ACADEMIC REGULATIONS
COURSE STRUCTURE
AND
DETAILED SYLLABUS

POWER ELECTRONICS AND ELECTRIC DRIVES

Department of
Electrical and Electronics Engineering

M.Tech Two Year Degree Course

(Applicable for the batch admitted from 2020-21)

GUDLAVALLERU ENGINEERING COLLEGE

(An Autonomous Institute with Permanent Affiliation to JNTUK, Kakinada)

Seshadri Rao Knowledge Village

GUDLAVALLERU - 521 356, Krishna District, Andhra Pradesh

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VISION & MISSION OF THE COLLEGE

Vision

To be a leading institution of engineering education and research, preparing students for leadership in their fields in a caring and challenging learning environment.

Mission

- To produce quality engineers by providing state-of-the-art engineering education.
- To attract and retain knowledgeable, creative, motivated and highly skilled individuals whose leadership and contributions uphold the college tenets of education, creativity, research and responsible public service.
- To develop faculty and resources to impart and disseminate knowledge and information to students and also to society that will enhance educational level, which in turn, will contribute to social and economic betterment of society.
- To provide an environment that values and encourages knowledge acquisition and academic freedom, making this a preferred institution for knowledge seekers.
- To provide quality assurance.
- To partner and collaborate with industry, government, and R and D institutes to develop new knowledge and sustainable technologies and serve as an engine for facilitating the nation's economic development.
- To impart personality development skills to students that will help them to succeed and lead.
- To instil in students the attitude, values and vision that will prepare them to lead lives of personal integrity and civic responsibility.
- To promote a campus environment that welcomes and makes students of all races, cultures and civilizations feel at home.
- Putting students face to face with industrial, governmental and societal challenges.

VISION & MISSION OF THE DEPARTMENT

Vision

To be a pioneer in electrical and electronics engineering education and research, preparing students for higher levels of intellectual attainment, and making significant contributions to profession and society.

Mission:

- To impart quality education in electrical and electronics engineering in dynamic learning environment and strive continuously for the interest of stake holders, industry and society.
- To create an environment conducive to student-centered learning and collaborative research.
- To provide students with knowledge, technical skills, and values to excel as engineers and leaders in their profession.

III. PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO-I : Apply fundamental principles of Electrical & Electronics Engineering, Mathematical Sciences relevant to Electric Power & Energy related industries and institutions.

PEO-II : Undertake research in the emerging areas of Power Semi-conductor Devices, Static Power Electronic Converters, Pc based Real time implementations with control system applications to Electrical Drives and Power Supplies.

PEO-III: Apply leadership skills through effective communication and work in a collaborative interdisciplinary environment.

PEO-IV: Acquire ethical values, social responsibilities and life-long learning ability through professional bodies encouraged during their study in the college campus.

IV. PROGRAM OUTCOMES (POs)

PO-1 : An ability to independently carry out research /investigation and development work to solve practical problems.

PO-2 : An ability to write and present a substantial technical report/document.

PO-3 : Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

V. ACADEMIC REGULATIONS

Applicable for the students of M.Tech from the Academic Year 2020-21.

1. PG – M.Tech Programs

The following M.Tech Programs are offered at present

i. Structural Engineering (SE)
ii. Power Electronics and Electric Drives (PEED)
iii. Machine Design (MD)
iv. VLSI Design and Embedded Systems (VLSID & ES)
v. Computer Science and Engineering (CSE)

2. Duration of the Program

The duration of the program is two academic years consisting of four semesters. However, a student is permitted to complete the course work of M.Tech program in the stipulated time frame of four academic years from the date of joining.

3. Minimum Instruction Days

Each semester consists of a minimum of ninety instruction days.

4. Program Credits

Each specialization of the M.Tech programs is designed to have a total of 70 credits and the student shall have to complete the two year course work and earn all the 70 credits for the award of M.Tech Degree.

5. Attendance Regulations

5.1 A student shall be eligible to appear for Semester End Examinations if he acquires a minimum of 75% of attendance in aggregate of all the subjects.

5.2 Condoning of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester will be considered for genuine reasons such as medical grounds and participation in co-curricular and extra-curricular activities and shall be granted only after approval by the College Academic Committee. Student should submit application for medical leave along with medical certificate from a registered medical practitioner within three days from reporting to the class work after the expiry of the medical leave. In case of participation in co-curricular and extra-curricular activities, either in the college or other colleges, students must take prior written permission from HoD concerned and should also submit the certificate of participation from the organizer of the event within three days after the completion of the event. Only such cases will be considered for condoning attendance shortage.

5.3 A student shall be eligible to claim for condonation of attendance shortage only once during the two years (four semesters) course work.

5.4 A student will not be promoted to the next semester unless he satisfies the attendance requirement of the current semester. He may seek re-admission for that semester when offered next.

5.5 Shortage of Attendance below 65% in aggregate shall in *NO* case be condoned.

5.6 Students whose shortage of attendance is not condoned in any semester are not eligible to take their end examination of that semester and their registration shall stand cancelled.

5.7 A fee stipulated by the college shall be payable towards condoning attendance shortage.

5.8 A Student is required to put up a minimum of 75% attendance in the Mandatory Non-credit courses for getting the satisfactory grade.

6. Examinations and Scheme of Evaluation

6.1 Theory Courses :

Each theory course shall be evaluated for a total of 100 marks, consisting of 30 marks for internal assessment and 70 marks for semester end examination.

Internal Assessment:

i) Of 30 marks for internal assessment, 10 marks are for continuous assessment in the form of two assignments and 20 marks are based on two mid-term examinations.

ii) Each assignment carries 10 marks and the average of two assignments shall be taken as the marks for continuous assessment.

iii) Each mid-term examination is conducted for 30 marks with one and half hour duration. Each mid-term examination consists of three questions, each for 10 marks. All the questions need to be answered.

iv) Sum of the75% marks of better scored mid-term examination and 25% marks of less scored mid-term examination are scaled down for 20 marks.

v) For the project based theory course, the distribution of 30 marks for internal evaluation shall be 20 marks for theory, based on two mid- term examinations and 10 marks for project. Each mid-term examination is conducted for 30 marks with one and half hour duration. Each mid-term examination consists of two questions, each for 15 marks, with internal choice. All the questions need to be answered. Sum of the 75% marks of better scored mid-term examination and 25% marks of less scored mid-term examination are scaled down for 20 marks.

External Assessment:

i) Semester End Examination will be conducted for 70 marks consisting of five internal choice questions i.e. "either" or choice, carrying 14 marks each. There will be two questions from each unit and the student should answer either of the two questions.

ii) For the project based theory course, the pattern of semester end examination is same as the above. There will be no external assessment for project component.

6.2 Laboratory Courses :

i) For practical subjects the distribution shall be 30 marks for Internal Evaluation and 70 marks for the End Examination. There shall be continuous evaluation by the internal subject teacher during the semester for 30 internal marks. Of the 30 marks for internal, 20 marks shall be for day-to-day performance (15 marks for day-to-day evaluation and 5 marks for Record) and 10 marks shall be evaluated by conducting an internal laboratory test towards the end of semester.

ii) Semester end examination shall be conducted by an internal examiner and an external examiner for 70 marks.

6.3 Mini Project with Seminar:

Mini Project with seminar shall be evaluated for a total of 100 Marks.

i) Of 100 marks, 30 marks shall be awarded by the project supervisor based on student's involvement in carrying out the project and the remaining 70 marks are based on presentation and viva-voce before a committee consisting of supervisor, head of the department and a senior faculty of the department.

ii) There will be no external assessment for mini project.

6.4 Mandatory Non-credit Course:

i) A student is required to take up two Non-Credit course viz. Constitution of India, English for Research Paper writing, one in I semester and the other in II semester. Marks are awarded based on the day-to-day performance in the seminars organized under each course. A student is required to score 40 marks out of 100 marks despite putting up a minimum of 75% attendance to be declared satisfactory in each mandatory non-credit course. The M.Tech degree shall only be awarded if a student gets satisfactory grade in each of the two mandatory non-credit courses and besides acquiring 70 credits of the M.Tech degree course.

ii) A student whose shortage of attendance is condoned in the case of credit courses in that semester shall also be eligible for condoning shortage of attendance up to 10% in the case of mandatory non-credit courses also.

iii) A student has to repeat the course whenever it is offered, if he does not get satisfactory grade or not fulfilling the attendance requirements in each non-credit course for getting the degree awarded.

6.5 MOOCs:

i) A Student shall register for MOOCs offered by NPTEL, CISCO, MICROSOFT and SAYLOR or any other agency with prior approval of departmental committee.

ii) The courses should be other than those offered under regular curriculum and are to be approved by the Departmental Committee consisting of the head of the department, mentor and one/two senior faculty members before the commencement of each semester.

iii) The duration of the course shall be 12 weeks / 50-70 hrs (maximum).

iv) The schedule of the course must be in line with the academic schedule of that semester.

v) The required credits shall be awarded on submission of certificate from the approved agency.

