UNIVERSITY VISION AND MISSION

VISION

B.S. Abdur Rahman Institute of Science & 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 ELECTRICAL AND ELECTRONICS ENGINEERING

VISION

To achieve excellence in the programs offered by the Department of Electrical and Electronics Engineering through quality teaching, holistic learning and innovative research.

MISSION

- To offer Under Graduate, Post Graduate & Research programs of industrial and societal relevance
- To provide knowledge and skill in the Design and realization of Electrical and Electronic circuits and systems
- To impart necessary managerial and soft skills to face the industrial challenges
- To pursue academic and collaborative research with industry and research institutions in India and abroad
- To disseminate the outcome of research and projects through publications, seminars and workshops

PROGRAMME EDUCATIONAL OBJECTIVES AND OUTCOMES

M.Tech (Power Electronics and Drives)

PROGRAMME EDUCATIONAL OBJECTIVES:

- To impart education and train graduate engineers in the field of power electronics to meet the emerging needs of society
- To train students in the design, analysis and fabrication of power electronic systems for varied industrial needs
- To provide knowledge and skill in the development of controls and drives to meet varied applications
- To involve graduates in research activities leading to innovative solutions in interfacing of power electronic controllers with non-conventional energy sources
- To provide skill and knowledge to work in production, maintenance and research & development areas of industries

PROGRAMME OUTCOMES

On completion of Program, the graduates will

- Be able to apply the knowledge of power electronics for various applications through energy efficient techniques
- Be able to use modern software packages for modeling, design and analysis of Power Electronic components and systems
- Have the capability to work in areas like embedded technology and evolutionary computing
- Have the ability to trouble shoot problems in power electronics and drives

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)
Seethakathi Estate, G.S.T. Road, Vandalur, Chennai - 600 048.

REGULATIONS 2013
FOR
M.TECH. DEGREE PROGRAMMES
(WITH AMENDMENTS INCORPORATED TILL JUNE 2015)

B.S. ABDUR RAHMAN UNIVERSITY, CHENNAI 48.
REGULATIONS -2013 FOR M.TECH / MCA / M.Sc. DEGREE PROGRAMMES

(With amendments incorporated till June 2015)

1.0 PRELIMINARY DEFINITIONS AND NOMENCLATURE

In these Regulations, unless the context otherwise requires

i) **"Programme"** means 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 of this University.

vi) **"Dean (Academic Affairs)"** means Dean (Academic Affairs) of B.S.Abdur Rahman University.

vii) **"Dean (Student Affairs)"** means Dean(Student Affairs) of B.S.Abdur Rahman University.

viii) **"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.	Full Time
M.Tech.	Part Time – Day / Evening
M.C.A.	Full Time
M. Sc.	Full Time
M. Sc.	Full Time

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 Projectwork in part-time mode for valid reasons, shall apply to the Dean (Academic Affairs) through the Head of the Department, if the student satisfies the clause 2.3.4 of this Regulation. 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 - Day time

In this mode of study, the students are required to attend classes for the courses registered along with full time students.

2.2.4 Part time - Evening

In this mode of study, the students are required to attend normally classes in the evening and on Saturdays, if necessary.

2.2.5 A part time student is not permitted to convert to full time mode of study.

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 A student eligible for admission to M.Tech. Part Time / Day Time programme shall have his/her permanent place of work within a distance of 65km from the campus of this Institution.

2.3.5 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. (Full Time) – (Lateral Entry)	4	8
M.Sc. (Full Time)	4	8

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

i. Core courses
ii. Elective courses
iii. Project work / thesis / dissertation
iv. Laboratory Courses
v. Case studies
vi. Seminars
vii. 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. degree Mech./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)	
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. in ECE / Electronics / EIE / ICE / EEE
		M.Tech.(Signal Processing)	
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)
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 and Predictive Analytics)	
		M.Tech. (Computer Science and Engineering with specialization in Big Data Analytics)	
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)	

ELIGIBLE ENTRY QUALIFICATIONS FOR ADMISSION TO P.G. PROGRAMMES

Sl. No.	Name of the Department	P.G. Programmes offered	Qualifications for admission
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. (Full Time) – (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)	
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)	
13	Chemistry	M.Sc.(Chemistry)	B.Sc (Chemistry) of B.Sc. (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 credit range
M.Tech.	75 to 85
M.C.A.	120 to 130
M.Sc.	75 to 85

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
* 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.

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	Non-project Semester	Project semester
M.Tech. (Full Time)	15 to 29	12 to 20
M.Tech. (Part Time)	6 to 18	12 to 16
M.C.A. (Full Time)	15 to 29	12 to 20
M.Sc. (Full Time)	15 to 25	12 to 20

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

3.10 A student may be permitted by the Head of the Department to choose electives offered from other PG programmes either within the Department or from other Departments up to a maximum of three courses during the period of his/her study, provided the Heads of the Departments offering such courses also agree.

3.11 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.

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

3.13 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.

3.14 PROJECT WORK/THESIS/DISSERTATION

3.14.1 Project work / Thesis / Dissertation shall be carried out under the supervision of a qualified teacher in the concerned Department.

3.14.2 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.

3.14.3 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.

3.14.4 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.

3.14.5 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.

3.14.6 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.

3.14.7 A student who has acquired the minimum number of total credits prescribed in the Curriculum for the award of Masters Degree will not be permitted to enroll for more courses to improve his/her cumulative grade point average (CGPA).

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 and enroll for all the courses.

7.2 For the subsequent semesters registration for the courses will be done by the student during a specified week before the semester-end examination 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 Adviser for the choice of courses. The Registration form shall be filled in and signed by the student and the Faculty Adviser.

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 Adviser. 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 should have registered for all preceding semesters before registering for a particular semester.

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)	18 (III semester)
M.Tech. (Part time)	18 (V semester)
M.C.A. (Full time)	45 (V semester)
M.C.A. (Full time) – (Lateral Entry)	22 (V semester)
M.Sc.(Full time)	30 (IV semester) if project is in IV semester 18 (III semester) if project is in III semester

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.

10.3 Every student should have been certified by the HOD that his / her conduct and discipline have been satisfactory.

11.0 ATTENDANCE

11.1 Attendance rules for all Full Time Programme and Part time - day 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 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.

13.0 ASSESSMENTS AND EXAMINATIONS

13.1 The following rule shall apply to the full-time and part-time 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, in each lecture based course.

13.3 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.

13.4 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

$$GPA = \frac{\sum_{i=1}^{n}(C_i)(GPi)}{\sum_{i=1}^{n} C_i} \qquad Where\ \ n = number\ of\ courses$$

where Ci 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:

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.

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. POWER ELECTRONICS AND DRIVES (FOUR SEMESTERS / FULL TIME)

CURRICULUM

SEMESTER I

Sl. No	Course Code	Course Title	L	T	P	C
1	MAB6185	Applied Mathematics for Electrical Engineers	3	1	0	4
2	EEB6121	Modeling and Analysis of Electrical Machines	3	1	0	4
3	EEB6122	Advanced Power Semiconductor Devices	3	0	0	3
4	EEB6123	Analysis of Converters & Inverters	3	0	0	3
5.	EEB6101	Research Methodology	3	0	0	3
6		Elective - I	3	0	0	3
7	EEB6124	Modelling & Simulation Laboratory	0	0	3	1
8	EEB6125	Seminar in Power Electronics and Drives	1	0	0	1
						22

SEMESTER II

Sl. No	Course Code	Course Title	L	T	P	C
1	EEB6231	Simulation of Power Electronic Systems	3	0	0	3
2	EEB6232	Electric Drive Systems	3	0	0	3
3	EEB6233	Design of Converters & Switched mode Power Systems	3	0	0	3
4	EEB6234	Embedded control of Electrical Drives	3	0	2	4
5		Elective - II	3	0	0	3
6		Elective - III	3	0	0	3
7	EEB6235	Power Electronics and Drives Laboratory	0	0	3	1
8.	EEB6236	Design/Fabrication Project	0	0	2	1
						21

SEMESTER III

Sl. No	Course Code	Course Title	L	T	P	C
1		Elective IV	3	0	0	3
2		Elective V	3	0	0	3
3		Elective VI	3	0	0	3
4	EEB7101	Project Management	3	0	0	3
5	EEB7121	Project Work - Phase I	0	0	12	6*
						12

SEMESTER IV

Sl. No	Course Code	Course Title	L	T	P	C
1	EEB7121	Project work - Phase II	0	0	36	18*
						18 + 6 = 24

* Credits for Project Work Phase I to be accounted along with Project Work Phase II in IV Semester.

TOTAL CREDITS : 79

LIST OF ELECTIVES

Sl. No	Course Code	Course
1.	EEBY31	Digital Signal Processing
2.	EEBY32	Digital Signal Processors
3.	EEBY33	Advancements in Power Electronics
4.	EEBY34	Power Electronics In Wind And Solar Power Conversion
5.	EEBY35	Power Electronic Applications To Power Systems
6.	EEBY36	Robotics And Factory Automation
7.	EEBY37	Advanced Control of Electric Drives
8.	EEBY38	SCADA and DCS
9.	EEBY39	Microcontrollers And Applications
10.	EEBY04	Special Electrical Machines and Controllers
11.	EEBY23	Soft Computing Techniques
12.	EEB6104	Systems Theory
13.	EEBY14	High Voltage Direct Current Transmission
14.	EEB6213	Flexible A.C. Transmission Systems
15.	EEBY15	Wind Energy Conversion Systems
16.	EEBY05	Power Quality
17.	SSBY01	Society, Technology and Sustainability

SEMESTER I

		L	T	P	C
MAB6185	APPLIED MATHEMATICS FOR ELECTRICAL ENGINEERS	3	1	0	4

OBJECTIVES:

The aim of this course is to

- familiarize students with of Advanced Matrix Theory.
- expose the students to Operations Research using concepts of linear programming and basic queuing models.
- enable the students to obtain numerical solutions of Ordinary and Partial differential equations.

MODULE I ADVANCED MATRIX THEORY **8**

Matrix norms – Jordan canonical form – Generalized eigenvectors – Singular value decomposition – Pseudo inverse – Least square approximations – QR algorithm.

MODULE II LINEAR PROGRAMMING **8**

Basic concepts – Graphical and Simplex methods –Transportation problem – Assignment problem.

MODULE III ONE DIMENSIONAL RANDOM VARIABLES **8**

Random variables – Probability functions – Moments – Moment generating functions and their properties - Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions– Function of random variables.

MODULE IV QUEUING MODELS **8**

Poisson Process – Markovian Queues – Single and Multi-server Models – Little's formula – Machine Interference Model – Steady State analysis – Self Service Queue.

MODULE V INITIAL VALUE PROBLEM FOR ORDINARY DIFFERENTIAL EQUATIONS **5**

Taylor's series method – Euler's and modified Euler's methods – Fourth order Runge-Kutta method for first order equations.

MODULE VI BOUNDARY VALUE PROBLEMS IN PARTIAL DIFFERENTIAL EQUATIONS 8

Numerical solution of PDE - Solution of Laplace's and Poisson equations - Liebmann's iteration process – Solution of heat conduction equation by Schmidt explicit formula and Crank Nicolson implicit scheme - Solution of wave equation.

