Applications”, Series: Communications and Control Engineering, 2nd edition. 2011.
3. Shankar Sastry, Marc Bodson, “Adaptive Control : Stability, Convergence and Robustness”, Prentice-Hall Advanced Reference Series (Engineering), 1994, Republished by Dover Publications in 2011 (ISBN-10: 0486482022)

**REFERENCE BOOKS:**

1. T. C.H.A. Hsia, “System Identification”, Lexington books, 1974.
2. Stephanopoulis G. “Chemical Process Control”, Prentice Hall of India, New Delhi, 1990.
3. Ljung, L., “System Identification: Theory for the user”, Prentice Hall, Englewood cliffs, 1987. 4. Sastry S. and Bodson M., “Adaptive control – stability, Convergence ad Robustness”, Prentice Hall inc., New Jersey, 1989.

**OUTCOMES:**

The student will be able to

- Analyze the circumstances in which adaptive control is to be used
- Identify the process parameters using the experimental data obtained from step response, impulse response and frequency response
- Estimate the process parameters using recursive least square method and maximum likelihood method
- Design deterministic and stochastic self tuning regulators
- Compare the design procedure and performance of model reference adaptive controllers and self tuning regulator
- Analyze the stability of adaptive controller and design adaptive controllers for selected processes.

**EICY 203 OPTIMAL CONTROL**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To explain the significance of optimal control in process industries and the different methods of optimization
- To introduce the concept of variational approach for the design of optimal control system
- To formulate linear quadratic optimal control system with a specified degree of stability
- To impart knowledge about discrete time linear state regulator system and discrete time linear quadratic tracking system
- To illustrate the application of dynamic programming and HJB equation in the design of constrained and/or time optimal control system

**MODULE I INTRODUCTION TO OPTIMAL CONTROL 07**

Statement of optimal control problem - problem formulation and forms of optimal control - performance measures - various methods of optimization - Linear programming - nonlinear programming

**MODULE II CALCULUS OF VARIATIONS 09**

Basic concepts – variational problem - Extreme functions with conditions - variational approach to optimal control systems

**MODULE III LINEAR QUADRATIC OPTIMAL CONTROL SYSTEM 09**

Problem formulation - finite time LQR - infinite time LQR - Linear Quadratic tracking system – LQR with a specified degree of stability

**MODULE IV DISCRETE TIME OPTIMAL CONTROL SYSTEM 10**

Variational calculus for DT system – DT optimal control system - DT linear state regulator system -- DT linear quadratic tracking system

**MODULE V CONSTRAINED OPTIMAL CONTROL 10**

Constrained system – Pontryagin minimum principle - Dynamic programming – Hamilton - Jacobi - Bellman equation - LQR system using HJB equation - Time optimal control system – fuel optimal control system – energy optimal control system

**Total hours: 45**

**TEXT BOOK:**

1. Naidu D.S, Optimal Control System, CRC Press, 2003.

**REFERENCE BOOKS::**

1. Kirk D.E, Optimal Control Theory, Dover publication, 2004.
2. Lewis F.L, Draguna Vrabia, Syrmos V.L, Optimal Control, John Wiley & Sons, 2012.

**OUTCOMES:**

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

- Formulate the optimization problem based on the requirement and evaluate its performance
- Apply the variational approach to optimal control system with conditions
- Differentiate finite time LQR and infinite time LQR and design linear quadratic tracking system
- Analyze discrete time optimal control systems used in different applications
- Design constrained optimal control system and time optimal control system

| EICY204 | VIRTUAL INSTRUMENTATION | L | T | P | C |
|---|---|---|---|---|---|
| | | 2 | 0 | 2 | 3 |

**OBJECTIVES:**

- To familiarize the concepts in VI and to realize its architecture.
- To learn the various programming techniques available in LABVIEW.
- To enhance knowledge in various VI tools
- To provide the knowledge in various analysis tools and develop programs
- To analyze the application of VI for measurement, control and simulation study.

**MODULE I INTRODUCTION VIRTUAL INSTRUMENTATION 09**

Historical perspective - advantages - block diagram and architecture of a virtual instrument - Conventional Instruments versus Traditional Instruments - data-flow techniques, graphical programming in data flow, comparison with conventional programming

**MODULE II VI PROGRAMMING TECHNIQUES 09**

VIs and sub-VIs, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, State machine, string and file I/O

**MODULE III DATA ACQUISITION 09**

Introduction to latest ADCs, DACs. Introduction to PC based data acquisition - typical plug-in data acquisition board - multiplexing of analog inputs - single ended and differential inputs - different strategy for sampling of multichannel analog inputs. Concept of universal DAQ card - use of timers/counters

**MODULE IV VI TOOLSETS 09**

Use of Analysis tools, Fourier transforms, power spectrum, correlation methods, windowing and filtering. Simulation of level, thermal, reactor processes. On-Off controller PID Controller

**MODULE V APPLICATIONS 09**

Distributed I/O modules-Virtual Laboratory, Virtual Oscilloscope, Virtual function generator, Simulation of systems using VI, Development of Control system, Industrial Communication, Image acquisition and processing, Motion control.

Development of Virtual Instrument using GUI, Real-time systems, Embedded Controller, OPC, HMI / SCADA software, Active X programming

**Total Hours: 45**

**LABORATORY COMPONENT**

1. Creating Virtual Instrumentation for simple applications
2. Programming exercises for loops and charts
3. Programming exercises for clusters and graphs.
4. Programming exercises on case and sequence structures, file Input / Output.
5. Data acquisition through Virtual Instrumentation.
6. Developing voltmeter using DAQ cards.
7. Developing signal generator using DAQ cards.
8. Simulating reactor control using Virtual Instrumentation.
9. Real time temperature control using Virtual Instrumentation.
10. Real time sequential control of any batch process

**OUTCOMES:**

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

- Analyze the concepts and architecture of virtual instrumentation
- Develop a program for loops, charts, clusters, and graphs.
- Design data acquition system and interface analog and digital instruments with PC.
- Analyze the various tools used for signal processing and simulate process in PC.
- Design selected virtual instruments and develop simulation system using VI

| EICY205 | ADVANCED FIBER OPTIC AND LASER INSTRUMENTATION | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To review the methods of Propagation of light, way of connecting connectors and splicer.
- To enhance working models on measurement of varies parameters and gain knowledge of working of fiber optic sensors.
- To provide in depth knowledge on the types of lasers and way of generation of laser
- To provide practical exposure in industry for measurement of critical parameters like velocity, acceleration and voltage and show the application of lasers in various applications
- To impart knowledge on procedure for medical treatment using lasers in biomedical field.

**MODULE I OPTICAL FIBERS AND THEIR PROPERTIES 09**

Principles of light propagation through a fiber - Different types of fibers and their properties — Fiber materials and their characteristics - Transmission characteristics of fibers - absorption losses - scattering losses — Dispersion– Connectors and splicers - Optical sources - Optical detectors.

**MODULE II INDUSTRIAL APPLICATION OF OPTICAL FIBERS 09**

Fiber optic instrumentation system - Fiber optic sensors Different types of modulators -Application in instrumentation - Interferometric method of measurement of length -Measurement of pressure, temperature, current, voltage, liquid level and strain.

**MODULE III LASER FUNDAMENTALS 09**

Fundamental characteristics of laser - three level and four level lasers - properties of lasers - laser modes - resonator configuration - Q-switching and mode locking - cavity dumping - types of laser - gas laser, solid laser, liquid laser - semi conductor laser.

**MODULE IV LASERS IN MEASUREMENTS AND TESTING 09**

Laser for measurement of distance, length, velocity, acceleration, current, voltage, and atmospheric effect - material processing - laser heating, welding, melting and trimming of materials - removal and vaporization. Holography - Basic principle; methods; Holographic interferometry and applications; Holography for non-

destructive testing - Holographic components

**MODULE V MEDICAL APPLICATIONS OF LASERS 09**

Medical applications of lasers; laser and tissue interaction - Laser instruments for surgery. Removal of tumors of vocal cards, brain surgery, plastic surgery, gynaecology, endoscopy, photodynamic laser surgery and oncology.

**Total hours: 45**

**REFERENCES:**

1. John and Harry, Industrial lasers and their applications, McGraw Hill, 1st Edition, 1974.
2. John F Ready, Industrial applications of lasers, Academic press, 2nd Edition, 1978.
3. John Crisp & Darry Elliott, Introduction to Fiber Optics, Newnes Publication, 3rd Edition 2005.
4. Jasprit Singh, Semi Conductor Optoelectronics: Physics & Technology, McGraw Hill, ISE Edition, 1995.
5. Silvano Donati, Electro-optical Instrumentation Sensing and Measurement with Laser, Prentice Hall, 1st Edition, 2004.

**OUTCOMES:**

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

- Analyze the techniques used for Propagation of light, way of connecting connectors and splicer.
- Design working model on measurement of atleast one parameter.
- Analyze the techniques of generation of laser beam.
- Implement the method to measure parameter and Develop the appropriate model for industrial application
- Design the electronic laser system for biomedical field to treat various problems like tumors, blood clot removal etc..

| EICY206 | APPLIED BIO-MEDICAL INSTRUMENTATION | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To provide knowledge on biomedical measurable variables, standards and awareness of electrical safety of medical equipments
- To have knowledge on modeling, simulation and analysis of biomedical signals
- To acquire and analyze biomedical signals
- To bring out the important and modern methods of imaging techniques and latest knowledge of medical monitoring equipments.
- To provide the latest information on implantable and prosthetic devices

**MODULE I INTRODUCTION TO BIOMEDICAL MEASUREMENTS 09**

Physiological systems and measurable variables - Components of a medical instrumentation system, Problems encountered in a measuring system, Nature and complexities of biomedical measurements - Medical equipment standards - organization, classification and regulation - Human and Equipment safety – Physiological effects of electricity, Methods of accident prevention

**MODULE II ADVANCES IN MODELING AND SIMULATION IN BIOMEDICAL INSTRUMENTATION 09**

Introduction to modeling and simulation – Difference in modeling engineering systems and physiological systems – Model based analysis of Action Potentials - cardiac output – respiratory mechanism and breath analysis - Blood glucose regulation

**MODULE III BIOMEDICAL SIGNALS AND THEIR ANALYSIS 09**

Types and Classification of biological signals – Signal transactions – Noise and artifacts and their management - characteristics - Origin, recording schemes and analysis of biomedical signals: Electrocardiography (ECG), Electroencephalography (EEG), Electroretinography (ERG) and Electromyography (EMG) – Processing and transformation of signals - applications of wavelet transforms in signal compression and denoising.

**MODULE IV INSTRUMENTATION FOR DIAGNOSIS AND MONITORING 09**

Tests and instrumentation for mechanics of breathing - Advanced medical imaging techniques and modalities - Computed tomography, Magnetic Resonance Imaging

and ultrasound - Algorithms and applications of artificial intelligence in medical image analysis and diagnosis -Telemedicine and its applications in tele monitoring.

**MODULE V BIOMEDICAL IMPLANTS, PROSTHETIC AND ORTHOTIC DEVICES 09**

Implantable medical devices: artificial valves, vascular grafts and artificial joints- cochlear implants - cardiac pacemakers – Principal and components of prosthesis and orthoses – orthoses for spinal pain – orthoses for osteoporosis – Arm and foot orthoses – future trends and research in orthoses .

**Total Hours: 45**

**TEXT BOOK:**

1. John G.Webster (editor), Medical Instrumentation Application and design, John Wiley & Sons, 2005.
2. R.S.Khandpur, “Hand Book of Bio-Medical Instrumentation”, 12th reprint, Tata McGraw Hill Publishing Co Ltd., 2008.
3. Leslie Cromwell, Fred J.Weibell, Erich A.Pfeiffer, “Bio-Medical Instrumentation and Measurements”, 2nd edition, Pearson Education, 2008 / PHI.