6.6 Project Work:

Every candidate shall be required to submit a dissertation on a topic approved by the Project Review Committee.

i) A Project Review Committee (PRC) shall be constituted for each specialization with Head of the Department / a Senior Faculty as Chairman and two other senior faculty members.

ii) Registration of Project Work: A candidate who has been promoted to 3rd semester shall be eligible to register for the project work.

iii) The eligible candidate can choose his project supervisor and submit the title, objective, abstract and plan of action of the proposed project work to the department for approval by the PRC. The candidate whose proposal is approved by the PRC shall register for the project work. The minimum duration of project work will be 36 weeks from the date of registration.

iv) If a candidate wishes to change his supervisor or topic of the project, he can do so with the approval of the PRC. In case of such changes, the candidate has to register afresh.

v) There shall be three reviews on the progress of the project work by the PRC with an interval of 12 weeks. The candidate needs to submit a report on the progress of his work and present it before the PRC for assessment. The PRC may suggest for an extension of date of submission of dissertation if the progress of work is not satisfactory or absent himself for the review.

vi) A candidate who has passed all the theory, laboratory and Mini project with seminar examinations and shown satisfactory progress of project work is permitted to submit the dissertation after 36 weeks from the date of registration.

vii) If a candidate fails to submit the dissertation by the end of the 4th semester, he has to take the permission for an extension by paying the semester(s) tuition fee.

viii) Three copies of the Project Thesis certified by the supervisor shall be submitted to the Department.

ix) Project evaluation and Viva-Voce examination is conducted at the end of 4th semester by a committee consisting of Project Supervisor, senior faculty of the department, HoD and an External Examiner nominated by the Chief Controller of Examinations out of a panel of three examiners suggested by the department.

The following grades are awarded for the project work:

i. Excellent
ii. Very Good
iii. Good
iv. Satisfactory
v. Unsatisfactory

The Grade "unsatisfactory" is treated as Fail. Failed Students should take supplementary examination after making required modifications, if any, in the dissertation with a minimum gap of 8 weeks by paying the required examination fee.

7. Criteria for Passing a Course and Award of Grades:

7.1 Criteria for Passing a Course:

i) A candidate shall be declared to have passed in individual theory / laboratory course, if he secures a minimum of 50% aggregate marks (internal & semester end examination marks put together), subject to securing a minimum of 40% marks in the semester end examination.

ii) The candidate shall be declared to have passed in Mini project with seminar if he secures 50% marks.

iii) The candidate shall be declared to have successfully completed the project work if he secures a minimum of 'satisfactory' grade in the project evaluation and viva-voce examination.

iv) On passing a course of a program, the student shall earn assigned credits in that course.

7.2 Method of Awarding Letter Grade and Grade Points for a Course:

A letter grade and grade points will be awarded to a student in each course based on his performance, as per the grading system given below.

Theory /Elective /Laboratory /Seminar / Term Paper /Project Dissertation (%)	Grade Points	Letter Grade
≥ 90	10	O (Outstanding
≥ 80 & < 90	9	A+ (Excellent)
≥ 70 & < 80	8	A (Very Good)
≥ 60 & < 70	7	B+ (Good)
≥ 50 & < 60	6	B (Above Average)
< 50	0	F (Fail)

7.3 Calculation of Semester Grade Point Average (SGPA)* for semester:

The performance of each student at the end of the each semester is indicated in terms of SGPA. The SGPA is calculated as given below:

SGPA = $\frac{\sum(CR \, X \, GP)}{\sum CR}$ for each semester.

where CR = Credits of a course

GP = Grade Points awarded for a course

* SGPA is calculated for a candidate who passed all the courses in that semester.

7.4 Eligibility for Award of M.Tech Degree:

A student will be declared eligible for the award of the M. Tech. Degree if he fulfills the following academic regulations.

(a) Pursued a course of study for not less than two academic years and not more than four academic years.

(b) Registered for prescribed **70** credits and secured **70** credits.

(c) Students, who fail to complete their Two years Course of study within Four years or fail to acquire the prescribed **70** Credits for the award of the degree within four academic years from the year of their admission shall forfeit their seat in M. Tech course and their admission shall stand cancelled.

7.5 Calculation of Cumulative Grade Point Average (CGPA) for Entire Program:

The CGPA is calculated as given below:

CGPA = $\frac{\sum(CR \, X \, GP)}{\sum CR}$ for entire program.

where CR = Credits of a course

GP = Grade points awarded for a course

* CGPA is calculated for a candidate who passed all the prescribed courses excluding project work.

7.6 Award of Division:

After satisfying the requirements prescribed for the completion of the program, the student shall be eligible for the award of B.Tech Degree and shall be placed in one of the following grades:

CGPA	Class
≥ 7.5	First Class with Distinction *
≥ 6.5 & < 7.5	First Class
≥ 6.0 & < 6.5	Second Class

*** CGPA** ≥ 7.5 will be awarded first class with distinction provided the student must have fulfilled all the program requirements in two (2) years duration.

8. Supplementary Examinations

i) Supplementary examinations will be conducted once in a year along with regular examinations.

ii) Semester end supplementary examinations shall be conducted till next regulation comes into force for that semester after the conduct of the last set of regular examinations under the present regulation.

iii) Thereafter supplementary examinations will be conducted in the equivalent courses as decided by the Board of Studies concerned.

9. Challenge Valuation

Challenge valuation of failed or passed subjects shall be performed as per the following norms.

i) Students can submit the application for challenge valuation, along with the prescribed fee receipt for evaluation of his answer script(s) of theory course(s) as per the notification issued by the Controller of Examinations.

The Controller of Examinations shall arrange for challenge valuation of such answer script(s).

ii) The challenge valuation will be carried out by a three member committee comprising an external subject expert nominated by the Chief Controller of Examinations, the internal subject expert and the BoS Chairman.

iii) After the challenge valuation, if the grade is improved or there is a change in the status i.e., fail to pass, the improved grade shall be notified, otherwise, the previous grade will remain.

10. Re-admission Criteria

A candidate, who is detained in a semester due to lack of attendance has to obtain written permission from the Principal for readmission into the same semester after duly fulfilling the required norms stipulated by the college and by paying the required tuition fee and special fee in addition to paying an administrative fee of Rs. 1,000/-

11. Break in Study

Student, who discontinues the studies for what-so-ever reason, can get readmission into appropriate semester of M.Tech program only with the prior permission of the Principal of the College, provided such candidate shall follow the transitory regulations applicable to the batch he joins. An administrative fee of Rs.2,000/- per each year of break in study in addition to the prescribed tuition and special fees shall be paid by the candidate to condone his break in study.

12. Transitory Regulations

When a student is detained due to shortage of attendance, he/she may be readmitted into the same semester in which he/she has been detained. However, the academic regulations under which the detained student was first admitted shall continue to be applicable to him/her. A candidate, who is detained in a semester, on readmission shall be required to do all the courses in the curriculum prescribed for the batch of students in which the student joins subsequently. However, exemption will be given to those candidates who have already passed such courses in the earlier semester(s) he was originally admitted into and he will be offered substitute subjects in place of them as decided by the Board of Studies. However, the decision of the Board of Studies will be final.

13. Withholding of Results

If the student has not paid the dues, if any, to the College or if any case of indiscipline is pending against him, the result of the student will be withheld. His degree will be withheld in such cases.

14. Malpractices

i) The Principal shall refer the cases of malpractices in internal assessment tests and semester end examinations to a malpractice enquiry committee constituted by him for the purpose. Such committee shall follow the approved levels of punishment. The Principal shall take necessary action against the erring students based on the recommendations of the committee.

ii) Any action by the candidate trying to get undue advantage in the performance or trying to help another, or derive the same through unfair means is punishable according to the provisions contained hereunder.

iii) Malpractices identified at spot centre during valuation

The following procedure is to be followed in the case of malpractice cases detected during valuation, scrutiny etc. at spot centre.

I. A notice is to be served to the candidate(s) involved **(i)** through the Principal of the college, **(ii)** to the candidate(s) to his college address and **(iii)** to the candidate(s) to his permanent address regarding the malpractice.

DISCIPLINARY ACTION FOR MALPRACTICES/IMPROPER CONDUCT IN EXAMINATIONS

	Nature of Malpractices / Improper conduct	Punishment
If the candidate		
1.a	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination.)	Expulsion from the examination hall and cancellation of the performance in that subject only.
b	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through Cell phones with any candidates or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that semester / year. The hall ticket of the candidate shall be cancelled.

3.	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate who has been impersonated shall be cancelled in all the subjects of the examination (including practicals and project work) already appeared and shall not be allowed to appear for the examinations of the remaining subjects of that semester / year. The candidate is also debarred for two consecutive semesters from class work and all examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the impostor is an outsider, he will be handed over to the police and a case is registered against him.
4.	Smuggles in the Answer book or takes out or arranges to send out the question paper during the examination or answer book during or after the examination.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that semester / year. The candidate is also debarred for two consecutive semesters from class work and all examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of performance in that subject.