Total Hours: 60

REFERENCES:

1. Lewis.D.W., “Matrix Theory” , Allied Publishers, Chennai 1995.
2. Elsgoltis, “Differential Equations and Calculus of Variations ", MIR Publishers, Moscow (1970).
3. Taha, H.A., " Operations research - An Introduction ", Mac Millan publishing Co., (1982).
4. Ochi, M.K. “Applied Probability and Stochastic Processes ", John Wiley & Sons (1992).
5. Jain M.K., Iyengar S.R.K. and Jain R.K., “Numerical methods for Scientific and Engineering Computation”, New Age International (P) Ltd, Publishers, 2003.

OUTCOMES:

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

- solve algebraic eigen value problems from practical areas.
- solve problems of linear programming and basic queuing models.
- solve real life problems using standard distributions.
- solve initial and boundary value problems numerically.

EEB6121	MODELLING AND ANALYSIS OF ELECTRICAL MACHINES	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To impart knowledge on reference frame theory, transformational variables and analysis of electric machines using reference frame theory.
- Prediction of torque and other related parameters using reference frame theory.

MODULE I PRINCIPLES OF ELECTROMAGNETIC ENERGY CONVERSION 9

General expression of store magnetic energy Co-energy and force/torque Example using single and doubly excited system.

MODULE II BASIC CONCEPTS OF ROTATING MACHINES 10

Calculation of air gap mmf and per phase machine inductance using physical machine data-Voltage and Torque equations of DC machine-three phase symmetrical induction machine and salient pole synchronous machines in phase variable form.

MODULE III INTRODUCTION TO REFERENCE FRAME THEORY 11

Static and rotating reference frames-transformation relationships, examples using static symmetrical three phase R,R-L,R-L-M and R-L-C circuits. Application of reference frame ,theory to three phase symmetrical induction and synchronous machines-Dynamic direct and quadrature axis-Model in arbitrarily rotating reference frames Voltage and torque-Equations derivation of steady state phasor relationship from dynamic model-Generalized theory of rotating electrical machine and Kron's primitive machine.

MODULE IV DETERMINATION OF SYNCHRONOUS MACHINE DYNAMIC EQUIVALENT CIRCUIT PARAMETERS 10

Standard and derived machine time constants-Frequency response test analysis and dynamic modeling of two phase asymmetrical induction machine and single phase induction machine.

MODULE V SPECIAL MACHINES **10**

Permanent magnet synchronous machine-Surface permanent magnet(square and sinusoidal back emf type)and interior permanent magnet machines-Construction and operating principle-Dynamic modeling and self controlled operation;Analysis of Switched Reluctance Motors.

MODULE VI CASE STUDY **10**

Modelling of DC machines – Modeling of AC machines through reference frame theory – Modeling of synchronous Machines

Total Hours: 60

REFERENCES:

1 C.V.Jones,"The Unified Theory of Electrical Machines", Butterworth, London, 1967

2 Miller T.J.E."Brushless permanent magnet and reluctance motor drives" Clarendon Press,Oxford,1989

OUTCOMES:

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

- Ability to apply reference frame theory to analyze and characterize the conventional electric machines.

EEB6122 ADVANCED POWER SEMICONDUCTOR DEVICES

L	T	P	C
3	0	0	3

OBJECTIVES:

- Analysis and modeling of power semiconductor Devices.
- Have a thorough understanding of the construction, theory and characteristics of the Devices like MOSFET, BJT's, IGBT's and SCR.
- Study in detail about the Firing and protection circuits for the semiconductor devices.
- Study about the thermal protection of the Devices.

MODULE I INTRODUCTION **6**

Power switching devices overview – Attributes of an ideal switch, application requirements, circuit symbols; Power handling capability – (SOA); Device selection strategy – On-state and switching losses - Power diodes - Types, forward and reverse characteristics, switching characteristics – rating.

MODULE II CURRENT CONTROLLED DEVICES **9**

BJT – Construction, static characteristics, switching characteristics; Negative temperature co-efficient and secondary breakdown - Thyristors – Physical and electrical principle underlying operating mode, Two transistor analogy – concept of latching; Gate and switching characteristics; converter grade and inverter grade and other types; series and parallel operation; comparison of BJT and Thyristor –steady state and dynamic models of BJT & Thyristor.

MODULE III VOLTAGE CONTROLLED DEVICES **9**

Power MOSFETs and IGBTs – Principle of voltage controlled devices, construction, types, static and switching characteristics, steady state and dynamic models of MOSFET and IGBTs - Basics of GTO, MCT, FCT, RCT and IGCT.

MODULE IV FIRING AND PROTECTING CIRCUITS **8**

Necessity of isolation, pulse transformer, optocoupler – Gate drives circuit: SCR, MOSFET, IGBTs and base driving for power BJT. - Over voltage, over current and gate protections; Design of snubbers.

MODULE V NOISE **6**

Noise sources in SMPS-Diode Storage Charge Noise-Noise generated due to switching-Common noises sources in SMPS-Noises Due to High frequency transformer-Measurement of Noise –EMI due to switching.

MODULE VI THERMAL PROTECTION **7**

Heat transfer – conduction, convection and radiation; Cooling – liquid cooling, vapour – phase cooling; Guidance for hear sink selection – Thermal resistance and impedance -Electrical analogy of thermal components, heat sink types and design – Mounting types.

Total Hours: 45

REFERENCES:

1 Rashid M.H., “Power Electronics circuits, Devices and Applications”, Prentice Hall India, Third Edition, New Delhi, 2008.

2 M.D. Singh and K.B.Khanchandani, “Power Electronics”, Tata McGraw Hill, 2006.

3 Singh.M.D and Khanchandani.K.B, “Power Electronics”, Tata McGraw Hill, 2001.

4 Mohan, Undcland and Robins, “Power Electronics – Concepts, applications and Design, John Wiley and Sons, Singapore, 2000.

5 B.W. Williams, “Power Electronics – Devices, Drivers, Applications and passive components”, Macmillan,1992.

OUTCOMES:

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

- Thorough Knowledge regarding the analysis and modeling of semiconductor Devices.
- Basic understanding of the semiconductor devices like rectifiers and transistors.
- Analyze basic operational of firing circuits.
- Able to learn more about Thermal protection of the devices.

EEB6123 ANALYSIS OF CONVERTERS & INVERTERS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To impart knowledge, analyze and to design the modern semi-conductor devices and their applications in power Electronic controller for rectification, inversion, frequency conversion with improved performance.

MODULE I AC – DC CONVERTER **8**

Single phase and three phase fully controlled rectifier with R, R-L, R-L with freewheeling diodes - Input line current harmonics and power factor – continuous and discontinuous mode of operation – inverter operation - Dual converters - Circulating current mode and Non circulating current mode – Effect of source impedance and overlap.

MODULE II DC - DC CONVERTERS **7**

Principle of operation of buck, boost, buck-boost, Cuk, fly back, forward, push-pull, Converters with continuous and discontinuous operation - Time ratio and current limit control – Resonant and quasi resonant converters

MODULE III AC VOLTAGE CONTROLLERS AND CYCLOCONVERTERS **8**

Analysis of single phase and three phase AC voltage controllers with R and RL loads – Analysis of single phase and three phase cycloconverters – Power circuits and gating circuits.

MODULE IV INVERTERS **7**

Single phase full bridge inverters – VSI, CSI and Auto sequential current source inverter (ASCI) - PWM inverters, SPWM, Selective Harmonic Elimination PWM and delta modulation, harmonic spectrum - Space vector modulation inverter.

MODULE V MULTILEVEL AND RESONANT INVERTERS **8**

Diode clamped – flying capacitor – cascade type multi level inverters – Series and parallel resonant inverters - zero current and Zero voltage switching resonant converters, frequency response.

MODULE VI DESIGN **7**

Method for control design: averaging method, small signal analysis, linearization - Geometric control, hysteresis control, boundary control - Design of inverters, resonant pulse converters, cyclo-converters, ac voltage controllers circuits. cycloconverters, AC voltage controllers , snubber circuit and triggering circuit.

Total Hours: 45

REFERENCES:

1. M. H. Rashid, "Power Electronics - Circuits, Devices and Applications", Pearson Education India, 2003.
2. Ned Mohan, Tore M. Undeland. "Power Electronics- Converters, Applications and Design", John Wiley & Sons (Asia) Private Ltd., 2003.
3. M.D.Singh , " Power Electronics"Tata McGraw-Hill Education, 07-Jul-2008.
4. R W Erickson and D Makgimovic,"Fundamental of Power Electronics" Springer, 2001 2nd Edition.
5. Vedam Subrahmanyam, "Power Electronics", New Age International (P) Limited, New Delhi, 1997.
6. D.M.Mitchell, DC-DC Switching Regulator Analysis McGraw-Hill Ryerson, Limited, 1988.

OUTCOMES:

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

- Understand the concept of Converters, inverters, choppers, and AC voltage controllers.
- Select the suitable devices for the required applications in power Electronic controller for rectification, inversion, frequency conversion.
- Use these devices to Design controllers for the AC and DC drive systems.

EEB6101	RESEARCH METHODOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- The aim of the course is to introduce scholars to a number of perspectives on research and to broaden their conceptions of what research involves. This course covers research design, information retrieval, problem formulation, use of statistical techniques, evaluation and writing of research reports, papers and ethics in research.

MODULE I RESEARCH PROBLEM FORMULATION 7

Research - objectives - types,Research process, solving engineering problems Identification of research topic - formulation of research problem, literature survey and review.

MODULE II RESEARCH DESIGN 8

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 - similitude.

MODULE III USE OF STATISTICAL TOOLS IN RESEARCH 8

Importance of statistics in research - concept of probability – popular distributions - sample design. Hypothesis testing, ANOVA, Design of experiments - factorial designs - orthogonal arrays, Multivariate analysis - correlation and regression, Curve fitting.

MODULE IV ANALYSIS AND INTERPRETATION OF DATA 7

Research Data analysis - interpretation of results- correlation with scientific facts - repeatability and reproducibility of results - accuracy and precision - limitations,Use of optimization techniques - Traditional methods – evolutionary optimization techniques.

MODULE V THE RESEARCH REPORT 7

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, IPR.

MODULE VI EVOLUTIONARY ALGORITHMS **8**

Introduction to evolutionary algorithm – Genetic Algorithm, simulated annealing, neural networks, optimization of neural networks, Fuzzy systems.

Total Hours: 45

REFERENCES:

1 Kothari C.R., Research, Methodology - Method and Techniques. New Age International (P) Ltd., New Delhi, Reprint 2003.

2 R.Ganesan, Research Methodology for Engineers, MJP Publishers, 2011.

3 Doebelin, Ernest O., Engineering Experimentation: planning, execution, reporting, McGraw - Hill International edition, 1995.