**REFERENCES:**

1. Shayne Cox Gad, Safety Evaluation of Medical Devices, Marcel Deckle Inc, 2002.
2. Michael C. K. Khoo, Physiological Control Systems- Analysis Simulation and Estimation, 2001.
3. Rangaraj M.Rangayan, Biomedical signal analysis, John Wiley & Sons (ASIA) Pvt. Ltd., 2008.
4. John M.Semmlow, Biosignal and Bio medical Image processing, CRC Press, 2004.
5. Joseph J. Carr and John M Brown, Introduction to Biomedical Equipment Technology,Pearson Education, 2004

**OUTCOMES:**

The students will be able to

- Identify unscrupulous manufacturers / importers who move equipments into India which are not safe.
- Model and simulate physiological systems
- Analyze typical waveforms of bio potentials

- Apply the modern methods of imaging techniques and analyse
- Choose implantable , prosthetic and orthotic devices for specific bio application

## PROFESSIONAL ELECTIVES FROM OTHER DEPARTMENT

| ECCY001 | DIGITAL IMAGE PROCESSING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- • Describe and explain basic principles of digital image processing;
- • Design and implement algorithms that perform basic image processing
- • Design and implement algorithms for advanced image analysis
- • Assess the performance of image processing algorithms and systems.

**MODULE I DIGITAL IMAGE FUNDAMENTALS 09**

Elements of digital image processing systems, Basics of visual perception, Psycho, visual model, Color image fundamentals, Brightness, contrast, hue, saturation, GB,HSI models, Image sampling & quantization.

**MODULE II IMAGE TRANSFORMS 09**

2D discrete transforms, DFT, DCT, WHT, KLT, DWT, Simulation of 2D transform by 1D transform.

**MODULE III IMAGE ENHANCEMENT, RESTORATION, SEGMENTATION & RECOGNITION 12**

Histogram modification and specification techniques, Noise distributions, Low and High Pass filters, Color image enhancement, Image degradation model – Unconstrained and constrained restoration, Geometric transformations, Spatial transformations, Gray level interpolation, Image Segmentation & its types, Pattern and Pattern classes.

**MODULE IV IMAGE COMPRESSION 08**

Need for image compression, Vector Quantization, Run Length Encoding, Shiftcodes, Block Truncation Coding, DCT and Wavelet Transform coding, Simulation of basic concepts.

**MODULE V IMAGE PROCESSING APPLICATIONS 07**

Biometric identification, Satellite image processing, Industrial machine vision application, Neural Networks in image processing, Medical image processing and Motion Analysis, Augmented\Virtual reality.

**Total Hours : 45**

**REFERENCES:**

1. Rafael C. Gonzalez, Richard E.Woods, Digital Image Processing, PearsonEducation, Inc., Second Edition, 2004
2. Anil K. Jain, Fundamentals of Digital Image Processing, Prentice Hall of India,2002.
3. David Salomon : Data Compression The Complete Reference, SpringerVerlag New York Inc., 2nd Edition, 2001
4. Rafael C. Gonzalez, Richard E.Woods, Steven Eddins, Digital ImageProcessing using MATLAB, Pearson Education, Inc., 2004.
5. William K.Pratt, Digital Image Processing, John Wiley, NewYork, 2002
6. G.W.Awcock & R.Thomas,Applied Image Processing,Mc Graw-Hill Inc,1996
7. Sonka,Hlavac,Boyle,Digital Image Processing and Computer Vision ,Cengage Learning,India Edition,2008
8. Madhuri A.Joshi, Digital Image Processing-An Algorithmic approach,Prentice Hall of India,2008

**OUTCOMES:**

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

- Acquire the knowledge of fundamental concepts of a digital image processing system
- Analyze 2D signals in the frequency domain through the various transforms.
- Describe various techniques for image enhancement and restoration.
- Recognize and apply suitable image segmentation techniques
- Identify and use of appropriate image compression techniques.
- Implement concepts of image processing using simulation technique.
- Apply suitable image processing techniques for various applications

| ECC6104 | ADVANCED DIGITAL SIGNAL PROCESSING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 4 |

**OBJECTIVES:**

Make the students to

- Describe the use of various transforms in digital signals & systems analysis.
- Estimate the spectrum of Discrete Random Signals.
- Model and design adaptive filters.
- Explain the concepts of multirate signal processing
- Choose the DSP processor for various applications

**MODULE I TRANSFORMS AND THEIR APPLICATIONS 06**

Review of Z Transform, Discrete Fourier Transform, Discrete Time Fourier Transform, Discrete Fourier series. Introduction to Discrete Wavelet Transform, Haarwavelet, Application of transforms to discrete signals.

**MODULE II DISCRETE TIME RANDOM PROCESSES AND SPECTRUM ESTIMATION 09**

Deterministic process – Stochastic (random) process – Auto correlation & auto covariance of random processes – Cross correlation of random variables – Ergodic random process – Gaussian random process – Stationary & WSS random process – Power spectrum – Parseval's theorem – Wiener-Khinchine theorem – Spectral factorization – Periodogram - Modified periodograms using Bartlett , Welch, Blackman &Tukey windows – AR, MA, ARMA model based spectral estimation – Yule-Walker Equations – Durbin's algorithm.

**MODULE III SIGNAL MODELING AND OPTIMUM FILTERS 08**

Least square method model – Prony's pole-zero model – Prony's all pole model – Levinson-Durbin's recursion – Lattice filters – Forward & backward linear prediction filters.

**MODULE IV ADAPTIVE FILTERS 08**

FIR adaptive filters – Steepest descent method - Widrow-Hoff LMS algorithm – Normalized LMS method – Adaptive channel equalization – Adaptive noise cancellation – IIR adaptive filters - RLS filters.

**MODULE V MULTIRATE DIGITAL SIGNAL PROCESSING 08**

Need for multirate sampling – Decimation – Interpolation - Poly-phase filters – Multistage implementation –Phase shifters – Sub-band coders – Trans multiplexers– Quadrature mirror filters.

**MODULE VI DSP PROCESSORS 06**

General and special purpose DSP Processors – Computer Architecture for signal processing – Havard Architecture – Pipelining – Hardware Multiply and Accumulate – Special Instructions – Replication – On-chip Memory Cache – Extended Parallelism – SIMD – VLIW and static super-scalar Processing – Brief study of TMS320C4X and ADSP 2106 processors.

**Total Hours: 60**

**REFERENCES:**

1. Monson Hayes, “Statistical digital signal processing and modeling” – JohnWiley& Sons – 2005.
2. John G.Proakis & Dimitris G. Maolakis “DSP principles, algorithms & applications” – 4th edition – Pearson Education – 2007.
3. A.V. Oppenheim and R.W Schafer, Englewood, “Digital Signal Processing”, Prentice Hall, Inc. 2006.
4. B. Venkatramani & M. Bhaskar, “Digital Signal Procesors architecture”, “Programming and applications”, Tata McGraw Hill, 2002.
5. Andreas Antoniou, “Digital signal Processing Processing”, Tata McGraw Hill, second edition, 2008.
6. Stewen W. Smith, “Digital signal Processing Processing” A practical guide for Engineers and scientist”, Elsevier Science, 2003

**OUTCOMES:**

The students will be able to,

- Apply various transforms in digital signals & systems analysis.
- Estimate the power spectrum of signals
- Design & analyze digital filters based on signal modeling
- Design & analyze the adaptive filters
- Implement multirate signal processing techniques.
- Summarize various DSP processor architectures.

**ECCY022 SPEECH AND AUDIO SIGNAL PROCESSING**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To introduce the speech and audio signal processing
- To discuss the speech mechanics, various analysis and synthesis methods
- To characterize speech, audio signals and hearing system.
- To introduce various algorithms for different applications.

**MODULE I INTRODUCTION 05**

Sources, propagation and environmental characteristics, audio sources, sampling, quantizing and compression. Human speech and hearing: speech generation, speech signal characteristics, the hearing system, hearing characteristics.

**MODULE II MECHANICS OF SPEECH 07**

Speech production mechanism, Nature of Speech signal, Discrete time modelling of Speech production, Representation of Speech signals, Classification of Speech Sounds, Phones, Phonemes, Phonetic and Phonemic alphabets, Articulatory features. Music production, Auditory perception, Anatomical pathways from the ear to the perception of sound, Peripheral auditory system, Psycho acoustics.

**MODULE III TIME DOMAIN METHODS FOR SPEECH PROCESSING 07**

Time domain parameters of Speech signal, Methods for extracting the parameters Energy, Average Magnitude, Zero crossing Rate, Silence Discrimination using ZCR and energy, Short Time Auto Correlation Function, Pitch period estimation using Auto Correlation Function.

**MODULE IV FREQUENCY DOMAIN METHOD FOR SPEECH PROCESSING 08**

Short Time Fourier analysis, Filter bank analysis, Formant extraction, Pitch Extraction, Analysis by Synthesis, Analysis synthesis systems, Phase vocoder, Channel Vocoder. omomorphic Speech Analysis: Cepstral analysis of Speech, Formant and Pitch Estimation – Homomorphic Vocoders.

**MODULE V LINEAR PREDICTIVE ANALYSIS OF SPEECH 09**

Formulation of Linear Prediction problem in Time Domain, Basic Principle, Autocorrelation method, Covariance method, Solution of LPC equations, Cholesky method, Durbin’s Recursive algorithm, lattice formation and solutions, Comparison

of different methods, Application of LPC parameters, Pitch detection using LPC parameters, Formant analysis, VELP, CELP.

**MODULE VI APPLICATION OF SPEECH & AUDIO SIGNAL PROCESSING 09**

Algorithms: Dynamic time warping, K-means clustering and Vector quantization, Gaussian mixture modeling, hidden Markov modeling - Automatic Speech Recognition: Feature Extraction for ASR, Deterministic sequence recognition, Statistical Sequence recognition, Language models - Speaker identification and verification, Voice response system, Speech synthesis: basics of articulatory, source-filter, and concatenative synthesis, VOIP.

**Total Hours : 45**

**REFERENCES:**

1. Ben Gold and Nelson Morgan," Speech and Audio Signal Processing", John Wiley and Sons Inc., 2004.
2. L.R.Rabiner and R.W.Schaffer, "Digital Processing of Speech signals", Prentice Hall 1978.
3. Quatieri, "Discrete-time Speech Signal Processing", Prentice Hall, 2001.
4. J.L.Flanagan, "Speech analysis: Synthesis and Perception", Springer-Verlag, Berlin.
5. I.H.Witten, "Principles of Computer Speech", Academic Press, 1982.

**OUTCOMES:**

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

- Explain speech signal, audio signal and hearing characteristics , mechanics and their generation
- Manipulate, visualize and analyze speech signals and use various processing methods
- Apply various decomposition techniques and modifiy the speech signals.
- Analyze speech and audio signals in time domain and frequency domain.
- Apply various algorithms for speech and audio processing and synthesizing.
- Characterize and justify various speech processing techniques for various applications.

**ECCY016 NETWORK SECURITY**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

The student will be able to,

- Understand security concepts, Ethics in Network Security.
- Understand security threats, and the security services and mechanisms to counter them.
- Ability to analyze performance of various cryptographic and cryptanalytic algorithms.
- Gain knowledge about the role of Firewalls and Intrusion Detection Systems.

**MODULE I SYMMETRIC CIPHERS (TECHNIQUES AND STANDARDS) –I 09**

Introduction – Services, Mechanisms and Attacks, OSI security Architecture, Model for network Security; Classical Encryption Techniques- Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Rotor Machines, Stegnography; Block Ciphers and Data Encryption Standard Simplified DES, Block Cipher Principles, Data Encryption Standard, Strength of DES, Differential and Linear Crypt Analysis, Block Cipher Design Principles, Block Cipher Modes of Operation.

**MODULE II SYMMETRIC CIPHERS (TECHNIQUES AND STANDARDS) – II 09**

Advanced Encryption Standard- Evaluation Criteria for AES, AES Cipher; Contemporary Symmetric Ciphers- Triple DES, Blowfish, RC5, Characteristics of Advanced Symmetric Block Ciphers, RC4 Stream Cipher; Confidentiality using Symmetric Encryption- Placement of Encryption Function, Traffic Confidentiality, Key Distribution, and Random Number Generation.

**MODULE III PUBLIC-KEY ENCRYPTION AND HASH FUNCTIONS 09**

Public Key Cryptography and RSA- Principles of Public Key Cryptosystems, RSA Algorithm; Key Management and other public key cryptosystems- Key Management, Diffie-Hellman Key Exchange, Elliptic Curve arithmetic, Elliptic Curve Cryptography; Message Authentication and Hash Functions Authentication Requirements, Authentication Functions, Message Authentication Codes, Hash Functions and MACs; Hash Algorithms- MD5 Message Digest Algorithm; Secure Hash Algorithm, RIPEMD 160, HMAC; Digital Signatures and Authentication

Protocols - Digital Signatures, Authentication Protocols, Digital Signature Standards.