6.	Refuses to obey the orders of the Chief Superintendent/Assistant Superintendent / any officer on duty or misbehaves or creates disturbance of any kind in or around the examination hall or organises a walkout or instigates others to walkout or threatens the officer-in-charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the Officer-in-charge or any person on duty in or outside the examination hall of any of his relations or indulges in any other act of misconduct or mischief which results in damage to or destruction of property in the examination hall or any part of the college campus or engages in any other act which in the opinion of the Officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	Expulsion from the examination hall and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester / year. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.
7.	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that semester. The candidate is also debarred for two consecutive semesters from class work and all university examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that semester. The candidate is also debarred and forfeits the seat.

9	If student of the college who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that semester. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the college will be handed over to the police and a police case is registered against them.
10.	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester / year.
11.	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester / year examinations.
12.	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be referred to the Chief Superintendent of Examinations for future action towards suitable punishment.	

II. A committee consisting of the following is to be constituted at spot centre to process such malpractice cases and the recommendations of the malpractice committee are to be sent to the Chief Controller of Examinations.

1. Principal — Chairman
2. Vice Principal - Academics — Member
3. Chief examiner of that subject — Member
4. Controller of Examinations — Convener

The involvement of the staff, who are in charge of conducting examinations, valuing examination papers and preparing / keeping records

of documents related to the examinations in such acts (inclusive of providing incorrect or misleading information) that infringe upon the course of natural justice to one and all concerned at the examination shall be viewed seriously and appropriate disciplinary action will be taken after thorough enquiry.

15. Other Matters

i) Deserving physically challenged candidates will be given additional examination time and a scribe based on the certificate issued by the concerned authority. Students who are suffering from contagious diseases are not allowed to appear either for internal or semester end examinations.

ii) The students who participated in coaching / tournaments held at State / National / International levels through University / Indian Olympic Association during semester end external examination period will be promoted to subsequent semesters as per the guidelines of University Grants Commission Letter No. F.1-5/88 (SPE/PES), dated 18-08-1994.

iii) The Principal shall deal in an appropriate manner with any academic problem which is not covered under these rules and regulations, in consultation with the Heads of the Departments and subsequently such actions shall be placed before the Academic Council for ratification. Any emergency modification of regulation, approved in the meetings of the Heads of the Departments shall be reported to the Academic Council for ratification.

16. General

i) The Academic Council may, from time to time, revise, amend or change the regulations, schemes of examination and /or syllabi.

ii) The academic regulations should be read as a whole for the purpose of any interpretation.

iii) In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Chairman of the Academic Council is final.

v) Wherever the word he, him or his occurs, it will also include she, her and hers.

VI. CURRICULAR COMPONENT

Sl. No.	Course Work - Subject Areas	Total No.of Credits	% of Total Credits
1	Baisc Sciences (BS)	3	4.28
2	Humanities and Social Sciences (HSS)	3	4.28
3	Professional Core (PC)	25	35.72
4	Professional Electives (PE)	9	12.86
7	Others (Seminar, Term Paper, Dissertation, etc.)	30	42.86

COURSE STRUCTURE

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SYLLABUS

COURSE STRUCTURE

I Semester

Sl. No.	Course Code	Name of the Course / Laboratory	No.of Periods per week			No.of Credits
			L	T	P	
1	EE3901	Electrical Machine Modeling and Analysis	3	-	-	3
2	EE3902	Analysis of Power Electronic Converters**	3	-	-	3
3		Professional Elective - I	3	-	-	3
4		Professional Elective - II	3	-	-	3
5		Research Methodology & IPR	3	-	-	3
6	EE3909	Power Electronics Simulation Laboratory	-	-	4	2
7	EE3910	Power Converters Laboratory	-	-	4	2
		Total	**15**	**-**	**8**	**19**
8	BA3902	Constitution of India (Audit Course)	2	-	-	

II Semester

Sl. No.	Course Code	Name of the Course / Laboratory	No.of Periods per week			No.of Credits
			L	T	P	
1	EE3911	Switched Mode Power Conversion	3	-	-	3
2	EE3912	Power Electronic Control of Electrical Drives **	3	-	-	3
3		Professional Elective - III	3	-	-	3
4		Professional Elective - IV	3	-	-	3
5	EE3919	Electric Drives Simulation Laboratory	-	-	4	2
6	EE3920	Electric Drives Laboratory	-	-	4	2
7	EE3921	Mini Project with Seminar	-	-	6	3
		Total	**12**	**-**	**14**	**19**
8	EG3901	English for Research Paper Writing (Audit Course)	2	-	-	-

III Semester

Sl. No.	Course Code	Name of the Course / Laboratory	No.of Periods per week			No.of Credits
			L	T	P	
1		Professional Elective - V	3	-	-	3
2		Open Elective	3	-	-	3
3		Dissertation Phase - I	-	-	20	10
		Total	**6**	**-**	**20**	**16**

** Project Based Course

L : Lecture T : Tutorial P : Practical

IV Semester

Sl. No.	Course Code	Name of the Course / Laboratory	No.of Periods per week			No.of Credits
			L	T	P	
1		Dissertation Phase - II	-	-	32	16
		Total	**-**	**-**	**32**	**16**

Professional Electives:

Professional Elective - I

EE3903 Modern Control Theory
EE3904 Power Quality and Custom Power Devices
EE3905 Programmable Logic Controllers and Applications

Professional Elective - II

EE3906 Artificial Intelligence Techniques
EE3907 Renewable Energy Technologies
EE3908 Flexible AC Transmission Systems

Professional Elective - III

EE3913 Control and Integration of Renewable Energy Systems
EE3914 Hybrid Electric Vehicles
EE3915 Advanced Digital Control Systems

Professional Elective - IV

EE3916 Advanced Digital Signal Processing
EE3917 Applications of Power Converters
EE3918 Microcontrollers

Professional Elective - V

EE3922 Digital Signal Processing Controlled Drives
EE3923 Smat Grid Technologies
EE39.... MOOCs

Open Electives:

CE3924 Sustainable Development
EE3924 Energy Audit, Conservation & Management
ME3924 Rapid Prototyping
EC4924 Automotive Electronics (Otther than VLSID&ES)
CS3924 Soft Computing Techniques

SYLLABUS

ELECTRICAL MACHINE MODELING AND ANALYSIS

I Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To know the concepts of generalized theory of electrical machines.
- To represent the DC and AC machines as Basic Two Pole machine.
- To model the electrical machines with voltage, current, torque and speed equations.
- To investigate the steady state and transient behavior of the electrical machines.
- To understand the dynamic behavior of the AC machines.

Course Outcomes

Upon successful completion of the course, the students will be able to

- Analyze the characteristics of different types of DC motors to design suitable controllers for different applications.
- apply the knowledge of reference frame theory for AC machines to model the induction and Synchronous machines.
- evaluate the steady state and transient behavior of induction and synchronous machines to propose the suitability of drives for different industrial applications
- analyze the behavior of induction machines using voltage and torque equations.

Course Content

UNIT– I: Basic Concepts of Modeling

Basic two-pole machine representation of Commutator machines, representations of 3-phase synchronous machine with and without damper bars and 3-phase induction machine, Kron s primitive Machine voltage, current and torque equations.

UNIT–II: DC Machine Modeling

Mathematical model of separately excited D.C motor – Steady state analysis-transient State analysis sudden application of inertia load-transfer function of separately excited D.C motor- Mathematical model of D.C Series motor, Shunt motor-Linearization techniques for small perturbations

UNIT–III: Reference frame theory & Modeling of single phase Induction Machines

Linear transformation-Phase transformation - three phase to two phase transformation (abc to áâ0) and vice-versa, transformation to rotating reference frame, (áâ0 to dqo) and vice versa -Power equivalence- Mathematical modeling of single phase induction machines.

UNIT–IV: Modeling of three phase Induction Machine

Generalized model in arbitrary reference frame-Derivation of commonly used induction machine models- Synchronously rotating reference frame model, Stator reference frame model-Rotor reference frame model—power equation, electromagnetic torque equation, state space model in induction motor with flux linkages as variables

UNIT–V: Modeling of Synchronous Machine

Synchronous machine inductances –derivation of voltage equations in the rotor s dq0 reference frame electromagnetic torque-current in terms of flux linkages-three phase synchronous motor. State space models with flux linkages as variables.

Text Books

1. Analysis of Electric Machinery and Drive Systems, 3rd Edition-Wiley-IEEE Press- Paul Krause, Oleg Wasynczuk, Scott D. Sudhoff, Steven Pekarek, Junr 2013.
2. Electric Motor Drives - Modeling, Analysis& control -R.Krishnan- Pearson Publications.

Reference Books

1. Generalized theory of Electrical Machines -Fifth edition, Khanna Publishers P. S. Bimbhra, 1985.
2. Dynamic simulation of Electric machinery using MATLAB / Simulink – CheeMunOng- Prentice Hall, 2003.
3. Magneto electric devices transducers, transformers and machines-G. R. Slemon- Wiley in New York, London, 1966.

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ANALYSIS OF POWER ELECTRONIC CONVERTERS

I Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To understand the control principle of ac to ac conversion with suitable power semi - conductor devices.
- To have the knowledge of ac to dc conversion and different ac to dc converter topologies.
- To understand the effect of operation of controlled rectifiers on p.f. and improvement of p.f. with PFC converters
- To acquire the knowledge on dc-ac converters and to know the different control techniques of dc-ac converters.
- To know multilevel inverter configuration to improve the quality of the inverter output voltage.

