P.S.R. ENGINEERING COLLEGE

(An Autonomous Institution & Affiliated to Anna University, Chennai)

SIVAKASI - 626140

M.E. Power Electronics and Drives

PG REGULATION-2012

CURRICULUM AND SYLLABI

[1st To 4th Semester]

THIS IS THE FINAL VERSION OF THE SYLLABUS AS RATIFIED AND APPROVED BY THE ACADEMIC COUNCIL OF THE COLLEGE IN THE MEETINGS HELD ON 1/6/2013 & 12/4/2014

DEAN(ACAD)

REGULATIONS FOR PG PROGRAMME (M.E/M.C.A/M.B.A) CANDIDATE ADMITTED DURING THE ACADEMIC YEAR 2012 - 2013 AND ONWARDS [PG Regulation-2012]

PRELIMINARY DEFINITIONS AND NOMENCLATURE

In these Regulations, unless the context otherwise requires:

i. "**Programme**" means Post graduate Degree Programme (M.E., M.C.A. and M.B.A)

ii. **"Branch**" means specialization or discipline of M.E. Degree Programme like "Applied Electronics", "Computer Science and Engineering", etc.

iii. "**Course**" means Theory or Practical subject that is normally studied in a semester, like Applied Mathematics, Embedded System Design, etc.

iv. "**Head of the Institution**" means the Principal of a College / Institution who is responsible for all academic activities of that College / Institution and for implementation of relevant Rules and Regulations.

v. **"Head of the Department"** means Head of the Department concerned.

vi. "**Controller of Examinations"** means the Authority of the College who is responsible for all activities of the Examinations.

vii. "**University**" means ANNA UNIVERSITY.

viii. **"College"** or **"Institution"** means P.S.R. Engineering College.

1. ADMISSION REQUIREMENTS

1.1 Candidates for admission to the first semester of the Master's Degree Programme shall be required to have passed an appropriate Degree Examination of Anna University or any other examination of any University or authority accepted as equivalent thereto.

1.2 Eligibility conditions for admission such as class obtained, number of attempts in qualifying examination and physical fitness will be as prescribed from time to time. &

1.3 Any other conditions as notified by the Government of Tamil Nadu.

2. PROGRAMMES OFFERED AND MODE OF STUDY

2.1. P.G. PROGRAMMES OFFERED

- M.E. Computer Science and Engineering
- M.E. Structural Engineering
- M.E. Applied Electronics
- M.E. Engineering Design
- M.E. Power Electronics and Drives
- M.C.A
- M.B.A

2.2. MODE OF STUDY

Full Time / Part Time (Daytime)

Candidates admitted should be available in the College/ Institution/ University during the complete working hours for curricular, co-curricular and extra-curricular activities assigned to them.

3. DURATION AND STRUCTURE OF THE P.G.PROGRAMMES

3.1 The minimum and maximum periods for completion of the PG Programmes are given below:

Programme	Min. No. of Semesters	Max. No. of Semesters
M.E	4	8
M.B.A	4	8
M.C.A	6	12

The Curriculum and Syllabi of all the P.G. Programmes shall be approved by the Academic Council of the College. The number of Credits to be earned for the successful completion of the programme shall be as specified in the Curriculum of the respective specialization of the P.G. Programme.

3.2 Credits will be assigned to the courses for different modes of study as given below:

3.2.1 The following will apply to all modes of P.G. Programmes.

- One credit for each lecture period allotted per week
- One credit for each tutorial period allotted per week
- One credit for each seminar/practical session of two periods designed per week.

3.2.2 The minimum prescribed credits required for the award of the degree shall be within the limits specified below:

PROGRAMME	PRESCRIBED CREDIT RANGE
M.E. (Full Time)	65 to 75
M.C.A	118
M.B.A	90

3.3 The P.G. Programmes will consist of:

- core subjects
- elective subjects
- project work / thesis / Dissertation
- The Programme will also include design projects / planning projects / seminars / practicals / practical training, if they are specified in the Curriculum.

3.4 The Curriculum and Syllabi of all the P.G. Programmes shall be approved by the Academic Council of the College.

3.5 A student shall pass all the subjects specified in the curriculum of the programme for the successful completion of the programme.

3.6. Each semester shall normally consist of 90 working days or 450 hours or 540 periods of 50 minutes duration. The Head of the Institution shall ensure that every teacher imparts instruction as per the number of periods specified in the syllabus and that the teacher teaches the full content of the specified syllabus for the course (subject) being taught. End-Semester Examination will ordinarily follow immediately after the last working day of the semester.

3.7 The maximum marks assigned to different courses shall be as given below:

3.7.1. i. Each of the theory subjects (excluding project work) shall carry maximum of 100 marks out of which the internal assessment will carry 25 marks, while the end semester Examination will carry 75 marks. The practical classes for all the Practical/Lab component subjects will be assessed continuously and marks will be entered in the prescribed proforma. The progress of Practical classes will be monitored by a committee formed by the concerned Head of the Departments / Professor in-charge of the course to ensure that the concerned staff conducts the laboratory experiments as specified in the syllabus. The maximum marks for the Practical/Lab component courses shall be 100, out of which the continuous internal assessment will carry 25 marks, while the end semester practical

examination will carry 75 marks. The award of the end semester practical examination marks shall be conducted by both the Internal and External examiners.

ii. The project report / Thesis / Dissertation of M.E. programme, during Phase I, will be evaluated based on the report and a viva-voce examination by an Internal Examiner and an External Examiner.

iii. The project work / Thesis / Dissertation of M.E. programme, during Phase II, will be evaluated based on the Project Report and a viva-voce examination by a team consisting of the supervisor / Internal Examiner and External Examiner for each specialization.

The project report / Thesis / Dissertation of M.B.A. programme (no phases), will be evaluated based on the report and a viva-voce examination by an Internal Examiner and an External Examiner.

iv. Practical Training / Summer Project if specified in the Curriculum shall not exceed the maximum duration of 4 weeks and should be organized by the Head of the Department for every student.

Practical Training / Summer Project of M.B.A. programme if specified in the Curriculum shall not exceed the maximum duration of 6 weeks and should be organized by the Head of the Department for every student.

v. At the end of Practical Training / Summer Project the candidate shall submit a certificate from the organization where he/she has undergone training 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 Institution. Certificates submitted by the students shall be attached to the mark list sent by the Head of the Institution.

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

3.7.3 A candidate may be permitted by the Head of the Department to choose one or two subjects from P.G. Programmes offered from other departments in the college / institution during the period of his / her study, provided the Head of the Department offering such course also agrees and there is no clash in the time-table for the lecture classes.

3.8. PROJECT WORK/THESIS *I* DISSERTATION

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

3.8.2 A candidate may, however, in certain cases, be permitted to work on the project in an Industrial/Research Organization, on the recommendations of Head of the Department, with the approval of the Head of the Institution. In such cases, the Project work shall be jointly supervised by a supervisor of the department and an Engineer / Scientist from the Organization and the student shall be instructed to meet the supervisor periodically and to attend the review committee meetings for evaluating the progress.

3.8.3 The Project work / Thesis / Dissertation (Phase-II) shall be used for a minimum of 16 weeks during the final semester from the next day of viva voce examination of Phase-1 Project.

The Project work / Thesis / Dissertation of M.B.A programme shall be used for a minimum of 16 weeks during the final semester.

3.8.4 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 at the end of the IV semester. The last date for the submission of Thesis (Phase-II) will be six months from the last date of the submission of Phase-I Project Report or Third Semester examination or 24 months from the date of commencement of First Semester class work, whichever is later. However, in exceptional cases, based on the recommendation of the Professor-in-charge of the course the Chairman, Academic Council can permit an extension of time not exceeding 31 days. If a candidate submits the project report/ thesis report/ dissertation after the specified deadline, he / she is deemed to have failed in the Project Work / Thesis ⁄ Dissertation and shall re-enroll for the same in a subsequent semester.

For M.B.A programme, 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 at the end of the IV semester. The last date for the submission of Thesis will be six months from the commencement of fourth semester. However, in exceptional cases, based on the recommendation of the Professor-in-charge of the course the Chairman, Academic Council can permit an extension of time not exceeding 31 days. If a candidate submits the project report ⁄ thesis report/ dissertation after the specified deadline, he *I* she is deemed to have failed in the Project Work / Thesis / Dissertation and shall re-enroll for the same in a subsequent semester.

3.8.5 Every candidate doing M.E. shall, based on his / her project work thesis dissertation, send a paper for publication in a journal or a conference in which full papers are published after usual review. An acknowledgement for having communicated to the journal or conference shall be attached to the report of the project work /thesis / dissertation. Such acknowledgements shall be sent to the Office of the Controller of Examinations along with the evaluation marks by the team of examiners without which the marks shall not be accepted.

3.8.6 A student who has passed in all the courses prescribed in the curriculum for the award of the degree shall not be permitted to re-enroll to improve his/her marks in a course or the aggregate marks.

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

4. FACULTY ADVISER

To help the students in planning their courses of study and for general advice on the academic programme, the Head of the Department will attach a certain number of students to a teacher of the Department who shall function as Faculty Adviser for those students throughout their period of study. Such Faculty Adviser shall advise the students and monitor the subjects taken by the students, check the attendance and progress of the students attached to him / her and counsel them periodically. If necessary, the faculty adviser may also discuss with or inform the parents about the progress of the students.

5. CLASS COMMITTEE

5.1 A Class Committee consists of teachers of the concerned class, student representatives and a chairperson who is not teaching the class. It is like the 'Quality Circle' (more commonly used in industries) with the overall goal of improving the teaching-learning process. The functions of the class committee include Solving problems experienced by students in the class room and in the laboratories.

- Clarifying the regulations of the degree programme and the details of rules therein.
- Informing the student representatives the academic schedule including the dates of assessments and the syllabus coverage for each assessment.
- Informing the student representatives the details of regulations regarding the weightage used for each assessment. In the case of practical courses (Iaboratory/ drawing/ project work/ seminar etc.) the breakup of marks for each experiment/ exercise/ module of work, should be clearly discussed in the class committee meeting and informed to the students.
- Analyzing the performance of the students of the class after each test and finding the ways and means of solving problems, if any.

- Identifying the weak students, if any, and requesting the teachers concerned to provide additional help or guidance or coaching to such weak students.

5.2 The class committee for a class under a particular specialization is normally constituted by the Head of the Department. However, if the students of different specializations are mixed in a class, the class committee is to be constituted by the Head of the Institution.

5.3 The class committee shall be constituted on the first working day of any semester or earlier.

5.4 At least 2 student representatives (usually 1 boy and 1 girl) shall be included in the class committee.

5.5 The chairperson of the class committee may invite the Faculty Adviser(s) and the Head of the Department to the meeting of the class committee.

5.6 The Head of the Institution may participate in any class committee of the institution.

5.7 The chairperson is required to prepare the minutes of every meeting, submit the same to the Head of the Institution within two days of the meeting and arrange to circulate among the concerned students and teachers. If there are some points in the minutes requiring action by the management, the same shall be brought to the notice of the management by the Head of the Institution.

5.8 The first meeting of the class committee shall be held within one week from the date of commencement of the semester, in order to inform the students about the nature and weight age of assessments within the framework of the Regulations. Two or three subsequent meetings may be held at suitable intervals. During these meetings the student members representing the entire class, shall meaningfully interact and express the opinions and suggestions of the class students to improve the effectiveness of the teaching-learning process.

6. COURSE COMMITTEE FOR COMMON COURSES

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 /Head the Institution 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. PROCEDURES FOR AWARDING MARKS FOR INTERNAL ASSESSMENT

7.1 Every teacher is required to maintain an 'ATTENDANCE AND ASSESSMENT RECORD' which consists of attendance marked in each lecture or practical or project work class, the test marks and the record of class work (topic covered), separately for each course. This should be submitted to the Head of the Department periodically (at least three times in a semester) for checking the syllabus coverage and the records of test marks and attendance. The Head of the Department will put his signature and date after due verification. At the end of the semester, the record should be verified by the Head of the Institution who will keep this document in safe custody (for five years).

7.2 Theory Subjects [25 marks)

(a). Unit Tests [60% weightage]:

Three tests each carrying sixty (60) marks shall be conducted by the Department / Institution. The total marks obtained in all the tests put together out of 180, shall be reduced to 60 marks and rounded to nearest integer (this implies equal weightage to all the three tests). However a retest at the discretion of the Head of the Department may be conducted for the deserving candidates.

(b). Assignment/Seminar/Miniproject [30% weightage]:

A student has an option to choose any one of the following:

i) Assignment:

Two assignments each carrying 15 marks and requiring work of average 5 to 6 hours of study and written work of average 5 to 6 hours shall be given to be carried out by each student in a separate assignment folder, duly indexed with headings, date of submission, marks, remarks and signature of faculty with date etc.

ii) Assignment and Seminar:

A student has to carry out one assignment and one seminar each carrying 15 marks each. An assignment normally requires work of average 5 to 6 hours of study and written work of average 5 to 6 hours which has to be submitted in a separate assignment folder, duly indexed with headings, date of submission, marks, remarks and signature of faculty with date etc. The student has to make one technical seminar on current topics related to the specialization. The students are expected to submit a report his/her presentation. The seminar will be assessed by the course tutor with common parameters as described by the department.

iii) Mini project

A student can carry out mini project carrying 30 marks either in hardware or software with the approval of the head of the department. The student has to submit a report before the end of the semester. Mini project will be assessed based on the model, presentation and report as decided by the department.

(c). Attendance [10% weightage]:

A maximum of 10 marks for attendance out of 100 marks shall be given to each student depending on his / her attendance percentage as per the distribution given below:

Percentage of Attendance	Marks
75	2
76 – 80	4
81 – 84	6
85 – 90	8
91 and above	10

7.3 Practical Subjects [25 marks]

Every practical exercise / experiment shall be evaluated based on conduct of exercise / experiment and records maintained. There shall be at least one test.