**MODULE IV NETWORK SECURITY PRACTICE 09**

Authentication Applications- Kerberos, X.509 Authentication Service; Electronic Mail Security- Pretty Good Privacy, S/MIME; IP Security- IP Security Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations; Web Security- Web Security Considerations, Secure Sockets Layer and Transport Layer Security, Secure Electronic Transaction.

**MODULE V SYSTEM SECURITY 09**

Intruders- Intruder Detection, Password Management; Malicious Software-Virus and Related Threats, Virus Counter Measures; Firewalls- Firewall Design Principles, Trusted Systems.

**Total Hours : 45**

**REFERENCES:**

1. William Stallings, “Cryptography and Network Security”, 3rd edition.Prentice Hall of India, New Delhi, 2004.
2. William Stallings, “Network Security Essentials”, 2rd edition.Prentice Hall of India, New Delhi, 2004.
3. Charlie Kaufman , “Network Security: Private Communication in Public World”, 2nd edition. Prentice Hall of India, New Delhi, 2004.

**OUTCOMES:**

On completion of the course the student will be able ,

- To identify common network security vulnerabilities/attacks; explain the foundations of network security;
- To identify the appropriate procedures required to secure networks;
- To evaluate the risks and threats to networked computers;
- To demonstrate detailed knowledge of the role of encryption to protect data;
- Get knowledge on development of security policies, standards and practices.
- To determine firewall requirements, and configure a firewall.

**MACY081 SIGNAL PROCESSING TECHNIQUES**

| L | T | P | C |
|---|---|---|---|
| 3 | 1 | 0 | 4 |

**OBJECTIVES:**

- To impart knowledge on various mathematical transforms for signal processing applications.

**MODULE I LAPLACE TRANSFORMATION FOR CONTINUOUS TIME SIGNALS 06+03**

Analog and digital signals - Periodic and aperiodic signals – Spectrum estimation for bandwidth requirement – Laplace Transform – Spectrum estimation – Frequency filtering for spectrum modification – Inverse Laplace Transform – Modified spectrum to get filtered signal.

**MODULE II Z -TRANSFORM FOR DISCRETE TIME SIGNALS 12+03**

Sampling of continuous time signals for discrete time signals – Nyquist sampling rate - Need for discrete signals – Quantization for digital signal – Z-Transform – Spectrum estimation of discrete signals – Digital filters for spectrum modification – Inverse Z-Transform – Modified spectrum to get filtered signal – Impulse response of digital systems - Bilinear Transform for analog to digital conversion.

**MODULE III DISCRETE FOURIER TRANSFORM FOR DISCRETE TIME SIGNALS 09+03**

Discrete Fourier Transform – Comparison with Z-Transform – Discrete signals for spectrum estimation – Digital filters for spectrum modification – Inverse Discrete Fourier Transform to get filtered signals – Fast Fourier Transform with decimation in either time or frequency

**MODULE IV DISCRETE COSINE TRANSFORM FOR DISCRETE TIME SIGNALS 09+03**

One dimensional and two dimensional discrete Cosine transforms – comparison with discrete Fourier transform – image processing applications like filtering & compression – two dimensional transform implementation using successive one dimensional transform – application in JPEG standards – zig zag scanning of transform coefficients – inverse discrete Cosine transform – expansion of compressed images – calculation of compression parameters of CF,RMSE,PSNR &CQ.

**MODULE V DISCRETE WAVELET TRANSFORM FOR DISCRETE TIME SIGNALS 09+03**

Wavelet – Haar wavelet – one dimensional forward discrete wavelet transform – comparison with discrete Cosine transform - two dimensional transform implementation using successive one dimensional transform – Image processing applications like filtering & compression - application in JPEG 2000 standards – zig zag scanning of transform coefficients – inverse discrete wavelet transform – expansion of compressed images – calculation of compression parameters of CF, RMSE, PSNR & CQ.

**L – 45; T – 15; Total Hours– 60**

**REFERENCES:**

1. Joel L.Schiff ," The Laplace Transform: Theory and Applications" – Springer – 1999.
2. Alexander D. Poularikas ,"The Transforms and Applications Handbook" Chapter 6 on Z- Transforms - Boca Raton : CRC Press LLC - 2000.
3. D.Sundararajan," The Discrete Fourier Transform: Theory," Algorithm and Applications – World Scientific Publishers – 2001.
4. K.Rao and P.Yip ," Discrete Cosine Transform – Elsevier ,"– 1990.
5. D.Sundararajan ," Discrete Wavelet Transform: A Signal Processing Approach ,"Wiley – 2015.

**OUTCOMES:**

On completion of the course, the student will be able to apply

- Laplace transform for analog signal analysis.
- Z Transform for discrete signal analysis.
- Discrete Fourier Transform for discrete signal analysis.
- Discrete Cosine Transform for discrete signal analysis.
- Discrete Wavelet Transform for discrete signal analysis.
- The methods to calculate compression parameters.

| ECCY050 | MEMS SYSTEM DESIGN | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

The objective of the course is to

- Provide the basic of MEMS device fabrication
- Fulfill the need of electronic engineer who wants to create MEMS devices
- Introduce the concepts of MEMS Electronic Sensors, Optical and RF system

**MODULE I INTRODUCTION TO MEMS 09**

MEMS and Microsystems, Miniaturization, Typical products, Micro sensors, Micro actuation, MEMS with micro actuators, Micro accelerometers and Micro fluidics, MEMS materials, Micro fabrication.

**MODULE II MECHANICS FOR MEMS DESIGN 09**

Elasticity, Stress, strain and material properties, Bending of thin plates, Spring configurations, torsional deflection, Mechanical vibration, Resonance, Thermo mechanics - actuators, force and response time, Fracture and thin film mechanics.

**MODULE III ELECTRO STATIC DESIGN 09**

Electrostatics: basic theory, electro static instability. Surface tension, gap and finger pull up, Electro static actuators, Comb generators, gap closers, rotary motors, inch worms, Electromagnetic actuators. bistable actuators.

**MODULE IV CIRCUIT AND SYSTEM ISSUES 09**

Electronic Interfaces, Feedback systems, Noise , Circuit and system issues, Case studies - Capacitive accelerometer, Peizo electric pressure sensor, Modelling of MEMS systems, CAD for MEMS.

**MODULE V INTRODUCTION TO OPTICAL AND RF MEMS 09**

Optical MEMS - System design basics - Gaussian optics, matrix operations, resolution. Case studies, MEMS scanners and retinal scanning display, Digital Micro mirror devices. RF MEMS - design basics, case study - Capacitive RF MEMS switch, performance issues.

**L:45 Total Hours:45**

**REFERENCES:**

1. Stephen Santuria," Microsystems Design", Kluwer publishers, 2000
2. Nadim Maluf," An introduction to Micro electro mechanical system design", Artech House, 2000.
3. Mohamed Gad-el-Hak, editor," The MEMS Handbook", CRC press Baco Raton, 2000.
4. Tai Ran Hsu," MEMS & Micro systems Design and Manufacture" Tata McGraw Hill, New Delhi, 2002.

**OUTCOMES:**

At the end of the course students will be able to

- Describe the process of MEMS fabrication
- Describe the mechanisms followed to design MEMS devices
- Elucidate the methods to make electrostatic MEMS sensors
- Elucidate the methods to make MEMS based accelerometers
- Describe the MEMS based RF Switches
- Discuss the MEMS based optical scanners and sensors

## PROFESSIONAL ELECTIVE (SEMESTER 3) (7/6 CREDITS)

| | | L | T | P | C |
|---|---|---|---|---|---|
| **EICY130** | **FAULT TOLERANT CONTROL** | **3** | **0** | **0** | **3** |

**OBJECTIVES:**

- To provide knowledge on the method of fault detection and diagnosis.
- To expose redundancy concept for fault detection and isolation.
- To impart knowledge on formulation, implementation of residual generators.
- To acquaint with the design of directional residual for parametric fault.
- To provide knowledge on various intelligent techniques for fault diagnosis and control.

**MODULE I INTRODUCTION 09**

Introduction-Scope - Approaches to fault detection and diagnosis:-Model free methods and Model based methods -Introduction to Random variables - Distribution Bivariated distribution-Multivariate distribution-Normal distribution - Maximum likelihood distribution-Hypothesis testing.

**MODULE II ANALYTICAL REDUNDANCY CONCEPT 09**

Additive faults and disturbance-Multiplicative faults and disturbance –Residual generation-Detection property-Isolation property Computational of Residual generation-Specification and implementation.

**MODULE III PARITY EQUATION IMPLEMENTATION OF RESIDUAL GENERATOR 09**

Parity equation formulation Implementation of single residual-Implementation with input output relation-Fault system matrix Design for structure residual - Structural definition-Canonical structures-Handling disturbance-Residual structure for multiple faults.

**MODULE IV DESIGN FOR DIRECTIONAL RESIDUAL 09**

Design for directional residual-Directional specifications-Parity equation - Linearly dependent columns Residual generation for parametric faults - Representation of parametric fault-Design for parametric fault and model errors-Robustness in residual generation-Perfect decoupling from disturbance.

**MODULE V ADVANCE TOPICS 09**

Fault diagnosis using Kalman filtering-Fault diagnosis using principle component analysis - Fault diagnosis using ANN and Fuzzy clustering Case study: Aircraft fault detection - FTC Requirements IEC-61511-1, Guidance IEC-61511-2 & Methods IEC-61511-3.

**Total hours: 45**

**REFERENCES:**

1. Janos.J.Gertler, “Fault detection and diagnosis in engineering system second edition, Marcel Dekker, 1998.
2. Rami S.Mangoubi, “Robust Estimation and Failure detection”, Springer-Verlag London, 1998.

**OUTCOMES:**

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

- Compare the different approaches used infault detection and diagnosis
- Analyze the various types of fault isolation methods.
- Formulate parity equation implementation of residual generators and design of residual structure for single and multiple faults.
- Design directional residual for parametric faults
- Carry out Fault diagnosis using Kalman filtering and principle component analysis

**EICY131 ROBOTICS AND AUTOMATION**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To provide in depth knowledge about Robotic design, hardware and its programming
- To train the students to take up industrial applications and learn using high level languages like C,C++, Embedded C and micro processor programming.
- To provide basic knowledge in the architecture and local control unit of embedded systems for robotics and
- To give adequate knowledge about interfacing of drivers for Robert movement.
- To impart skill in developing Robot design like object detection, pick and place and line follower and path recognination and following.

**MODULE I INTRODUCTION AND ROBOT KINEMATICS 09**

Basic concepts of Robots and automation-classification-specifications-Application-Notation-Direct Kinematics-Co-ordinate frames-rotations-Homogeneous coordinates-The Arm equation-Kinematic analysis of a typical Robot -Inverse Kinematics -Tool configuration-Inverse kinematics of a typical Robot -Workspace analysis and trajectory planning-Work envelope of different robots-The pick and place operation

**MODULE II DYNAMIC OF ROBOTS 09**

Continuous path motion-interpolated motion-Straight line motion-Tool configuration Jacobian matrix and manipulator Jacobian-Manipulator Dynamics- -Kinetic of potential energy-Energized forces- Lagrange's Equation -Euler Dynamic model.

**MODULE III ROBOT CONTROL 06**

The control problem-state equation-Single axis PID control-PD gravity control-Computed torque control-Variable Structure control-Impedance control.

**MODULE IV ROBOT VISION & MICRO ROBOTICS 12**

Fundamentals of Robot applications-Robot vision –Image representation-Template-matching-polyhedral objects-Shape analysis- Segmentation – Iterative processing -Robot cell design-Types of applications-material handling applications-Machine loading and unloading-spot welding-arc welding-spray

painting-Micro Robotics and MEMS- Fabrication technology for micro robotics, Stability issues in legged robots, under actuated manipulators.

**MODULE V MOBILE ROBOTS AND CONTROL ISSUES 09**

Industrial automation-General layout-general configuration of an automated flow line-conveyor systems - major features – types - Roller, State wheel, Belt, Chain and overhead trolley-Inspection station with feedback loops to up steam workstations-shop floor control-3 phases-order scheduling.