Course Outcomes

Upon successful completion of the course, the students will be able to

- describe and analyze the operation of AC-DC converters.
- analyze the operation of power factor correction converters.
- analyze the operation of three phase inverters with PWM control.
- study the principles of operation of multi- level inverters and their applications.

Course Content

UNIT – I: Overview of Switching Devices

Power MOSFET, IGBT, GTO, GaN devices-static and dynamic characteristics, gate drive circuits for switching devices.

UNIT – II: AC-DC converters

Single phase fully controlled converters with RL load– Evaluation of input power factor and harmonic factor- Continuous and Discontinuous load current, Power factor improvements, Extinction angle control, symmetrical angle control, PWM control. Three Phase AC-DC Converters, fully controlled converters feeding RL load with continuous and discontinuous load current, Evaluation of input power factor and harmonic factor-three phase dual converters.

UNIT – III: Power Factor Correction Converters

Single-phase single stage boost power factor corrected rectifier, power circuit principle of operation, and steady state- analysis, three phase boost PFC converter.

UNIT – IV: PWM Inverters

Principle of operation-Voltage control of single phase inverters - sinusoidal PWM – modified PWM – phase displacement Control – Trapezoidal, staircase, stepped, harmonic injection and delta modulation. Voltage Control of Three-Phase Inverters- Sinusoidal PWM- 600PWM- Third Harmonic PWM- Space Vector Modulation- Comparison of PWM Techniques- Three phase current source inverters-Variable dc link inverter.

UNIT – V: Multi-level Inverters

Introduction, Multilevel Concept, Types of Multilevel Inverters- Diode-Clamped Multilevel Inverter, Principle of Operation, Features of Diode-Clamped Inverter, Improved Diode-Clamped Inverter- Flying-Capacitors Multilevel Inverter- Principle of Operation, Features of Flying-Capacitors Inverter- Cascaded Multilevel Inverter-Principle of Operation- Features of Cascaded Inverter-Switching Device Currents-DC-Link Capacitor Voltage Balancing- Features of Multilevel Inverters-Comparisons of Multilevel Converters.

Text Books

1. Power Electronics: Converters, Applications, and Design- Ned Mohan, Tore M. Undeland, William P. Robbins, John Wiley& Sons, 2nd Edition, 2003.
2. Power Electronics-Md.H.Rashid –Pearson Education Third Edition- First Indian Reprint-2008.

Reference Books

1. Power Electronics Daniel W. Hart - McGraw-Hill, 2011.
2. Elements of Power Electronics – Philip T. Krein, Oxford University press, 2014.
3. Power Converter Circuits – William Shepherd & Li Zhang-Yes Dee CRC Press, 2004.

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Professional Elective - I

MODERN CONTROL THEORY

I Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To familiarize the concepts of state variables analysis.
- To impact the knowledge on design of control systems using state variable techniques.
- To familiarize students with stability methods of non-linear systems.
- To introduce the fundamental concepts on optimal control theory.

Course Outcomes

Upon successful completion of the course, the students will be able to

- formulate and solve the various state space representations of dynamic systems.
- examine a system for its controllability and observability.
- design a state feedback controller and an observer.
- analyze the behavior of non-linear systems through describing functions.
- determine the stability of a given system using various state variable techniques.
- design an optimal control system using variational approach.

Course Content

UNIT – I: State Variable Analysis

The concept of state – State Equations for Dynamic systems– Solution of Linear Time Invariant Continuous-Time State Equations, State transition matrix and it s properties. Controllability and Observability of state model in Jordan Canonical form - Controllability and Observability Canonical forms of State model.

UNIT – II: Design using state variable Technique

Design of state feedback controller through pole placement technique-Necessary and sufficient condition- Ackermann s formula. Concept of observer-Design of full order state observer-reduced order observer.

UNIT – III: Non Linear Systems

Classification of Nonlinearities- common physical nonlinearities– Characteristics of nonlinear systems - Singular Points –Linearization of nonlinear systems– Describing function – describing function analysis of nonlinear systems- Stability analysis of Nonlinear systems through describing functions.

UNIT – IV: Stability Analysis

Stability in the sense of Lyapunov, Lyapunov s stability and Lyapunov s instability theorems – Stability Analysis of Linear Continuous time invariant systems by Lyapunov method – Generation of Lyapunov functions – Variable gradient method – Krasooviski s method.

UNIT – V: Introduction to Optimal Control

Minimization of functional of single function – Constrained minimization – Minimum principle – Control variable inequality constraints – Control and state variable inequality constraints – Euler Lagrangine equation.

Typical optimal control performance measures-optimal control based on Quadratic performance measures- Quadratic optimal regulator systems- State regulator problems –Output regulator problems, tracking problems; Riccati equation-Infinite time regulator problem-Reduce matrix Riccati equation determination of optimal feedback gain matrix.

Text Books

1. Modern Control Engineering – by K. Ogata, Prentice Hall of India, 3rd edition, 1998.
2. Automatic Control Systems by B.C. Kuo, Prentice Hall Publication.

Reference Books

1. Modern Control System Theory – by M. Gopal, New Age International Publishers, 2nd edition,1996
2. Control Systems Engineering by I.J. Nagarath and M.Gopal, New Age International (P) Ltd.
3. Digital Control and State Variable Methods – by M. Gopal, Tata McGraw–Hill Companies, 1997.
4. Systems and Control by Stainslaw H. Zak , Oxford Press, 2003.
5. Optimal control theory: an Introduction by Donald E.Kirk by Dover publications.
6. Modern control systems, Richard C. Dorf and Robert H. Bishop, 11th Edition, Pearson Edu, India,2009

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Professional Elective - I

POWER QUALITY AND CUSTOM POWER DEVICES

I Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To understand significance of power quality and power quality parameters.
- To know types of transient over voltages and protection of transient voltages.
- To understand harmonics, their effects, harmonic indices and harmonic minimization techniques.
- To understand the importance of power devices and their applications.
- To understand different compensation techniques to minimize power quality disturbances.

Course Outcomes

Upon successful completion of the course, the students will be able to

- identify the issues related to power quality in power systems.
- address the problems of transient and long duration voltage variations in power systems.
- analyze the effects of harmonics and study of different mitigation techniques.
- identify the importance of custom power devices and their applications.
- acquire knowledge on different compensation techniques to minimize power quality disturbances.

Course Content

UNIT – I: Introduction to Power Quality

Overview of Power Quality, Concern about the Power Quality, General Classes of Power Quality Problems, Voltage Unbalance, Waveform Distortion, Voltage fluctuation, Power Frequency Variations, Power Quality Terms, Voltage Sags, swells, flicker and Interruptions - Sources of voltage and current interruptions, Nonlinear loads.

UNIT – II: Transient and Long Duration Voltage Variations

Source of Transient Over Voltages - Principles of Over Voltage Protection, Devices for Over Voltage Protection, Utility Capacitor Switching Transients, Utility Lightning Protection, Load Switching Transient Problems. Principles of Regulating the Voltage, Device for Voltage Regulation, Utility Voltage Regulator.

Application, Capacitor for Voltage Regulation, End-user Capacitor Application, Regulating Utility Voltage with Distributed generation.

UNIT – III: Harmonic Distortion and Solutions

Voltage vs. Current Distortion, Harmonics vs. Transients – Power System Quantities under Non-sinusoidal Conditions, Harmonic Indices, Sources of harmonics, Locating Sources of Harmonics, System Response Characteristics, Effects of Harmonic Distortion, Inter harmonics, Harmonic Solutions Harmonic Distortion

Evaluation, Devices for Controlling Harmonic Distortion, Harmonic Filter Design, Standards on Harmonics.

UNIT – IV: Custom Power Devices

Custom power and custom power devices, voltage source inverters, reactive power and harmonic compensation devices, compensation of voltage interruptions and current interruptions, static series and shunt compensators, compensation in distribution systems, interaction with distribution equipment, installation considerations.

UNIT – V: Application of Custom Power Devices in Power Systems

Static and hybrid Source Transfer Switches, Solid state current limiter - Solid state breaker. P-Q theory – Control of P and Q, Dynamic VoltageRestorer (DVR): Operation and control – Interline Power Flow Controller (IPFC): Operation and control of Unified Power Quality Conditioner (UPQC); Generalized power quality conditioner.

Text Books

1. Electrical Power Systems Quality, Dugan R C, McGranaghan M F, Santoso S, and Beaty H W, Second Edition, McGraw-Hill, 2002.
2. Understanding Power Quality Problems: Voltage Sags and Interruptions, Bollen M H J, First Edition, IEEE Press; 2000.
3. Guidebook on Custom Power Devices, Technical Report, Published by EPRI, Nov 2000.
4. Power Quality Enhancement Using Custom Power Devices – Power Electronics and Power Systems, Gerard Ledwich, ArindamGhosh, Kluwer Academic Publishers, 2002.