The criteria for determining the internal assessment marks are:

Experiment / Record / Average Practical classes' performance: 50 % Weightage

Practical Test : 40 % Weightage

Attendance : 10 % Weightage

Total 100 marks shall be reduced to 25 Marks.

7.4 Theory Subjects with Laboratory Component

(a). Unit Tests [60% weightage]:

If there is a theory subject with Laboratory component, there shall be three tests; the first two tests (each 60 Marks) will be from theory portions and third test (maximum mark 60) will be for laboratory component. The total 180 marks should be reduced to 60 marks. However a retest at the discretion of the Head of the Department may be conducted for the deserving candidates.

(b). Assignment [30% weightage]:

Two assignments each carrying 15 marks and requiring work of average 5 to 6 hours of study and written work of average 5 to 6 hours shall be given to be carried out by each student in a separate assignment folder, duly indexed with headings, date of submission, marks, remarks and signature of faculty with date etc.

(c). Attendance [10% weightage]:

A maximum of 10 marks for attendance out of 100 marks shall be given to each student depending on his / her attendance 'percentage as per the distribution given below:

Percentage of Attendance	Marks
75	2
76 – 80	4
81 – 84	6
85 – 90	8
91 and above	10

7.5 M.E. Project Work

There shall be a minimum of two reviews for both Phase-I and Phase-II to be conducted separately. The internal and external marks distribution for each phase is given in the table below. The student shall make presentation on the progress made before the review committee. The Head of the Institution/Department shall constitute a review committee for each branch of study.

Project (M.E)	Internal (25 %)		External (75%)	
	Review-I	Review-II	Thesis by External	Viva-voce
Phase-I	25	25	60	90
Phase-II	50	50	120	180

M.B.A/M.C.A. Project Work

There shall be a minimum of two reviews and a model viva-voce for Project Work to be conducted with internal 100 marks and external 300 marks. The student shall make presentation on the progress made before the review committee. The Head of the Institution / Department shall constitute a review committee.

Project work (M.B.A/M.C.A)	Internal (25 %)			External (75%)	
	Review-I	Review-II	Viva-voce	Project Report	Viva-voce
	25	25	50	120	180

8. REQUIREMENTS FOR COMPLETION OF A SEMESTER

A candidate who has fulfilled the following conditions shall be deemed to have satisfied the requirements for completion of a semester.

8.1 A candidate will be permitted to appear for the Examination for any semester, only if

i) he / she secures not less than 75% of attendance in the number of working days during that semester, provided that it shall be open to Chairman of the Academic Council and any authority delegated with such powers (by the governing body) to grant exemption (based on the recommendation of the Head of the Department) to a candidate who has failed to secure 75% of the attendance for valid reasons and has secured not less than 65% of the attendance. Such exemptions can be allowed only ONCE during his/ her entire course of study.

ii) Candidates representing University in State / National/International/Inter University Sports events, Co & Extra - Curricular activities, paper or project presentation with prior permission from the Head of Institution are given exemption up to 10% of the required attendance and such candidates shall be permitted to appear for the current semester examination.

iii) his / her conduct has been certified to be satisfactory by the concerned Head of Department.

iv) Condonation can be allowed only ONCE during his/ her entire course of study.

8.2 Candidates who do not complete the semester (as per clause 8.1), will not be permitted to write the end-semester examination and are not permitted to go to next semester. They are required to repeat the incomplete semester in a subsequent academic year after getting the necessary permission from the authorities.

9. REQUIREMENTS FOR APPEARING FOR SEMESTER EXAMINATION

A candidate shall normally be permitted to appear for the semester examination of the current semester if he/she has satisfied the semester completion requirements (Subject to Clause 8.1) and has registered for examination in all courses of that semester. Registration is mandatory for all arrear subjects along with current semester subjects, failing which the candidate will not be permitted to move to the higher semester.

10. END SEMESTER EXAMINATION

10.1 There shall be one end-semester examination of 3 hours duration for each lecture based course.

10.2 The project report / Thesis / Dissertation of M.E. programme, during Phase I, will be evaluated based on the report and a viva-voce examination by an Internal Examiner and an External Examiner.

10.3 The project work / Thesis / Dissertation of M.E. programme, during Phase II, will be evaluated based on the Project Report and a viva-voce examination by a team consisting of the supervisor / Internal Examiner and an External Examiner for each specialization.

The following will be the weightages for different courses.

Lecture or Lecture cum Tutorial

Internal Assessments	25%
Semester Examination	75%

Laboratory based subjects

Internal Assessments	25%
Semester Examination	75%

Project work

Internal Assessment	25%
Evaluation of Project Report	
by external examiner	30%
Viva- Voce Examination	45%
(by both Internal & External Examiners)	

M.E.Project

(i). For PHASE- I [Maximum Marks: 100]

Internal Assessment:	50 Marks [Guide: 50 %, Committee: 50%]]
Semester Examination:	150 Marks [Evaluation: 60 Marks, Viva-Voce: 90Marks]

(ii). For Phase- II [Maximum Marks: 400]

Internal Assessment:	100 Marks [Guide: 50%, Committee: 50%)
Semester Examination:	300 Marks [Evaluation: 120 Marks, Viva-Voce: 180 Marks)

MBA Project [MaximumMarks:400]

Internal Assessment:	100 Marks

Semester Examination:	300 Marks [Evaluation: 120 Marks, Viva-Voce: 180 Marks)

11. PASSING REQUIREMENTS

11.1. For each subject the examination will be conducted for 100 marks. A candidate who secures not less than 50% at the total marks in the End Semester examination and Internal Assessment put together in both theory and Practical subjects, including Project work, subject to securing a minimum of 50% in the End - Semester examination, wherever applicable, shall be declared to have passed the examination in that subject. When the mark secured for 100 is converted to 75, for a pass minimum 37 marks must be secured.

11.2 If a candidates fails to secure a pass in a particular course it is mandatory that he/she shall register and reappear for the examination in that course during the next semester when examination is conducted in that course; he/she should continue to register and reappear for the examination till he / she secures a pass.

12. MALPRACTICE

If a student indulges in malpractice in any of the end semester examinations, he / she shall be liable for punitive action as and when prescribed by the Anna University.

13. ELIGIBILITY FOR THE AWARD OF THE MASTER'S DEGREE

13.1 A student shall be declared eligible *for* the award *of* the degree if he/she has successfully passed all the subjects as specified by the curriculum corresponding to his / her programme within the stipulated time.
No disciplinary action is pending against him/her.

13.2 The award *of* the degree must have been approved by the University.

14. ISSUE OF MARK SHEETS

Individual mark sheet / grade sheet for each semester will be issued, containing the following information through the Head of the Department concerned, after the publication of the results.

i) The grades obtained in each course.
ii) Whether the candidate has passed / failed in the courses concerned.

15. CLASSIFICATION OF THE DEGREE AWARDED

15.1 A candidate who qualifies for the Degree (vide clause 13) by passing the examination in all subjects of the entire course in first attempt within the specified minimum number of semesters securing a CGPA of not less than 8.5 shall be declared to have passed the examination for the degree in FIRST CLASS WITH DISTINCTION. For this purpose the withdrawal from examination (vide clause 16) will not be construed as an appearance. Further, the authorized break of study (vide clause 17(iii)) will not be counted for the purpose of classification.

15.2 A candidate who qualifies for the award of the Degree (vide clause 13) having passed the examinations in all the subjects of the course within the specified minimum number of semesters reckoned from his/her commencement of study plus one year securing a CGPA of not less than 6.5 shall be declared to have passed the examination for the degree in FIRST CLASS. For this purpose, the authorized break of study (vide clause 17(iii)} will not be counted for the purpose of classification.

15.3 All other candidates (not covered in clauses 15.1 and 15.2) who qualify for the award of the degree (vide Clause 13) shall be declared to have passed the examination in Second Class.

15.4 A candidate who is absent in semester examination in a subject / project work after having enrolled for the same shall be considered to have appeared in that examination for the purpose of classification.

16. PROVISION FOR WITHDRAWAL FROM EXAMINATION

A candidate may, for valid reasons (medically unfit / unexpected family situations), be granted permission to withdraw from appearing for any subject or subjects of only one semester examination during the entire duration of the degree programme. Also only one application for withdrawal is permitted for that semester examination in which withdrawal is sought. Withdrawal application shall be valid only if the candidate is, otherwise, eligible to write the examination and if it is made prior to the commencement of the last examination in that semester and duly recommended by the Head of Department and approved by the Head of the Institution.

Withdrawal shall not be construed as an appearance for the eligibility of a candidate for the purpose of classification vide clause 15.1 and 15.2.

(i) "Withdrawal application is to be made within TEN days prior to the commencement of the examination".
(ii) "Withdrawal is NOT permitted for arrears examinations of the previous semesters".
(iii) Notwithstanding the requirement of mandatory TEN days notice, applications for withdrawal for special cases under extraordinary conditions will be considered on the merit of the case.

17. AUTHORIZED BREAK OF STUDY FROM A PROGRAMME

i) Break of study shall be granted only once for valid reasons (on medical grounds only) for a maximum of one year during the entire period of study of the degree programme. However, in extraordinary situation the candidate may apply for additional break of study not exceeding another one year by paying prescribed fee for break of study. If a candidate intends to temporarily discontinue the programme In the middle of the semester for valid reasons and rejoin the programme in a later semester, permission may be granted based on the merits of the case provided he / she applies to the Head of the Institution with recommendation from the concerned HOD in advance, but not later than the last date for registering for the end semester examination of the semester in question, through the Head of Department stating the reasons therefore and the probable date of rejoining the programme .

ii) However, if the candidate. has not completed the first semester of the programme, break of study will be considered only on valid medical reasons. The candidate permitted to rejoin the programme after the break shall be governed by the rules and regulations in force at the time of rejoining. Such candidates may have to do additional courses prescribed by the Academic Council, if the regulation is changed.

iii) The authorized break of study will not be counted for the duration specified for passing all the courses for the purpose of classification vide Clause 15.1 and 15.2.

iv) The total period for completion of the programme reckoned from, the commencement of the first semester to which the candidate was admitted shall not exceed the maximum period specified in clause 3 irrespective of the period of break of study in order that he / she may be eligible for the award of the degree (vide clause 13).

v) If any student is detained for want of requisite attendance, progress and good conduct, the period spent in that semester shall not be considered as permitted 'Break of Study' and Clause 17(iii)is not applicable for this case.

18. REVALUATION

Copies of answer script for theory subject(s) can be obtained from the Office of the Controller of Examinations on payment of a prescribed fee specified for this purpose through proper application.

A candidate can apply for revaluation of his / her semester examination answer paper in a theory course, within a week from the declaration of results, on payment of a prescribed fee through proper application to the Office of the Controller of Examinations, as per the norms given by the Chairman, Academic Council. Revaluation is not permitted for Practical Courses and Project work.

19. RANK OF A STUDENT

A candidate who qualifies for the Degree by passing the examination in all subjects of the entire course in first attempt within a period of two consecutive academic years from the date of admission to the course can be given his position in the class as rank. The Rank is determined from I Semester to IV Semester examination mark percentages.

20. PROCEDURE FOR USING SCRIBER

If a candidate is physically handicapped (in case of accidents / ill health) at the time of examination, then he / she may be permitted to use a scriber to write the examination. In such case 30 minutes extra time will be permitted. The Scriber should be a non-engineering student / graduate.

21. INDUSTRIAL VISIT

Every student is required to undergo one Industrial visit, starting f*rom* the first semester of the Programme. Every teacher shall take the students at least for one industrial visit in a year.

22. DISCIPLINE

Every student is required to observe disciplined and decorous behavior both inside and outside the college and not to indulge in any activity which will tend to bring down the prestige of the College. In the event an act of indiscipline being reported, the Principal shall constitute a disciplinary committee consisting of three Heads of Departments of which one should be from the faculty of the student, to inquire into acts of discipline. The disciplinary action is subject to review by the University in case the student represents to the University. Any expulsion of the student from the college shall be with prior concurrence from Directorate of Technical Education / University.

23. CREDIT SYSTEM

The letter grade and the grade point are awarded based on percentage of marks secured by a candidate in individual subjects as detailed below:

Range of Total Marks	Letter Grade	Grade Points (GP)
90 to 100	S	10
80 to 89	A	9
70 to 79	B	8
60 to 69	C	7
55 to 59	D	6
50 to 54	E	5
0 to 49	U	0
Incomplete	I	0
Withdrawal	W	0

Absent	AB	0

"U" - denotes failure in the course.

"I" - denotes incomplete as per clause 8.1 and hence prevention from writing End Semester Examination.

"W" - denotes withdrawal from the subject.

"RA" - Reappearance denotes failure in the course.

"AB" - Absent

After results are declared, Consolidated Mark sheets will be issued to each student which will contain the following details:

The list of subjects enrolled during the semester and the grades scored. The Grade Point Average (GPA) for the semester and the Cumulative Grade Point Average (CGPA) of all courses enrolled from first semester onwards.

GPA is the ratio of the sum of the products of the number of credits of courses registered and the points corresponding to the grades scored in those subjects, taken for all the subjects, to the sum of the number of credits of all the subjects in the semester.

$$GPA = \frac{\text{Sum of } [\ C \times GP\ ]}{\text{Sum of } C}$$

Where, C - credit of a particular subject &

GP - grade point obtained by the student in the respective subjects.

CGPA will be calculated in a similar manner, considering all the subjects enrolled from first semester. 'U", "I", "W' and "AB" grades will be excluded for calculating GPA and CGPA. Each subject is normally assigned certain number of credits with 1 credit per lecture period per week, 1 credit per tutorial period per week, 1 credit for 2 periods of laboratory or practical or seminar or project work per week (2 credits for 3 or 4 periods of practical). However, the performance of a student is evaluated only based on the mark system.

24. REVISION OF REGULATIONS AND CURRICULAM

The college may from time to time revise, amend or change the regulations, scheme of examinations and syllabi, if found necessary.