**Total hours: 45**

**REFERENCES:**

1. Saeed B.Niku, “Introduction to robotics- Analysis, Systems, Application” Prentice Hall of India Pvt. Ltd., 2008.
2. Koren, “Robotics for Engineers”, McGraw Hill International Company. Tokyo 2005.
3. Vokotravotic, “Introduction to Robotics”, Springer, 1985.
4. K.S.Fu, R.C.Gonzally, C.S.G. Lee, “Robotics Control, Sensing, Vision and Intelligent”, Mcgraw Hill Book Company,1997.
5. Robort J.Schilling, “Fundamentals of robotics- Analysis and Control, Prentice Hall of India Pvt. Ltd., 2002.

**OUTCOMES:**

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

- Analyze the hardware components of processors, sub components and its programming languages used for it.
- Develop programs for the use of Robot in industrial applications for applications like fixing car parts, cleaning, welding and adjustment of load in correct coordinates.
- Analyze the different embedded architecture and interfaces of Robotic parts for movement.
- Design and develop Robotic motion control and data acquisition system for given application.
- Analyze the various coding techniques used in process industries.

**EICY 132 INSTRUMENTATION IN POWER PLANT**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To have an idea about different methods of Power Generation, with a particular emphasis on thermal power Generation.
- Should aware about the various measurements involved in power generation plants.
- To Impact knowledge about the different types of analysers used in power plant
- Should aware about the different types of controls and control loops.
- The student should know the methods of monitoring different parameters like speed, vibration of turbines and their control.

**MODULE I INTRODUCTION 07**

Brief Survey of power generation – Hydro, thermal, Instrumentation in power generation, thermal power plants – block diagram, details of boiler process, co-generation.

**MODULE II MEASUREMENTS IN POWER PLANTS 08**

Full Measurement – review of temperature and pressure measurement of steam, water flow measurement, review of recording and indicating instruments in power stations, water level of gauge for Boiler drum, gas analysis meter smoke instruments, dust monitor – measurement of Impurities in feed water, Instrument maintenance aspects.

**MODULE III BOILER CONTROL - I 08**

Boiler control – combustion of Fuels (gaseous liquid and solid), excess air, combustion chemistry and products of combustion, requirement for excess combustion, air-circulation of efficiency of Boiler, steam temperature control systems – super heaters and de-super heaters

**MODULE IV BOILER CONTROL - II 08**

Feed water supply and Boiler water circulation systems – Drum level control systems – boiler draft systems – measurement and control of furnace draft – measurement and control of combustion – draft and air flow control related functions. Interlodes in Boiler start up.

**MODULE V ANALYSERS – FLUE GAS ANALYSIS 07**

Combustion control for liquid and gaseous fuel Boilers coal or solid fuel, pulverized coal fired boilers, flue gas oxygen analyser, pH meter. Pollution monitoring instruments, dissolved oxygen analyser silica analyser and conductivity meter.

**MODULE VI TURBINE MONITORING 07**

Speed, vibration, shell temperature monitoring and control, lubricant oil temperature control – L.P. Heater, H.P. Heater, condenser Hot Well Control, Interlocks in turbine operation.

**Total hours: 45**

**REFERENCE BOOKS:**

1. S.M. Elonka and A.L. Kohal, 'Standard Boiler Operations', Tata McGraw Hill, New Delhi, 1994.
2. R.K.Jain, 'Mechanical and Industrial Measurements', Khanna Publishers, New Delhi, 1995.
3. E.Al. Wakil, 'Power Plant Engineering', Tata McGraw Hill, 1984

**OUTCOMES:**

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

- Analyze the different methods of Power Generation
- Compare the different sensors used for the measurement of temperature, pressure, level etc.
- Select appropriate analytical instruments required for power plants.
- Analyze the performance of different control loops in boiler.
- Identify the techniques used for monitoring steam turbines

| EICY133 | INSTRUMENTATION IN PETROCHEMICAL INDUSTRY | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- The students should know with raw material pertaining to making of petroleum process
- They should know about various operations
- To learn the measurement, automation and control system in respect of petrochemical industry
- Should accustomed to computer application in petrochemical industry
- To learn about major petroleum products

**MODULE I COMPOSITION OF PETROLEUM 08**

Brief review of petroleum, its formation and composition of crude oil, exploration recovery techniques.

**MODULE II OPERATION IN PETROLEUM INDUSTRY 08**

Characterizsation of crude oil, Pretreatment of crude, removal of moisture, salts etc; General refinery setup and functions of various units, refinery flow diagram, equipment and tank farm layout.

**MODULE III TYPES OF REFINERIES AND DISTILLATION 08**

Types of refineries such as simple intermediate and complex, Pre-flashing distillation principles, atmospheric distillation, coloum types, vacuum distillation, pressure distillation methane deri.

**MODULE IV MAJOR PETROLEUM PRODUCTS 07**

Major petroleum products like LPG, Gasoline, Industrial Solvents, Haptha, Kerosene, Aviation turbine fuel, High speed diesel, Furnace oil, Lubricants, Bitumen, base oil molecular re-building process e.g. Gasto liquid Process, methane derivatives, acetylene derivatives ethylene derivatives, propylene derivatives.

**MODULE V MEASUREMETNS AND CONTROL LOOPS IN PETROCHEMICAL INDUSTRY 09**

Parameters to be measured in Petrochemical Industry, Selection of Instruments, Intrinsic safety Instruments, Control of distillation column, Control of Catalytic Crackers, Control of Vinyl Chloride and PVC production.

**MODULE VI STATISTICAL STUDY OF PETROLEUM INDUSTRIES 05**

Statistical information Indian Petroleum and Petrochemical / Industry, future trends and developments.

**Total hours: 45**

**REFERENCE BOOKS:**

1. Austin G.T. Shreeves, Chemical Process Industries, McGraw Hill International student edition, Singapore, 1985.
2. Liptak B.G. Instrumentation in Process Industries, Chilton Book Company, 1994.

**OUTCOMES:**

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

- Analyze the techniques used for crude oil exploration and recovery
- Identify the methods employed for pretreatment of crude oil including removal of gas and moisture
- Compare the different types of refineries and analyze the unit operations in a typical refinery
- Select the production routes for important petrochemicals
- Design control systems for selected control loops in petrochemical industry

## PROFESSIONAL ELECTIVE FROM OTHER DEPARTMENT

| | | L | T | P | C |
|---|---|---|---|---|---|
| **ECCY025** | **WIRELESS COMMUNICATION** | **3** | **0** | **0** | **3** |

**OBJECTIVES:**

- To introduce current wireless systems and spectrum allocation
- To explain general ray tracing models and path loss models
- To impart knowledge on wireless channels and capacity
- To introduce MIMO systems, multiuser system, OFDM and broadband modulation
- To impart knowledge on multiuser systems .

**MODULE I INTRODUCTION 09**

Current wireless systems, Wireless spectrum and allocation to existing systems, radio propagation models, path loss calculation, ray tracing methods, empirical path loss models, discrete time and space time statistical channel models.

**MODULE II CAPACITY AND DIVERSITYOF WIRELESS CHANNELS 09**

Capacity in AWGN, capacity of flat fading channels, capacity of frequency selective fading channels. Receiver Diversity& Transmitter Diversity techniques.

**MODULE III MULTIPLE ANTENNA SYSTEMS 09**

Narrow band MIMO model, MIMO channel capacity, MIMO Diversity and beam forming, diversity multiplexing tradeoff, space time modulation and coding, Smart antennas.

**MODULE IV MULTI CARRIER MODULATION 09**

Data transmission using multiple carriers, Multi carrier modulation with overlapping subchannels. Mitigation of subcarrier fading, Discrete implementation of multicarrier systems, OFDM, PAPR.

**MODULE V SPREAD SPECTRUM AND MULTI USER SYSTEMS 09**

Spread spectrum principle – DSSS – FHSS , multiuser DSSS – spreading codes, downlink and uplink channels , multicarrier CDMA system and multi user FHSS systems. Multiuser channels - uplink and downlink channel capacity – Multiuser detection .

**Total Hours: 45**

**REFERENCES:**

1. Andrea Goldsmith," Wireless Communication" , Cambridge Univ. Press, 2006.
2. Andreas F.Molisch, "Wireless Communications" 2nd Edition, Wiley publications, 2014
3. Theodore S.Rappaport., "Wireless Communications", 2nd Edition, Pearson Education, 2002.
4. Yong SooCho , "MIMO – OFDM wireless communications with MATLAB", IEEE press, John Wiley publications, 2010.

**OUTCOMES:**

On completion of this course, student will be able to

- Describe ray tracing models and path loss models
- Characterize wireless channels and describe channel models
- Discuss MIMO narrow band model and transmission techniques with multiple antennas.
- Explain multi carrier modulation schemes
- Explore on broadband modulation and multiuser systems
- Discuss on wireless communication techniques

**ECCY011 MEDICAL IMAGE PROCESSING**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To explain fundamental concepts of digital image processing
- Design and implement algorithms that perform basic image pre-processing
- To interpret medical images through various multimodal imaging sources
- To describe idea on image representation,analysis, classification, reconstruction, registration and visualization of medical images.

**MODULE I IMAGE FUNDAMENTALS 09**

Image perception, MTF of the visual system, Image fidelity criteria, Image model, Image sampling and quantization – two dimensional sampling theory, Image quantization, Optimum mean square quantizer, Image transforms – 2D-DFT and other transforms.

**MODULE II IMAGE PREPROCESSING 09**

Image enhancement, point operation, Histogram modeling, spatial operations, Transform operations, Image restoration, Image degradation model, Inverse and Weiner filtering. Image Compression, Spatial and Transform methods.

**MODULE III MEDICAL IMAGE RECONSTRUCTION 09**

Mathematical preliminaries and basic reconstruction methods, Imagereconstruction in CT scanners, MRI, functional MRI, Ultra sound imaging, 3DUltra sound imaging Nuclear Medicine Imaging Modalities-SPECT, PET,Molecular Imaging.

**MODULE IV IMAGE ANALYSIS AND CLASSIFICATION 09**

Image segmentation: pixel based, edge based, region based, segmentation. Image representation and analysis, Feature extraction and representation, Statistical, Shape, Texture, feature and image classification: Statistical, Rulebased, Neural Network approaches.

**MODULE V IMAGE REGISTRATIONS AND VISUALIZATION 09**

Rigid body visualization: Principal axis registration, Interactive principal axisregistration, Feature based registration, Elastic deformation based registration,Image visualization: 2D display methods, 3D display methods, virtual realitybased interactive visualization.

**Total Hours : 45**

**REFERENCES:**

1. AtamP.Dhawan, “Medical Image Analysis”, Wiley Interscience Publication,NJ, USA 2003.
2. R.C.Gonzalez and R.E.Woods, “Digital Image Processing”, Second Edition,Pearson Education, 2002.
3. Anil. K. Jain, “Fundamentals of Digital Image Processing”, Pearson education,Indian Reprint 2003.
4. Alfred Horowitz, “MRI Physics for Radiologists – A Visual Approach”, Secondedition Springer Verlag Network, 1991.
5. KavyanNajarian and Robert Splerstor, “Biomedical signals and Imageprocessing”, CRC, Taylor and Francis, New York, 2006.
6. John L.Semmlow, “Biosignal and Biomedical Image Processing Matlab Basedapplications”, Marcel Dekker Inc., New York, 2004.
7. Jerry L. Prince and Jonathan M.Links, “Medical Imaging Signals and Systems”, Pearson Education Inc. 2006.

**OUTCOMES:**

On completion of the course the student will be able to

- Explain the fundamental concepts of digital image processing
- Recognize & apply suitable image enhancement,compression and restoration techniques.
- Compare various imaging sources(i.e.,MRI,CT,SPECTetc)
- Solve Mathematical Preliminaries for image Reconstruction
- Describe various techniques for image analysis and classification
- Use appropriate image registration technique for various applications

**ECCY026 WIRELESS SENSOR NETWORKS**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To make the students list the Wireless Sensor Network Architecture and its Applications
- To explain the physical layer design,
- To describe the MAC protocols and time synchronization algorithms
- To discuss various routing protocols, localization algorithms used for sensor network.
- To explain basics of sensor network programming and Internet of Things

**MODULE I NODE ARCHITECTURE 07**

Introduction to sensor network – Application – Difference between Adhoc and Sensor Network - Node architecture - Hardware components overview - Energy consumption of Sensor nodes - Operating Systems and Execution Environment - some examples of Sensor nodes.