Reference Books

1. Park & Paulay, “Reinforced Concrete”, John Wiley & sons Publications.
1. Power Quality Primer, Kennedy B W, First Edition, McGraw-Hill, 2000.
2. Power System Harmonics, Arrillaga J and Watson N R, Second Edition, John Wiley & Sons, 2003.
3. Electric Power Quality control Techniques, W. E. Kazibwe and M. H. Sendaula, Van Nostrad Reinhold, New York.
4. Power Quality C. Shankaran, CRC Press, 2001
5. Harmonics and Power Systems –Franciso C.DE LA Rosa-CRC Press (Taylor & Francis).
6. Power Quality in Power systems and Electrical Machines-EwaldF.fuchs, Mohammad A.S.Masoum-Elsevier
7. Power Quality, C. Shankaran, CRC Press, 2001
8. Instantaneous Power Theory and Application to Power Conditioning, H. Akagiet.al., IEEE Press, 2007.
9. Custom Power Devices - An Introduction, Arindam Ghosh and Gerard Ledwich, Springer, 2002
10. A Review of Compensating Type Custom Power Devices for Power Quality Improvement, Yash Pal et.al., Joint International Conference on Power System Technology and IEEE Power India Conference, 2008. POWERCON 2008.

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Professional Elective - I

PROGRAMMABLE LOGIC CONTROLLERS & APPLICATIONS

I Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To have knowledge on PLC.
- To acquire the knowledge on programming of PLC.
- To understand different PLC registers and their description.
- To have knowledge on data handling functions of PLC.
- To know how to handle analog signal and converting of A/D in PLC.

Course Outcomes

Upon successful completion of the course, the students will be able to

- understand the PLCs and their I/O modules.
- develop control algorithms to PLC using ladder logic etc.
- manage PLC registers for effective utilization in different applications.
- handle data functions and control of two axis and their axis robots with PLC.
- design PID controller with PLC.

Course Content

UNIT – I: PLC Basics

PLC system, I/O modules and interfacing, CPU processor, programming equipment, programming formats, construction of PLC ladder diagrams, devices connected to I/O modules.

UNIT – II: PLC Programming

Input instructions, outputs, operational procedures, programming examples using contacts and coils. Drill press operation. Digital logic gates, programming in the Boolean algebra system, conversion examples. Ladder diagrams for process control: Ladder diagrams and sequence listings, ladder diagram construction and flow chart for spray process system.

UNIT – III: PLC Registers

Characteristics of Registers, module addressing, holding registers, input registers, output registers. PLC Functions: Timer functions and Industrial applications, counters, counter function industrial applications, Arithmetic functions, Number comparison functions, number conversion functions.

UNIT – IV: Data Handling Functions

SKIP, Master control Relay, Jump, Move, FIFO, FAL, ONS, CLR and Sweep functions and their applications. Bit Pattern and changing a bit shift register, sequence functions and applications, controlling of two axis and three axis Robots with PLC, Matrix functions.

UNIT – V: Analog PLC operation

Analog modules and systems, Analog signal processing, multi bit data processing, analog output application examples, PID principles, position indicator with PID control, PID modules, PID tuning, PID functions.

Text Books

1. Programmable Logic Controllers – Principle and Applications by John W. Webb and Ronald A.Reiss, Fifth Edition, PHI
2. Programmable Logic Controllers – Programming Method and Applications by JR. Hackworth and F.D Hackworth Jr. – Pearson, 2004.

Reference Books

1. Introduction to Programmable Logic Controllers- Gary Dunning-Cengage Learning. Programmable Logic Controllers –W.Bolton-Elsevier publisher.

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Professional Elective - II

ARTIFICIAL INTELLIGENCE TECHNIQUES

I Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To have knowledge on concept of neural network.
- To know different types of neural networks and training algorithms.
- To understand the concept of genetic algorithm and its application in optimization.
- To have the knowledge on fuzzy logic and design of fuzzy logic controllers.
- To know the applications of AI Techniques in electrical engineering.

Course Outcomes

Upon successful completion of the course, the students will be able to

- differentiate between Algorithmic based methods and knowledge based methods.
- use appropriate AI framework for solving power system problems.
- design fuzzy logic controllers for power engineering applications.

Course Content

UNIT – I: Introduction

Artificial Neural Networks (ANN) – definition and fundamental concepts – Biological neural networks – Artificial neuron – activation functions – setting of weights – typical architectures – biases and thresholds – learning/training laws and algorithms. Perceptron – architectures, ADALINE and MADLINE – linear separability-XOR function.

UNIT – II: ANN Paradigms

ADALINE – feed forward networks – Back Propagation algorithm- number of hidden layers – gradient decent algorithm – Radial Basis Function (RBF) network. Kohonen sself organizing map (SOM), Learning Vector Quantization (LVQ) and its types – Functional Link Networks (FLN) – Bidirectional Associative Memory (BAM) – Hopfield Neural Network.

UNIT – III: Classical and Fuzzy Sets

Introduction to classical sets- properties, Operations and relations; Fuzzy sets, Membership, Operations,Properties, Fuzzy relations, Cardinalities, Membership functions.

UNIT – IV: Fuzzy Logic Controller (FLC)

Fuzzy logic system components: Fuzzification, Inference engine (development of rule base and decision making system), Defuzzification to crisp sets-Defuzzification methods.

UNIT – V: Application of AI Techniques

Speed control of DC motors using fuzzy logic –load flow studies using back propagation algorithm,single area and two area load frequency control using fuzzy logic.

Text Books

1. Introduction to Artificial Neural Systems - Jacek M. Zuarda, Jaico Publishing House, 1997.
2. Fuzzy logic with Fuzzy Applications – T.J Ross – McGraw Hill Inc, 1997.

Reference Books

1. Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications by S.Rajasekaran and G.A.Vijayalakshmi Pai – PHI Publication.
2. Modern power Electronics and AC Drives – B.K.Bose -Prentice Hall, 2002
3. Genetic Algorithms- David E Goldberg. Pearson publications.
5. Introduction to Neural Networks using MATLAB 6.0 by S N Sivanandam, S Sumathi, S N Deepa TMGH
6. Introduction to Fuzzy Logic using MATLAB by S N Sivanandam,SSumathi,S N Deepa Springer,2007.

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Professional Elective - II

RENEWABLE ENERGY TECHNOLOGIES

I Semester

Lecture	: 4	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To learn technical challenges in renewable energy.
- To learn basics of wind energy conversion & PV power generation.
- To analyze the fuel cell system.

Course Outcomes

Upon successful completion of the course, the students will be able to

- understand various general aspects of renewable energy systems.
- analyze and design induction generator for power generation from wind.
- design MPPT controller for solar power utilization.
- utilize fuel cell systems for power generation

Course Content

UNIT – I: Introduction

Renewable Sources of Energy; Distributed Generation; Renewable Energy Economics - Calculation of Electricity Generation Costs; Demand-Side Management Options; Supply-Side Management Options; Control of renewable energy based power Systems.

UNIT – II: Induction Generators

Principles of Operation; Representation of Steady-State Operation; Power and Losses Generated - Self-Excited Induction Generator; Magnetizing Curves and Self-Excitation – Mathematical Description of the Self-Excitation Process; Interconnected and Stand-alone operation - Speed and Voltage Control.

UNIT – III: Wind Power Plants

Site Selection; Evaluation of Wind Intensity; Topography; Purpose of the Energy Generation- General Classification of Wind Turbines; Rotor Turbines; Multiple-Blade Turbines; Drag Turbines; Lifting Turbines - Generators and Speed Control Used in Wind Power Energy; Analysis of Small wind energy conversion system.

UNIT – IV: Photovoltaic Power Plants

Solar Energy; Generation of Electricity by Photovoltaic Effect; Dependence of a PV Cell on Temperature and irradiance - input-output Characteristics - Equivalent Models and Parameters for Photovoltaic Panels; MPPT schemes: P&O,INC, effect of partial shaded condition. Applications of Photovoltaic Solar Energy-Economical Analysis of Solar Energy.

UNIT – V: Fuel Cells

The Fuel Cell; Low- and High-Temperature Fuel Cells; Commercial and Manufacturing Issues - Constructional Features of Proton Exchange,Membrane Fuel Cells; Reformers; Electrolyzer Systems; Advantages and Disadvantages of Fuel Cells - Fuel Cell Equivalent Circuit; Practical Determination of the Equivalent Model Parameters; Aspects of Hydrogen for storage.

Text Books

1. Felix A. Farret, M. Godoy Simo‘ es, Integration of Alternative Sources of Energy, John Wiley & Sons, 2006.
2. Remus Teodorescu, Marco Liserre, Pedro Rodríguez, Grid Converters for Photovoltaic and Wind Power Systems, John Wiley & Sons, 2011.

Reference Books

1. Gilbert M. Masters, Renewable and Efficient Electric Power Systems, John Wiley & Sons, 2004.

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Professional Elective - II

FLEXIBLE AC TRANSMISSION SYSTEMS

I Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To Introduce the Flexible AC Transmission System devices, basic types of FACTS controllers and different types of converters and their operation in different modes.
- To expose the practical problems associated with the operation of Power system and the necessity of FACTS devices

Course Outcomes

Upon successful completion of the course, the students will be able to

- understand the Fundamental concepts of FACTS Devices.
- familiarize with the operational characteristics of Voltage source converters used in FACTS devices.
- identify a suitable FACTS controller for shunt compensation.
- familiarize with the control characteristics FACTS devices.
- Identify and design a suitable controller using FACTS Devices for Series compensation.