---------- End ----------

REGULATION – 2012
M.E. POWER ELECTRONICS AND DRIVES
CURRICULUM 1st TO 4th SEMESTER

S.No	Subject Code	Course Title	Internal Marks	Final Exam Marks	Total Marks	Hrs & Credits			
						L	T	P	C
SEMESTER I									
Theory									
1	12PE11	Applied Mathematics for Electrical Engineers	25	75	100	3	1	0	4
2	12PE12	Modeling and Analysis of Electrical Machines	25	75	100	3	1	0	4
3	12PE13	Analysis and Design of Power Converters	25	75	100	3	1	0	4
4	12PE14	Analysis of Inverters	25	75	100	3	0	0	3
5	12PE15	System Theory	25	75	100	3	1	0	4
6	E1	Elective – I	25	75	100	3	0	0	3
Total					600	18	4	0	22

S.No	Subject Code	Course Title	Internal Marks	Final Exam Marks	Total Marks	Hrs & Credits			
						L	T	P	C
SEMESTER II									
Theory									
1	12PE21	Solid State DC Drives	25	75	100	3	0	0	3
2	12PE22	Solid State AC Drives	25	75	100	3	0	0	3
3	12PE23	Special Electrical Machines	25	75	100	3	1	0	4
4	12PE24	Microcontroller & DSP Based System Design	25	75	100	3	0	0	3
5	E2	Elective – II	25	75	100	3	0	0	3
6	E3	Elective – III	25	75	100	3	0	0	3
Practical									
7	12PE25	Power Electronics and Drives Lab	25	75	100	0	0	3	2
Total					700	18	1	3	21

S.No	Subject Code	Course Title	Internal Marks	Final Exam Marks	Total Marks	Hrs & Credits			
						L	T	P	C
SEMESTER III									
Theory									
1	E4	Elective – IV	25	75	100	3	0	0	3
2	E5	Elective – V	25	75	100	3	0	0	3
3	E6	Elective – VI	25	75	100	3	0	0	3
Practicals									
4	12PE36	Project – (Phase I)	50	150	200	0	0	12	6
Total					500	9	0	12	15

S.No	Subject Code	Course Title	Internal Marks	Final Exam Marks	Total Marks	Hrs & Credits			
						L	T	P	C
SEMESTER IV									
1	12PE41	Project – (Phase II)	100	300	400	0	0	24	12

TOTAL CREDITS TO BE EARNED FOR THE AWARD OF DEGREE = 70

LIST OF ELECTIVES

SEMESTER I

S.No	Subject Code	COURSE TITLE	Internal Marks	Final Exam Marks	Total Marks	Hrs & Credits			
						L	T	P	C
1.	12PE1A	Advanced Power Semi-conductor Devices	25	75	100	3	0	0	3
2.	12PE1B	Control System design	25	75	100	3	0	0	3
3.	12PE1C	Electromagnetic Field Computation and Modeling	25	75	100	3	0	0	3
4.	12PE1D	Digital Instrumentation	25	75	100	3	0	0	3

SEMESTER II

S.No	Subject Code	COURSE TITLE	Internal Marks	Final Exam Marks	Total Marks	Hrs & Credits			
						L	T	P	C
1.	12PE2A	Flexible AC Transmission Systems	25	75	100	3	0	0	3
2.	12PE2B	Power Quality	25	75	100	3	0	0	3
3.	12PE2C	Computer Aided Design of Power Electronics Circuits	25	75	100	3	0	0	3
4.	12PE2D	Power Electronics in Power System	25	75	100	3	0	0	3
5.	12PE2E	Computer Aided Design of Instrumentation Systems	25	75	100	3	0	0	3
6.	12PE2F	Pulse Width Modulation for Power Converters	25	75	100	3	0	0	3
7.	12PE2G	Computer Network Engineering	25	75	100	3	0	0	3
8.	12PE2H	Programmable Logic Controllers	25	75	100	3	0	0	3

SEMESTER III

S.No	Subject Code	COURSE TITLE	Internal Marks	Final Exam Marks	Total Marks	Hrs & Credits			
						L	T	P	C
1	12PE3A	VLSI System Design	25	75	100	3	0	0	3
2	12PE3B	Wind Energy Conversion Systems	25	75	100	3	0	0	3
3	12PE3C	High Voltage Direct Current Transmission	25	75	100	3	0	0	3
4	12PE3D	Power Electronics for Renewable Energy Systems	25	75	100	3	0	0	3
5	12PE3E	Smart Grid	25	75	100	3	0	0	3
6	12PE3F	Programming with VHDL	25	75	100	3	0	0	3
7	12PE3G	System Identification And Adaptive Control	25	75	100	3	0	0	3
8	12PE3H	Applications of MEMS Technology	25	75	100	3	0	0	3
9	12PE3I	Modern Rectifiers and resonant Converters	25	75	100	3	0	0	3
10	12PE3J	Soft Computing Techniques	25	75	100	3	0	0	3
11	12PE3K	Protection For Electrical Drives	25	75	100	3	0	0	3
12	12PE3L	Evolutionary Computation	25	75	100	3	0	0	3

12PE11 APPLIED MATHEMATICS FOR ELECTRICAL ENGINEERS **L T P C 3 1 0 4**

AIM

To equip the students with knowledge of advanced mathematical techniques required for the analytical study of the technical subjects under Power Electronics.

OBJECTIVES

- To study about the matrix theory used in electrical engineering.
- To study the one dimensional random variables and queuing models.
- To study the various computational methods.

UNIT I ADVANCED MATRIX THEORY 12

Eigen-values using QR transformations – Generalized eigen vectors – Canonical forms – Singular value decomposition and applications – Pseudo inverse – Least square approximations.

UNIT II LINEAR PROGRAMMING 12

Formulation – Graphical Solution – Simplex Method – Two Phase Method – Transportation and Assignment Problems.

UNIT III ONE DIMENSIONAL RANDOM VARIABLES 12

Random variables - Probability function – moments – moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a Random Variable.

UNIT IV QUEUING MODELS 12

Poisson Process – Markovian queues – Single and Multi Serve r Models – Little's formula – Machine Interference Model – Steady State analysis – Self Service queue.

UNIT V COMPUTATIONAL METHODS IN ENGINEERING 12

Boundary value problems for ODE – Finite difference methods – Numerical solution of PDE – Solution of Laplace 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: 60 PERIODS

REFERENCE BOOKS

1. Bronson, R., Matrix Operation, Schaum's outline series, McGraw Hill, New York, 1989.
2. Taha, H. A., Operations Research: An Introduction, 7th Edition, Pearson Education Asia, New Delhi (2002).
3. R. E. Walpole, R. H. Myers, S. L. Myers, and K. Ye, Probability and Statistics for Engineers & Scientists, Asia, 8th Edition, 2007.
4. Donald Gross and Carl M. Harris, Fundamentals of Queueing theory, 2nd Edition, John Wiley and Sons, New York (1985).
5. Grewal, B.S., Numerical methods in Engineering and Science, 7th Edition, Khanna Publishers, 2007

12PE12 MODELING AND ANALYSIS OF ELECTRICAL MACHINES **L T P C 3 1 0 4**

AIM

To provide a framework of techniques for analysis and simulation of performance of electrical machines**.**

OBJECTIVES

- To analyze the various types of machines and model with different transformation techniques.
- To study the special machines and its model.

UNIT I PRINCIPLES OF ELECTROMAGNETIC ENERGY CONVERSION 12

General expression of stored magnetic energy, co-energy and force/ torque – example using single and doubly excited system –Calculation of air gap mmf and per phase machine inductance using physical machine data.

UNIT II REFERENCE FRAME THEORY 12

Static and rotating reference frames – transformation of variables – reference frames – transformation between reference frames – transformation of a balanced set –balanced steady state phasor and voltage equations – variables observed from several frames of reference.

UNIT III DC MACHINES 12

Voltage and torque equations – dynamic characteristics of permanent magnet and shunt DC motors – state equations - solution of dynamic characteristic by Laplace transformation.

UNIT IV INDUCTION MACHINES 12

Voltage and torque equations – transformation for rotor circuits – voltage and torque equations in reference frame variables – analysis of steady state operation – free acceleration characteristics – dynamic performance for load and torque variations – dynamic performance for three phase fault – computer simulation in arbitrary reference frame.

UNIT V SYNCHRONOUS MACHINES 12

Voltage and Torque Equation – voltage Equation in arbitrary reference frame and rotor reference frame – Park equations - rotor angle and angle between rotor – steady state analysis – dynamic performances for torque variations- dynamic performance for three phase fault – transient stability limit – critical clearing time – computer simulation.

TOTAL: 60 PERIODS

REFERENCE BOOKS

1. Paul C.Krause, OlegWasyzczuk, Scott S, Sudhoff, "Analysis of Electric Machinery and Drive Systems", IEEE Press, 2nd Edition.
2. R.Krishnan, "Electric Motor Drives, Modeling, Analysis and Control", Prentice Hall of India, 2002.
3. Samuel Seely, "Electromechanical Energy Conversion", Tata McGraw Hill Publishing Company.
4. A.E, Fitzgerald, Charles Kingsley, Jr, and Stephan D, Umanx, " Electric Machinery", TatMcGraw Hill, 6th Edition, 2002.

12PE13 ANALYSIS AND DESIGN OF POWER CONVERTERS L T P C

3 1 0 4

AIM

The subject deals with the semiconductor switches, their applications in various conversions of power.

OBJECTIVES

- To obtain the switching characteristic of different types of power semi-conductor devices.
- To determine the operation, characteristics and performance parameters of controlled rectifiers.
- To apply switching techniques and basic topologies of DC-DC switching regulators.

UNIT I SINGLE PHASE AC-DC CONVERTER 12

Static Characteristics of power diode, SCR and GTO, half controlled and fully controlled converters with R-L, R-L-E loads and freewheeling diodes – continuous and discontinuous modes of operation - inverter operation –Sequence control of converters – performance parameters: harmonics, ripple, distortion, power factor – effect of source impedance and overlap-reactive power and power balance in converter circuits

UNIT II THREE PHASE AC-DC CONVERTER 12

Semi and fully controlled converter with R, R-L, R-L-E - loads and freewheeling diodes – inverter operation and its limit – performance parameters – effect of source impedance and over lap – 12 pulse converter.

UNIT III DC-DC CONVERTERS 12

Principles of step-down and step-up converters – Analysis of buck, boost, buck-boost and Cuk converters – time ratio and current limit control – Full bridge converter – Resonant and quasi – resonant converter

UNIT IV AC VOLTAGE CONTROLLERS 12

Static Characteristics of TRIAC- Principle of phase control: single phase and three phase controllers – various configurations – analysis with R and R-L loads.

UNIT V CYCLOCONVERTERS 12

Principle of operation – Single phase and Three-phase Dual converters - Single phase and three phase cyclo-converters – power factor Control – Introduction to matrix converters.

TOTAL: 60 PERIODS

REFERENCE BOOKS

1. Ned Mohan, T.M Undeland and W.P Robbin, “Power Electronics: converters, Application and design” John Wiley and sons. Wiley India edition, 2006.
2. Rashid M.H., “Power Electronics Circuits, Devices and Applications ", Prentice Hall of India, New Delhi, 2004.
3. Cyril W.Lander, “Power Electronics”, Third Edition McGraw hill-1993
4. P.C Sen.," Modern Power Electronics ", Wheeler publishing Co, First Edition, New Delhi-1998.
5. P.S.Bimbra, “Power Electronics”, Khanna Publishers, Eleventh Edition, 2003.
6. Power Electronics by Vedam Subramanyam, New Age International publishers, New Delhi Second Edition, 2006

12PE14 ANALYSIS OF INVERTERS L T P C

3 0 0 3

AIM

To analyse the structure and functioning of inverter circuits

OBJECTIVES

- To design and analyze the different types of inverters.
- To study the working of advanced types of inverters such as multilevel inverters and resonant inverters.
- Apply switching techniques and basic topologies of DC-AC converters

UNIT I SINGLE PHASE INVERTERS 9

Introduction to self commutated switches : MOSFET and IGBT - Principle of operation of half and full bridge inverters – Performance parameters – Voltage control of single phase inverters using various PWM techniques – various harmonic elimination techniques – forced commutated Thyristor inverters.

UNIT II THREE PHASE VOLTAGE SOURCE INVERTERS 9

180 degree and 120 degree conduction mode inverters with star and delta connected loads – voltage control of three phase inverters: single, multi pulse, sinusoidal, space vector modulation techniques.

UNIT III CURRENT SOURCE INVERTERS 9

Operation of six-step thyristor inverter – inverter operation modes – load – commutated inverters – Auto sequential current source inverter (ASCI) – current pulsations – comparison of current source inverter and voltage source inverters

UNIT IV MULTILEVEL INVERTERS 9

Multilevel concept – diode clamped – flying capacitor – cascade type multilevel inverters - Comparison of multilevel inverters - application of multilevel inverters

UNIT V RESONANT INVERTERS 9

Series and parallel resonant inverters - voltage control of resonant inverters – Class E resonant inverter – resonant DC – link inverters.

TOTAL: 45 PERIODS

REFERENCE BOOKS

1. Rashid M.H., "Power Electronics Circuits, Devices and Applications ", Prentice Hall India,3rd Edition, New Delhi, 2004.
2. Jai P.Agrawal, "Power Electronics Systems", Pearson Education, 2nd Edition, 2002.
3. Bimal K.Bose "Modern Power Electronics and AC Drives", Pearson Education, 2nd Edition, 2003.
4. Ned Mohan, Undeland and Robbin, "Power Electronics: converters, Application and design" John Wiley and sons.Inc, Newyork, 1995.
5. Philip T. krein, "Elements of Power Electronics" Oxford University Press -1998.
6. P.C. Sen, "Modern Power Electronics", Wheeler Publishing Co,1st Edition, New Delhi, 1998.
7. P.S.Bimbra, "Power Electronics", Khanna Publishers, 11th Edition, 2003.