**MODULE II NETWORK ARCHITECTURE 07**

Sensor Network Scenarios – Optimization goals- Design Principles –Gateway Concepts–Wireless Channel fundamentals - Physical layer and transceiver design considerations in Wireless Sensor Network

**MODULE III MAC PROTOCOLS & TIME SYNCHRONIZATION 10**

Fundamentals of MAC Protocols – Low duty cycle protocols – Contention based Protocols – schedule based protocols – IEEE 802.15.4 MAC – Address and name management in wireless sensor network. Need for time synchronization

**MODULE IV LOCALIZATION & ROUTING PROTOCOLS 12**

Properties of localization and positioning procedures – Range based Localization – Range free Localization Routing Metrics – Data Centric Routing– Proactive Routing - On Demand Routing – Hierarchical Routing – QoS based Routing Protocols

**MODULE V SENSOR NETWORK PROGRAMMING and IoT 09**

Challenges in sensor network programming – Node Centric programming – Dynamic programming – Sensor Network Simulators - Internet of Things (IoT): overview, Applications, potential & challenges, and architecture.

**Total Hours : 45**

**REFERENCES:**

1. Holger Karl and Andreas Willig, “Protocols and Architectures for Wireless Sensor Networks”, John Wiley and Sons, 2012.
2. WaltenegusDargie and Christian Poellabauer, “Fundamentals of Wireless Sensor Networks – Theory and Practice”, John Wiley and Sons, First edition, 2010.
3. G.Anastasi, Marco Conti, Mario Di Francesco and Andrea Passarella, “Energy Conservation in Wireless Sensor Networks: A Survey”, Adhoc Networks, Vol.7, No.3 May 2009, Elsevier Publications, pp.537-568.
4. “Adrian McEWen and Hakim Cassimalli, “Designing the Internet of Things” Wiley publications, November 2013.

**OUTCOMES:**

At the end of the course students will be able to

- Describe Wireless Sensor Network Architecture and its Applications
- Explain the physical layer design
- Compare the various MAC protocols and illustrate time synchronization algorithms
- Distinguish various routing protocols, localization algorithms used for sensor network.
- To describe the basics of sensor network programming and Internet of Things
- Analyze various Sensor Network Simulators

| EEC 6128 | EMBEDDED AND ADVANCED CONTROL OF ELECTRICAL DRIVES | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 4 |

**OBJECTIVES:**

- The objective of this course is to introduce embedded application design for Electrical Drives.
- To provide practical experience with microcontroller systems
- Introduces Mikro C compiler for 16 series PICs.
- Demonstrates the use of the PIC Microcontrollers for Electrical Drives.

**MODULE I PIC16F8XX- MICROCONTROLLERS 04**

Device Overview- Features and Function- Core SFRs- I/O Ports- Timers-CCP MODULEs- Serial Communication MODULEs- Analog MODULEs - Internal oscillator - External oscillator in LP, XT or HS, RC and RCIO modes – EEPROM – Watch Dog Timer- Black-out and Brown-out Resets.

**MODULE II MIKRO C COMPILER 05**

Mikro C Compiler reference- Valid C Characters- Variables- Constants- Types- Increment and decrement - structure-Operators and expressions-Loops- Conditionals-micro C Libraries- ADC, CAN, CANSPI, EEPROM, Ethernet, PWM, Keypad, LCD, SPI Ethernet, RS485,USART and Trigonometric Libraries - Preprocessor- Statements.

**MODULE III MIKRO C BUILDING APPLICATIONS 05**

Mikro C IDE : Code Editor- Code Explorer – Debugger – Error Window – Statistics – Integrated Tools - Building applications :Projects – Source Files :Search Paths – Managing Source Files – Compilation : Output Files – Assembly View – Error Messages.- Flashing Software : Overview of PICkit2.

**MODULE IV ALGORITHM AND PROGRAMMING IN MIKROC 20**

Digital realization of error amplifier, limiter and Proportional-Integral-Derivative (PID) controller - PID algorithm - Source codes in Mikro C: ADC and PWM – SVPWM – Unipolar and Bipolar SPWM – Phase Angle Control with Zero Crossing Detection.

**MODULE V MICROCONTROLLER COMMUNICATION 06**

PIC to PIC Communication using UART - Communication with RS232 Serial Bus - Interfacing EEPROM -I²C Communication with PIC Microcontroller - Interfacing lcd and Temperature sensors - ZigBee communication between PICs.

**MODULE VI CLOSED LOOP CONTROL OF ELECTRIC DRIVES 20**

Closed Loop Control of the Plant Model - Hardware and Software Implementation using PIC Microcontrollers: Speed control of Chopper fed separately excited DC Motor – AC Motor Control Using TRIAC Phase Controller, SPWM and SVPWM inverter fed induction motor - Stepper Motor Interfacing – Servo Motor control.

**Total Hours: 60**

**REFERENCES:**


1. John Main, “PIC Microcontroller C”, 2006-2007 Edition, 2007.
2. Mikro C- Compiler for PIC Microchip controllers- mikro Electronik, 2012.
3. Martin P. Bates,” Programming 8-bit PIC Microcontrollers in C: With Interactive Hardware Simulation.
4. Tim Wilmshurst “Designing Embedded Systems with PIC Microcontrollers- Principles and applications”
5. Martin P. Bates,” PIC Microcontrollers –An Introduction” Newnes,2011.
6. Dogan Ibrahim, “Advanced PIC Microcontroller Projects in C: From USB to RTOS”, Elsevier Ltd, 2008.
7. Han-Way Huang, Leo Chartrand, "PIC Microcontroller: An Introduction to Software & Hardware Interfacing", Delmar Cengage Learning, 2004.


**OUTCOMES:**

At the end of the course, the student is expected to possess knowledge and achieve skills on the following:

- Work on different projects making use of the PIC microcontroller
- Implement external interfaces in various embedded system projects by using various interfacing techniques.
- Enable the student to design software to interact with real-world systems
- Design and develop both the hardware and software microcontroller based Electric Drive systems.
- Develop and demonstrate how to accomplish a given task using Embedded “C” language on a microcontroller.
- Demonstrate a working knowledge of the necessary steps and methods used to interface a microcontroller system to devices such as motors, sensors, etc.

**EEC 6235 SOLID STATE AC AND DC DRIVES**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To understand the stable steady-state operation and transient dynamics of a motor-load system.
- To study and analyze the operation of the converter / chopper fed dc drive and to solve simple Problems.
- To study and understand the operation of both classical and modern induction motor drives.
- To understand the differences between synchronous motor drive and induction motor drive and to learn the basics of permanent magnet synchronous motor drives with converter.
- To analyze and design the current and speed controllers for a closed loop solid-state DC and AC motor drive and simulation using a software package

**MODULE I FUNDAMENTAL OF DC AND AC MOTOR 06**

Components of electrical Drives-electric machines, power converter, controllers-dynamics of electric drive - torque equation - equivalent values of drive parameters - components of load torques types of load - four quadrant operation of a motor– steady state stability– load equalization – classes of motor duty - determination of motor rating.

**MODULE II SENSORS FOR DRIVES 06**

Hall Effect Sensors – Mechanical Sensors for speed and angular positions – Absolute Encoders – Incremental Encoders – Resolvers

**MODULE III CLOSED LOOP CONTROL OF DC AND AC DRIVES 09**

Transient analysis of separately excited motor – converter control of dc motors – analysis of separately excited & series motor with 1 - phase and 3 - phase converters – dual converter – analysis of chopper controlled dc drives – converter ratings and closed loop control – transfer function of self, separately excited DC motors – linear transfer function model of power converters – sensing and feeds back elements – current and speed loops, P, PI and PID controllers – response comparison – simulation of converter and chopper fed DC drive.

**MODULE IV SCALAR METHODS FOR IM DRIVES FROM STATOR SIDE 09**

Stator voltage control of induction motor–torque-slip characteristics-operation with different types of loads – operation with unbalanced source voltages and single

phasing – analysis of induction motor fed from non - sinusoidal voltage supply – stator frequency control - variable frequency operation – V/F control, controlled current and controlled slip operation – effect of harmonics and control of harmonics

**MODULE V SCALAR METHODS FOR IM DRIVES FROM ROTOR SIDE 08**

PWM inverter drives – multiquadrant drives – rotor resistance control – slip torque characteristic – torque equations, constant torque operation – slip power recovery scheme – torque equation – torque slip characteristics – power factor – methods of improving power factor – limited sub synchronous speed operation – super synchronous speed operation.

**MODULE VI SYNCHRONOUS MOTOR DRIVES 07**

Principle of synchronous motor control – Introduction to CSI Single phase and three phase CSI – CSI fed synchronous machines – adjustable frequency operation of synchronous motors –voltage source inverter drive with open loop control – self controlled synchronous motor with electronic commutation – self controlled synchronous motor drive using load commutated thyristor inverter.

**Total Hours: 45**

**REFERENCES:**

1. R. Krishnan, Electrical Motor Drives, PHI 2003.
2. G.K.Dubey, Power semiconductor controlled drives, Prentice Hall- 2000.
3. G.K.Dubey, Fundamentals of Electrical Drives, Narosa-1999.
4. A. Nasar, Boldea , Electrical Drives, Second Edition, CRCPress-2006.
5. M. A. ElSharkawi , Fundamentals of Electrical Drives , Thomson Learning - 2000. 49
6. Vedam Subrahmaniam, Electric Drives, TMH-2000.

**OUTCOMES:**

At the end of the course, the student is expected to possess knowledge and achieve skills on the following: Analyse the system considering the steady state and dynamic characteristics.

- Abilty to design a closed loop control of AC and DC drives.
- Talent in selection of motor for various application.
- Software knowledge in matlab , for drive application.
- Modeling AC,DC machines with appropriate loads
- Design a system with suitable parameters to control a drive system.

| EECY047 | SPECIAL ELECTRICAL MACHINES AND CONTROLLERS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To impart knowledge on Construction, principle of operation and performance of switched reluctance motors.
- To understand the Construction, principle of operation and performance of SM.
- To impart knowledge on Construction, principle of operation and performance of AC commutator motors.
- To study about the Construction, principle of operation and performance of permanent magnet brushless D.C. motors and PMSM.
- To impart knowledge on Construction, principle of operation and performance of linear motors.
- To learn the softwares Magnet AND ANSYS for performance analysis of motor.

**MODULE I SWITCHED RELUCTANCE MOTORS 07**

Constructional features - principle of operation - Torque equation - Power controllers Characteristics and control - Microprocessor based controller.

**MODULE II STEPPING MOTORS 07**

Constructional features, principle of operation-modes of excitation torque, production in Variable Reluctance (VR) stepping motor- dynamic characteristics, Drive systems - circuit for open loop control- closed loop control of stepping motor.

**MODULE III AC COMMUTATOR MOTORS 07**

Principle of operation – Equivalent circuit – Phasor diagram – Performance of Repulsion motor and Universal motor.

**MODULE IV PERMANENT MAGNET MOTORS 07**

Principle of operation – types – magnetic circuit analysis – EMF and Torque equations – Power Controllers – Motor characteristics and control of PMSM and BLDC motors.

**MODULE V LINEAR MOTORS 07**

Linear Induction motor (LIM) classification – construction – Principle of operation – Concept of current sheet – goodness factor – DC Linear motor (DCLM) types –

circuit equation , DCLM control applications ,Linear Synchronous motor(LSM) – Types - Performance equations – Applications.

**MODULE VI CASE STUDY 10**

Modeling and simulation – Switched Reluctance Machines – Permanent magnet BLDC Motor – PMSM – MAGNET 6.0, ANSYS software.

**Total Hours: 45**

**REFERENCES:**

1. Taylor E O, “The performance and design of AC Commutator motors”, Sir Issac Pitman & Sons, London, 1998.
2. Kenjo T, “Stepping Motors and their Microprocessor Controls”, Clarendon Press London, 1984.
3. Miller T J E, “Brushless Permanent Magnet and Reluctance Motor Drives”, Clarendon Press, Oxford, 1989.
4. Naser A and Boldea L,”Linear Electric Motors: Theory Design and Practical Applications”, Prentice Hall Inc., New Jersey 1987.

**OUTCOMES:**

At the end of the course, the student is expected to possess knowledge and achieve skills on the following:

- Talent in selection of motor for various application
- A thorough understanding of various special electric machines and their applications.
- Able to analyse any electric machine.
- Ability to model small power rating of motor for real time application
- Software knowledge in Magnet, ANSYS for electrical application.
- Able to present the rudiments of linear machines.