Course Content

UNIT–I: FACTS Concepts

FACTS concepts, Transmission interconnections, power flow in an AC System, loading capability limits, Dynamic stability considerations, importance of controllable parameters, basic types of FACTS controllers, benefits from FACTS controllers.

UNIT–II: Voltage Source Converters

Single phase, three phase, full wave bridge converters, transformer connections for 12 pulse, 24 and 48 pulse operation. Three level voltage source converter, pulse width modulation converter, basic concept of current source converters, and comparison of current source converters with voltage source converters.

UNIT–III: Static Shunt Compensation

Objectives of shunt compensation, midpoint voltage regulation, voltage instability prevention, improvement of transient stability, Power oscillation damping, methods of controllable var generation, variable impedance type static var generators, switching converter type var generators, hybrid var generators.

UNIT–IV: SVC and STATCOM

The regulation and slope transfer function and dynamic performance, transient stability enhancement and power oscillation damping, operating point control and summary of compensation control.

UNIT–V: Static Series Compensators

Concept of series capacitive compensation, improvement of transient stability, power oscillation damping, functional requirements. GTO thyristor controlled series capacitor (GSC), thyristor switched series capacitor (TSSC), and thyristor controlled series capacitor (TCSC), control schemes for GSC, TSSC and TCSC.

Text Books

1. "Understanding FACTS Devices" N.G.Hingorani and L.Guygi, IEEE Press. Indian Edition is available—Standard Publications (Units I to V)

Reference Books

1. HVDC & FACTS Controllers applications of static converters in power systems - Vijay K.Sood- Springer publishers.
2. Sang.Y.H and John.A.T, "Flexible AC Transmission systems" IEEE Press (2006).

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RESEARCH METHODOLOGY & IPR

I Semester

Practical	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

To make the students

- impart the importance of research & IPR in professional growth.

Course Outcomes

Upon successful completion of the course, the students will be able to

- analyze various research methodologies
- perform research design
- collect and analyze the data required for research
- able to write research reports
- apply for Patents, Designs, Trade and Copyright.

Course Content

UNIT–I: Introduction

Research Methodology: Meaning of Research – Objectives – Types – Research Approaches – Significance of Research - Research Methods versus Methodology – Research and Scientific Method – Research Process – Criteria of Good Research – Research Ethics – Problems Encountered by Researchers in India.

Defining the Research Problem: What is a Research Problem? – Selecting the Problem – Necessity of Defining the problem – Technique Involved in Defining a Problem – An Illustration – Conclusion.

UNIT–II: Research Design

Meaning of Research Design – Need for Research Design – Features of a Good Design – Important Concepts Relating to Research Design – Different Research Designs – Basic Principles of Experimental Designs – Important Experimental Designs – Conclusion.

UNIT–III: Data Collection & Preparation, Report Writing

Data Collection: Introduction – Experiments and Surveys – Collection of Primary Data – Collection of Secondary Data – Selection of Appropriate Method for Data Collection – Case Study Method

Data Preparation: Data Preparation Process – Some Problems in Preparation Process – Missing Values and Outliers – Types of Analysis – Statistics in Research

Report Writing: Significance of Report Writing – Difference Steps in Writing Report – Layout of the Research Report – Types of Reports – Oral Presentation – Mechanics of Writing a Research Report – Precautions for Writing Research Reports - Conclusion.

UNIT–IV: Nature of Intellectual Property

Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT–V: Patent Rights & Developments

Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

Text Books

1. Kothari C.R "Research Methodology-Methods and Techniques",New age international Publishers, New Delhi.
2. T. Ramappa, "Intellectual Property Rights in India"

Reference Books

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students".
2. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.

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POWER ELECTRONICS SIMULATION LABORATORY

I Semester

Practical	: 4	Internal Marks	: 30
Credits	: 2	External Marks	: 70

Course Objectives

- To analyze the operation of DC-DC converters, AC-DC converters and DC-AC converters by simulation.

Course Outcomes

Upon successful completion of the course, the students will be able to

- understand the operation of DC-DC converters, AC-DC converters, AC voltage regulators and DC-AC converters by simulation.

List of Experiments:

Any 10 of the following experiments are to be conducted.

1. Simulation of Buck converter using small signal model.
2. Simulation of Boost converter using small signal model.
3. Simulation of single phase half bridge inverter.
4. Simulation of single-phase full bridge inverter using Uni-polar & Bi-polar PWM techniques.
5. Simulation of three phase inverter using sine-triangle PWM.
6. Simulation of three phase inverter using space vector PWM.
7. Simulation of three level three phase NPC inverter.
8. Study of neutral point voltage floating in NPC three level inverter
9. Simulation of 3-level flying capacitor inverter & evaluation of capacitor voltage balanced methods.
10. Simulation of single phase AC voltage regulator.
11. Simulation of three phase AC voltage regulator.
12. Comparison of harmonic profile of two level& three level inverter (FFT analysis).
13. Simulation of 5-level inverter using carrier based PWM methods.
14. Simulation of three phase full converter with RL & RLE loads.
15. Simulation of three-phase dual converter.

Text Books

1. "MATLAB & SIMULINK for Engineers" by Agam Kumar Tyagi, OUP, 2011

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Reference Books

1. ""Power Electronics" by Dr.P.S. Bimbhra, Khana Publisher, Fourth Edition, 2011.

POWER CONVERTERS LABORATORY

I Semester

Practical	: 4	Internal Marks	: 30
Credits	: 2	External Marks	: 70

Course Objectives

- To study and understand the different converters and inverters for single and three phase loads.

Course Outcomes

Upon successful completion of the course, the students will be able to

- implement the converter and inverters in real time applications.

List of Experiments:

Any 10 of the following experiments are to be conducted.

1. Study the characteristics of IGBT, MOSFET & GTO s.
2. Design of gate drive circuits for IGBT & MOSFET s.
3. Determination of input p.f. and harmonic factor for 1-Õsemi- converter and 1-Õ full converter (Inductive load)
4. Study of p.f. improvement in 1-Õ full-converter with symmetric and extinction angle control.
5. Determination of input p.f. and harmonic factor for 3-Õ full converter (Inductive load).
6. Determination of input p.f. and harmonic factor for 3-Õ semi converter (Inductive load).
7. Study of 1-Õ dual converter.
8. Study of buck converter.
9. Study of Four quadrant chopper (Inductive load).
10. Study of 1-Õ square wave and sinusoidal PWM inverter.
11. Study of 3-Õ inverter with 120o and 180o mode of operation.
12. Study of 3-Õ sinusoidal PWM inverter.

Reference Books

1. Power Electronics - Md. H. Rashid - Pearson Education Third Edition - First Indian Reprint - 2008.
2. Power Converter Circuits - William Shedpherd & Li Zhang - Yes Dee CRC Press, 2004.

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Audit Course - I

CONSTITUTION OF INDIA

I Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To understand the structure of Executive, Legislature and Judiciary.
- To understand the autonomous nature of Constitutional bodies like Supreme Court and High court controller and Auditor general of India and Election Commission of India.
- To understand the Central and State relation financial and administrative.

Course Outcomes

Upon successful completion of the course, the students will be able to

- apply the knowledge on Fundamental Rights and Duties and Directive principles of state policy.
- explain the role of President and Prime Minister and also know the Structure of Supreme court and High court.
- understand the Structure of State Government and also analyze the role of Governor and Chief Minister.
- compare and Contrast District administration role and importance.
- evaluate the various commissions of viz., SC/ST/OBC and Women.

Course Content

UNIT–I:

History of Making of the Indian Constitution: Sources. Features – Citizenship, Preamble, Fundamental Rights and Duties, Directive principles of State Policy.

UNIT–II:

Union Government and its administration Structure of the Indian Union: Federalism – Centre – state relationship. President: Role, power and position. Prime Minister and Council of ministers. Loksabha, Rajyasabha The Supreme Court and High Court: Powers and Functions.

UNIT–III:

State Government and its Administration Governor – Role and Position – Chief Minister and Council of ministers.

UNIT–IV:

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation, Pachayati raj: Functions, PRI: ZilaPachayat. Elected offi-

cials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT–V:

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

Text Books

1. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.
2. Subash Kashyap, Indian Constitution, National Book Trust.
3. J.C.Johari, Indian Government and Politics Hans.
4. H.M.Sreevani, Constitutional Law of India, 4th edition in 3 Volumes (Universal Law of Publication).

Reference Books

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.

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SWITCHED MODE POWER CONVERSION

II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course objectives

- To understand the control operation of non-sinusoidal DC-DC converters.
- To understand the basic operation of resonant converters.
- To understand the control operation of isolated DC-DC converters.
- To understand the control schemes of DC-DC converters and designing of magnetic components.
- To understand the modeling and control design of switch mode conversion based on linearization.
- To understand how to analyze the switch mode converters using small-signal analysis.