12PE15 SYSTEM THEORY

L	T	P	C
3	1	0	4

AIM

To provide an insight theory on linear and non linear control systems

OBJECTIVES

- To enable the students to have a fair knowledge about the use of mathematical techniques in control system.
- To learn the concepts of state variable techniques, non-linear systems and basics of optimal and adaptive control.
- To study the observability and controllability of feedback system.

UNIT I PHYSICAL SYSTEMS AND STATE ASSIGNMENT 12

Systems - Electrical - Mechanical – Hydraulic – Pneumatic – Thermal systems – Modelling of some typical systems like DC Machines - Inverted Pendulum

UNIT II STATE SPACE ANALYSIS 12

Realization of state models: minimal realization – balanced realization – solution of state equations: – state transition matrix - its properties - free - forced responses – properties - controllability – observability - stabilizability – detectability.

UNIT III NON-LINEAR SYSTEMS 12

Types of non-linearity – Typical examples – Equivalent linearization - Phase plane analysis – Limit cycles – Describing functions- Analysis using Describing functions- Jump resonance

UNIT IV STABILITY 12

Stability concepts – equilibrium points – BIBO and asymptotic stability – direct method of Liapunov – application to non-linear problems – frequency domain stability criteria – Popov's method and its extensions.

UNIT V CONTROLLER SYNTHESIS FOR NON-LINEAR SYSTEMS 12

Linear design and non-linear verification – Non-linear internal model control – Parameter optimization – Model predictive controller – Optimal controller – State feedback and observers.

TOTAL: 60 PERIODS

REFERENCE BOOKS

1. M. Gopal, "Modern Control System Theory", New Age International, 2nd edition 2009.
2. Bay.J.S., Linear State Space Systems, McGraw-Hill, 1999.
3. M. Chidambaram, "Computer Control of Process", Alpha Science International, Ltd., 2002.
4. Chi-Tsong Chen, "Linear System Theory and Design", 3rd edition, Oxford University Press, 1999.
5. K. Ogatta, "Modern Control Engineering", Pearson Education Asia, Low Priced Edition,1997.
6. Glad.T.,Ljung.L., Control Theory – Multivariable and Non-linear methods, Taylor and Francis, London and NY.
7. G. J. Thaler, "Automatic Control Systems", Jaico publishers, 1993.

12PE21 SOLID STATE DC DRIVES L T P C
3 0 0 3

AIM

To study and understand the operation of electric drives controlled from a power electronic Converter and to introduce the design concepts of controllers

OBJECTIVES

- To understand the stable steady-state operation and transient dynamics of a motor-load system.
- To analyze the operation of the converter / chopper fed direct current drive.
- To analyze the closed loop control and digital control of direct current drives.
- To design the current and speed controllers for a closed loop solid-state direct current motor drives.

UNIT I DC MOTORS FUNDAMENTALS AND MECHANICAL SYSTEMS 9

DC motor- Types, induced emf, speed-torque relations; Speed control – Armature and field speed control; Ward Leonard control – Constant torque and constant horse power operation - Introduction to high speed drives and modern drives.Characteristics of mechanical system – dynamic equations, components of torque, types of load; Requirements of drives characteristics – multi-quadrant operation; Drive elements, types of motor duty and selection of motor rating.

UNIT II CONVERTER CONTROL 9

Principle of phase control – Fundamental relations; Analysis of series and separately excited DC motor with single-phase and three-phase converters – waveforms, performance parameters, performance characteristics.Continuous and discontinuous armature current operations; Current ripple and its effect on performance; Operation with free wheeling diode; Implementation of braking schemes; Drive employing dual converter.

UNIT III CHOPPER CONTROL 9

Introduction to time ratio control and frequency modulation; Class A, B, C, D and E chopper controlled DC motor – performance analysis, multi-quadrant control - Chopper based implementation of braking schemes; Multi-phase chopper; Related problems.

UNIT IV CLOSED LOOP CONTROL 9

Modeling of drive elements – Equivalent circuit, transfer function of self, separately excited DC motors; Linear Transfer function model of power converters; Sensing and feeds back elements - Closed loop speed control – current and speed loops, P, PI and PID controllers – response comparison. Simulation of converter and chopper fed d.c drive.

UNIT V DIGITAL CONTROL OF DC DRIVE 9

Phase Locked Loop and micro-computer control of DC drives – Program flow chart for constant horse power and load disturbed operations; Speed detection and gate firing.

TOTAL: 45 PERIODS

REFERENCE BOOKS

1. Gopal K Dubey, "Power Semiconductor controlled Drives", Prentice Hall Inc., New Yersy, 1989.
2. P.C Sen "Principles of Electrical Machines and Power Electronics" 2nd Edition, John wiley and sons., New York, 1997.
3. R.Krishnan, "Electric Motor Drives – Modeling, Analysis and Control", Prentice-Hall of India Pvt. Ltd., New Delhi, 2003.
4. Gobal K.Dubey, "Fundamentals of Electrical Drives", Narosal Publishing House, New Delhi, 2001.
5. Bimal K.Bose "Modern Power Electronics and AC Drives", Pearson Education (Singapore) Pte. Ltd., New Delhi, 2003.
6. Vedam Subramanyam, "Electric Drives – Concepts and Applications", Tata McGraw-Hill publishing company Ltd., New Delhi, 2nd Edition, 2010.
7. S.K. Pillai "Fundamental Of Electrical Drives "New Age publications., New Delhi, 2nd Edition, Reprint 2004.

12PE22 SOLID STATE AC DRIVES L T P C

3 0 0 3

AIM

To study and understand the operation of both conventional speed control and power electronic control of AC motors.

OBJECTIVES

- To study the principle of modern control techniques for AC drives.
- To understand the torque control, field oriented control and flux vector estimation of induction motor
- To learn the synchronous motor control using brush and brushless excitation.
- To understand the load commutated inverter fed drives

UNIT I INTRODUCTION TO INDUCTION MOTORS 9

Steady state performance equations – Rotating magnetic field – torque production, Equivalent circuit– Variable voltage, constant frequency operation – Variable frequency operation, constant Volt/Hz operation. Drive operating regions, variable stator current operation, different braking methods.

UNIT II VSI AND CSI FED INDUCTION MOTOR CONTROL 9

AC voltage controller circuit – six step inverter voltage control-closed loop variable frequency PWM inverter with dynamic braking-CSI fed IM variable frequency drives comparison

UNIT III ROTOR CONTROLLED INDUCTION MOTOR DRIVES 9

Static rotor resistance control - injection of voltage in the rotor circuit – static scherbius drives - power factor considerations – modified Kramer drives

UNIT IV FIELD ORIENTED CONTROL 9

Field oriented control of induction machines – Theory – DC drive analogy – Direct and Indirect methods – Flux vector estimation.

UNIT V DIRECT TORQUE CONTROL 9

Direct torque control of Induction Machines – Torque expression with stator and rotor fluxes, DTC control strategy

TOTAL: 45 PERIODS

REFERENCE BOOKS

1. Bimal K Bose, "Modern Power Electronics and AC Drives", Pearson Education Asia 2002.
2. Vedam Subramanyam, "Electric Drives – Concepts and Applications", Tata McGraw Hill, 2nd Edition, 2010.
3. Gopal K Dubey, "Power Semiconductor controlled Drives", Prentice Hall Inc., New Yersy, 1989.
4. R.Krishnan, "Electric Motor Drives – Modeling, Analysis and Control", Prentice-Hall of India Pvt. Ltd., New Delhi, 2003.
5. W.Leonhard, "Control of Electrical Drives", Narosa Publishing House, 1992.
6. Murphy J.M.D and Turnbull, "Thyristor Control of AC Motors", Pergamon Press, Oxford, 1988.
7. S.K. Pillai "Fundamental Of Electrical Drives "New Age publications., New Delhi, 2nd Edition, Reprint 2004.

12PE23 SPECIAL ELECTRICAL MACHINES L T P C
3 1 0 4

AIM

To expose the students to the principle of operation,control and performance of various major special electrical machines.

OBJECTIVES

- To impart knowledge on special electrical machines like stepper motors,switched reluctance motors and permanent magnet machines.
- To study the speed torque characteristics of various machines.
- To study the different types of control techniques for all types of machines.

UNIT I SYNCHRONOUS RELUCTANCE MOTORS 12

Constructional features: axial and radial air gap Motors. Operating principle, reluctance torque – phasor diagram, motor characteristics – Linear induction machines.

UNIT II STEPPING MOTORS 12

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

UNIT III SWITCHED RELUCTANCE MOTORS 12

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

UNIT IV PERMANENT MAGNET SYNCHRONOUS MOTORS 12

Principle of operation, EMF, power input and torque expressions, Phasor diagram, Power controllers, Torque speed characteristics, Self control, Vector control, Current control schemes.

UNIT V PERMANENT MAGNET BRUSHLESS DC MOTORS 12

Commutation in DC motors, Difference between mechanical and electronic commutators, Hall sensors, Optical sensors, Multiphase Brushless motor, Square wave permanent magnet brushless motor drives, Torque and emf equation, Torque-speed characteristics, Controllers-Microprocessor based controller.

TOTAL: 60 PERIODS

REFERENCE BOOKS

1. Miller, T.J.E. "Brushless permanent magnet and reluctance motor drives ", Clarendon Press, Oxford, 1989.
2. Kenjo, T, "Stepping motors and their microprocessor control ", Clarendon Press, Oxford, 1989.
3. LIM Kenjo, T and Naganori, S "Permanent Magnet and brushless DC motors ", Clarendon Press, Oxford, 1989.
4. Kenjo, T. Power Electronics for the microprocessor Age, 1989.
5. B.K. Bose, "Modern Power Electronics & AC drives" Pearson Education Asia 2002.
6. R.Krishnan, "Electric Motor Drives – Modeling, Analysis and Control", Prentice-Hall of India Pvt. Ltd., New Delhi, 2003.
7. Venkatrathinam, "Special Electrical machines", University Press 2008.

12PE24 MICROCONTROLLER AND DSP BASED SYSTEM DESIGN

L	T	P	C
3	0	0	3

AIM

To familiarize students with microcontroller and modern digital processing techniques

OBJECTIVES

- To understand the operation and applications of microcontrollers.
- To learn the addressing modes,instruction sets of PIC microcontroller and DSP controller.
- To write simple programs using PIC microcontroller and DSP based controller.

UNIT I PIC 16C7X MICROCONTROLLER 9

Architecture memory organization – Addressing modes – Instruction set – Programming techniques – simple programs

UNIT II PERIPHERALS OF PIC 16C7X 9

Timers – interrupts – I/O ports – I^2C bus for peripheral chip access – A/D converter – UART

UNIT III MOTOR CONTROL SIGNAL PROCESSORS 9

Introduction- System configuration registers - Memory Addressing modes - Instruction set – Programming techniques – simple programs

UNIT IV PERIPHERALS OF SIGNAL PROCESSORS 9

General purpose Input/Output (GPIO) Functionality- Interrupts - A/D converter-Event Managers (EVA, EVB)- PWM signal generation

UNIT V APPLICATIONS OF PIC AND SIGNAL PROCESSORS 9

Voltage regulation of DC-DC converters- Stepper motor and DC motor control- Clarke's and parks transformation-Space vector PWM- Control of Induction Motors

TOTAL: 45 PERIODS

REFERENCE BOOKS

1. John B.Peatman , 'Design with PIC Microcontrollers,' Pearson Education, Asia 2004.
2. Hamid A.Toliyat, Steven Campbell, 'DSP based electromechanical motion control', CRC Press 2005.
3. Lucio Di Jasio,Tim Wilmshurst, "PIC Microcontrollers", Newnes publications 2008.

12PE25 POWER ELECTONICS & DRIVES LAB

L	T	P	C
0	0	3	2

LIST OF EXPERIMENTS

1. Micro controller based speed control of Converter/Chopper fed DC motor.
2. Micro controller based speed control of VSI fed three-phase induction motor.
3. Micro controller based speed control of Stepper motor.
4. DSP based speed control of BLDC motor.
5. DSP based speed control of SRM motor.
6. Self control operation of Synchronous motors.
7. Condition monitoring of three-phase induction motor under fault conditions.
8. Re-programmable Logic Devices and Programming

(a) VHDL programming – Examples

(b) Verilog HDL programming – Examples

(c) Realization of control logic for electric motors using FPGA.

9. Simulation of Four quadrant operation of three-phase induction motor.
10. Simulation of Automatic Voltage Regulation of three-phase Synchronous Generator.
11. Design of switched mode power supplies.
12. Mathematical modeling and simulation of DC-DC Chopper

TOTAL= 45 PERIODS

ELECTIVES

SEMESTER I

12PE1A ADVANCED POWER SEMICONDUCTOR DEVICES

L	T	P	C
3	0	0	3

AIM

To study the analysis and design of modern power semiconductor devices.

OBJECTIVES

- To study the internal structure and the switching and operating characteristics of the basic power devices.
- To design the parameters of power semiconductor devices.
- To understand the concepts of protection and control circuits.

UNIT I INTRODUCTION **9**

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 – EMI due to switching - Power diodes - Types, forward and reverse characteristics, switching characteristics – rating.

UNIT II CURRENT CONTROLLED DEVICES **9**

BJT's – Construction, static characteristics, switching characteristics; Negative temperature co-efficient and secondary breakdown; Power darlington - 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.

UNIT 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.

UNIT IV FIRING AND PROTECTING CIRCUITS 9

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.

UNIT V THERMAL PROTECTION 9

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: 45 PERIODS

REFERENCE BOOKS

1. B.W. Williams, Power Electronics: Devices, Drivers and Applications, John Wiley & Sons, NY; 1987.
2. Rashid M.H., "Power Electronics Circuits, Devices and Applications ", Prentice Hall India, Third Edition, New Delhi, 2004.
3. MD Singh and K.B Khanchandani, "Power Electronics", Tata McGraw Hill,2nd Edition 2006.
4. Mohan, Undcland and Robins, "Power Electronics – Concepts, applications and Design, John Wiley and Sons, Singapore, 2000.