# GENERAL ELECTIVES

| GECY101 | PROJECT MANAGEMENT | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

The objectives of the course would be to make the students

- Learn to e valuate and choose an optimal project and build a project profile.
- Attain knowledge on risk identification and risk analysis
- Gain insight into a project plan and components
- Familiar with various gamut of technical analysis for effective project implementation
- Learn to apply project management techniques to manage resources.

**MODULE I INTRODUCTION & PROJECT INITIATION 09**

Introduction to project and project management - projects in contemporary organization – The project life cycle - project initiation - project evaluation methods & techniques - project selection criteria - project profile.

**MODULE II RISK ANALYSIS 09**

Sources of risk: project specific - competitive - industry specific - market and international risk – perspectives of risk – risk analysis: sensitivity analysis - scenario analysis - breakeven analysis - simulation analysis - decision tree analysis – managing/mitigating risk – project selection under risk.

**MODULE III PROJECT PLANNING & IMPLEMENTATION 09**

Project planning – importance – functions - areas of planning - project objectives and policies - steps in planning process - WBS – capital requirements - budgeting and cost estimation - feasibility analysis - creation of project plan – project implementation: pre-requisites - forms of project organization

**MODULE IV TECHNICAL ANALYSIS 09**

Technical analysis for manufacturing/construction/infrastructure projects – process/technology - materials and inputs - product mix - plant capacity – plant location and site selection – plant layout - machinery and equipment – structures and civil works – schedule of project implementation – technical analysis for software projects.

**MODULE V PROJECT MANAGEMENT TECHNIQUES 09**

Project scheduling - network construction – estimation of project completion time – identification of critical path - PERT & CPM – crashing of project network - complexity of project scheduling with limited resources - resource allocation - resource leveling – resource smoothing – overview of project management software.

**Total Hours: 45**

**REFERENCES:**

1. Projects: Planning, Analysis, Financing, Implementation and Review, Prasanna Chandra, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2004.
2. Project Management and Control, Narendra Singh, Himalaya Publishing, New Delhi, 2015.
3. A Management Guide to PERT/CPM, Jerome, D. Weist and Ferdinand K. Levy, Prentice Hall of India, New Delhi, 1994.

**OUTCOMES:**

On successfully completing this course, the student will be able to:

- Evaluate & select a project as well as develop a project profile.
- Identify various risks associated with the project and manage it effectively.
- Prepare a detailed project plan addressing its components.
- Perform technical analysis for effective project implementation
- Apply project management techniques for maximizing resource utilization.

**GECY102 SOCIETY, TECHNOLGY & SUSTAINABILITY**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To aware of new technologies through advances in Science and Engineering.
- To make them realise the profound impact on society.
- To understand the ethical issues raised by technological changes and its effect on society.
- To introduce students a broad range of perspectives on the adoption and use of technologies.
- To make them realize the need of sustainability in the context of emerging technologies.

**MODULE I TECHNOLOGY AND ITS IMPACTS 09**

Origin and evolution of technologies – Nature of technology- Innovation – Historical Perspective of technology – Sources of technological change - Co-evolution of technology and economy – Scientific knowledge and technological advance – Science and Engineering aspects of Technology – Impact on the Society – Social and Ethical Issues associated with technological change – Social and environmental consequences - Impact of technological change on human life – Technology and responsibility – Technology and social justice.

**MODULE II TECHNOLOGY AND ITS ADVANCEMENT 09**

Sociological aspects of technology – Ethics and technology – Technology and responsibility – International Economics, Globalisation and Human Rights – Sustainability and Technology – Population and environment - Technology, Energy and Environment – Organisations and technological change.

**MODULE III SOCIETY AND TECHNOLOGY 09**

Impact of technologies on contemporary society – Role of society in fostering the development of technology – Response to the adaption and use of technology – Impact of technology on developer and consumers – Technological change and globalisation.

**MODULE IV IMPACT OF A SPECIFIC TECHNOLOGY ON HUMAN WELFARE 09**

Impact of the following technologies on Human life – Medical and Biomedical – Genetics Technology – Electronics and Communications – Electronic media

Technology – Information Systems Technology – Nanotechnology – Space Technology and Energy Technology.

**MODULE V THE IMPORTANCE OF SUSTAINABILITY 09**

Sustainability – A brief history – Concepts and contexts for sustainability – Ecological imbalance and biodiversity loss – Climate change – Population explosion. Industrial ecology – systems approach to sustainability – Green engineering and technology- sustainable design- sustainable manufacturing- Green consumer movements – Environmental ethics – Sustainability of the planet Earth – Future planning for sustainability.

**Total Hours: 45**

**REFERENCES:**

1. Volti Rudi, “Society and Technology Change”, 6th Edition, Worth publishers Inc, USA, 2009.
2. Arthur W.A, “The nature of Technology: What it is and how it evolves”, Free Press, NY, USA, 2009.
3. Winston M and Edelbach R, “Society, Ethics and Technology”, 3rd Edition, San Francisco, USA, 2005.
4. Martin A.A Abraham, “Sustainability Science and Engineering: Defining Principles”, Elsevier Inc, USA, 2006.
5. R.V.G.Menon, “Technology and Society”, Pearson Education, India, 2011.

**OUTCOMES:**

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

- Understand the benefits of modern technology for the well-being of human life.
- Connect sustainability concepts and technology to the real world challenges.
- Find pathway for sustainable society.

**GECY103 ARTIFICIAL INTELLIGENCE**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- Expose the history and foundations of artificial intelligence.
- Showcase the complexity of working on real time problems underlying the need for intelligent approaches.
- Illustrate how heuristic approaches provide a good solution mechanism.
- Provide the mechanisms for simple knowledge representation and reasoning.
- Highlight the complexity in working with uncertain knowledge.
- Discuss the current and future applications of artificial intelligence.

**MODULE I HISTORY AND FOUNDATIONS 08**

History – Scope – Influence from life – Impact of computing domains - Agents in environments - Knowledge representation – Dimensions of Complexity – Sample application domains – Agent structure.

**MODULE II SEARCH 10**

Problem solving as search – State spaces – Uninformed Search – Heuristic search – Advanced search – Constraint satisfaction - Applications.

**MODULE III KNOWLEDGE REPRESENTATION AND REASONING 10**

Foundations of knowledge representation and reasoning, representing and reasoning about objects, relations, events, actions, time, and space predicate logic, situation calculus, description logics, reasoning with defaults, reasoning about knowledge, sample applications.

**MODULE IV REPRESENTING AND REASONING WITH UNCERTAIN KNOWLEDGE 08**

Probability, connection to logic, independence, Bayes rule, Bayesian networks, probabilistic inference, sample applications.

**MODULE V CASE STUDY AND FUTURE APPLICATIONS 09**

Design of a game / Solution for problem in student's domain. Natural Language processing, Robotics, Vehicular automation – Scale, Complexity, Behaviour – Controversies.

**Total Hours: 45**

**TEXT BOOK:**

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, Prentice Hall, Third Edition, 2010.
2. David Poole, Alan Mackworth, Artificial Intelligence: Foundations of Computational Agents, Cambridge University Press, 2010.
3. Nils J. Nilsson, The Quest for Artificial Intelligence, Cambridge University Press, Online edition, 2013.
4. Keith Frankish, William M. Ramsey (eds) The Cambridge Handbook of Artificial Intelligence, Cambridge University Press, 2014.

**OUTCOMES:**

Students who complete this course will be able to

- Discuss the history, current applications, future challenges and the controversies in artificial intelligence.
- Apply principle of AI in the design of an agent and model its actions.
- Design a heuristic algorithm for search problems.
- Analyze and represent the fact using logic for a given scenario
- Represent uncertainty using probabilistic models
- Develop a simple game or solution using artificial intelligence techniques.

**GECY104 GREEN COMPUTING**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To focus on the necessity of green computing technology.
- To expose to various issues with information technology and sustainability.
- To attain knowledge on the technologies for enabling green cloud computing.
- To elaborate on the energy consumption issues
- To illustrate a Green and Virtual Data Center
- To develop into a Green IT Technologist.

**MODULE I INTRODUCTION 08**

Trends and Reasons to Go Green - IT Data Center Economic and Ecological Sustainment - The Growing Green Gap: Misdirected Messaging, Opportunities for Action - IT Data Center “Green” Myths and Realities - PCFE Trends, Issues, Drivers, and Related Factors - Green Computing and Your Reputation- Green Computing and Saving Money- Green Computing and the Environment

**MODULE II CONSUMPTION ISSUES 10**

Minimizing power usage – Cooling - Electric Power and Cooling Challenges - Electrical – Power -Supply and Demand Distribution - Determining Energy Usage - From Energy Avoidance to Efficiency - Energy Efficiency Incentives, Rebates, and Alternative Energy Sources - PCFE and Environmental Health and Safety Standards- Energy-exposed instruction sets- Power management in power-aware real-time systems.

**MODULE III NEXT-GENERATION VIRTUAL DATA CENTERS 09**

Data Center Virtualization - Virtualization beyond Consolidation - Enabling Transparency - Components of a Virtual Data Center - Datacenter Design and Redesign - Greening the Information Systems - Staying Green- Building a Green Device Portfolio- Green Servers and Data Centers- Saving Energy

**MODULE IV TECHNOLOGIES FOR ENABLING GREEN AND VIRTUAL DATA CENTERS 08**

Highly Effective Data Center Facilities and Habitats for Technology - Data Center Electrical Power and Energy Management - HVAC, Smoke and Fire Suppression

- Data Center Location - Virtual Data Centers Today and Tomorrow - Cloud Computing, Out-Sourced, and Managed Services.

**MODULE V SERVERS AND FUTURE TRENDS OF GREEN COMPUTING 10**

Server Issues and Challenges - Fundamentals of Physical Servers - Types, Categories, and Tiers of Servers - Clusters and Grids - Implementing a Green and Virtual Data Center - PCFE and Green Areas of Opportunity- 12 Green Computer Companies- What's in Green computer science-Green off the Grid aimed for data center energy evolution-Green Grid Consortium- Green Applications- Green Computing Making Great Impact On Research

**Total Hours: 45**

**REFERENCES:**

1. Bud E. Smith,"Green Computing Tools and Techniques for Saving Energy, Money, and Resources", Taylor & Francis Group, CRC Press, ISBN-13: 978-1-4665-0340-3, 2014.
2. Jason Harris, "Green Computing and Green IT Best Practices, On Regulations and Industry Initiatives, Virtualization and power management, materials recycling and Tele commuting, Emereo Publishing .ISBN-13: 978-1-9215-2344-1,2014.
3. Ishfaq Ahmed & Sanjay Ranka, "Handbook of Energy Aware and Green Computing", CRC Press, ISBN: 978-1-4665-0116-4, 2013.
4. Kawahara, Takayuki, Mizuno, "Green Computing with Emerging Memory", Springer Publications, ISBN:978-1-4614-0811-6, 2012
5. Greg Schulz, "The Green and Virtual Data Center", CRC Press, ISBN-13:978-1-4200-8666-9, 2009.
6. Marty Poniatowski, "Foundation of Green IT: Consolidation, Virtualization, Efficiency, and ROI in the Data Center", Printice Hall, ISBN: 9780-1-3704-375-0, 2009.

**OUTCOMES:**

Students who complete this course will be able to

- Demonstrate issues relating to a range of available technologies, systems and practices to support green computing.
- Select appropriate technologies that are aimed to reduce energy consumption.
- Address design issues needed to achieve an organizations' green

computing objectives.

- Analyze the functionality of Data Centers.
- Critically evaluate technologies and the environmental impact of computing resources for a given scenario.
- Compare the impact of Green Computing with other computing techniques.

**GECY105 GAMING DESIGN**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To master event-based programming
- To learn resource management as it relates to rendering time, including level-of-detail and culling.
- To become familiar with the various components in a game or game engine.
- To explore leading open source game engine components.
- To become familiar of game physics.
- To be compatible with game animation.

**MODULE I INTRODUCTION 09**

Magic Words – What Skills Does a Game Designer Need? – The Most Important Skill -The Five Kinds of Listening-The Secret of the Gifted.