Course Outcomes

Upon successful completion of the course, the students will be able to

- analyze operation and control of non-isolated and isolated switch mode converters.
- design of non-isolated and isolated switch mode converters.
- analyze operation and control of resonant converters.
- feedback design of switch mode converters based on linearized models.

Course Content

UNIT–I: Non-isolated Switch Mode Converters

Control of DC-DC converters: Buck converters, Boost converters, Buck-Boost converter, CUK Converter, continuous and discontinuous operation, Converter realization with non-ideal components.

UNIT–II: Isolated Switched Mode Converters

Forwarded converter, flyback converter, push-pull converter, half-bridge converter, full bridge converter.

UNIT–III: Resonant Converters

Basic resonant circuit concepts, series resonant circuits, parallel resonant circuits, zero current switching quasi-resonant buck converter, zero current switching quasi-resonant boost converter, zero voltage switching quasi-resonant buck converter, zero voltage switching quasi-resonant boost converter.

UNIT–IV: Control Schemes of Switching Converters

Voltage control, Current mode control, control scheme for resonant converters. Magnetic design consideration: Transformer design, inductor and capacitor design.

UNIT–V: Modeling and Controller Design Based on Linearization

Formulation of averaged models for buck and boost converters: state space analysis, average circuit models, linearization and small – signal analysis, small-signal models.

Control design based on linearization: Transfer function of converters, control design, large signal issues in voltage-mode and current-mode control.

Text Books

1. Fundamentals of Power Electronics-Erickson, Robert W., Maksimovic, Dragan, Springer, 2011.
2. Power switching converters-Simon Ang, Alejandro Oliva, CRC Press, 2010.
3. Elements of Power Electronics – Philip T. Krein, Oxford University press, 2014.
4. Design of Magnetic Components for Switched Mode Power Converters-Umanand, S.P. Bhat, John Wiley & Sons Australia, 1992.

Reference Books

1. Power Electronics: Essentials and applications- L. Umanand, Wiley publications
2. Switching Power Supply Design-Abraham I. Pressman, McGraw-Hill Ryerson, Limited, 1991.
3. Power Electronics – IssaBatareseh, Jhon Wiley publications, 2004.
4. Power Electronics: converters Applications & Design – Mohan, Undeland, Robbins-Wiley publications.

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POWER ELECTRONIC CONTROL OF ELECTRICAL DRIVES

II Semester

Lecture	: 3	nternal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To familiarize with advanced control schemes for induction motor drives and control techniques for PMSM, BLDC and SRM drives.

Course Outcomes

Upon successful completion of the course, the students will be able to

- understand the concepts of scalar and vector control methods for drive systems.
- analyze and design controllers and converters for induction motor, PMSM and BLDC drives.
- select and implement proper control techniques for induction motor and PMSM for specific applications.
- analyze and design control techniques and converters for SRM drives.

Course Content

UNIT–I: Vector Control of Induction Motor Drive

Principle of scalar and vector control, direct vector control, indirect vector control, rotor flux oriented control, stator flux oriented control, air gap flux oriented control, decoupling circuits.

UNIT–II: Sensor less Control of induction Motor Drive

Advantages of speed sensor less control, voltage current based speed sensor less control, MRAS-model reference adaptive systems, Extended Kalman filter observers.

UNIT–III: Direct Torque Control of Induction Motor Drive

Principle of Direct torque control (DTC), concept of space vectors, DTC control strategy of induction motor, comparison between vector control and DTC, applications, space vector modulation based DTC of induction motors.

UNIT–IV: Control of Permanent Magnet Synchronous Machines (PMSM) and Brushless DC (BLDC) Motor Drives

Advantages and limitations of Permanent magnet machines, operating principle of PMSM,modeling of PMSM, operating principle of BLDC, modeling of BLDC, similarities and difference between PMSM and BLDC, need for position sensing in BLDC motors, control strategies for PMSM and BLDC, methods of reducing torque ripples of BLDC motor.

UNIT–V: Control of Switched Reluctance Motor (SRM) Drive

SRM structure, Merits and limitations, stator excitation, converter topologies, SRM waveforms, Torque control schemes, speed control of SRM, torque ripple minimization, instantaneous -torque control using current controllers and flux controllers.

Text Books

1. Bose B. K., "Power Electronics and Variable Frequency Drives ,IEEE Press, Standard Publisher Distributors. 2001.
2. Krishnan R., "Electric Motor Drives – Modeling, Analysis and Control", Prentice Hall of India Private Limited.

Reference Books

1. Switched Reluctance Motors and Their Control-T. J. E. Miller, Magna Physics, 1993.
2. Power electronic converters applications and design-Mohan, Undeland, Robbins-Wiley publications

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Professional Elective - III

CONTROL & INTEGRATION OF RENEWABLE ENERGY SYSTEMS

II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course objectives

- To understand different conventional & non-conventional dynamic energy conversion technologies.
- To learn the principles of static energy conversion technologies.
- To understand the basics of real & reactive power control with renewable generators.
- To learn the principles of standalone and grid connected systems.

Course Outcomes

Upon successful completion of the course, the students will be able to

- gain knowledge on different renewable energy sources and storage devices
- recognize, model and simulate different renewable energy sources
- analyze, model and simulate basic control strategies required for grid connection
- implement a complete system for standalone/grid connected system

Course Content

UNIT – I: Introduction

Electric grid introduction, Supply guarantee and power quality, Stability, Effects of renewable energy penetration into the grid, Boundaries of the actual grid configuration, Consumption models and patterns, static and dynamic energy conversion technologies, interfacing requirements.

UNIT – II: Dynamic Energy Conversion Technologies

Introduction to different conventional and nonconventional dynamic generation technologies, principle of operation and analysis of reciprocating engines, gas and micro turbines, hydro and wind based generation technologies, control and integrated operation of different dynamic energy conversion devices.

UNIT – III: Static Energy Conversion Technologies

Introduction to different conventional and nonconventional static generation technologies, principle of operation and analysis of fuel cell, photovoltaic based generators, and wind based generation technologies, different storage technologies such as batteries, fly wheels and ultra-capacitors, plug-in-hybrid vehicles, control and integrated operation of different static energy conversion devices.

UNIT – IV: Real and Reactive Power Control

Control issues and challenges in Diesel, PV, wind and fuel cell based generators, PLL, Modulation Techniques, Dimensioning of filters, Linear and nonlinear controllers, predictive controllers and adaptive controllers, Fault-ride through Capabilities, Load frequency and Voltage Control.

UNIT – V: Integration of different Energy Conversion Technologies

Resources evaluation and needs, Dimensioning integration systems, Optimized integrated systems, Interfacing requirements, integrated Control of different resources, Distributed versus Centralized Control, Synchro Converters, Grid connected and Islanding Operations, stability and protection issues, load sharing, Cases studies.

Text Books

1. Ali Keyhani Mohammad Marwali and Min Dai, "Integration and Control of Renewable Energy in Electric Power System" John Wiley publishing company
2. S. Chowdhury, S. P. Chowdhury, P. Crossley, "Microgrids and Active Distribution Networks", IET Power Electronics Series, 2012
3. G. Masters, "Renewable and Efficient Electric Power Systems", IEEE-Wiley Publishers, 2013

Reference Books

1. Quing-Chang Zhong, "Control of Power Inverters in Renewable Energy and Smart Grid Integration", Wiley, IEEE Press
2. Bin Wu, Yongqiang Lang, NavidZargari, "Power Conversion and Control of Wind Energy Systems", Wiley 2011.

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Professional Elective - III

HYBRID ELECTRIC VEHICLES

II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To learn the concept of hybrid vehicles, types of electric drives used in hybrid vehicles and their control.

Course Outcomes

Upon successful completion of the course, the students will be able to

- know the concept of electric vehicles and hybrid electric vehicles.
- familiar with different motors used for hybrid electric vehicles.
- understand the power converters used in hybrid electric vehicles
- know different batteries and other energy storage systems.

Course Content

UNIT–I: Introduction

History of hybrid vehicles, architectures of HEVs, series and parallel HEVs, complex HEVs.

UNIT–II: Hybridization of Automobile

Fundamentals of vehicle, components of conventional vehicle and propulsion load; Drive cycles and drive terrain; Concept of electric vehicle and hybrid electric vehicle; Plug-in hybrid vehicle, constituents of PHEV, comparison of HEV and PHEV; Fuel Cell vehicles and its constituents.

UNIT–III: Plug-in Hybrid Electric Vehicle

PHEVs and EREVs blended PHEVs, PHEV Architectures, equivalent electric range of blended PHEVs; Fuel economy of PHEVs, power management of PHEVs, end-of-life battery for electric power grid support, vehicle to grid technology, PHEV battery charging.

UNIT–IV: Power Electronics in HEVs

Rectifiers used in HEVs, voltage ripples; Buck converter used in HEVs, non-isolated bidirectional DC-DC converter, regenerative braking, voltage source inverter, current source inverter, isolated bidirectional DCDC converter, PWM rectifier in HEVs, EV and PHEV battery chargers.