12PE1B CONTROL SYSTEM DESIGN L T P C

3 0 0 3

AIM

To know about the conventional design methods, optimal control and state estimation for various systems.

OBJECTIVES

- To make the students to know about conventional design methods of various systems
- To design a system in discrete domain
- To know about optimal control of systems.
- To know about discrete state variable design and state optimization technique.

UNIT I CONVENTIONAL DESIGN METHODS 9

Design specifications- PID controllers and compensators- Root locus based design- Bode based design-Design examples

UNIT II DESIGN IN DISCRETE DOMAIN 9

Sample and Hold-Digital equivalents-Impulse and step invariant transformations-Methods of discretisation-Effect of sampling- Direct discrete design – discrete root locus
Design examples

UNIT III OPTIMAL CONTROL 9

Formation of optimal control problems-results of Calculus of variations- Hamiltonian formulation-solution of optimal control problems- Evaluation of Riccati's equation State and output Regulator problems-Design examples

UNIT IV DISCRETE STATE VARIABLE DESIGN 9

Discrete pole placement- state and output feedback-estimated state feedback-discrete optimal control-dynamic programming-Design examples

UNIT V STATE ESTIMATION 9

State Estimation Problem -State estimation- Luenberger's observer-noise characteristics- Kalman-

Bucy filter-Separation Theorem-Controller Design-Wiener filter-Design examples.

TOTAL: 45 PERIODS

REFERENCE BOOKS

1. M. Gopal "Modern control system Theory" New Age International, 2nd Edition,2008.
2. Benjamin C. Kuo "Digital control systems", Oxford University Press, 2004.
3. G. F. Franklin, J. D. Powell and A. E. Naeini "Feedback Control of Dynamic Systems", PHI (Pearson), 2002.
4. Graham C. Goodwin, Stefan F. Graebe and Mario E. Salgado "Control system Design", PHI (Pearson), 2003.
5. G. F. Franklin, J. D. Powell and M Workman, "Digital Control of Dynamic Systems", PHI (Pearson), 2002.
6. B.D.O. Anderson and J.B. Moore., 'Optimal Filtering', prentice hall Inc., N.J., 1979.
7. Loan D. Landau, Gianluca Zito," Digital Control Systems, Design, Identification and Implementation", Springer, 2006.

12PE1C ELECTROMAGNETIC FIELD COMPUTATION AND MODELLING

L	T	P	C
3	0	0	3

AIM

To acquaint the students with the knowledge of basic electromagnetic field equations and their solutions, design and compute electromagnetic field for basic configurations and design applications

OBJECTIVES

- To study the basic field theory and field equations
- To obtain the solution for field equations by analytical and numerical methods and by FEM technique
- To compute the electric and magnetic field intensities for basic configurations
- To design the electromagnetic field for devices used in electrical applications

UNIT I INTRODUCTION **9**

Review of basic field theory – electric and magnetic fields – Maxwell's equations – Laplace, Poisson and Helmoltz equations – principle of energy conversion – force/torque calculation – Electro thermal formulation.

UNIT II SOLUTION OF FIELD EQUATIONS I **9**

Limitations of the conventional design procedure, need for the field analysis based design, problem definition , solution by analytical methods-direct integration method – variable separable method – method of images, solution by numerical methods- Finite Difference Method.

UNIT III SOLUTION OF FIELD EQUATIONS II **9**

Finite element method (FEM) – Differential/ integral functions – Variational method – Energy minimization – Discretisation – Shape functions –Stiffness matrix –1D and 2D planar and axial symmetry problem.

UNIT IV FIELD COMPUTATION FOR BASIC CONFIGURATIONS **9**

Computation of electric and magnetic field intensities– Capacitance and Inductance – Force, Torque, Energy for basic configurations.

UNIT V DESIGN APPLICATIONS **9**

Insulators- Bushings – Cylindrical magnetic actuators – Transformers – Rotating machines.

TOTAL: 45 PERIODS

REFERENCE BOOKS

1. K.J.Binns, P.J.Lawrenson, C.W Trowbridge, "The analytical and numerical solution of Electric

and magnetic fields", John Wiley & Sons, 1993.
2. Nathan Ida, Joao P.A.Bastos , "Electromagnetics and calculation of fields", Springer-Verlage, 1992.
3. Nicola Biyanchi , "Electrical Machine analysis using Finite Elements", Taylor and Francis Group, CRC Publishers, 2005.
4. S.J Salon, "Finite Element Analysis of Electrical Machines." Kluwer Academic Publishers, London, 1995, distributed by TBH Publishers & Distributors, Chennai, India.
5. User manuals of MAGNET, MAXWELL & ANSYS software.
6. Silvester and Ferrari, "Finite Elements for Electrical Engineers" Cambridge University press, 1983.

12PE1D DIGITAL INSTRUMENTATION L T P C
3 0 0 3

AIM

To learn the concept of digital principles, digital Instrumentation setup to measure various parameters and the recent trends in digital instrumentation

OBJECTIVES

- To assemble the knowledge of memory devices and concepts of data sampling
- To discern various methods of digital measurement techniques
- To gather the knowledge about digital display and recording devices
- To make the students to possess the knowledge of various electronic devices used in communication and also about recent trends in digital instrumentation.

UNIT I INTRODUCTION 9

Digital codes – Memory devices – Basic building blocks – Gates, FF and counters – Discrete data handling – Sampling – Sampling theorem – Aliasing errors – Reconstruction – Extrapolation – Synchronous and asynchronous sampling.

UNIT II DIGITAL METHODS OF MEASUREMENTS 9

Review of A/D, D/A techniques – F/V and V/F conversion techniques – Digital voltmeters and multimeters – Automation and accuracy of digital voltmeters and multimeters – Digital phase meters – Digital tachometers – Digital frequency, period and time measurements – Low frequency measurements – Automatic time and frequency scaling – Sources of error – Noise – Inherent error in digital meters, hidden errors in conventional ac measurements – RMS detector in digital multimeters – Mathematical aspects of RMS.

UNIT III DIGITAL DISPLAY & RECORDING DEVICES 9

Digital storage oscilloscopes – Digital printers and plotters – CDROMS –Hard disk, injet & laser printers and LCD display CROs, LED/LCD monitor, digital signal analyzer and digital data acquisition,Flash memory storage.

UNIT IV SIGNAL ANALYSIS 9

Amplifiers, filters, transmitter, receiver, wireless base and mobile station test sets, noise figures meters, RF network analyser and high frequency signal sources.

UNIT V CURRENT TRENDS IN DIGITAL INSTRUMENTATION 9

Introduction to special function add on cards – Resistance card – Input and output cards – Counter, test and time of card and digital equipment construction with modular designing; interfacing to microprocessor, micro controllers and computers - Computer aided software engineering tools (CASE) – Use of CASE tools in design and development of automated measuring systems – Interfacing IEEE cards – Intelligent and programmable instruments using computers.

TOTAL: 45 PERIODS

REFERENCE BOOKS

1. Bouwens, A.J., "Digital Instrumentation", McGraw Hill, 1st Edition.

2. John Lenk, D., "Handbook of Micro computer based Instrumentation and Control", PHI, 1984.
3. Doebelin, 'Measurement System, Application & Design', IV Ed, McGraw-Hill, 5th Edition.
4. H. S. Kalsi, " Electronic Instrumentation" Tata McGraw-Hill Education, 01-Jun-2004.

SEMESTER II

12PE2A FLEXIBLE AC TRANSMISSION SYSTEMS

L	T	P	C
3	0	0	3

AIM

To provide a knowledge of application of power electronics in the efficient design and operation of power systems.

OBJECTIVES

- To understand the working principle of various types of shunt and series FACTS controller.
- To derive the steady state model of FACTS devices suitable for use in power system studies.
- To study the interaction effects of different types of FACTS devices on the steady state and dynamic behavior of power system.

UNIT I INTRODUCTION **9**

Reactive power control in electrical power transmission lines -Uncompensated transmission line - series compensation – Basic concepts of static Var Compensator (SVC) – Thyristor Switched Series capacitor (TCSC) – Unified power flow controller (UPFC).

UNIT II STATIC VAR COMPENSATOR (SVC) AND APPLICATIONS **9**

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 – Applications: Enhancement of transient stability – Steady state power transfer – Enhancement of power system damping – Prevention of voltage instability.

UNIT III THYRISTOR CONTROLLED SERIES CAPACITOR (TCSC) AND APPLICATIONS **9**

Operation of the TCSC – Different modes of operation – Modelling of TCSC – Variable reactance model – Modelling for Power Flow and stability studies. Applications: Improvement of the system stability limit – Enhancement of system damping-SSR Mitigation.

UNIT IV VOLTAGE SOURCE CONVERTER BASEDFACTS CONTROLLERS **9**

Static Synchronous Compensator (STATCOM) – Principle of operation – V-I Characteristics. Applications: Steady state power transfer-Enhancement of transient stability - Prevention of voltage instability. SSSC-operation of SSSC and the control of power flow –Modelling of SSSC in load flow and transient stability studies. Applications: SSR Mitigation-UPFC and IPFC

UNIT V CO-ORDINATION OF FACTS CONTROLLERS **9**

Controller interactions – SVC – SVC interaction – Co-ordination of multiple controllers using linear control techniques – Control coordination.

TOTAL: 45 PERIODS

REFERENCE BOOKS

1. R.Mohan Mathur, Rajiv K.Varma, "Thyristor – Based Facts Controllers for Electrical

Transmission Systems", IEEE press and John Wiley & Sons, Inc.
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. Enrique Acha, Claudio R. Fuerte-Esquivel, Hugo Ambriz-Pérez, César Angeles-Camacho," FACTS: Modeling and Simulation in Power Networks", Wiley 2004.

12PE2B **POWER QUALITY** **L T P C**
3 0 0 3

AIM

To enhance the knowledge of the students in the emerging area of power quality and several key issues related to its modelling, assessment and mitigation.

OBJECTIVES

- To provide the fundamentals of power quality, voltage regulation, impact of voltage sag, swells harmonic analysis and power quality monitoring.
- To study about the various harmonic elimation methods.
- To apply knowledge of power quality and harmonics in power systems, and engineering to the analysis and design of electrical circuits

UNIT I INTRODUCTION **9**

Introduction – Characterisation of Electric Power Quality: Transients, short duration and long duration voltage variations, Voltage imbalance, waveform distortion, Voltage fluctuations, Power frequency variation, Power acceptability curves – power quality problems: poor load power factor, Non linear and unbalanced loads, DC offset in loads, Notching in load voltage, Disturbance in supply voltage – Power quality standards.

UNIT II NON-LINEAR LOADS **9**

Single phase static and rotating AC/DC converters, Three phase static AC/DC converters, Battery chargers, Arc furnaces, Fluorescent lighting, pulse modulated devices, Adjustable speed drives.

UNIT III MEASUREMENT AND ANALYSIS METHODS **9**

Voltage, Current, Power and Energy measurements, power factor measurements and definitions, event recorders, Measurement Error – Analysis: Analysis in the periodic steady state, Time domain methods, Frequency domain methods: Laplace's, Fourier and Hartley transform – The Walsh Transform – Wavelet Transform.

UNIT IV ANALYSIS AND CONVENTIONAL MITIGATION METHODS **9**

Analysis of power outages, Analysis of unbalance: Symmetrical components of phasor quantities, Instantaneous symmetrical components, Instantaneous real and reactive powers, Analysis of distortion: On–line extraction of fundamental sequence components from measured samples – Harmonic indices – Analysis of voltage sag: Detorit Edison sag score, Voltage sag energy, Voltage Sag Lost Energy Index (VSLEI)- Analysis of voltage flicker, Reduced duration and customer impact of outages, Classical load balancing problem: Open loop balancing, Closed loop balancing, current balancing, Harmonic reduction, Voltage sag reduction.

UNIT V POWER QUALITY IMPROVEMENT **9**

Utility-Customer interface –Harmonic filters: passive, Active and hybrid filters –Custom power

devices: Network reconfiguring Devices, Load compensation using DSTATCOM, Voltage regulation using DSTATCOM, protecting sensitive loads using DVR, UPQC –control strategies: P-Q theory, Synchronous detection method – Custom power park –Status of application of custom power devices.

TOTAL: 45 PERIODS

REFERENCE BOOKS

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. Power Quality - R.C. Duggan, McGraw-Hill, 2003.
4. Power system harmonics –A.J. Arrillga, John Wiley second Edition, 2003.
5. Power electronic converter harmonics –Derek A. Paice.IEEE Press 1996.
6. T.J.E.Miller "Reactive Power Control in Electric Systems, John Wiley Inc., US (1982)

12PE2C	COMPUTER AIDED DESIGN OF POWER ELECTRONIC CIRCUITS	L	T	P	C
		3	0	0	3

AIM

To explicate the methods of analysis of power electronic systems, advanced techniques in simulation, modeling of power electronic devices and their simulation.

OBJECTIVES

- To elucidate the advanced techniques in simulation of power electronics systems.
- To realize the modeling and analysis of power electronic devices and non – linear devices.
- To bone up the students with the simulation of power electronic circuits and their case studies.

UNIT I INTRODUCTION 9

Importance of simulation – General purpose circuit analysis – Methods of analysis of power electronic systems – Review of power electronic devices and circuits.

UNIT II ADVANCED TECHNIQUES IN SIMULATION 9

Analysis of power electronic systems in a sequential manner – coupled and decoupled systems – Various algorithms for computing steady state solution in power electronic systems – Future trends in computer simulation.

UNIT III MODELING OF POWER ELCTRONIC DEVICES 9

Introduction – AC sweep and DC sweep analysis – Transients and the time domain analysis – Fourier series and harmonic components – BJT, FET, MOSFET and its model- Amplifiers and Oscillator – Non-linear devices

UNIT IV SIMULATION OF CIRCUITS 9

Introduction – Schematic capture and libraries – Time domain analysis – System level integration and analysis – Monte Carlo analysis – Sensitivity/stress analysis – Fourier analysis.