4 George E. Dieter., Engineering Design, McGraw Hill - International edition, 2000.

5 Rao S.S. Engineering Optimization - theory and Practice, New Age International (P) New Delhi, reprint.

6 Madhav S. Phadke, Quality Engineering using Robust Design, Prentice Hall, Eaglewood Cliffs, New Jersey, 1989.

7 Dan Jones, Technical writing style, Pearson Education Company, Massachusetts, 1998.

8 Abdul Rahim R., Thesis writing: A Manual for Researchers, New Age International (P) Ltd., 1996.

9 Fuzzy Logic with Engg Applications, Timothy J.Ross, Wiley Publications, 2nd Edition, 1983.

10 Simulated Annealing: Theory and Applications (Mathematics and Its Applications, by P.J. van Laarhoven& E.H. Aarts).

11 Genetic Algorithms in Search, Optimization, and Machine Learning by David E. Goldberg.

OUTCOMES:

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

- The research scholar is expected to have attained proficiency in formulating a research problem and use statistical tools in the analysis and interpretation of data pertaining to the research.
- The student is expected to follow ethics in his research and bring out a comprehensive research report.
- The student is also expected to present technical papers related to the area of research.

EEB6124	MODELING & SIMULATION LABORATORY	L	T	P	C
		0	0	3	1

OBJECTIVES:

The aim of this course is

- To enable the students to understand the modeling details of Power electronic Components and circuits in detail.
- To understand the behavior of controlled rectifier circuits for different types of electrical loads and the working of different type of Power Electronic Converters.

LIST OF EXPERIMENTS

1. Modelling of Simple PN junction diode
2. Modelling of Silicon controlled rectifier.
3. Modelling of MOSFET / IGBT / BJT
4. Simulation of Single phase semi converter
   (a) R Load
   (b) RL Load
   (c) RLE (Motor) Load
5. Simulation of Single phase fully controlled converter
   (a) R Load
   (b) RL Load
   (c) RLE (Motor) Load
6. Simulation of Single phase Dual converter
7. Simulation of three phase semi converter
8. Simulation of three phase fully controlled converter
9. Simulation of single phase full bridge inverter
10. Simulation of three phase full bridge inverter
    (a) 180 degree mode operation
    (b) 120 degree mode operation

11. Simulation of PWM inverters
    (a) Sinusoidal PWM
    (b) Square PWM
12. Simulation of Three phase AC Voltage Controller
    (a) Lamp Load
    (b) Motor Load

OUTCOMES:

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

- Model & Simulate the Power Electronic Components and Circuits using various Simulation Softwares.

EEB6125 SEMINAR IN POWER ELECTRONICS & DRIVES **L T P C**

1 0 0 1

OBJECTIVES:

- To understand how research papers are written and how to read and review the papers critically and efficiently.
- To enable the student to acquire knowledge in any of the current topics relevant to Power Electronics & Drives or any other allied area in the absence of a text book.
- To impart skills necessary for presenting and defending a research work.

COURSE DESCRIPTION:

The student is expected to undertake a detailed study on a chosen topic relevant to power electronics & drives or any other allied area, under the supervision of a faculty member as well as to give presentations on a topic. The topic should be based on research papers published in refereed journals/ conferences or original research work conducted by the student.

A student is expected to present a minimum of three seminars in a semester. Each seminar will be evaluated by the course teacher. A consolidated presentation should be given at the end of the semester and a viva-voce will be conducted by a department committee. Final grade will be awarded based on the performance in all the continuous assessments and the final assessment.75% weightage should be given to continuous assessment and 25% weightage for the final assessment, while awarding the grades.

OUTCOMES:

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

- Do a self assessment on his/her presentation skills and improve upon the weaker areas.
- Listen to a scientific presentation and to ask pertinent questions regarding the material presented.
- Actively participate in a discussion of strengths and weaknesses of a research work presented by scholars.

- Critically evaluate the technical work presented in journals/conferences and present such materials in a seminar.
- Defend approaches and conclusions by providing appropriate answers to questions posed by the audience.

SEMESTER II

EEB6231 SIMULATION OF POWER ELECTRONIC SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVES:

- The aim of this course is to expertise the students with the software packages like MATLAB SIMULINK, PSPICE, MFILE and the process of interfacing MATLAB SIMULINK with MFILE using S function blocks, develop and describe dynamic behavior of basic power electronic Circuits to meet the specific functional objectives, develop and outline operating principles and application of power electronic circuits as motor drives.
- In addition to learning the practical aspects of converters, load and supply side interactions, the students will also have a better understanding of the close relationship between hardware and simulation models of actual systems.

MODULE I INTRODUCTION **7**

Need for Simulation - Challenges in simulation - Classification of simulation programs - Overview of PSPICE, MATLAB and SIMULINK. Mathematical Modeling of Power Electronic Systems: Static and dynamic models of power electronic switches - Static and dynamic equations and state-space representation of power electronic systems

MODULE II PSPICE **7**

File formats - Description of circuit elements - Circuit description – Output variables -Dot commands - SPICE models of Diode, Thyristor, Triac, BJT, Power MOSFET, IGBT and MCT.

MODULE III MATLAB and SIMULINK **7**

Toolboxes of MATLAB - Programming and file processing in MATLAB – Model definition and model analysis using SIMULINK - S-Functions - Converting SFunctions to blocks.

MODULE IV FUNDAMENTAL SIMULATION **7**

Diode rectifiers -Controlled rectifiers - AC voltage controllers - DC choppers – PWM inverters – Voltage source and current source inverters - Resonant pulse inverters -Zero current switching and zero voltage switching inverters.

MODULE V SIMULATION OF CIRCUITS 8

Cycloconverters – Resonance – Filters – Verification of Theorems – Amplifiers – Relegated Circuits

MODULE VI SIMULATION OF DRIVES 9

Simulation of speed control schemes for DC motors – Rectifier fed DC motors –Chopper fed DC motors – VSI and CSI fed AC motors – PWM Inverter – DC link inverter.

Total Hours: 45

REFERENCES:

1 Ramshaw. E., Schuuram D. C., “PSpice Simulation of Power Electronics Circuits – An Introductory Guide”, Springer, New York, 1996.

2 Chee-Mun Ong, "Dynamic Simulation of Electric Machinery: Using MATLAB/ Simulink", Prentice Hall PTR, New Jersey, 1998.

3 Ned Mohan, "Power Electronics: Computer Simulation Analysis and Education using PSPICE", Minnesota Power Electronics Research and Education, USA,1992.

4 Bimal K Bose, "Power Electronics and Variable Frequency Drives", IEEE Press, New Jersey, 1996.

5 The PSpice User's Guide", Microsim Corporation, California, 1996.

OUTCOMES:

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

- Ability to model electrical systems
- Ability to handle PSPICE, MATLAB and SIMULINK

EEB6232	ELECTRIC DRIVE SYSTEMS	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 6

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 CLOSED LOOP CONTROL POD DC AND AC DRIVES 8

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 III DIGITAL CONTROL OF DC DRIVES 8

Phase locked loop and micro computer control of DC drives –program flow

chart for constant horse power and load disturbed operation –speed detection and gate firing .

MODULE IV INDUCTION MOTOR DRIVES **8**

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 INVERTER DRIVES – IM **8**

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 **7**

Speed control of synchronous motors – adjustable frequency operation of synchronous motors – principles of synchronous motor control – 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, Powersemiconductor 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.

6. W. Leohnard, Control of Electric Drives,-Springer-2001.

7. Murphy and Turnbull, Power Electronic Control of AC motors, Pergamon Press, 1973.

8. 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:

- 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.

EEB6233	DESIGN OF CONVERTERS AND SWITCHED MODE POWER SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To apply the basic concepts of power electronics for designing converters and protection circuits.
- Design and implement practical circuits for UPS, SMPS etc

MODULE I INTRODUCTION **6**

Reactive Elements in Power Electronic Systems - Design of inductor, transformer & Capacitors for power electronic applications – SCR, IGBT, MOSFET Protection circuits- Ratings – Safe Operating Area- Heat Sink Design.

MODULE II CONTROLLED CONVERTERS **8**

Gate Pulse Generating circuits- conventional and using microcontrollers - Gate Drive circuits- Pulse transformers- opto triacs.

MODULE III APPLICATION CIRCUITS **7**

DC- DC Converter for Electric Vehicles- Resonant Inverters for Electronic Ballasts – Harmonic Analysis of Inverters using Harmonic Analyser – Implementation of phase controller for illuminating lights & Electric Furnace Control using Micro controllers.

MODULE IV SWITCHED MODE POWER CONVERTERS **8**

Basic concepts of Switched Mode power converters - DC -DC converters Characteristics - Constituent elements - Operating principles - stress and sizing of elements - control methods.

MODULE V RESONANT CONVERTERS **8**

Classification of resonant converters, Basic resonant circuit concepts, Load resonant converters, Resonant switch converters, Zero voltage switching.

MODULE VI DESIGN OF SWITCHING POWER SUPPLIES **8**

SMPS Design : Design of feedback compensators - Unity power factor rectifiers - Resistor emulation principle and applications to rectifiers . Design and Implementation of UPS.

Total Hours: 45

REFERENCES:

1. M.H.Rashid, " Power Electronics Handbook", Elsevier Press,2005.
2. Nihal Kularatna, "Power Electronics Design Handbook: Low Power Components and Applications", 2012.
3. Keith.H.Sueker, "Power Electronics Design:A Practitioner's Guide", 2003.
4. Issa Batarseh, "Power Electronic Circuits ", John Wiley, 2004.
5. Philip T Krein, "Elements of Power Electronics ",Oxford Press,1997.
6. Mohan, Un del and and Robbins; Power Electronics: Converters, Applications and Design, John Wiley and Sons, 2011.
7. Umanand.L, Power Electronics: Essentials and Applications, Wiley India, 2009.
8. Umanand.L, Bhat,S.R., Design of Magnetic Components for Switched Mode Power Converters, Wiley Eastern Publication, 1992.

OUTCOMES:

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

- Ability to design converter system for electrical applications
- Ability to understand and design SMPS

EEB6234 EMBEDDED 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.
- Introduces Mikro C compiler for 16 series PICs.
- Demonstrates the use of the PIC Microcontrollers for Electrical Drives.

MODULE I PIC16F8XX- MICROCONTROLLERS **12**

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 **10**

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 ALGORITHM AND PROGRAMMING IN MIKROC **12**

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 IV ISOLATORS AND DRIVERS **8**

High Speed Opto-Couplers – Zero Crossing Detectors - Optically Isolated High Voltage and High Current sensing circuits – Speed Measurement : Optical Encoders – Tacho generators- Driver ICs: IR2XXX Series Full Bridge and Half Bridge MOSFET / IGBT Driver ICs – MOC series SCR / TRIAC Driver ICs.

MODULE V CLOSED LOOP CONTROL OF ELECTRIC DRIVES **10**

Closed Loop Control of the Plant Model - Hardware and Software Implementation using PIC Microcontrollers: DC Motor control using PWM based

DC-DC converters and Controlled Rectifiers – AC Motor Control Using TRIAC Phase Controller, SPWM and SVPWM inverters - Stepper Motor Interfacing – Servo Motor control.

MODULE VI MIKRO C BUILDING APPLICATIONS 8

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.- Burning Software : Overview of Microbrn - ICSP port.