**MODULE II THE DESIGNER CREATES AN EXPERIENCE 09**

The Game Is Not the Experience -Is This Unique to Games? -Three Practical Approaches to Chasing Rainbows -Introspection: Powers, Perils, and Practice -Dissect Your Feelings -Defeating Heisenberg -Essential Experience.

**MODULE III THE EXPERIENCE IN THE PLAYER MIND AND GAME MECHANICS 08**

Modeling – Focus -Empathy – Imagination – Motivation – Space – Objects, Attributes, and States – Actions – Rules.

**MODULE IV GAMES THROUGH AN INTERFACE 09**

Breaking it Down – The Loop of Interaction – Channels of Information – Other Interface.

**MODULE V BALANCED GAME MECHANICS 10**

Balance – The Twelve Most Common Types of Game Balance – Game Balancing Methodologies - Balancing Game Economies.

**Total Hours: 45**

**REFERENCES:**

1. Jesse Schell, "The Art of Game Design: A Book of Lenses", 2nd Edition

ISBN-10: 1466598646, 2014.

2. Ashok Kumar, Jim Etheredge, Aaron Boudreaux, “Algorithmic and Architectural Gaming Design: Implementation and Development", 1st edition, Idea Group, U.S ISBN-10: 1466616342, 2012.
3. Katie Salen Tekinba, Melissa Gresalfi, Kylie Peppler, Rafi Santo, "Gaming the System - Designing with Gamestar Mechanic" MIT Press , ISBN-10: 026202781X, 2014.
4. James M. Van Verth, Lars M. Bishop "Essential Mathematics for Games and Interactive Applications", Third Edition, A K Peters / CRC Press, ISBN-10: 1482250926, 2015.

**OUTCOMES:**

Students who complete this course will be able to

- Realize the basic history and genres of games
- Demonstrate an understanding of the overall game design process
- Explain the design tradeoffs inherent in game design
- Design and implement basic levels, models, and scripts for games
- Describe the mathematics and algorithms needed for game programming
- Design and implement a complete three-dimensional video game

**GECY106 SOCIAL COMPUTING**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To create original social applications, critically applying appropriate theories and effective practices in a reflective and creative manner.
- To critically analyze social software in terms of its technical, social, legal, ethical, and functional features or affordances.
- To encourage the development of effective communities through the design, use, and management of social software.
- To give students with a base of knowledge and advances for them to critically examine existing social computing services.
- To plan and execute a small-scale research project in social computing in a systematic fashion.
- To become familiar with the concept of computational thinking.

**MODULE I BASIC CONCEPTS 09**

Networks and Relations: Relations and Attributes, Analysis of Network Data, Interpretation of network data -New Social Learning – Four Changes that Shift Work - Development of Social Network Analysis: Sociometric analysis and graph theory, Interpersonal Configurations and Cliques – Analysing Relational Data.

**MODULE II SOCIAL LINK 09**

Individual Actors, Social Exchange Theory, Social Forces, Graph Structure, Agent Optimization Strategies in Networks – Hierarchy of Social Link Motivation- Social Context.

**MODULE III SOCIAL MEDIA 08**

Trends in Computing – Motivations for Social Computing – Social Media: Social relationships, Mobility and Social context – Human Computation – Computational Models- Business use of social Media.

**MODULE IV SOCIAL INFORMATION FILTERING 09**

Mobile Location Sharing – Location based social media analysis – Social Sharing and Social Filtering – Automated recommender Systems – Traditional and Social Recommender Systems.

**MODULE V SOCIAL NETWORK STRATEGY 10**

Application of Topic Models – Opinions and Sentiments – Recommendation Systems – Language Dynamics and influence in online communities – Psychometric analysis – Case Study: Social Network Strategies for surviving the zombie apocalypse.

**Total Hours: 45**

**REFERENCES:**


1. Tony Bingham, Marcia Conner, “The New Social Learning, Connect. Collaborate. Work”, 2nd Edition, ATD Press, ISBN-10:1-56286-996-5, 2015.
2. Nick Crossley, Elisa Bellotti, Gemma Edwards, Martin G Everett, Johan Koskinen, Mark Tranmer, “Social Network Analysis for Ego-Nets”, SAGE Publication, 2015.
3. Zafarani, Abbasi and Liu, Social Media Mining: An Introduction, Cambridge University Press, 2014.
4. Christina Prell, “Social Network Analysis: History, Theory and Methodology”, 1st Edition, SAGE Publications Ltd, 2012.
5. John Scott, “Social Network Analysis”, Third Edition, SAGE Publication, 2013.
6. Jennifer Golbeck, “Analyzing the Social Web”, Elsevier Publication, 2013.
7. Huan Liu, John Salerno, Michael J. Young, “Social computing and Behavioral Modeling”, Springer Publication, 2009.


**OUTCOMES:**

Students who complete this course will be able to

- Realize the range of social computing applications and concepts.
- Analyze data left after in social media.
- Recognize and apply the concepts of computational models underlying social computing.
- Take out simple forms of social diagnostics, involving network and language models, applying existing analytic tools on social information.
- Evaluate emerging social computing applications, concepts, and techniques in terms of key principles.
- Design and prototype new social computing systems.

**GECY107 SOFT COMPUTING**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

The aim of the course is to

- Enumerate the strengths and weakness of soft computing
- Illustrate soft computing methods with other logic driven and statistical method driven approaches
- Focus on the basics of neural networks, fuzzy systems, and evolutionary computing
- Emphasize the role of euro-fuzzy and hybrid modeling methods
- Trace the basis and need for evolutionary computing and relate it with other soft computing approaches

**MODULE I SOFT COMPUTING - BASICS 06**

Soft computing – Hard Computing – Artificial Intelligence as the basis of soft computing – Relation with logic driven and statistical method driven approaches- Expert systems – Types of problems: Classification, Functional approximation, Optimizations – Modeling the problem – Machine Learning – Hazards of Soft Computing – Current and future areas of research

**MODULE II ARTIFICIAL NEURAL NETWORK 12**

Artificial Neuron – Multilayer perceptron – Supervised learning – Back propagation network –Types of Artificial Neural Network: Supervised Vs Un Supervised Network – Radial basis function Network – Self Organizing Maps – Recurrent Network – Hopfield Neural Network – Adaptive Resonance Theory – Issues in Artificial Neural Network – Applications

**MODULE III FUZZY SYSTEMS 09**

Fuzzy Logic – Membership functions – Operators – Fuzzy Inference systems – Other sets: Rough sets, Vague Sets – Fuzzy controllers - Applications

**MODULE IV NEURO FUZZY SYSTEMS 09**

Cooperative Neuro fuzzy systems – Neural network driven fuzzy reasoning – Hybrid Neuro fuzzy systems – Construction of Neuro Fuzzy systems: Structure Identification phase, Parameter learning phase – Applications

**MODULE V EVOLUTIONARY COMPUTING 09**

Overview of evolutionary computing – Genetic Algorithms and optimization –

Genetic Algorithm operators – Genetic algorithms with Neural/Fuzzy systems – Variants of Genetic Algorithms– Population based incremental learning – Evolutionary strategies and applications

**Total Hours: 45**

**TEXTBOOKS:**

1. Samir Roy, “Introduction to Soft Computing: Neuro-Fuzzy and Genetic Algorithms”, Pearson, 2013
2. Anupam Shukla, Ritu Tiwari and Rahul Kala, “Real life applications of Soft Computing”, CRC press, 2010.
3. Fakhreddine O. Karray, “Soft Computing and Intelligent Systems Design: Theory, Tools and Applications”, Pearson, 2009

**OUTCOMES:**

At the end of the course the students will be able to

- Enumerate the theoretical basis of soft computing
- Explain the fuzzy set theory
- Discuss the neural networks and supervised and unsupervised learning networks
- Demonstrate some applications of computational intelligence
- Apply the most appropriate soft computing algorithm for a given situation

**GECY108 EMBEDDED SYSTEM PROGRAMMING**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To introduce the design of embedded computing systems with its hardware and software architectures.
- To describe entire software development lifecycle and examine the various issues involved in developing software for embedded systems.
- To analyze the I/O programming and Embedded C coding techniques
- To equip students with the software development skills necessary for practitioners in the field of embedded systems.

**MODULE I INTRODUCTION OF EMBEDDED SYSTEM 09**

Embedded computing – characteristics and challenges – embedded system design process – Overview of Processors and hardware units in an embedded system – Compiling, Linking and locating – downloading and debugging – Emulators and simulators processor – External peripherals – Memory testing – Flash Memory.

**MODULE II SOFTWARE TECHNOLOGY 09**

Software Architectures, Software development Tools, Software Development Process Life Cycle and its Model, Software Analysis, Design and Maintenance.

**MODULE III INPUT/OUTPUT PROGRAMMING 09**

I/O Instructions, Synchronization, Transfer Rate & Latency, Polled Waiting Loops, Interrupt – Driven I/O, Writing ISR in Assembly and C, Non Maskable and Software Interrupts

**MODULE IV DATA REPRESENTATION IN EMBEDDED SYSTEMS 09**

Data representation, Twos complement, Fixed point and Floating Point Number Formats, Manipulating Bits in -Memory, I/O Ports, Low level programming in C, Primitive data types, Arrays, Functions, Recursive Functions, Pointers, Structures & Unions, Dynamic Memory Allocation, File handling, Linked lists, Queues, Stacks.

**MODULE V EMBEDDED C 09**

Embedded Systems programming in C – Binding & Running Embedded C program in Keil IDE – Dissecting the program - Building the hardware. Basic techniques for reading & writing from I/O port pins – switch bounce - LED Interfacing using Embedded C.

**Total Hours: 45**

**REFERENCES:**

1. Marilyn Wolf, "Computers as components ", Elsevier, 2012.
2. Qing Li and Carolyn Yao, "Real-Time Concepts for Embedded Systems", CMP Books, 2003.
3. Daniel W. Lewis, "Fundamentals of embedded software where C and assembly meet", Pearson Education
4. Michael Bass, "Programming Embedded Systems in C and C++", Oreilly, 2003.

**OUTCOMES:**

On completion of this course the student will be able to

- Design the software and hardware components in embedded system
- Describe the software technology
- Use interrupt in effective manner
- Use keil IDE for programming
- Program using embedded C for specific microcontroller
- Design the embedded projects

**GECY109 PRINCIPLES OF SUSTAINABLE DEVELOPMENT**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To impart knowledge in the concepts and dimensions of sustainable development.
- To gain knowledge on the framework for achieving sustainability.

**MODULE I CONCEPT OF SUSTAINABLE DEVELOPMENT 09**

Environment and Development - Population poverty and Pollution – Global and Local environmental issues – Resource Degradation- Greenhouse gases – Desertification-industrialization – Social insecurity, Globalization and environment. History and emergence of the concept of sustainable development-Objectives of Sustainable Development.

**MODULE II COMPONENTS AND DIMENSIONS OF SUSTAINABLE DEVELOPMENT 09**

Components of Sustainability – Complexity of growth and equity – Social economic and environmental dimensions of sustainable development – Environment – Biodiversity – Natural – Resources – Ecosystem integrity – Clean air and water – Carrying capacity – Equity, Quality of Life, Prevention, Precaution – Preservation and Public Participation Structural and functional linking of developmental dimensions.

**MODULE III FRAMEWORK FOR ACHIEVING SUSTAINABILITY 09**

Operational guidelines – interconnected prerequisites for sustainable development Empowerment of Women, children, Youth, Indigenous People, Non-Governmental Organizations Local Authorities, Business and industry – Science and Technology for sustainable development – performance indicators of sustainability and assessment mechanism – Constraints and barriers for sustainable development.

**MODULE IV SUSTAINABLE DEVELOPMENT OF SOCIO ECONOMIC SYSTEMS 09**

Demographic dynamics of sustainability – Policies for socio-economic development – Strategies for implementing eco-development programmes Sustainable development through trade – Economic growth – Action plan for implementing sustainable development – Urbanization and sustainable Cities – Sustainable Energy and Agriculture – sustainable livelihoods.