UNIT V CASE STUDIES 9

Simulation of Converters, Choppers, Inverters, AC voltage controllers, and Cyclo-converters feeding R, R-L, and R-L-E loads – computation of performance parameters: harmonics, power factor, angle of overlap.

TOTAL: 45 PERIODS

REFERENCE BOOKS

1. Rashid, M., Simulation of Power Electronic Circuits using PSPICE, PHI, 2006.

2. Rajagopalan, V. "Computer Aided Analysis of Power Electronic systems"-Marcell – Dekker Inc., 1987.
3. John Keown "Microsim, Pspice and circuit analysis"-Prentice Hall Inc., 1998.

12PE2D POWER ELECTRONICS IN POWER SYSTEMS L T P C
3 0 0 3

AIM

To study and understand the different types of power electronic devices used for power systems applications.

OBJECTIVES

- To impart knowledge on generation of harmonics in power system.
- To design and analyze the different types of protection schemes for converters
- To study the different Applications of converters in HVDC systems
- To understand the different types of FACTS controllers.

UNIT I HARMONICS 9

HVAC and DC Links- Layout- Types- Generation of Harmonics- Characteristics and non-characteristics harmonics- Troubles caused by harmonics- Harmonic filters- Influence of Harmonics on the operation of drives- Performance evaluation.

UNIT II PROTECTION OF HVAC/HVDC SYSTEMS 9

Voltage control- Static tap changers using thyristors- Different control schemes- comparison- Static circuit breakers using thyristors- CBs for HVAC.HVDC systems- Breaking by resonant conditions- characteristics of HRC and semiconductor fuses.

UNIT III VAR COMPENSATION 9

VAR compensation- Basic concepts- voltage regulation and power factor correction- phase balancing and power factor correction of unbalanced loads- Properties of static compensator- TCR, TSR, TSC, SR- Control strategies- Modeling and control of thyristor controlled series compensators.

UNIT IV UNIFIEDPOWERFLOWCONTROLLERS 9

Unified Power flow Control- Implementation of power flow control using thyristors- Implementation of Unified power flow controller schemes. Static excitation control- Solid state excitation of synchronous generators- Different schemes- Generator excitation- Control Strategies.

UNIT V FACTSCONTROLLERS 9

FACTS controller- STATCOM- special purpose FACTS Controller- multifunctional FACTS Controller- Approximate multimodel decomposition- Variable structure FACTS Controller: Non-Linear control- series capacitor control- resistor control.

TOTAL: 45 PERIODS

REFERENCE BOOKS

1. Begamudre R.D, "EHVAC Transmission Engineering", Wiley Eastern Ltd., 2nd Edition, 1991.
2. Padiyar K.R. "HVDC Power Transmission Systems- Technology", New Age International (P) Ltd., 2nd Edition.
3. Miller T.J.E., "Reactive Power Control in Electrical Systems", Wiley InterScience. New York, 1982.
4. Gyugyi.L, "Unified Power Flow Control Concept for Flexible AC Transmission", IEE Proc-c., Vol 39, 204, July 1992.
5. Narain G. Hingorani, Lasizio Gyugyi, "Understanding FACTS Concepts and Technology of Flexible AC Transmission Systems", Standard Publishers Distributors, New Delhi, 2001.

12PE2E COMPUTER AIDED DESIGN OF INSTRUMENTATION SYSTEMS

L	T	P	C
3	0	0	3

AIM

To acquire the knowledge about design, analysis and simulation of instrumentation systems.

OBJECTIVES

- To make the students to develop the sapience in data acquisition and instrument interfacing.
- To make the students to obtain the astuteness of pc based instrumentation and virtual instrumentation programming techniques, design, analysis and simulation of physical systems.

UNIT I DATA ACQUISITION AND INSTRUMENT INTERFACE 9

Programming and simulation of Building block of instrument Automation system – Signal analysis, I/O port configuration with instrument bus protocols - ADC, DAC, DIO, counters & timers, PC hardware structure, timing, interrupts, DMA, software and hardware installation, current loop, RS 232/RS485, GPIB, USB protocols,

UNIT II VIRTUAL INSTRUMENTATION PROGRAMMING TECHNIQUES 9

Block diagram and architecture of a virtual instrument, Graphical programming in data flow, comparison with conventional programming, Vis and sub-Vis, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O.

UNIT III DESIGN TEST & ANALYSIS 9

Spectral estimation using Fourier Transform, power spectrum, correlation methods, Stability analysis, Fault analysis –Sampling, Data Parity and error coding checks, Synchronization testing – Watch dog timer, DMA method – Real-time Clocking, Noise- Gaussian, White analysis

UNIT IV PC BASED INSTRUMENTATION 9

Introduction – Evolution of signal standard – HART Communication protocol – Communication modes – HART networks – control system interface – HART commands – HART field controller implementation – HART and the OSI model

UNIT V SIMULATION OF PHYSICAL SYSTEMS 9

Simulation of linear & Non-linear models of systems, Hardware in loop simulation of physical systems using special softwares.

TOTAL: 45 PERIODS

REFERENCE BOOKS

1. K. Ogatta, “Modern control engineering”, Fourth edition, Pearson education 2002.
2. Dorf and Bishop, “Modern Control Engineering”, Addison Weseley, 1998.
3. Patrick H. Garrett,” High performance Instrumentation and Automation”, CRC Press, Taylor & Francis Group, 2005.
4. MAPLE V programming guide.
5. MATLAB/SIMULINK user manual.
6. MATHCAD/VIS SIM user manual.
   LABVIEW simulation user manual

12PE2F	PULSE WIDTH MODULATION FOR POWER CONVERTERS	L	T	P	C
		3	0	0	3

AIM

To design and analyze the various types of PWM converter topologies.

OBJECTIVES

- To study the high frequency power converters and its applications.
- To study and formulate the different types of pulse width modulation strategies.
- Tounderstand the concept of optimization of space vector modulation.

UNIT I MODULATION OF ONE INVERTER PHASE LEG 9

Fundamental Concept of PWM-Evaluation of PWM Schemes-Double Fourier Integral Analysis of a Two-Level PWM waveform-Naturally Sampled PWM-PWM Analysis by Duty Cycle Variation-Regular Sampled PWM.

UNIT II MODULATION OF SINGLE-PHASE VOLTAGE SOURCE INVERTERS 9

Topology of a Single Phase Inverter-Three level Modulation of a Single Phase Inverter-Analytic Calculation of Harmonic Losses-Sideband Modulation-Switched Pulse Position-Switched Pulse Sequence.

UNIT III MODULATION OF THREE-PHASE VOLTAGE SOURCE INVERTERS 9

Topology of a Three Phase VSI-Three Phase Modulation with Sinusoidal Reference -Third Harmonic Reference Injection-Analytic Calculation of Harmonic Losses-Discontinuous Modulation Strategies-Triplen Carrier Ratios and Sub harmonics.

UNIT IV ZERO SPACE VECTOR PLACEMENT MODULATION STRATEGIES 9

Space Vector Modulation-Phase Leg Reference Books for SVM-Naturally Sampled SVM-Analytical Solution for SVM-Harmonic Losses for SVM-Placement of the Zero Space Vector-Discontinuous Modulation.

UNIT V PROGRAMMED MODULATION STRATEGIES 9

Optimized Space Vector Modulation-Harmonic Elimination PWM-Performance Index for Optimality-Optimum PWM-Minimum Loss PWM.

TOTAL: 45 PERIODS

REFERENCE BOOKS

1. D.Grahame Holmes, Thomas A. Lipo, "Pulse Width Modulation For Power Converters; Principles and Practice," John Wiley & Sons, Inc., Publications, 2003.
2. Dorin O. Neacsu," Power Switching Converters", CRC Press,"Taylor & Francis, 2006.
3. Ned Mohan, Undeland and Robbin, "Power Electronics: converters, Application and design" John Wiley and sons.Inc, Newyork, 1995

12PE2G	COMPUTER NETWORK ENGINEERING	L	T	P	C
		3	0	0	3

AIM

To make the students acquire fairly good knowledge on networking computer for reliable and secured operation.

OBJECTIVES

- To understand the rudiments of computer networking
- To analyse in detail and understand the different protocols
- To learn network security aspects

UNIT I PROTOCOLS OF ARCHTECTURE 9

Data communication-Protocols and standards-Basic concepts-Line configuration-Topology-Transmission modes-Categoriesof Networks-Internetworks-OSI Model-Functions of the layers

UNIT II COMMUNICATION MEDIA ANDDATALINKPROTOCOLS 9

Dail up MODEMS, Digital Subscriber Line (DSL)-Internetworking Devices or Connecting devices-Repeater, Bridge,Routers and Gateways. Flow control and error control, stop and wait, Sliding windows, Automatic Repeat (ARQ)

UNIT III LOCAL AREA NETWORKS AND WIDE AREA NETWORKS 9

Wired LAN:IEEE 802 standards, LLC, MAC layer protocols – CSMA/CD Ethernet, Token Bus, Token Ring,FDDI-Wireless LAN:Bluetooth-Architecture-Layers-L2CAP WAN: Circuit Switch packet Switch, Message Switching, X .25 Protocols- Architecture and Layers of Protocol, Frame Delay, ISDN and ATM Protocol

UNIT IV TRANSPORT PROTOCOLS AND ROUTING TECHNIQUES 9

Duties of transport layer-Connection-The OSI transport protocol-UDP-SCTP-Overview of Routing Techniques

UNIT V UPPER OSI LAYERS 9

Session layer protocols, Presentation layer – Data Security, Encryption/Decryption, Authentication,Data Composition,Application layer protocols – MHS - File transfer, Virtual terminal, CMIP.

TOTAL: 45 PERIODS

REFERENCE BOOKS

1. Behrouz A Forouzan , "Data Communication and Networking", Tata McGraw- Hill, 4th Edition,2011.
2. William Stallings, "Data and Computer Communication", 9th Edition, Prentice Hall of India, 2010.
3. Andrew S.Tanenbaum, "Computer networks", Fourth Edition, Prentice Hall of India, 2003.
4. Brijendra Singh, "Data Communication and Computer Networks", Second Edition, Prentice Hall of India, 2006.

12PE2H	PROGRAMMABLE LOGIC CONTROLLER	L	T	P	C
		3	0	0	3

AIM

To make the students to fathom in to the concepts of history, elements, programming techniques of PLC logic controller.

OBJECTIVES

- To learn the main elements of PLC Controller.
- To know about the programming techniques of PLC Controller.
- To study elaborately about the application of PLC Controller.

UNIT I INTRODUCTION TO PROGRAMMABLE LOGIC CONTROLLER 9

Study the history of development - examples of early applications - review of common computer mathematical functions - digital logic gates.

UNIT II MAIN ELEMENTS OF THE PLC SYSTEM 9

CPU - memory maps - single bit I/O modules - Power Supplies.

UNIT III PLC PROGRAMMING 9

Equipment – formats - ladder diagrams – scanning – Programming On/Off Inputs to produce On-Off Outputs - Basic PLC Programming.

UNIT IV PROGRAM USING REGISTER FUNCTIONS 9

Input - output registers - timer - counter functions - understand PLC arithmetic functions - square root - comparisons creation of ladder diagrams for process-control.

UNIT V APPLICATIONS 9

Skip - Master Control Relay Functions - Interlocks Data Move Systems - Real time control using PLC - PID function in PLC – Soft PLC's, Lab Exercises.

TOTAL:45 PERIODS

REFERENCE BOOKS

1. John W.Webb and Ronald A Reis, Programmable Logic Controllers – Principles and Applications, Prentice Hall, New Jersey, 2nd edition, 1998.
2. Frank D. Petruzella, Programmable Logic Controllers, McGraw Hill, Newyork, 4th edition, 2011.
3. Curtis D. Johnson, Process Control Instrumentation Technology, Prentice Hall, New Delhi, 7th edition, 2002.
4. Stenerson J., Fundamentals of Programmable Logic Controllers, Sensors and Communications, Prentice Hall, 1998.
5. Michel G. and Duncan, F., Programmable Logic Controllers: Architecture and Application, John Wiley & Sons Pvt ltd., 1990.
6. Carrow, R.A., Soft Logic: A Guide to Using a PC as a Programmable Logic Controller, Tata McGraw Hill, New Delhi, 1997.

12PE3A VLSI SYSTEM DESIGN

L	T	P	C
3	0	0	3

AIM

Overview of VLSI System Design and fabrication

OBJECTIVES

- To study about the VLSI design strategies.
- To study the applications of VLSI for power electronics and power converters.

UNIT I VLSI DESIGN CONCEPTS 9

Evolution of VLSI – VLSI Design process- Architectural design- Logical design- Physical design- Layout styles- Full custom- Semi custom approaches- Need for design rules- types of design rules- Design for MOS and CMOS circuits-Simple layout examples- Sheet resistance, area capacitance, wiring capacitance- Dry capacitive loads.

UNIT II VLSI FABRICATION TECHNIQUES 9

Wafer fabrication- Wafer processing- Oxidation- Patterning- Silican on insulator- CMOS Process enhancements- Analytical techniques- Ion beam techniques- Chemical methods- Package.Fabrication technology- Reliability requirements- Field loss- Failure Mechanism- Design Automation.

UNIT III ANALOG VLSI 9

Introduction to Analog VLSI- Analog Circuit Building Blocks- Switches, active resistors- Current sources and sinks- Current / Amplifiers- MOS and BJT, Inverting amplifiers- CMOS and BJT two stage OpAmp- Analog Signal Processing Circuits- Sensors- D/A and A/D Converters.

UNIT IV DIGITAL VLSI 9

Logic Design- Switch Logic- Gate logic-Dynamic CMOS Logic- Structured Design- Simple Combinational Logic Design- Clocked, Sequential Design- Subsystem Design- Design of Shifters- Arithmetic Processors- ALU- Serial Parallel and Pipelines Multiplier Arrays.