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 with the PIC18F Series”, Elsevier Ltd, 2008.
7. Han-Way Huang, Leo Chartrand, "PIC Microcontroller: An Introduction to Software & Hardware Interfacing", Delmar Cengage Learning, 2004.
8. Ramesh Gaonkar, "Fundamentals of Microcontrollers and Applications.

OUTCOMES:

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

- It completes a set that introduces embedded application design using the Microchip PIC 16F8XXX range.
- This is the most popular microcontroller for education and training, which is also rapidly gaining ground in the industrial and commercial sectors.

EEB6235 POWER ELECTRONICS AND DRIVES LABORATORY **L T P C**

0 0 3 1

OBJECTIVES:

- To understand the design and modelling of Electric drives in detail
- To enable the student to obtain a firm grasp of various Power Electronic Circuits and their practical applications in drives.
- To acquire knowledge of the application of Embedded Controllers to the conversion and control of electrical energy.

LIST OF EXPERIMENTS

1. Fabrication of Chopper fed DC drive using high voltage driver ICs (IR 21XX series).
2. SPWM based single phase AC drive using PIC 16F877A micro controller.
3. AC voltage controller fed Induction motor drive using PIC 16F877A micro controller.
4. Harmonic Analysis of converter Fed Drive.
5. Lab VIEW controlled AC and DC drives.
6. Simulation of closed loop control of fully controlled converter fed DC motor drive.
7. Simulation of closed loop control of chopper fed DC motor drive.
8. Simulation of VSI fed three phase induction motor drive.
9. Simulation of three phase synchronous motor and drive.
10. DTC Algorithms for Reducing Torque and Flux Ripples of PMSM Based on Fuzzy Logic and PWM Techniques.
11. Dynamic Simulation of Electrical Machines and Drive Systems Using MATLAB GUI.

OUTCOMES:

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

- This course allows the students to the knowledge in advanced controllers, electric power equipment, Power electronics circuit design, control systems, and a tremendous range of sub-areas.
- This course allows students to model complete AC and DC Drives.

EEB6236	DESIGN / FABRICATION PROJECT	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To prepare students to design and fabricate power electronics circuitry for various electrical applications.
- applying tools and methodologies of a field of practice in a design project
- developing knowledge of organizational and social contexts of a chosen field of practice
- applying skills and academic knowledge in a workplace

LIST OF EXERCISES:

1. Control Circuitry for Special Electric Machines
2. Power Electronics Topologies
3. Design and fabrication of Boost Converter for PV panel
4. Design and fabrication of Switching power supplies.
5. Micro Controller based Intelligent AC voltage controller for lamps and fans
6. Analysis of harmonics in above designed converters using Harmonic Analyzer

OUTCOMES:

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

- Awareness of the impact of Power Electronic circuits on utility supply
- The students are assessed on their performance in meeting the criteria of Open-ended, design-oriented labs. Three small projects have to be designed, built and tested. The students should justify their design.
- Ability to build power electronic circuits
- Ability to read and understand datasheets of power electronic devices and related ICs

SEMESTER III

EEB7101	PROJECT MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To familiarize the students with all aspects of Project Management.
- To use various tools like PERT / CPM for enhancing the project management skills.
- To discuss various safety aspects and familiarize with Government Regulations on Export – Import, pollution control etc.

MODULE I **7**

Project definition, Project Profile and standards, Feedback information (MIS), Evaluation and Modification, Selection, Criteria

MODULE II **8**

Planning the process, Strategic and Managerial Planning, Organising the process planning, cost and costing, Cost Control systems, Economic Balancing, Network Planning, Methods (PERT/CPM), Engineering Flow Diagrams, Cost requirements, Analysis and Estimation of Process Feasibilities (Technical/Economical) Analysis, Cost – Benefit Ratio Analysis, Project Budgeting, Capital Requirements, capital Market, Cash Flow Analysis, Break even strategies.

MODULE III **7**

Plant Engineering Management, Objectives, Programme, Control, Plant Location and Site Selection, Layout diagrams, Selection and procurement of equipment and machineries, Installation, Recommission, Commissioning and performance appraisal, Strategies choice and Influence, Product planning and development, Provision and maintenance of service facilities.

MODULE IV **7**

Process safety, Materials safety and Handling regulations, Safety in equipment and machinery operations, Design considerations of safety organization and control, Pollution, Pollution control and Abatement, Industrial Safety Standard Analysis.

MODULE V **7**

Government regulations on procurement of raw materials and its allocation. Export – Import regulations, Pricing policy, Industrial licensing procedure, Excise and other commercial taxes, Policies on depreciation and corporate tax, Labour laws, Social welfare legal measurements, Factory act, Regulations of Pollution Control Board.

MODULE VI **9**

Case Study in Computer aided project management

Total Hours: 45

REFERENCES:

1 Cheremisinoff, N. P., Practical Guide to Industrial Safety: Methods for Process Safety Professionals, CRC Press, 2001.

2 Couper, J. R., Process Engineering Economics, CRC Press, 2003.

3 Perry, J. H. “Chemical Engineer’s Hand Book”, 8th Ed., McGraw Hill, New York, 2007.

4 Peters, M.S., Timmerhaus, C.D. and West, R. E., “Plant Design and Economics for Chemical Engineers”, 5th Edn., McGraw Hill, 2003.

5 Silla, H., Chemical Process Engineering: Design and Economics, CRC Press, 2003.

6 Vinoski, W., Plant Management Handbook, Pearson Education, Limited, 1998

7 Watermeyer, P., Handbook for Process Plant Project Engineers, John Wiley and Sons, 2002.

OUTCOMES:

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

- The students is expected to become a professional in project management by acquiring the skills in a scientific manner

EEB7121	PROJECT WORK				
	PHASE - I (SEMESTER III)	**L**	**T**	**P**	**C**
		0	**0**	**12**	**6***
	PHASE - II (SEMESTER IV)	**L**	**T**	**P**	**C**
		0	**0**	**36**	**18+6***

* Credits for Project work (Phase-I) of third semester will be accounted along with Project work (Phase-II) of fourth semester

OBJECTIVES:

- To enable a student to do an individual project work which may involve design, modeling, simulation and fabrication.
- To analyze a problem both theoretically and practically.
- To motivate the students to involve in research activities leading to innovative solutions for industrial and societal problems.

COURSE DESCRIPTION:

Project work shall be carried out by each and every individual student under the supervision of a faculty of this department. A student may however, in certain cases, be permitted to work for the project in association with other departments or 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 the faculty of the other department of the University or an Engineer / Scientist from the organization. The student shall meet the faculty periodically and attend the periodic reviews for evaluating the progress.

Project work will be carried out in two phases, Phase-I during the pre-final semester and Phase-2 during the final semester. Phase-I shall be pursued for a minimum of 12 periods per week and Phase - II in 36 periods per week. Credits for Phase I will be accounted along with Phase II in the final semester.

In each phase, there will be three reviews for continuous assessment and one final review and viva voce at the end of the semesters. The Project Report 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.

OUTCOMES:

At the end of the course, the student

- Will be able to comprehend the problem thoroughly and provide complete solution
- Will be able to utilize the software knowledge in preparing the solution through simulation studies
- To disseminate the outcome of the work for societal issue

ELECTIVES

EEBY31	**DIGITAL SIGNAL PROCESSING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- This course is an introduction to DSP concepts and implementation. It starts by explaining the need for digital signal processing and DSP systems.
- A complete model of a DSP system is examined from the input transducer, through all the stages including: signal conditioning, anti-aliasing filter, analog-to-digital and digital-to-analog conversion and output smoothing filter.
- Real life examples will be used to illustrate the use and need for each part of a DSP system.

MODULE I DISCRETE TIME SIGNALS AND SYSTEMS **7**

Signals-continuous and Discrete signals - Classification, Representation and applications, Signal Processing, System-classification, operation on signals, Analysis of time and frequency response of discrete time systems, convolution sum and correlation.

MODULE II DISCRETE FOURIER TRANSFORM **8**

Z-Transform – ROC, system function, stability crieterion, Discrete fourier series, Discrete Time fourier Transform, Fast Fourier Transform- Radix 2 FFT

MODULE III DIGITAL FILTERS **8**

Realization of Digital filters –IIR Filters – Discretization of analog filters using Impulse Invariant Technique and Bilinear transformation- Design of Butterwoth and chebyshev digital filters FIR filters-Design using windowing techniques-simple matlab programs

MODULE IV FINITE WORD LENGTH EFFECT IN DIGITAL FILTERS **7**

Number representation- types, Quantization Noise- Input Quantization error-Coefficient Quantization error, Limit cycle oscillations, Finite word length effect in FIR and IIR filter, Quantization effecti DFT and FFT

MODULE V MULTISTAGE REPRESENTATION **7**

Sampling of bandpass signal- anti aliasing filter- Decimation by an integer

factor-Interpolation by an integer factor – Sampling rate conversion – Implementation of digital filter banks- Sub band coding- A/D and D/A conversion- Introduction to wavelets

MODULE VI DIGITAL SIGNAL PROCESSORS **8**

DSP architecture- Study of TMS 320 C 50 Processor- Basic Programming – addition, subtraction, multiplication, correlation, convolution. Study of TMS 320 C 54 Processor Basic Programming –addition, subtraction, multiplication, correlation, convolution

Total Hours: 45

REFERENCES:

1. John G Proakis and Manolakis, " Digital Signal Processing Principles, Algorithms and Applications", Pearson, Fourth Edition, 2007.
2. Sanjit K.Mitra, " Digital Signal Processing: A computer based approach" Tata McGraw Hill second edition 2004..
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" 2003.

OUTCOMES:

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

- Be able to convert between time and frequency domain representations of signals and systems.
- Understand the practical aspects of sampling and reconstruction and be able to select a suitable sampling rate for a given signal processing problem.

- Be capable of designing and analysing analogue and digital filters for a given specification.
- Be able to demonstrate an understanding of the use and applications of the discrete Fourier transform.
- Have gained practical experience with the implementation of digital filters.
- Skill to write simple DSP program

EEBY32 DIGITAL SIGNAL PROCESSORS L T P C

3 0 0 3

OBJECTIVES:

- To impart knowledge on the architectural details and instruction set of TMS320F2812 processor
- To implement DSP Processor in real time Digital Motor Control application

MODULE I INTRODUCTION 6

TMS320F2812 Architecture - The F2812 CPU-F2812 Math Units-Data Memory Access -Internal Bus Structure- Atomic Arithmetic Logic Unit (ALU) -Instruction Pipeline - Memory Map - Code Security Module - Interrupt Response- Operating Modes - Reset Behaviour

MODULE II PROGRAM DEVELOPMENT TOOLS 8

Code Composer Studio IDE - The Software Flow - Code Composer Studio – Basics - Lab Hardware Setup - Code Composer Studio – Step by Step procedure - Create a project - Setup Build Options Linker Command File - Download code into DSP - beginner's project - Objective Procedure - Open Files, Create Project File- C28x Flash Programming - C28x Start-up Sequences -C28x Flash Memory Sectors Flash Flash Configuration Registers - Flash Programming Procedure .