**MODULE V SUSTAINABLE DEVELOPMENT AND INTERNATIONAL RESPONSE 09**

Role of developed countries in the development of developing countries – international summits – Stockholm to Johannesburg – Rio principles – Agenda-Conventions – Agreements – Tokyo Declaration – Doubling statement – Tran boundary issues integrated approach for resources protection and management

**Total Hours: 45**

**REFERENCES:**

1. Sayer J. and Campbell, B., The Science of Sustainable Development: Local Livelihoods and the Global environment - Biological conservation restoration & Sustainability, Cambridge university Press, London, 2003.
2. M.K. Ghosh Roy. and Timberlake, Sustainable Development, Ane Books Pvt. Ltd, 2011.
3. Mackenthun K.M., Concepts in Environmental Management, Lewis Publications London, 1999.
4. APJ Abdul Kalam and Srijan Pal Singh, Target 3 Billion: Innovative Solutions Towards Sustainable Development, Penguin India, 2011

**OUTCOMES:**

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

- Describe the concepts of sustainable development
- Define the components and dimensions of sustainable development
- Outline the Frame work for achieving sustainability.
- State the policies and strategies for implementing sustainable development for Socio economic programmes.
- Examine the role of developed countries in sustainable development.

| GECY110 | QUANTITATIVE TECHNIQUES IN MANAGEMENT | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVE:**

To impart knowledge on

- Concepts of operations research
- Inventory control in production management
- Financial management of projects
- Decision theory and managerial economics

**MODULE I OPERATIONS RESEARCH 09**

Introduction to Operations research – Linear programming – Graphical and Simplex Methods, Duality and Post-Optimality Analysis – Transportation and Assignment Problems

**MODULE II PRODUCTION MANAGEMENT 09**

Inventory control, EOQ, Quantity Discounts, Safety Stock – Replacement Theory – PERT and CPM – Simulation Models – Quality Control.

**MODULE III FINANCIAL MANAGEMENT 09**

Working Capital Management – Compound Interest and Present Value methods – Discounted Cash Flow Techniques – Capital Budgeting.

**MODULE IV DECISION THEORY 09**

Decision Theory – Decision Rules – Decision making under conditions of certainty, risk and uncertainty – Decision trees – Utility Theory.

**MODULE V MANAGERIAL ECONOMICS 09**

Cost concepts – Break even Analysis – Pricing techniques – Game Theory applications.

**Total Hours: 45**

**REFERENCES:**

1. Vohra, N.D. , Quantitative Techniques in Management, Tata McGraw Hill Co., Ltd, New Delhi, 2009.
2. Seehroeder, R.G., Operations Management, McGraw Hill, USA, 2002.
3. Levin, R.I, Rubin, D.S., and Stinsonm J., Quantitative Approaches to Management, McGraw Hill Book Co., 2008.

4. Frank Harrison, E., The Managerial Decision Making Process, Houghton Miffin Co. Boston, 2005.
5. Hamdy A. Taha, Operations Research- An Introduction, Prentice Hall, 2002.

**OUTCOME:**

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

- Apply the concepts of operations research for various applications
- Create models for inventory control in production management
- Compute the cash flow for a project
- Choose a project using decision theory based on the risk criterion.
- Apply the concepts of managerial economics in construction management

**GECY111 PROGRAMMING USING MATLAB & SIMULINK**

| L | T | P | C |
|---|---|---|---|
| 1 | 0 | 2 | 2 |

**OBJECTIVES:**

The aim of this course is to:

- Teach students how to mathematically model engineering systems
- Teach students how to use computer tools to solve the resulting mathematical models. The computer tool used is MATLAB and the focus will be on developing and solving models of problems encountered in engineering fields

**MODULE I INTRODUCTION TO MATLAB AND DATA PRESENTATION 10**

Introduction to MATLAB-Vectors, Matrices -Vector/Matrix Operations & Manipulation- Functions vs scripts- Making clear and compelling plots-Solving systems of linear equations numerically and symbolically.

**Lab Experiments**

1. Study of basic matrix operations and manipulations.
2. Numerical and symbolical solution of linear equations.

**MODULE II ROOT FINDING AND MATLAB PLOT FUNCTION 10**

Linearization and solving non-linear systems of equations- The Newton-Raphson method- Integers and rational numbers in different bases- Least squares regression -Curve fitting-Polynomial fitting and exponential fitting.

**Lab Experiments**

1. Solution of non linear equations using Newton-Raphson method.
2. Determination of polynomial fit and exponential fit for the given data.

**MODULE III LINEAR AND NON-LINEAR DIFFERENTIAL EQUATIONS 13**

Numerical integration and solving first order, ordinary differential equations (Euler's method and Runge-Kutta) - Use of ODE function in MATLAB- Converting second order and higher ODEs to systems of first order ODEs- Solving systems of higher order ODEs via Euler's method and Runge-Kutta) - Solving single and systems of non-linear differential equations by linearization-Use of the function ODE in MATLAB to solve differential equations - Plot Function –Saving & Painting Plots.

**Lab Experiments**

1. Solution of fourth order linear differential equations using
    a. Trapezoidal Rule

   b. Euler method
2. Solution of fourth order non-linear differential equations using
   a. Modified Euler method
   b. Runge – Kutta method

**MODULE IV INTRODUCTION OF SIMULINK 12**

Simulink & its relations to MATLAB – Modeling a Electrical Circuit- Modeling a fourth order differential equations- - Representing a model as a subsystem- Programme specific Simulink demos.

**Lab Experiments**

1. Solution of fourth order non-linear differential equations using simulink.
2. Programme specific experiment based on simulink.

**Total Hours (Including Practicals): 45**

**REFERENCE:**

1. Griffiths D V and Smith I M, “Numerical Methods for Engineers”, Blackwell, 1991.
2. Laurene Fausett, “Applied Numerical Analysis Using MATLAB”, Pearson 2008.
3. Moin P, “Fundamentals of Engineering Numerical Analysis”, Cambridge University Press, 2001.
4. Wilson HB, Turcotte LH, Advanced mathematics and mechanics applications using MATLAB”, CRC Press, 1997
5. Ke Chen, Peter Giblin and Alan Irving, “Mathematical Exploration with MATLAB”, Cambridge University Press, 1999.

**OUTCOMES:**

At the end of this unit students will be able to:

- Use Matlab as a convenient tool for solving a broad range of practical problems in engineering from simple models to real examples.
- Write programs using first principles without automatic use of built-in ones.
- Write programs for solving linear and nonlinear systems, including those arising from boundary value problems and integral equations, and for root-finding and interpolation, including piecewise approximations.
- Be fluent in exploring Matlab’s capabilities, such as using matrices as the fundamental data-storage unit, array manipulation, control flow, script and function m-files, function handles, graphical output.
- Make use of Maltab visual capabilities for all engineering applications.

- An ability to identify, formulate, and solve engineering problems. This will be accomplished by using MATLAB to simulate the solution to various problems in engineering fields

**GECY112 JAVA PROGRAMMING**

| L | T | P | C |
|---|---|---|---|
| 1 | 0 | 2 | 2 |

**OBJECTIVES:**

- To learn the fundamentals of Java programming such as data types, variables and arrays.
- To study the syntax and necessity of decision making and iterative statements.
- To create a class and invoke the methods.
- To instigate programming in overloading of methods.
- To emphasize the concept of packages.
- To learn the exception handling routines.

**MODULE I INTRODUCTION TO JAVA PROGRAMMING 08**

History and Evolution of Java – Overview of Java – Data types, variables and arrays – Operators – Control statements.

**MODULE II METHODS AND CLASSES 07**

Class fundamentals – Declaring objects – Methods – Constructors – Garbage collection – Overloading methods – Constructor overloading – Access control – Inheritance – Packages - Exception handling.

**L: 15, P: 30, Total Hours: 15**

**REFERENCES:**

1. Herbert Schildt, “Java The Complete Reference”, 9th Edition, Oracle Press, 2014, ISBN: 978007180855-2.
2. Nicholas S. Williams, **“**Professional Java for Web Applications: Featuring WebSockets, Spring Framework, JPA Hibernate and Spring Security (WROX)”, John Wiley & Sons, 2014, ISBN: 978111865651-8.
3. E Balagurusamy, “Programming with Java”, 5th Edition, Tata Mcgraw Hill, 2014.
4. Yashavant Kanetka**, “**Let Us Java”, 2nd Edition, BPB Publications, 2012**.**

**OUTCOMES:**

Students who complete this course will be able to

- Implement basic Java programming.
- Create a class and invoke methods for real world problems.

- Construct simple overloading of methods programs.
- Implement various types of inheritance concepts.
- Describe the access control mechanism.
- Handle exception thrown while implementing programming.

**GECY113 PYTHON PROGRAMMING**

| L | T | P | C |
|---|---|---|---|
| 1 | 0 | 2 | 2 |

**OBJECTIVES:**

- To learn the list and records of python programming.
- To study the control statements and string functions of python.
- To instigate the fundamental python programming.
- To emphasize GUI in python.
- To integrate python with embedded systems.
- To implement programs in python.

**MODULE I INTRODUCTION TO PYTHON PROGRAMMING 08**

Installation and environment set up – syntax used in python – variable types – operators – Loops – decision making – string functions - formatted files - GUI basics.

**MODULE II EMBEDDED PROGRAMMING USING PYTHON 07**

Web interface – system tools – script execution context - Motion-triggered LEDs – Python - Arduino prototyping-storing and plotting Arduino data-Remote home monitoring system.

**L: 15, P: 30, Total Hours: 15**

**REFERENCES:**

1. Nick Goddard, “Python Programming”, 2nd edition, ISBN: 1533337772, 2016.
2. Pratik Desai, “Python Programming for Arduino”, 1st edition, Packt publishing, 2015, ISBN: 9781783285938.
3. Mark Lutz, Learning Python: Powerful Object-Oriented Programming, 5th Edition, O'Reilly Media, 2013.
4. Richard H. Barnett, Sarah Cox, Larry O'Cull, “Embedded C Programming and the Atmel AVR”, 2nd edition, 2006.
5. Michael Barr, Anthony Massa, “Programming Embedded Systems”, 2nd Edition, O'Reilly Media, 2006.

**OUTCOMES:**

Students who complete this course will be able to

- Implement date and time function programming using python.

- Write formatted file programming.
- Construct simple python programs.
- Create web interface using python programming
- Develop embedded system with python programming.
- Build Arduino prototype using python programming.

**GECY114 INTELLECTUAL PROPERTY RIGHTS (IPR)**

| L | T | P | C |
|---|---|---|---|
| 1 | 0 | 0 | 1 |

**OBJECTIVES:**

- To study about Intellectual property rights and its need
- To explore the patent procedure and related issues

**MODULE I INTRODUCTION 07**

Introduction and the need for intellectual property right (IPR) – IPR in India – Genesis and Development – IPR in abroad – Important examples of IPR – Copyrights, Trademarks, Patents, Designs, Utility Models, Trade Secrets and Geographical Indications – Industrial Designs

**MODULE II PATENT 08**

Concept of Patent – Product / Process Patents & Terminology – Duration of Patents – Law and Policy Consideration Elements of Patentability –- Patentable Subject Matter – Procedure for Filing of Patent Application and types of Applications – Procedure for Opposition – Revocation of Patents – Working of Patents- Patent Agent – Qualification and Registration Procedure – Patent databases and information system – Preparation of patent documents – Process for examination of patent application- Patent infringement – Recent developments in patent system

**Total Hours: 15**

**REFERENCES**

1. B.L.Wadehra; Law Relating to Patents, Trade Marks, Copyright, Designs & Geographical Indications; Universal law Publishing Pvt. Ltd., India 2000
2. Ajit Parulekar and Sarita D' Souza, Indian Patents Law – Legal & Business Implications; Macmillan India ltd , 2006
3. P. Narayanan; Law of Copyright and Industrial Designs; Eastern law House, Delhi, 2010.
4. E. T. Lokganathan, Intellectual Property Rights (IPRs): TRIPS Agreement & Indian Laws Hardcover, 2012
5. Alka Chawla, P N Bhagwati , Law of Copyright Comparative Perspectives 1st Edition, LexisNexis, 2013
6. V. K. Ahuja, Law Relating to Intellectual Property Rights 2nd Edition, LexisNexis, 2nd Edition, 2013

7. Deborah E. Bouchoux, Intellectual Property: The Law of Trademarks, Copyrights, Patents, and Trade Secrets, 2015
8. Jatindra Kumar Das, Law of Copyright, PHI Learning, 2015

**COURSE OUTCOMES:**

Students should be able to

- Identify the various types of intellectual property and their value
- Apply the procedure to file a patent and to deal the related issues
- Search and extract relevant information from various intellectual database