UNIT V ASIC DESIGN AND VHDL 9

Architecture and Programming Techniques of ROMs, EPROMs, PLA, PAL, Gate Arrays, CPLDs and FPGAs, Xilinx family, LCA I/O Block- Programmable Interconnect- Configuration Memory. VHDL- Syntax and Semantics- Identifiers and Literals- Entities and Architectures- Packages and Library Interface- Sequential statement- Arithmetic Operators- VHDL and Logic Synthesis- Introduction to structural model- Verilog : Basics of Verilog- Operators, Hierarchy procedures and assignments- timing controls and delays- Tasks and functions- Control statements- Verilog and Logic Synthesis.

TOTAL: 45 PERIODS

REFERENCE BOOKS

1. Pucknell D.A. and Kamran Eshraghion, "Basic VLSI Design", Prentice Hall of India, New Delhi, 3rd Edition, 1994.
2. Fabricus E.D., "Introduction to VLSI Design", McGraw Hill International Edition, 1990.
3. Haskard M.R., May L.C., "Analog VLSI Design- NMOS and CMOS", Prentice Hall, 1998.
4. Kevin Skahill., "VHDL for Programmable Logic Device", Addison-Wesley, 1996.
5. Smith., "Application Specific Integrated Circuits", Addison-Wesley, 2nd reprint, 2000.
6. David Pellaris, Douglas Taylor, "VHDL Made Easy", PHI Inc., 1997.
7. Amar Mukherjee, "Introduction to NMOS and CMOS VLSI System Design", Prentice Hall, USA, 1986.
8. Douglas Perry, "VHDL", McGraw Hill International, 4rd Edition, 2002.

12PE3B WIND ENERGY CONVERSION SYSTEMS L T P C
3 0 0 3

AIM

To introduce the basic concepts of wind energy conversion systems.

OBJECTIVES

- To understand the power generation using different types of wind turbines.
- To study about the modeling of fixed and variable speed wind turbines in WECS.
- To learn about the impact of grid connected WEC systems.

UNIT I INTRODUCTION 9

Components of WECS-WECS schemes-Power obtained from wind-simple momentum theory-Power coefficient-Sabinin's theory-Aerodynamics of Wind turbine

UNIT II WIND TURBINES 9

HAWT-VAWT-Power developed-Thrust-Efficiency-Rotor selection-Rotor design considerations-Tip speed ratio-No. of Blades-Blade profile-Power Regulation-yaw control-Pitch angle control-stall control-Schemes for maximum power extraction.

UNIT III FIXED SPEED SYSTEMS 9

Generating Systems- Constant speed constant frequency systems -Choice of Generators-Deciding factors-Synchronous Generator-Squirrel Cage Induction Generator- Model of Wind Speed- Model wind turbine rotor - Drive Train model-Generator model for Steady state and Transient stability analysis.

UNIT IV VARIABLE SPEED SYSTEMS 9

Need of variable speed systems-Power-wind speed characteristics-Variable speed constant frequency systems synchronous generator- DFIG- PMSG -Variable speed generators modeling - Variable speed variable frequency schemes.

UNIT V GRID CONNECTED SYSTEMS 9

Stand alone and Grid Connected WECS system-Grid connection Issues-Machine side & Grid side controllers-WECS in various countries

TOTAL: 45 PERIODS

REFERENCE BOOKS

1. L.L.Freris "Wind Energy conversion Systems", Prentice Hall, 1990.
2. Ion Boldea, "Variable speed generators", Taylor & Francis group, 2006.
3. E.W.Golding "The generation of Electricity by wind power", Redwood burn Ltd., Trowbridge, 1976.
4. S.Heir "Grid Integration of WECS", Wiley 1998.

12PE3C HIGH VOLTAGE DIRECT CURRENT TRANSMISSION L T P C
3 0 0 3

AIM

To familiarize the students with high voltage direct current transmission techniques, types, analysis and simulation of various HVDC systems.

OBJECTIVES

- To study the advantages of HVDC transmission over HVAC transmission.
- To analyse the converters and control techniques used in various HVDC systems.
- To obtain the knowledge about power flow and simulation of HVDC systems.

UNIT I DC POWER TRANSMISSION TECHNOLOGY 9

Introduction - Comparison of AC and DC transmission – Application of DC transmission – Description of DC transmission system - Planning for HVDC transmission – Modern trends in DC transmission – DC breakers – Cables, VSC based HVDC.

UNIT II ANALYSIS OF HVDC CONVERTERS AND HVDC SYSTEM CONTROL 9

Pulse number, choice of converter configuration – Simplified analysis of Graetz circuit - Converter bridge characteristics – characteristics of a twelve pulse converter- detailed analysis of converters.General principles of DC link control – Converter control characteristics – System control hierarchy - Firing angle control – Current and extinction angle control – Generation of harmonics and filtering - power control – Higher level controllers.

UNIT III MULTITERMINAL DC SYSTEMS 9

Introduction – Potential applications of MTDC systems - Types of MTDC systems - Control and protection of MTDC systems - Study of MTDC systems.

UNIT IV POWER FLOW ANALYSIS IN AC/DC SYSTEMS 9

Per unit system for DC Quantities - Modelling of DC links - Solution of DC load flow - Solution of AC-DC power flow - Case studies.

UNIT V SIMULATION OF HVDC SYSTEMS 9

Introduction – System simulation: Philosophy and tools – HVDC system simulation – Modeling of HVDC systems for digital dynamic simulation – Dynamic in traction between DC and AC systems.

TOTAL: 45 PERIODS

REFERENCE BOOKS

1. K.R.Padiyar, , "HVDC Power Transmission Systems", New Age International (P) Ltd., New Delhi, 2nd Edition 2010.
2. J.Arrillaga,"High Voltage Direct Current Transmission", Peter Pregrinus, London, 1983.
3. P. Kundur, "Power System Stability and Control", 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.
6. Edward Wilson Kimbark “Direct Current Transmission” Wiley-Interscience, 1971.

12PE3D POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS

L	T	P	C
3	0	0	3

AIM

To study about various electrical and power electronic devices used in renewable energy generation systems.

OBJECTIVES

- To know about various renewable energy sources, their production and its impact on the environment.
- To study the fundamentals of reference theory, operation and analysis of various electrical machines used in generation of power from renewable energy sources.
- To apply the knowledge of power electronic circuits and devices for various types of renewable energy sources

UNIT I INTRODUCTION **9**

Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost-GHG Emission) - Qualitative study of different renewable energy resources: Solar, wind, ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems.

UNIT II ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION **9**

Review of reference theory fundamentals-principle of operation and analysis: IG, PMSG, SCIG and DFIG.

UNIT III POWER CONVERTERS **9**

Solar: Block diagram of solar photo voltaic system -Principle of operation: line commutated converters (inversion-mode) - Boost and buck-boost converters- selection Of inverter, battery sizing, and array sizing Wind: three phase AC voltage controllers- AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters, Grid Interactive Inverters-matrix converters.

UNIT IV ANALYSIS OF WIND AND PV SYSTEMS **9**

Stand alone operation of fixed and variable speed wind energy conversion systems and solar system-Grid connection Issues -Grid integrated PMSG and SCIG Based WECS-Grid Integrated solar system

UNIT V HYBRID RENEWABLE ENERGY SYSTEMS **9**

Need for Hybrid Systems- Range and type of Hybrid systems- Case studies of Wind-PV-Maximum Power Point Tracking (MPPT)

TOTAL: 45 PERIODS

REFERENCE BOOKS

1. Rashid .M. H “power electronics Hand book”, Academic press, 2001.
2. Rai. G.D, “Non conventional energy sources”, Khanna publishes, 1993.
3. Rai. G.D,” Solar energy utilization”, Khanna publishes, 1993.
4. Gray, L. Johnson, “Wind energy system”, prentice hall linc, 1995.

5. Non-conventional Energy sources B.H.Khan Tata McGraw-hill Publishing Company, New Delhi 2010.

12PE3E SMART GRID

L	T	P	C
3	0	0	3

AIM

This subject deals with smart grid, technologies used in it and devices to improve the power quality.

OBJECTIVES

- To gain knowledge about the concepts and fundamentals of Smart grid.
- To study the structure of smart grid and technologies used.
- To understand the types of meters used in smart grid.
- To know how smart grids are effective in power quality management.
- To enhance the students about high performance computing for smart grid applications.

UNIT I INTRODUCTION TO SMART GRID 9

Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits, Difference between conventional & Smart Grid, Concept of Resilient & Self Healing Grid, Present development & International policies in Smart Grid, Diverse perspectives from experts and global Smart Grid initiatives

UNIT II SMART GRID TECHNOLOGIES 9

Technology Drivers, Smart energy resources,Smart substations, Substation Automation, Feeder Automation ,Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Protection and control, Distribution systems: DMS, Volt/VAr control,Fault Detection, Isolation and service restoration, Outage management,High-Efficiency Distribution Transformers, Phase Shifting Transformers, Plug in Hybrid Electric Vehicles (PHEV).

UNIT III SMART METERS AND ADVANCED METERING INFRASTRUCTURE 9

Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits,AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit(PMU), Intelligent Electronic Devices(IED) & their application for monitoring & protection.

UNIT IV POWER QUALITY MANAGEMENT IN SMART GRID 9

Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

UNIT V HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS 9

Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), IP based Protocols, Basics of Web Service and CLOUD Computing to make Smart Grids smarter, Cyber Security for Smart Grid.

TOTAL: 45 PERIODS

REFERENCE BOOKS

1. Stuart Borlase "Smart Grid :Infrastructure, Technology and Solutions",CRC Press 2013.
2. Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", Wiley
3. Vehbi C. Güngör, DilanSahin, TaskinKocak, Salih Ergüt, Concettina Buccella, Carlo Cecati, and

Gerhard P. Hancke, Smart Grid Technologies: Communication Technologies and Standards IEEE Transactions On Industrial Informatics, Vol. 7 No. 4, November 2011.
4. Xi Fang, Satyajayant Misra, Guoliang Xue, and Dejun Yang "Smart Grid – The New and Improved Power Grid: A Survey" , IEEE Transaction on Smart Grids.

12PE3F PROGRAMMING WITH VHDL L T P C
3 0 0 3

AIM

To learn the concepts and fundamentals of VHDL programming.

OBJECTIVES

- To edify the students about the fundamentals of VHDL and its fundamentals.
- To elucidate the data types, packages and components of VHDL.
- To design and write programs for programmable logic devices.

UNIT I VHDL FUNDAMENTALS 9

Fundamental concepts- Modeling digital system-Domain and levels of modeling-modeling languages-VHDL modeling concepts-Scalar Data types and operations- constants and Variable-Scalar Types-Type Classification-Attributes and scalar types-expression and operators-Sequential statements.

UNIT II DATA TYPES AND BASIC MODELING CONSTRUCTIONS 9

Arrays- unconstrained array types-array operations and referencing- records - Access Types- Abstract Date types- -basic modeling constructs-entity declarations-Architecture bodies-behavioral description-structural descriptions- design Processing, case study: A pipelined Multiplier accumulator.

UNIT III SUBPROGRAMS , PACKAGES AND FILES 9

Procedures-Procedure parameters- Concurrent procedure call statements –Functions –Overloading – visibility of Declarations-packages and use clauses- Package declarations-package bodies-use clauses-Predefined aliases-Aliases for Data objects-Aliases for Non-Data items-Files- I/O-Files. Case study: A bit vector arithmetic Package.

UNIT IV SIGNALS, COMPONENTS, CONFIGURATIONS. 9

Basic Resolved Signals-IEEE std_Logic_1164 resolved subtypes- resolved Signal Parameters - Generic Constants- Parameterizing behavior- Parameterizing structure-components and configurations-Generate Statements-Generating Iterative structure-Conditionally generating structure-Configuration of generate statements-case study: DLX computer Systems.

UNIT V DESIGN WITH PROGRAMMABLE LOGIC DEVICES 9

Realization of -Micro controller CPU. - Memories-I/O devices-MAC-Design,synthesis,simulation and testing.

TOTAL: 45 PERIODS

REFERENCE BOOKS

1. Peter J.Ashenden, "The Designer's guide to VHDL", Morgan Kaufmann publishers, an Francisco, Second Edition, May 2001.
2. Zainalabedin navabi, "VHDL Analysis ans modeling of Digital Systems", McGraw Hill international Editions, Second Editions, 1998.
3. Charles H Roth, Jr. "Digital system Design using VHDL", Thomson, 2006.
4. Douglas Perry, "VHDL Programming by Example", Tata McGraw Hill,4th Edition 2002.
5. Navabi.Z., "VHDL Analysis and Modeling of Digital Systems", McGraw International, 1998.
6. Peter J Ashendem, "The Designers Guide to VHDL", Harcourt India Pvt Ltd, 2002.
7. Skahill. K, "VHDL for Programmable Logic", Pearson education, 1996.

12PE3G SYSTEM IDENTIFICATION AND ADAPTIVE CONTROL L T P C
3 0 0 3

AIM

To lucubrate the ideas of system identification and their adaptive control.

OBJECTIVES

- To study the models of various types of systems.
- To demarcate different methods for identification of the system.
- To validate and identify non – linear models.
- To know about the adaptive control and techniques of the systems and their case studies.

UNIT I MODELS FOR IDENTIFICATION 9

Models of LTI systems: Linear Models-State space Models-OE model- Model sets, Structures and Identifiability-Models for Time-varying and Non-linear systems: Models with Nonlinearities – Non-linear state-space models-Black box models, Fuzzy models'

UNIT II NON-PARAMETRIC AND PARAMETRIC IDENTIFICATON 9

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

UNIT III NON-LINEAR IDENTIFICATION AND MODEL VALIDATION 9

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

UNIT IV ADAPTIVE CONTROL AND ADAPTATION TECHNIQUES 9

Introduction – Uses – Auto tuning – Self Tuning Regulators (STR) – Model Reference Adaptive Control (MRAC) – Types of STR and MRAC – Different approaches to self-tuning regulators – Stochastic Adaptive control – Gain Scheduling.