MODULE III DIGITAL I/O 7

Data Memory Mapped Peripherals - The Peripheral Frames - Unit Digital I/O Registers Module - Watchdog Timer - System Control and Status Register - Low Power Mode – Digital Input / Output programmes.

MODULE IV INTERRUPT SYSTEM 8

C28x Core Interrupt Lines - The C28x RESET - Reset Bootloader - Interrupt Sources - Maskable Interrupt Processing - Peripheral Interrupt Expansion - C28x CPU Timers - Serial Peripheral Interface (SPI) Data Transfer - SPI Registers - SPI communication between the C28x and a Dual DAC Texas Instruments TLV5617A and EEPROM ST M95080.

MODULE V C28X EVENT MANAGER AND C28X ANALOGUE DIGITAL CONVERTER 8

Event Manager Block Diagram - General Purpose Timer Operating Modes - Interrupt Sources - GP Timer Registers - GP Timer Interrupts - Event Manager Compare Units Capture Units - Quadrature Encoder Pulse Unit (QEP).- Generate a PWM sine wave -.ADC Module Overview - ADC in Cascaded Mode -ADC in Dual Sequencer Mode - ADC Register Block

MODULE VI DIGITAL MOTOR CONTROL APPLICATIONS 8

C28x IQ – Math Library - IQ – Math Library Functions - IQ- Math Application- FOC -C28x FIR – Filter - Texas Instruments C28x Filter Library- . C28x Digital Motor Control - Field Orientated Control (FOC) Core Math Operations - PARK Transform - CLARKE Transform - Texas Instruments Digital Motor Control Library Modules . FOC for PMSM - Hardware Laboratory Setup - PMSM control project – Build levels.

Total Hours: 45

REFERENCES:

1. Code Composer Studio User's Guide Literature Number: SPRU328 February 2000, Copyright © 1999-2000, Texas Instruments Incorporated.
2. TMS320F2810, TMS320F2811, TMS320F2812, TMS320C2810, TMS320C2811, TMS320C2812 Digital Signal Processors Data Manual, Copyright © 2001– 2012, Texas Instruments Incorporated.
3. TMS320F2812 DIGITAL SIGNAL PROCESSOR IMPLEMENTATION TUTORIAL – Texas Instruments.
4. B. B. Venkatramani & M.Bhaskar, " Digital Signal Procesors architecture, Programming and applications, Tata McGraw Hill 2002.
5. TMS320F/C24/X DSP controllers, Reference guide literature No : SPRU 160c, June 1994.

OUTCOMES:

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

- Programming Knowledge in DSP and its real time application.
- Computing steps necessary to build a control scheme for Field Oriented Control (FOC).
- Board level operations of the eZdspTM F2812 based on the Texas Instruments TMS320F2812 Digital Signal Processor.

EEBY33 ADVANCEMENTS IN POWER ELECTRONICS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study the principal converter types and their recent trends, a brief review of power integrated circuits
- To acquaint the students with the recent trends in converters, structure and working of FACTS, Intelligent power MODULEs

MODULE I RESONANT CONVERTERS **10**

Zero voltage and Zero current switching, Classification of resonant converters - Basic resonant circuit concepts - Load resonant converters - Resonant switch converters - Zero voltage switching, clamped voltage topologies -Resonant DC link Inverters and Zero voltage switching - High frequency link integral half cycle converters - Applications in SMPS and lighting.

MODULE II IMPROVED UTILITY INTERFACE **7**

Generation of current harmonics, Current harmonics and power factor - Harmonic standards and recommended practices - Need for improved utility interface - Improved single phase utility interface - Improved three phase utility interface - Electromagnetic interference.

MODULE III EMERGING DEVICES AND CIRCUITS **7**

Power Junction Field Effect Transistors - Field Controlled Thyristors - JFET based devices Vs other power devices - MOS controlled Thyristors - Power integrated circuits - New semiconductor materials for power devices.

MODULE IV CUSTOM POWER **8**

Modelling and methods of analysis of SVC and FACTS controllers - System control and protection - Harmonics and filters, Simulation and study of SVC and FACTS under dynamic conditions.

MODULE V NEURAL NETWORK AND FUZZY CONTROLLERS **8**

Current and speed control of induction motors - Current control algorithm sensor less motion control strategy - Induction motor controller using VHDL design. Fuzzy logic control of a synchronous generator - System representation, VHDL modelling - FPGA implementation.

MODULE VI DC & AC SERVO DRIVES **5**

Block diagram - Control strategies - Diagnosis of electrical drives - Networking of electric drives - Ethernet communication.

Total Hours: 45

REFERENCES:

1 Ned Mohan., Undeland and Robbins, "Power Electronics: Converters, Applications and Design", John Wiley and Sons (Asia) Pvt Ltd, Singapore, 2003.

2 Rashid, M.H., “Power Electronics Circuits, Devices and Applications”, Prentice Hall India, New Delhi, 2004 .

3 Joseph Vithayathil., “Power Electronics”, Tata McGraw - Hill Series in Electrical and Computer Engineering, USA, 1995.

4 Las Zlo Gyugyi, Narain G Hingorani, “Understanding FACTS: Concepts & Technology of Flexible AC Transmission System”, The Institute of Electrical and Electronics Engineers. Inc., New York, 2000.

5 Mohan Mathur P, Rajiv K Varma, Thyristor Based FACTS Controllers for Electrical Transmission Systems, John Wiley and Sons Inc., and IEEE Press,USA, 2002.

6 Roger C Dugan, Maric F Mcgranaghan, “Electrical Power System Quality”, Tata McGraw - Hill Inc, New York, 1996.

7 Tagare D M, “Reactive Power Management”, Tata McGraw - Hill Publications, New Delhi, 2004.

OUTCOMES:

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

- Ability to have the knowledge about the advanced design of emerging devices in power Electronics
- To design a system which works on soft computing techniques like fuzzy and neural networks

EEBY34	POWER ELECTRONICS IN WIND AND SOLAR POWER CONVERSION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the demand for electrical power generation from the renewable wind and fundamentals of wind power.
- To study and understand about the wind turbine components, power generation machinery ,control systems .To simulate the wind turbine dynamic behavior when integrated to grid
- To study and understand about the solar power generation, Peak power tracking techniques and its control systems.

MODULE I INTRODUCTION 6

Historical Development and current status of Wind power-Generators and Power Electronics for wind turbines - Impact of wind power-Wind speed estimation-wind speed measurements-Rayleigh distribution-Maximum Power obtainable-Bertz limit-Power coefficient Tip speed ratio–aerodynamics of wind rotor-Blade element theory-aerodynamic efficiency-Wind energy Conversion System Components.

MODULE II WIND ENERGY SYSTEM 8

Basic principle of Wind Energy Conversion System(WECS)-Performance of Induction generator for WECS-Self excited Induction generator(SEIG) for isolated Power generators-capacitance requirements-power conditioning schemes.

MODULE III POWER ELECTRONICS IN WIND ENERGY CONVERSION SYSTEM 8

Induction generator-Controlled firing angle scheme with AC and DC side Capacitor-Scalar method-flux vector scheme-Control scheme for Synchronous generator with variable speed drive-Variable speed synchronous generator control with boost converter.

MODULE IV PHOTOVOLTAIC ENERGY CONVERSION 8

Introduction- Solar radiation and measurement - Solar cells and their characteristics - Influence of insulation and temperature - PV arrays - Electrical

storage with batteries - Solar availability in India - Switching devices for solar energy conversion – PV cell technologies.

MODULE V POWER CONDITIONING SCHEMES 8

DC Power conditioning Converters - Maximum Power point tracking algorithms - AC Power conditioners Synchronized operation with grid supply - Harmonic problem – building integrated PV systems.

MODULE VI POWER ELECTRONICS IN PV SYSTEMS AND APPLICATIONS 7

Basic switching Devices - Line commutated inverters – Charge controllers – Water pumping – Audio visual equipments – Street lighting.

Total Hours: 45

REFERENCES:

1. S.N.Bhadra, D.Kasthra,S.Banerjee,"Wind Electrical Systems,"Oxford Higher Eduction, 2005.
2. Thomas Ackermann, "Wind Power in Power system," Wiley 2012.
3. L.L.Freris "Wind Energy conversion Systems", Prentice Hall, 1990.
4. Jian Zhang, Adam Dysko, John O'Reilly, William E. Leithead," Modeling and performance of fixed-speed induction generators in power system oscillation stability studies", Electric Power System Research Vol. 78 (2008) 1416-1424.
5. Mukund R. Patel, "Wind and solar power systems", CRC Press 2004.
6. Rai. G. D. "Non – conventional energy sources", Khanna Publishers, 2002.

OUTCOMES:

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

- Understanding of fundamental of wind power ,detailed model of the Wind Energy components and its control systems.
- Acquire the knowledge about the modeling of various wind generators and its dynamic behavior when integrate with grid.
- Understanding the basic characteristics, working and application of PV cells.
- Understanding of stand - alone systems and Grid connected systems.

EEBY35	POWER ELECTRONICS APPLICATIONS TO POWER SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To have a thorough understanding of the construction, theory and characteristics of the Devices like MOSFET, BJT's, IGBT's and SCR.
- To analysis and modeling of Inverters and converters.
- To study in detail about the Reactive power compensation and FACTS devices.
- To study about the definition and issues in power quality.

MODULE I INTRODUCTION **7**

Basic Concept of Power Electronics, Different types of Power Electronic Devices - Diodes,Transistors,SCR, MOSFET, IGBT and GTO's.

MODULE II AC TO DC CONVERTERS **9**

Single Phase and three phase bridge rectifiers, half controlled and Fully Controlled Converters With R, RL, AND RLE loads. Free Wheeling Diodes, Dual Converter, Sequence Control of Converters - inverter operation, Input Harmonics and Output Ripple, Smoothing Inductance - Power Factor Improvement effect of source impedance, Overlap, Inverter limit.

MODULE III DC TO AC CONVERTERS **9**

General Topology of single Phase and three phase voltage source and current source inverters- Need for feedback diodes in anti parallel with switches - Multi Quadrant Chopper viewed as a Single phase inverter- Configuration of Single phase voltage source inverter: Half and Full bridge, Selection of Switching Frequency and Switching Device. Voltage Control and PWM strategies.

MODULE IV STATIC REACTIVE POWER COMPENSATION **8**

Shunt Reactive Power Compensation - Fixed Capacitor Banks, Switched Capacitors, Static Reactor Compensator, Thyristor Controlled Shunt Reactors (TCR) - Thyristor Controlled Transformer- FACTS Technology-Applications of static thyristor Controlled Shunt Compensators for load compensation ,Static

Var Systems for Voltage Control, Power Factor Control and Harmonic Control of Converter Fed Systems.

MODULE V POWER QUALITY **6**

Power Quality - Terms and Definitions - Transients - Impulsive and Oscillatory Transients - Harmonic Distortion - Harmonic Indices - Total Harmonic Distortion - Total Demand Distortion- Locating Harmonic Sources Harmonic s from commercial and industrial Loads -Devices for Controlling Harmonics Passive and Active Filters -Harmonic Filter Design.

MODULE VI VOLTAGE SAGS AND HARMONICS **6**

Sources of over voltages - Capacitor switching – lightning- Mitigation of voltage swells - surge arrester. Sources of sags and interruptions, estimating voltage sag performance, motor starting sags mitigation of voltage sags harmonics.

Total Hours: 45

REFERENCES:

1. N.Mohan,T.M. Undeland and W.P.Robbins, Power Electronics : Converter, Applications and Design , John Wiley and Sons, 2000.
2. M.H.Rashid, Power Electronics, Prentice Hall of India, 2006.
3. B.K.Bose, Power Electronics and A.C. Drives, Prentice Hall, 2004.
4. Roger C.Dugan, Mark .F. Mc Granaghan, Surya Santaso, H.Wayne Beaty, “Electrical Power Systems Quality”, Second Edition, Mc Graw Hill, 2002.
5. T.J.E. Miller, Static Reactive Power Compensation, John Wiley and Sons, Newyork,1982.
6. Mohan Mathur.R., Rajiv.K.Varma, “Thyristor Based FACTS controllers for Electrical Transmission Systems”, IEEE press .1999.
7. Tripathy, S.C., 'Electric Energy Utilisation and Conservation', Tata McGraw Hill Publishing Company Ltd. New Delhi, 1991.
8. Soni, M.L., P.V. Gupta and Bhatnagar, 'A Course in Electrical Power', Dhanpat Rai Sons, New Delhi, 1983.
9. Roger.C.Dugan, Mark.F.McGranagham, Surya Santoso, H.Wayne Beaty, ‘Electrical Power Systems Quality’ McGraw Hill, 2003.

10. M.H.J Bollen, 'Understanding Power Quality Problems: Voltage Sags and Interruptions', (New York: IEEE Press, 1999). (For Chapters 1, 2, 3 and 5)

OUTCOMES:

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

- Regarding the analysis and modeling of Inverters & Converters.
- Basic understanding of the semiconductor devices like rectifiers, Thyristors and transistors.
- Understanding the principle of operation of FACTS devices.
- Knowing the issues in power quality.

EEBY36 ROBOTICS AND FACTORY AUTOMATION L T P C

3 0 0 3

OBJECTIVES:

- To Identify the basic component of manufacturing automation and categorize different types of automated production process,
- To understand how knowledge based system technology can improve manufacturing enterprises, to design elementary mechanism for automation
- To understand the principle of industrial sensors.

MODULE I FUNDAMENTAL CONCEPTS OF ROBOTICS 7

History, Present status and future trends in Robotics and automation - Laws of Robotics - Robot definitions - Robotics systems and robot anatomy - Specification of Robots - resolution, repeatability and accuracy of a manipulator- Robotics applications.

MODULE II ROBOT DRIVES AND POWER TRANSMISSION SYSTEMS 8

Robot drive mechanisms, hydraulic, electric servomotor, stepper motor, pneumatic drives- Mechanical transmission method, Gear transmission, Belt drives, cables, Roller chains, Link - Rod systems - Rotary-to-Rotary motion conversion, Rotary-to-Linear motion conversion, Rack and Pinion drives, Lead screws, Ball Bearing screws, End effectors, Types.

MODULE III SENSORS 8

Sensor characteristics, Position sensors, Potentiometers, Encoders, Resolvers, LVDT, Velocity sensors, Tachogenerators - Encoders - Proximity sensors, Limit switches, Tactile sensors - Touch sensors - Force and torque sensors

MODULE IV VISION SYSTEMS FOR ROBOTICS 8

Robot vision systems, Image capture- cameras vision and solid state, Image representation - Gray scale and colour images, image sampling and quantization - Image processing and analysis - Image data reduction - Segmentation - Feature extraction - Object Recognition- Image capturing and communication - JPEG, MPEGs and H.26x standards, packet video, error concealment - Image texture analysis.

MODULE V PLC **7**

Building blocks of automation, Controllers , PLC- Role of PLC in FA - Architecture of PLC - Advantages - Types of PLC - Types of Programming - Simple process control programs using Relay Ladder Logic and Boolean logic methods - PLC arithmetic functions.

MODULE VI FACTORY AUTOMATION **7**

Flexible Manufacturing Systems concept - Automatic feeding lines, ASRS, lines, automatic inspection - Computer Integrated Manufacture - CNC, intelligent automation. Industrial networking, bus standards, HMI Systems, DCS and SCADA, Wireless controls.

Total Hours: 45

REFERENCES:

1. Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering An Integrated Approach", Eastern Economy Edition, Prentice Hall of India P Ltd., 1989.
2. Fu K.S., Gonzalez R.C., Lee C.S.G., "Robotics: Control, Sensing, Vision and Intelligence", McGraw Hill Book Company, 1987.
3. Mikell P Groover et. al., "Industrial Robots - Technology, Programming and Applications", McGraw Hill, New York, 1986.
4. Saeed B Niku, “Introduction to Robotics Analysis, Systems, Applications Prentice Hall of India Pvt Ltd New Delhi, 2003.
5. Deh S R., "Robotics Technology and Flexible Automation", Tata McGraw Hill Publishing, Company Ltd., 1994.

OUTCOMES:

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

- Ability to design a robot
- Ability to troubleshoot Factory Automation products

EEBY37 ADVANCED CONTROL OF ELECTRIC DRIVES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To Study the Basic Principles of Electrical Drives
- To select the appropriate DSP controllers, PWM inverter Control, Space vector Modulation, Neural Network and Fuzzy Controllers based on control Systems
- To study the performance of advanced control

MODULE I INTRODUCTION **8**

Need for advanced controls - Principal factors affecting the choice of drive, Parameter identification techniques for electric motors - Electromagnetic compatibility of electrical drives - Different options for an adjustable speed electric drive - Simulation of electrical drives, Advanced control strategies for electrical drives - DSP based control of electric drives.

MODULE II DSP CONTROLLERS **7**

TMS320 Family overview 320C24x series of DSP controllers - Architecture overview - C24x CPU Internal Bus Structure - Memory - Central Processing unit, Memory and I/O Spaces, Overview of Memory and I/O Spaces, Program control Address Modes - System Configuration and Interrupts clocks and low Power Modes Digital input / output (I/O).

MODULE III PWM INVERTER CONTROL **8**

Inverter - operation principle - Inverter Switching - Unipolar, Bipolar, Inverter Dead Time - Inverter Modulation , Different Types, Sine Triangle Analysis of Sine Triangle Modulation - Trapezoidal Modulation - Third harmonic Modulation - Analysis of Third harmonic Modulation, output filter requirement for different PWM Techniques.

MODULE IV SPACE VECTOR MODULATION **8**

Concept of a Space Vector Components for Three-phase sine wave source/ level components for voltage source Inverter operated in square wave Mode, Space Vector Modulation (SVM), principle of SVM, SVM compared to regular sampled PWM phase lag reference for SVM, Naturally sampled SVM, Analytical solution for SVM, Harmonic losses for SVM, Placement of the zero space vector, Discontinuous modulation – comparison with PWM techniques.

MODULE V NEURAL NETWORK AND FUZZY CONTROLLERS 8

Current and speed control of induction motors - Current control algorithm sensor less motion control strategy - Induction motor controller using VHDL design. Fuzzy logic control of a synchronous generator - System representation, VHDL modelling - FPGA implementation

MODULE VI DC AND AC DRIVES 6

Block diagram – control strategies – Diagnosis of Electrical Drives – Networking of Electric Drives – Ethernet Communication

Total Hours: 45

REFERENCES:

1. Bimal K.Bose, “Power Electronics and Variable Frequency Drives – Technology and Application”, IEEE Press,1997.
2. N.Mohan, Electric Machines and Drives: A first Course, Wiley, 2012.
3. De Doncher,Rik,Pulle,Duco W.J.,Veltmn, “Andre Advanced Electrical drives”, 2011.
4. Electrical drives – 1, Boldea & S.A.Nasar – The Oxford Press Ltd, 2006.
5. Grafame Holmes.D and Thomas A. Lipo, “Pulse Width Modulation for Power converters – Principles and Practice” – IEEE Press, 2003.
6. Peter Vas, “Vector control of AC Machines”, Oxford University Press,1990.
7. Hamid A. Toliyat and Steven G.Campbell,DSP Based Electromechanical Motion Control, CRC press, 2004.
8. Ned Mohan, “Advanced Electric Drives : Analysis, Control and Modelling usind Simulink:, John Wiley and Sons Ltd..,,2001.

OUTCOMES:

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

- To integrate and justify techniques to be used to control the drives
- To identify the inverter topology to be used for designing the drives
- Ability to design any electrical drive which works on the topologies like fuzzy, neural network, Space vector, etc.,

EEBY38 SCADA AND DCS L T P C

3 0 0 3

OBJECTIVES:

- The aim of this course is to give an in depth study of SCADA and PLC.
- To acquire knowledge of application of software automation blocks and DCS.
- To expose the students to the Micro SCADA techniques

MODULE I INTRODUCTION 6

Introduction to automation tools PLC, DCS, SCADA, Hybrid DCS/PLC.

MODULE II DCS PROJECT 8

Development of User Requirement Specifications - Functional Design Specifications for automation tool - GAMP, FDA.

MODULE III PROGRAMMABLE LOGIC CONTROLLERS 8

Introduction of Advanced PLC programming, Selection of processor, Input/ output MODULEs - Interfacing of Input/output devices, Operator Interface - OPC- study of SCADA software - Interfacing of PLC with SCADA software.

MODULE IV DCS 9

Introduction to architecture of different makes - DCS Specifications, configuration of DCS blocks for different applications - Interfacing of protocol based sensors -Actuators and PLC systems, Plant wide database management- Security and user access management - MES, ERP Interface.

MODULE V STUDY OF ADVANCE PROCESS CONTROL BLOCKS 9

Statistical Process Control - Model Predictive Control - Fuzzy Logic Based Control - Neural-Network Based Control Higher Level Operations: Control & Instrumentation for process optimization - Applications of the above techniques to the same standard units/processes.

MODULE VI MICRO SCADA FOR POWER ELECTRONICSYSTEMS 5

System concept –Hardware: Base computer - Workstations-Front ends-Peripherals Software Programming-Process Objects – Command Procedures Procedures – RTU Integration –Communication to Third Party Systems –

Functional description: process pictures- operation-Alarm handling-Event Handling- reports- Trends

Total Hours: 45

REFERENCES:

1. Gary Dunning, “Introduction to Programmable logic Controllers”, Delmar Thomson learning, 2001.
2. Webb & Reis, “Programmable logic Controllers”, (Prentice Hall), 2003.
3. Jose A. Romagnoli, Ahmet Palazoglu, 'Introduction to process Control' (CRC Taylor and Francis group), 2013.
4. “Statistical Process Control” -ISA Handbook.
5. B.G. Liptak “Handbook of Instrumentation- Process Control”.
6. Installation and user manuals of different DCS, PLC Vendors, 2004.

OUTCOMES:

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

- Basics of SCADA & DCS.
- Appropriate knowledge and skills in Industrial automation systems with the use of DCS, PLCs, and SCADA.
- An ability to apply creativity in design of systems, components or processes appropriate to power electronic circuits.