UNIT V CASE STUDIES 9

Inverted Pendulum, Robot arm, process control application: heat exchanger, Distillation column, application to power system, Ship steering control.

TOTAL: 45 PERIODS

REFERENCE BOOKS

1. Ljung," System Identification Theory for the User", PHI, 1987.
2. Torsten Soderstrom, Petre Stoica, "System Identification", prentice Hall `International (UK) Ltd, 1989.
3. Astrom and Wittenmark," Adaptive Control ", Pearson Eduation 2nd Edition 1995.
4. William S. Levine, " Control Hand Book"CRC Press 2011.
5. Narendra and Annasamy," Stable Adaptive Control Systems, Prentice Hall, 1989

12PE3H APPLICATIONS OF MEMS TECHNOLOGY L T P C
3 0 0 3

AIM

To understand intricately the concepts of MEMS technology.

OBJECTIVES

- To introduce the ideas of MEMS technology to enrollee.
- To understand the principles of electrostatic and thermal sensors and their actuation.
- To study about piezoelectric sensing and its actuation and case studies.

UNIT I MEMS: MICRO-FABRICATION, MATERIALS AND ELECTRO-MECHANICAL CONCEPTS 9

Overview of micro fabrication – Silicon and other material based fabrication processes – Concepts: Conductivity of semiconductors-Crystal planes and orientation-stress and strain-flexural beam bending analysis-torsional deflections-Intrinsic stress- resonant frequency and quality factor.

UNIT II ELECTROSTATIC SENSORS AND ACTUATION 9

Principle, material, design and fabrication of parallel plate capacitors as electrostatic sensors and actuators-Applications

UNIT III THERMAL SENSING AND ACTUATION 9

Principle, material, design and fabrication of thermal couples, thermal bimorph sensors, thermal resistor sensors-Applications.

UNIT IV PIEZOELECTRIC SENSING AND ACTUATION 9

Piezoelectric effect-cantilever piezo electric actuator model-properties of piezoelectric materials-Applications

UNIT V CASE STUDIES 9

Piezoresistive sensors, Magnetic actuation, Micro fluidics applications, Medical applications, Optical MEMS.

TOTAL: 45 PERIODS

REFERENCE BOOKS

1. Chang Liu, "Foundations of MEMS", Pearson International Edition, 2006.
2. Marc Madou , "Fundamentals of microfabrication",CRC Press, 1997.
3. Boston , "Micromachined Transducers Sourcebook",WCB McGraw Hill, 1998.
4. M.H.Bao "Micromechanical transducers :Pressure sensors, accelerometers and gyroscopes", Elsevier, Newyork, 2000.

12PE3I MODERN RECTIFIERS AND RESONANT CONVERTERS L T P C
3 0 0 3

AIM

To learn about line commutated and PWM converters power conversion technique and design of resonant converters and its applications.

OBJECTIVES

- To understand the analyze the basic topologies of line commutated and PWM converters
- To understand the different types of modulation schemes and control techniques of the converters
- To estimate the switching and conduction losses taking place in switched mode converters.

UNIT I POWER SYSTEM HARMONICS & LINE COMMUTATED RECTIFIERS 9

Average power-RMS value of a waveform-Power factor-AC line current harmonic standards IEC 1000-IEEE 519- The Single phase full wave rectifier-Continuous Conduction Mode-Discontinuous Conduction Mode-Behaviour when C is large-Minimizing THD when C is small-Three phase rectifiers- Continuous Conduction Mode-Discontinuous Conduction Mode-Harmonic trap filters.

UNIT II PULSE WIDTH MODULATED RECTIFIERS 9

Properties of Ideal rectifiers-Realization of non ideal rectifier-Control of current waveform-Average current control-Current programmed Control- Hysteresis control- Nonlinear carrier control-Single

phase converter system incorporating ideal rectifiers-Modeling losses and efficiency in CCM high quality rectifiers-Boost rectifier Example -expression for controller duty cycle-expression for DC load current-solution for converter Efficiency.

UNIT III RESONANT CONVERTERS 9

Review on Parallel and Series Resonant Switches-Soft Switching- Zero Current Switching - Zero Voltage Switching -Classification of Quasi resonant switches-Zero Current Switching of Quasi Resonant Buck converter, Zero Current Switching of Quasi Resonant Boost converter, Zero Voltage Switching of Quasi Resonant Buck converter, Zero Voltage Switching of Quasi Resonant Boost converter: Steady State analysis.

UNIT IV DYNAMIC ANLYSIS OF SWITCHING CONVERTERS 9

Review of linear system analysis-State Space Averaging-Basic State Space Average Model-State Space Averaged model for an ideal Buck Converter, ideal Boost Converter, ideal Buck Boost Converter, for an ideal Cuk Converter.

UNIT V CONTROL OF RESONANT CONVERTERS 9

Pulse Width Modulation-Voltage Mode PWM Scheme-Current Mode PWM Scheme-Design of Controllers: PI Controller, Variable Structure Controller, Optimal Controller for the source current shaping of PWM rectifiers.

TOTAL: 45 PERIODS

REFERENCE BOOKS

1. Robert W. Erickson &Dragon Maksimovic" Fundamentals of Power Electronics" Second Edition, 2001 Springer science and Business media.
2. William Shepherd and Li zhang," Power Converters Circuits " CRC Press 2004.
3. Simon Ang and Alejandro Oliva "Power- Switching Converters" Taylor & Francis Group.3rd Edition 2010.

12PE3J SOFT COMPUTING TECHNIQUES L T P C
3 0 0 3

AIM

To learn the basic concepts of computational intelligent techniques and its applications

OBJECTIVES

- To provide the basic understanding of neural networks, fuzzy logic fundamentals and genetic algorithm program the related algorithms and design the required and related systems.
- To expose the concepts of feed forward and feedback neural networks.
- To train about the concept of fuzziness involved in various systems.
- To provide adequate knowledge about fuzzy set theory and application of fuzzy logic control to real time systems.
- To apply neural networks and fuzzy systems to model and solve complicated practical problems.

UNIT I INTRODUCTION 9

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

UNIT II ARTIFICIAL NEURAL NETWORKS 9

Concept of Artificial Neural Networks and its basic mathematical model, McCulloch-Pitts neuron model, simple perceptron, Adaline and Madaline, Feed-forward Multilayer Perceptron. Learning and Training the neural network. Data Processing: Scaling, Fourier transformation, principal-component analysis and wavelet transformations. Hopfield network, Self-organizing network and recurrent

network. Neural Network based controller

UNIT III FUZZY LOGIC SYSTEM 9

. Introduction to crisp sets and fuzzy sets, basic fuzzy set operation and approximate reasoning. Introduction to fuzzy logic modeling and control. Fuzzification, inferencing and defuzzification. Fuzzy knowledge and rule bases. Fuzzy modeling and control schemes for nonlinear systems. Self-organizing fuzzy logic control. Fuzzy logic control for nonlinear time-delay system.

UNIT IV GENETIC ALGORITHM 9

Basic concept of Genetic algorithm and detail algorithmic steps, adjustment of free parameters. Solution of typical control problems using genetic algorithm. Concept on some other search techniques like tabu search and and-colony search techniques for solving optimization problems.

UNIT V APPLICATIONS 9

GA application to power system optimization problem, Case studies: Identification and control of linear and nonlinear dynamic systems using Matlab-Neural Network toolbox.Stability analysis of Neural-Network interconnection systems. Implementation of fuzzy logic controller using Matlab fuzzy-logic toolbox. Stability analysis of fuzzy control systems.

TOTAL: 45 PERIODS

REFERENCE BOOKS

1. Jacek.M.Zurada, "Introduction to Artificial Neural Systems", Jaico Publishing House, 1999.
2. KOSKO, B. "Neural Networks and Fuzzy Systems", Prentice-Hall of India Pvt. Ltd., 1994.
3. KLIR G.J. & FOLGER T.A. "Fuzzy sets, uncertainty and Information", Prentice-Hall of India Pvt. Ltd., 1993.
4. Zimmerman H.J. "Fuzzy set theory-and its Applications"-Kluwer Academic Publishers, 1994.
5. Driankov, Hellendroon, "Introduction to Fuzzy Control", Narosa Publishers.Reprint 2001
6. S.N.Sivanandam, S.N.Deepa, “Introduction of Genetic Algorithms” Springer, New York, 2010.

12PE3K PROTECTION FOR ELECTRICAL DRIVES L T P C
3 0 0 3

AIM

To familiarize the students with the knowledge of protection for electrical drives.

OBJECTIVES

- To know about programmable logic controllers.
- To model the protection system required for various drive systems.
- To learn about the protection methods for ac and dc drives.

UNIT I PROGRAMMABLE LOGIC CONRTOLLERS(PLC) 9

Evolution of Modern PLC- Relay Based PLC- Microprocessor based PLC- Input and Output Modules- Other Functional Elements- Personal Computer as PLC- Programming the PLC- Communication in PLC- Typical applications of PLC- PID control capability in Programmable controllers.

UNIT II DISTRIBUTED CONTROL SYSTEM 9

Evolution of DCS- Typical architecture- Local Control Unit (LCU) and architecture- LCU languages- LCU process interfacing issues- Communication Systems requirements- Architectural issues- Protocol issues- Communication media- message security- Communication Systems standards- Field bus- Heart operation Interface: requirements- Display alarms and alarm management- Engineering Interface: requirements- Supervisory control.

UNIT III MODELLING OF DRIVE SYSTEM 9

Mathematical modeling of Drive System- I order, II order Process- Analysis of Closed loop control system- Stability analysis- controllability and observability of time invariant system. Design of control algorithm using Z transform- PID algorithms- Design for Load Changes.

UNIT IV DC DRIVE PROTECTION 9

Overvoltage protection of power controllers feeding DC Drives: Origin of Voltage Transient- Suppression of Voltage Transient- Delayed Commutation- Commutation Overlap- Protection against failure of communication in AC- DC Converter and DC- DC Chopper feeding a DC Drive- Protection against failure of field- Short Circuit Protection- Soft Start Control- Protection against Over Speed- Protection against fluctuating loads- Drive instability- development of schemes for above types of Drive Protection- Use of PLC in these schemes.

UNIT V AC DRIVE PROTECTION 9

Protection against over/under Voltages and under frequency in AC Drives- Protection against over Current due to acceleration and deceleration- Protection against failure of communication in inverters, Cycloconverters and AC Voltage converters feeding AC Drives- Protection against over speed - Drive instability- Protection against stalling- Protection against single phasing- development of schemes for above types of Drive Protection- Use of PLC in these schemes.

TOTAL: 45 PERIODS

REFERENCE BOOKS

1. Michael P. Lucas "Distributed Control Systems", Van Noster and Reinhold co., 1986.
2. Kuo B.B., "Digital Control Systems", Holt Reinhart, 1980.
3. Vedam Subramanian, "Electrical Drives and Control", New Age International (P) Ltd., New Delhi, 1998.
4. Murphy J.M.D. and Turnbull F.G., "Thyristor Control of AC Motor", Pergamon Press, Oxford, 1998.
5. Dewan, Slemon S.B., Stravghen G.R., "Power Semiconductor Drives", John Wiley and Sons, New York, 1984.

12PE3L EVOLUTIONARY COMPUTATION L T P C
3 0 0 3

AIM

To obtain knowledge about evolutionary computational methods.

OBJECTIVES

- To know about various optimization techniques.
- To learn about genetic algorithms and genetic search technique.
- To acquaint the knowledge about the applications of genetic algorithm and particle swarm optimization.
- To study the ant colony optimization technique.

UNIT I INTRODUCTION 9

Introduction to optimization – Concept of system and state – Performance measure – Constraints – Conditions for optimality – Linear and nonlinear optimization techniques – Stochastic optimization. Introduction to evolutionary computing – Comparison with traditional optimization techniques

UNIT II GENETIC ALGORITHMS (GA) 9

GA simulation – Schema processing – Data structures – reproduction – Crossover – Mutation – Fitness scaling – Constrained genetic algorithms- Penalty functions. Classification of GA - Simple GA – Compact GA – Orthogonal GA – Problems with GA – Genetic drift – Deception – Real-time and on-line issues – Algorithmic implementation of GA.

UNIT III GENETIC SEARCH TECHNIQUE 9

Classes of search techniques – GA cycle – Distributed, parallel, structured GA, Dominance, Diploidy, Abeyance – Selection methods – Recombination – Discrete, real valued, binary valued – Single and multi-point crossover – Population models – Multi-objective optimization.

UNIT IV APPLICATIONS OF GA AND PSO 9

GA in optimization of discrete and continuous systems – GA in pattern recognition – GA based machine learning – GA in signal processing - GA in computer communication. Particle Swarm Optimization (PSO) – Background, operation and basic flow of PSO - Applications of PSO - Comparison between PSO and GA.

UNIT V ANT COLONY OPTIMIZATION 9

Ant colony optimization - Biological inspiration – similarities and differences between real ants and artificial ants – characteristics, algorithms and applications of ant colony optimization.

TOTAL: 45 PERIODS

REFERENCE BOOKS

1. Kalamoy Deb,"Optimization for Engineering Design: algorithms and examples", Prentice Hall of India Ltd, 2004.
2. Pierre. D.A., "Optimization Theory with Applications", Courier Dover Publications, 1987.
3. Rao S.S., "Optimization Theory and Applications", Halsted Press, II edition, 1984.
4. David E. Goldberg, "Genetic Algorithms in Search, Optimization and Machine Learning", International Student Edition, Addison Wesley, 2007.
5. S.N.Sivanandam, S.N.Deepa, "Introduction of Genetic Algorithms" Springer, New York, 2010.
6. IEEE Transactions on Evolutionary Computing.