EEBY39 MICROCONTROLLERS AND APPLICATIONS L T P C

3 0 0 3

OBJECTIVES:

- The aim of this course is to introduce Microcontroller Intel 8051,Controller 68HCII, PIC Microcontrollers and their applications,
- To study the architecture of 8051, 68HCII, 16C74, their addressing modes and Instruction sets,
- To introduce the need and use of Interrupt structure, timers and to be acquainted with the applications.

MODULE I INTRODUCTION TO MICROCONTROLLERS 6

Introduction, Microcontrollers and microprocessors, history of microcontrollers, embedded versus external memory devices, 8-bit and 16-bit microcontrollers, CISC and RISC processors, Harvard and Von Neumann architecture

MODULE II INTRODUCTION TO 8051 7

Architecture of 8051 - Memory organization - Register Banks - Bit addressable area - SFR - Addressing modes, Programming - MCS51 Family features: 8031/8051/8751 - MCS-51 instruction set, interrupts in MCS-51, timers and counters, serial communication – Power saving modes - Simple Programs using stack pointer.

MODULE III MCS51 APPLICATIONS 7

Overview of 89CXX and 89C20XX Atmel microcontrollers, pin description of 89C51 and 89C2051, using flash memory square wave generation, rectangular wave generation, pulse generation, stair case ramp generation, sine wave generation, pulse width measurement, frequency counter.

MODULE IV MOTOROLA 68HC11 8

Controller features - Different modes of operation and memory map - Functions of I/O ports in single chip and expanded multiplexed mode, Timer system. Input capture, output compare and pulsed accumulator features of 68HC11, Serial peripheral and serial communication interface - Analog to digital conversion features - Watchdog feature.

MODULE V PIC 18XFF2 MICROCONTROLLERS 9

Architecture - memory organization - addressing modes - instruction set - Timers - Capture / Compare / PWM (CCP) MODULEs - Interrupts - I/O ports - 12C bus for peripheral chip access - A /D converter - USART - Interfacing LCD display - Keypad interfacing - ADC and DAC interfacing – Programming techniques using C and Assembly

MODULE VI APPLICATION AND CASE STUDY USING 8051 8

Stepper Motor Control - DC Motor Control - Temperature controller system using 8051. Intruder alarm system: Introduction, System Operation, Key software components used in this example, the software.

Total Hours: 45

REFERENCES:

1. "8-bit Embedded Controllers", Intel Corporation, 1990.
2. John B. Peat man., "Design with Microcontrollers", Tata McGraw - Hill, Singapore, 1988.
3. John B. Peat man, Design with PIC Microcontrollers, Pearson Education Inc, India, 2005.
4. The 8051 Microcontroller and Embedded systems - M.A. Mazadi, J.G. Mazadi & R.D. McKinlay - pearson PHI, 2013.
5. The 8051 Microcontroller - K.J. Ayala.
6. Thonson Mazidi, Rolin McKinlay,Danny Causey, PIC Microcontroller and Embedded Systems: Using Assembly and C for PIC 18, Prentice Hall, 2009.

OUTCOMES:

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

- A solid understanding of the fundamental hardware layout of a microprocessor and a microcontroller.
- Working knowledge in ports and interrupts.
- A comfort level in assembly language and C programming for microcontrollers.

EEBY04	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 stepping motors.
- To understand the Construction, principle of operation and performance of switched reluctance motors.
- 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 8

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

MODULE II STEPPING MOTORS 8

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 8

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

MODULE IV PERMANENT MAGNET MOTORS 8

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 **5**

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 **8**

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
- Ability to model small power rating of motor for real time application
- Software knowledge in Magnet, ANSYS for electrical application.

EEBY23 SOFT COMPUTING TECHNIQUES L T P C

3 0 0 3

OBJECTIVES:

- To expose the students to the concepts of feed forward neural networks.
- To provide adequate knowledge about feedback neural networks.
- To teach about the concept of fuzziness involved in various systems. To provide adequate knowledge about fuzzy set theory.
- To provide comprehensive knowledge of fuzzy logic control and adequate knowledge of application of fuzzy logic control to real time systems.
- To expose the ideas of GA and EP in optimization and control.

MODULE I INTRODUCTION 6

Approaches to intelligent control - Architecture for intelligent control- Symbolic reasoning system - rule-based systems - the AI approach - Knowledge representation- Expert systems – applications of expert systems.

MODULE II FUNDAMENTALS OF ARTIFICIAL NEURAL NETWORKS 9

Objectives - History- Biological Inspiration- Neuron Model- McCulloch-Pitts neuron model, Single- Input Neuron-Multi-Input Neuron- Network Architectures- A Layer of Neurons-Multiple Layers of Neurons. Perceptron. Architecture- Single-Neuron Perceptron- Multi-Neuron Perceptron- Perceptron- Learning Rules - Constructing Learning Rules- Training Multiple-Neuron Perceptrons.

MODULE III ASSOCIATIVE NETWORKS 8

Simple Associative Networks- Auto-associative and hetero-associative nets; Learning in neural nets: Supervised and unsupervised learning; Unsupervised Hebb Rule- Hebb Rule with Decay-Instar Rule-Outstar Rule- Kohonen Rule. Adaline Network- Madaline Network - Back Propagation Neural networks – Hopfield Networks-adaptive networks.

MODULE IV FUZZY SET THEORY & FUZZY SYSTEMS 8

Fuzzy versus crisp- crisp sets, fuzzy sets – operations and properties - Membership function – Crisp relations – Fuzzy relations .Crisp logic – fuzzy logic – Fuzzy rule based system- defuzzification methods – Applications.

MODULE V GENETIC ALGORITHMS 8

Genetic Algorithms-: History- Basic concepts –working principle- Encoding - Fitness Function – Reproduction .Genetic operators-Cross over- types – Mutation Operator - coding steps of GA - Convergence characteristics

MODULE VI APPLICATIONS OF AI TECHNIQUES USING MATLAB 6

Matlab Neural Network toolbox – Matlab Fuzzy logic toolbox- Applications of AI techniques: Power Systems -Load forecasting - Load flow studies – Applications to Power electronics.

Total Hours: 45

REFERENCES:

1. Fundamentals of Neural Networks – Architectures, Algorithms and applications by Laurene Fausett, 2006
2. Wassermann, P. D. "Neural Computing" Van Reinhold, 1988.
3. Zimmermann, H. J., 'Fuzzy Set Theory and Its Applications', 2nd Edition, Kluwer Academic Publishers, 1991.
4. Martin T. Hogan , Howard B.Demuth. M,'Neural network design'4th edition, 2004.
5. Zureda, J.M.,'Introduction to Artificial Neural Systems', Jaico publishing house Bombay, 1994.
6. Bose N.K, Liang P. 'Neural Network Fundamentals with graphs, Algorithms and applications', TMH Pub. Co. Ltd, 2001.
7. Neural Networks, Fuzzy logic and Genetic algorithms Synthesis and Applicationsby S.Rajasekaran, G.A.Vijayalaksmi Pai, PHI private learning Ltd, New Delhi, 2011

OUTCOMES:

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

- Understand the concepts, advantages and disadvantages of the techniques in evolutionary computation
- Design suitable neural networks, fuzzy systems, genetic representations with appropriate fitness functions for simple problems,
- Know the key issues in using these techniques in Matlab for search of difficult search-spaces
- Awareness of the different approaches and different applications in the field.

EEB6104	SYSTEMS THEORY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the concept of state variable representation of physical systems
- To introduce the concept of Controllability, Stabilisability, Detectability and Observability.
- To evaluate Stability of Linear and Non Linear Systems.

MODULE I STATE VARIABLE REPRESENTATION 8

Introduction- Concept of state – State equation for dynamic systems –Time invariance and linearity - Non uniqueness of state model – State Diagrams.

MODULE II SOLUTION OF STATE EQUATION 8

Existence and uniqueness of solutions to continuous time state equations- Solution of nonlinear and linear time varying state equations –Evaluation of matrix exponential - System modes – Role of eigen values and eigen vectors.

MODULE III CONTROLLABILITY AND OBSERVABILITY 8

Controllability and Observability – Stabilizability and Detectability – Test for continuous time systems – Time varying and time invariant case – Output controllability.

MODULE IV STABILITY FOR LINEAR SYSTEMS 6

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.

MODULE V STABILITY FOR NON LINEAR SYSTEMS 7

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 MODAL CONTROL **8**

Introduction – SISO and MIMO systems – the effect of state feedback on controllability and observability – pole placement by state feedback for SISO systems – Full Order and reduced order observers

Total Hours: 45

REFERENCES:

1. M.Gopal, “Modern Control System Theory”, New Age International, 2005.
2. K.Ogata, “Modern Control Engineering”, Prentice Hall of India, 2002.
3. John .S.Bay, “Fundamentals of Linear State Space Systems”, Tata McGraw – Hill, 1999.
4. Z.Bubnicki, “Modern Control Theory”, Springer, 2005.

OUTCOMES:

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

- Ability to design observer using pole placement techniques.
- Ability to analyze complex systems using mathematical models.
- Ability to analyze the stability of Linear and Non-Linear Systems.

EEBY14 HIGH VOLTAGE DIRECT CURRENT TRANSMISSION

L	T	P	C
3	0	0	3

OBJECTIVES:

- To identify situations where HVDC is a better alternative
- To acquire knowledge of HVDC converters, system control and development of MTDC systems
- To perform power flow analysis in an integrated EHVAC - HVDC system.

MODULE I COMPARISON OF EHVAC AND HVDC SYSTEMS **7**

Technical and economic problems in bulk power transmission over long distances using EHV / UHV AC lines - HVDC alternatives for transmission - Description of HVDC systems - its application - comparison of EHVAC and HVDC systems.

MODULE II ANALYSIS OF HVDC CONVERTERS **8**

Planning of HVDC transmission - modern trends in HVDC transmission - DC breakers - U/G cable transmission - VSC based HVDC - pulse number - choice of converter configuration - simplified analysis of Graetz circuit - 6 pulse converter bridge characteristics - generation of harmonics and filtering.

MODULE III ANALYSIS AND CONTROL OF HVDC SYSTEMS **8**

Twelve pulse converter characteristics - its advantages - detailed analysis of Converters - Principles of DC link control - converter / inverter control characteristics - system control hierarchy - firing angle control - current and extinction angle control - power control - higher level controllers.

MODULE IV MULTI TERMINAL HVDC SYSTEMS **7**

Introduction to MTDC systems – potential applications of MTDC systems – Types of MTDC systems – Control and protection of MTDC systems – Detailed study about developments of MTDC systems.

MODULE V POWER FLOW ANALYSIS **8**

Per unit system for DC quantities – modeling of DC links – solution of DC power flow – solution of AC – DC power flow – case studies

MODULE VI SIMULATION **7**

System simulation – philosophy and tools – HVDC systems simulation: modeling of HVDC systems for digital simulation – dynamic interaction between DC and AC systems. Application in Wind Power generation.

Total Hours: 45

REFERENCES:

1. K.R. Padiyar, “HVDC Power Transmission Systems”, New Age International (P) Ltd., New Delhi, 2002.
2. J. Arrillaga, “High Voltage Direct Current Transmission”, Peter Pregrinus, London, 1983.
3. P. Kundur, “Power System stability and Control”, Tata McGraw Hill, 1993.
4. Erich Uhlmann, “Power Transmission by Direct Current”, BS Publications, 2004.
5. V.K. Sood, HVDC and FACTS Controllers - Applications of Static Converters in power system, April 2004, Kluwer Academic Publishers.

OUTCOMES:

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

- Identification of situations where HVDC transmission is a better alternative
- The operation and control of converter / inverter for power control
- Steady state performance simulation and analysis
- MTDC systems and its development

EEB6213 FLEXIBLE A.C. TRANSMISSION SYSTEMS L T P C

3 0 0 3

OBJECTIVES:

- To understand the working principles of different types of shunt and series FACTs Controllers.
- To understand and derive the steady state model of FACTS devices suitable for use in power system studies.
- To understand the dynamic models of FACTS devices suitable for use in transient stability programs.

MODULE I INTRODUCTION 8

Reactive power - uncompensated transmission lines - load compensation - system compensation - lossless distributed parameter lines -symmetrical lines - midpoint conditions of a symmetrical line case study passive compensation - shunt compensation -series compensation - effect on power-transfer capacity

MODULE II STATIC VAR COMPENSATOR (SVC) 8

Voltage control by SVC - advantages of slope in dynamic characteristics - influence of SVC on system voltage - design of SVC voltage regulator - modelling of SVC for power flow and transient stability.

MODULE III THYRISTOR CONTROLLED SERIES CAPACITOR (TCSC) 7

Operation of the TCSC - different modes of operation - modelling of TCSC - variable reactance model - modeling for power flow and stability studies. sub-synchronous resonance- torsional interaction,- torsional torque - NGH damping schemes.

MODULE IV VOLTAGE SOURCE CONVERTER BASED FACTS CONTROLLERS 7

Static synchronous compensator (STATCOM) - principle of operation - V-I characteristics. SSSC-operation of SSSC and the control of power flow - modeling of SSSC in load flow and transient stability studies -UPFC and IPFC.

MODULE V CO-ORDINATION OF FACTS CONTROLLERS 7

Controller interactions - SVC - SVC interaction - co-ordination of multiple controllers using linear control techniques - control coordination using genetic algorithms.

MODULE VI APPLICATIONS OF FACTS CONTROLLERS 8

Applications of SVC - enhancement of transient stability - steady state power transfer - enhancement of power system damping - prevention of voltage instability. -applications of TCSC- improvement of the system stability limit - enhancement of system damping. applications of STATCOM- steady state power transfer-enhancement of transient stability - prevention of voltage instability - applications of SSSC – SSR mitigation.

Total Hours: 45

REFERENCES:

1. R.Mohan Mathur, Rajiv K.Varma, "Thyristor - Based FACTS Controllers for Electrical Transmission Systems", IEEE press and John Wiley & Sons, Inc, 2002.
2. Narain G. Hingorani, "Understanding FACTS -Concepts and Technology of Flexible AC Transmission Systems", Standard Publishers Distributors, Delhi-110 006.
3. K.R.Padiyar," FACTS Controllers in Power Transmission and Distribution", New Age International(P) Limited, Publishers, New Delhi, 2008.
4. A.T.John, "Flexible A.C. Transmission Systems", Institution of Electrical and Electronic Engineers (IEEE), 1999.
5. V.K.Sood, HVDC and FACTS controllers - Applications of Static Converters in Power System, Kluwer Academic Publishers, April 2004.

OUTCOMES:

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

- Describe how FACTS devices are designed
- Explain and analyze their functions
- Derive basic mathematical models for these components
- Analyze the impact of these components on power system stability
- Perform calculations on different control strategies for these devices
- Apply the controllers for various problems by simulation.

EEBY15 WIND ENERGY CONVERSION SYSTEMS L T P C

3 0 0 3

OBJECTIVES:

- To understand the demand for electrical power generation from the renewable wind and fundamentals of wind power.
- To study and understand about the wind turbine components, power generation machinery, control systems.
- To simulate the wind turbine dynamic behavior when integrated to grid.

MODULE I INTRODUCTION 8

Introduction-Historical Development and current status of Wind power-Generators and Power Electronics for wind turbines - Power System Impacts of Wind turbines-Wind speed estimation-wind speed measurements-Rayleigh distribution-Maximum Power obtainable-Bertz limit-Power coefficient – aerodynamics of Wind rotor-Blade element theory-aerodynamic efficiency-Wind energy Conversion System Components.

MODULE II WIND TURBINE 8

Types of Wind Turbine-Rotor design consideration-Tip speed ratio-blade profile-Power regulation-Yaw control –Pitch angle control-stall control-schemes for maximum power extraction.

MODULE III FIXED SPEED AND VARIABLE SPEED SYSTEMS 8

Fixed speed and variable speed wind turbine- Need of variable speed systems-Power-wind speed characteristics-Generation schemes with fixed and variable speed turbines-Comparison of different schemes.

MODULE IV MODELING AND SIMULATION OF FIXED SPEED AND VARIABLE SPEED WIND GENERATORS 8

Modeling of Fixed speed Induction generator-axes transformation-flux linkage equations-voltage equations-state equations-modeling of variable speed DFIG for Wind Energy Conversion Systems-Converter Control System- transient stability simulation of fixed speed induction generator using EUROSTAG 4.3-Doubly Fed Induction Generator(DFIG) modeling - controller modelling - modelling of DFIG in EUROSTAG - transient stability simulation of power systems with induction generators using EUROSTAG 4.3.

MODULE V POWER ELECTRONICS IN WIND ENERGY CONVERSION SYSTEM 8

Induction generator-Controlled firing angle scheme with AC and DC side Capacitor-Scalar method-flux vector scheme-Control scheme for Synchronous generator with variable speed drive-Variable speed synchronous generator control with boost converter.

MODULE VI GRID CONNECTED SYSTEMS 5

Stand alone and Grid Connected WECS system-Grid connection Issues- - Impacts of wind power on Power System Stability-wind plant reactive power capability and its requirements-voltage Control and active power control - Storage technologies.

Total Hours: 45

REFERENCES:

1. S.N.Bhadra,D.Kasthra,S.Banerjee,”Wind Electrical Systems,”Oxford HigherEduction, 2005.
2. Thomas Ackermann,”Wind Power in Power system,”Wiley 2012.
3. L.L.Freris "Wind Energy conversion Systems", Prentice Hall, 1990.
4. Jian Zhang, Adam Dysko, John O'Reilly, William E. Leithead," Modeling and performance of fixed-speed induction generators in power system oscillation stability studies", Electric Power System Research Vol. 78 (2008) 1416-1424.
5. Andre´s Feijoo, Jose Cidras, Camilo Carrillo, "A third order model for the doubly-fed induction machine", Electric Power Systems Research 56 (2000) 121-127.
6. Eurostag 4.3 Theory Manual Part I.
7. Ion Boldea, "Variable speed generators", Taylor & Francis group, 2006.
8. E.W.Golding "The generation of Electricity by wind power", Redwood burn Ltd., Trowbridge, 1976.
9. S.Heir "Grid Integration of WECS", Wiley 1998.

OUTCOMES:

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

- Understanding of fundamental of wind power detailed model of the Wind Energy components and its control systems.
- Acquire the knowledge about the modeling of various wind generators and its dynamic behavior when integrate with grid.

EEBY05	POWER QUALITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- The main objective of the course is to enhance the knowledge of the participants in the emerging area of power quality and several key issues related to its modeling, assessment and mitigation.
- The course will provide a platform to an in-depth discussion on the various challenges and their possible remedies with respect to maintaining power quality in electricity sector, which will benefit participants from academic and R & D institutions, professional engineers from utilities, industries and policy makers.

MODULE I INTRODUCTION **8**

Introduction-Consequences of Poor Power Quality: Technical impacts - Financial impacts- Responsibility sharing among various parties - The Impact of Power Quality on the Economy of Electricity Markets:: The quality market model outline- The consumers representation - The firm representation- Peculiarities of electricity markets - The Insertion of quality in the electricity Market Model.

MODULE II CHARACTERISATION OF ELECTRIC POWER QUALITY **8**

Power Quality Standards and Guidelines- Unbalance- Harmonics - Transients- Sag, Swell, Interruption, Under voltage and Overvoltage - DC Offset, Electric Noise, Voltage Fluctuation, Flicker and Power Frequency Variation.

MODULE III POWER QUALITY ANALYSIS **8**

Unbalance Assessment Using Sequence Components- Unbalance Assessment Using Feature Pattern Extraction Method (FPEM).- Harmonic Assessment using FPEM-Harmonic Assessment by Area Based Technique(ABT)- Assessment of Power Components by FPEM and ABT-. Transients Analysis: Model Based Approaches- ESPRIT Method.

MODULE IV MITIGATION METHODS **8**

Active Power Filters (APF):Control methods and strategies-Grid Synchronization-Voltage controller- Current controller - Inductive filter design-

DC-link capacitor design- Power quality applications of predictive controlled converters: Multilevel converters- Unity power factor rectifier-Dynamic voltage restorer. Harmonics Effect in Industrial- Harmonic Distortion in Renewable Energy Systems

MODULE V POWER QUALITY MONITORING 5

Power Quality indexes, levels and limits Monitoring in installations - Monitoring in grids- Normalizing and classifying Power Quality –data- Automation and control of distribution systems - SAF control - PAF control- Numerical Relays- : Harmonic analyzers - Transient-disturbance analyzers- Data loggers and chart recorders.

MODULE VI POWER QUALITY IMPROVEMENT 8

Load compensation using DSTATCOM, Voltage regulation using DSTATCOM, protecting sensitive loads using DVR, Unified Power Quality Conditioner Based on a Fuzzy Logic--UPQC -control strategies: P-Q theory, Synchronous detection method.

Total Hours: 45

REFERENCES:

1. Arindam Ghosh "Power Quality Enhancement Using Custom Power Devices", Kluwer Academic Publishers, 2002.
2. G.T.Heydt, "Electric Power Quality", Stars in a Circle Publications, 1994 (2nd edition) .
3. R.C. Duggan , Power Quality, Mcgraw-Hill, New York, 1996.
4. Power electronic converter harmonics -Derek A. Paice.
5. Andreas Eberhard “Power Quality” Published by InTech,March-2011.
6. Surajit Chattopadhyay, Madhuchhanda Mitra,Samarjit Sengupta “Electric Power Quality” Springer, 2010.

OUTCOMES:

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

- Understand the power quality issues and its importance
- Evaluate the characteristics of power quality disturbances
- Identify the techniques to mitigate power quality disturbances.

SSBY01	SOCIETY, TECHNOLOGY AND SUSTAINABILITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Aware of new technologies through advances in Science and Engineering.
- To make them realise the profound impact on society.
- 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 9

Origin and evolution of technologies - Nature of technology- Innovation - Historical Perspective of technology - Sources of technological change - Coevolution 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 9

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 9

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 **9**

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 **9**

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.