UNIT–V: Battery and Storage Systems

Energy Storage Parameters; Lead–Acid Batteries; Ultra capacitors; Flywheels - Superconducting Magnetic Storage System; Pumped Hydroelectric Energy Storage; Compressed Air Energy Storage - Storage Heat; Energy Storage as an Economic Resource.

Text Books

1. Ali Emadi, Advanced Electric Drive Vehicles, CRC Press, 2014.
2. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.

Refernce Books

1. MehrdadEhsani, YimiGao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
2. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.
3. H. Partab: Modern Electric Traction – Dhanpat Rai & Co, 2007.
4. Pistooa G., "Power Sources , Models, Sustanability, Infrastructure and the market", Elsevier 2008
5. Mi Chris, Masrur A., and Gao D.W., " Hybrid Electric Vehicle: Principles and Applications with Practical Perspectives" 1995.

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Professional Elective - III

ADVANCED DIGITAL CONTROL SYSTEMS

II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To introduce the theory of z–transformations and its applications for analysis of digital control systems.
- To impart knowledge on the stability of discrete time system using various methods.
- To fimiliraize the basic concepts on the discrete–time systems in state–space model representation.
- To introduce the concepts on design of state feedback controller and observer.

Course Outcomes

Upon successful completion of the course, the students will be able to

- apply z–transforms for the mathematical analysis of digital control systems
- determine stability of digital control systems using various test methods.
- apply the concept of controllability and observability to design an appropriate digital feedback controller.
- develop digital hardware controller.

Course Content

UNIT–I: Sampling and Reconstruction

Overview of modern digital control theories, z- and inverse z- transformation and properties, difference Equation – solution by recursion and z-transform, relationship between s- plane and z-plane, sampling theorem – data conversion and quantization mathematical modeling- data reconstruction and filtering of sampled signals – zero- order – hold.

UNIT–II: Stability Analysis

Digital control systems – pulse transfer function of open loop, closed loop systems, stability tests of linear digital control systems, relationship between G(s) and G(z).

UNIT–III: State Space Analysis

State equations of discrete data systems, solution of discrete state equations, state transition matrix Z-transform method. Relation between state equation and transfer functions, Concepts of controllability and observability.

UNIT–IV: State Feedback Controllers and Observers

Digital State observer Design of the full order and reduced order state observer – pole placement design by state feedback, Design of Dead Beat controller – some case studies.

UNIT–V: Digitizing Analog Controllers

Digitizing analog controllers, digital hardware control, and Actuators limitation.

Text Books

1. Discrete-Time Control systems - K. Ogata, PHI/Addison-Wesley Longman Pte. Ltd., India, Delhi, 2nd edition, 1995. (Unit II,III,IV)
2. Digital Control Systems - Kuo, Oxford University Press, 2nd edition, 1992.(Unit I,V)

Reference Books

1. Digital control of dynamic systems – Gene F. Frankin, J.David powell, Michael workman, pearson education, 3rd edition 2000.
2. Digital control and state variable methods – M.Gopal, Tata McGraw Hill, India, 4th edition, 1997.
3. Continuous and Discrete Control Systems – Dorsay, McGraw – Hill, 1996.

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Professional Elective - IV

ADVANCED DIGITAL SIGNAL PROCESSING

II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To understand the various digital filter structures
- To design the FIR and IIR Filters
- To know the importance of FFT algorithm for computation of Discrete Fourier Transform
- To analyze the finite word length effects on various filters
- To learn the concepts of power spectrum estimation of periodic and non-periodic signals

Course Outcomes

Upon successful completion of the course, the students will be able to

- describe structure of digital filters.
- design digital filters with different techniques.
- understand the implementation aspects of signal processing algorithms.
- know the effect of finite word length in signal processing.
- analyze different power spectrum estimation techniques

Course Content

UNIT–I: Digital Filter Structure

Block diagram representation-Equivalent Structures-FIR and IIR digital filter Structures All pass Filters-tunable IIR Digital Filters-IIR tapped cascaded Lattice Structures-FIR cascaded Lattice structures-Parallel-Digital Sine-cosine generator-Computational complexity of digital filter structures.

UNIT–II: Digital Filter Design

Preliminary considerations-Bilinear transformation method of IIR filter designdesign of lowpass, high pass-band pass, and band stop- IIR digital filters-Spectral transformations of IIR filters, FIR filter design-based on windowed Fourier series- design of FIR digital filters with least –meansquare- error-constrained least-square design of FIR digital filters

UNIT–III: DSP Algorithm Implementation

Computation of the discrete Fourier transform- number representation arithmetic operations handling of overflow-tunable digital filters-function approximation.

UNIT–IV: Analysis of Finite Word Length Effects

The quantization process and errors- quantization of fixed –point and floating - point Numbers-Analysis of coefficient quantization effects, Analysis of arithmetic round-off errors, dynamic range scaling-signal- to- noise ratio in low -order IIR filters-low-sensitivity digital filters- Reduction of Product round-off errors using error feedback-Limit cycles in IIR digital filters, Round-off errors in FFT Algorithms.

UNIT–V: Power Spectrum Estimation

Estimation of spectra from finite duration observations signals – Nonparametric methods for power spectrum estimation – parametric method for power spectrum estimation, estimation of spectral form-finite duration observation of signals-non-parametric methods for power spectrum estimation-Walsh methods-Blackman & torchy method.

Text Books

1. Digital signal processing-Sanjit K. Mitra-TMH second edition, 2002.
2. Discrete Time Signal Processing – Alan V.Oppenheim, Ronald W.Shafer - PHI-1996 1st edition-9th reprint

References Books

1. Digital Signal Processing and principles, algorithms and Applications – John G.Proakis -PHI –3rd edition-2002.
2. Digital Signal Processing – S.Salivahanan, A.Vallavaraj, C. Gnanapriya – TMH - 2nd reprint-2001
3. Theory and Applications of Digital Signal Proceesing-LourensR. Rebinar&Bernold.
4. Digital Filter Analysis and Design-Auntonian-TMH.

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Professional Elective - IV

APPLICATIONS FOR POWER CONVERTERS

II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To understand the inverters for induction heating applications
- To understand the power converters for different industrial applications
- To understand modeling of high voltage power supplies using the power converters for radar and space applications
- To understand modeling of low voltage and high current power supplies using the power converters for microprocessors and computer loads
- To understand the applications of DC-DC converters

Course Outcomes

Upon successful completion of the course, the students will be able to

- analyze power electronic application requirements.
- identify suitable power converter from the available configurations.
- develop improved power converters for any stringent application requirements.
- improvise the existing control techniques to suit the application. Design of Bi-directional converters for charge/discharge applications

Course Content

UNIT–I: Inverters for Induction Heating

For induction cooking, induction hardening, melting, and welding applications.

UNIT–II: Power Converters for Lighting, pumping and Refrigeration Systems

Electronic ballast, LED power drivers for indoor and outdoor applications. PFC based grid fed LED drivers, PV / battery fed LED drivers. PV fed power supplies for pumping/refrigeration applications.

UNIT–III: High Voltage Power Supplies

Power supplies for X-ray applications - power supplies for radar applications - power supplies for space applications.

UNIT–IV: Low voltage High Current Power Supplies

Power converters for modern microprocessor and computer loads.

UNIT – V: Bi-directional DC-DC (BDC) Converters

Electric traction, automotive Electronics and charge/discharge applications, Line Conditioners and Solar Charge Controllers.

Text Books

1. Ali Emadi, A. Nasiri, and S. B. Bekiarov: Uninterruptible Power Supplies and Active Filters, CRC Press, 2005.
2. M. Ehsani, Y. Gao, E. G. Sebastien and A. Emadi: Modern Electric, Hybrid Electric and Fuel Cell Vehicles, 1st Edition,CRC Press, 2004.

References Books

1. William Ribbens: Understanding Automotive Electronics, Newnes, 2003.
2. Steve Winder Power Supplies for LED Driving, Newnwes, 2008.

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Professional Elective - IV

MICROCONTROLLERS

II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To learn about microcontrollers architecture.
- To learn about DSP architecture and assembly programming for DSP processors.
- To learn about basics of FPGA controllers.

Course Outcomes

Upon successful completion of the course, the students will be able to

- design the interfacing circuits for input and output to PIC micro controllers and DSP processors.
- write ALP for DSP processors.
- design PWM controller for power electronic circuits using FPGA.

Course Content

UNIT–I: PIC Microcontrollers

Overview and Features, PIC 16C6X/7X, FSR(File Selection Register) [Indirect Data Memory Address Pointer], PIC Reset Actions, PIC Oscillator Connections, PIC Memory Organizations, PIC PIC 16C6X/7X Instructions, Addressing Modes, I/O Ports, Interrupts in PIC 16C61/71, PIC 16C61/71 Timers, PIC 16C71 Analog-to-Digital Converter (ADC).

UNIT–II: Introduction to DSP

Introduction to the C2xx DSP core and code generation, The components of the C2xx DSP core,

Mapping external devices to the C2xx core , peripherals and Peripheral Interface , System configuration registers , Memory , Types of Physical Memory , memory Addressing Modes , Assembly Programming using C2xx DSP, Instruction Set, Software Tools.

UNIT–III: I/O & Control Registers

Pin Multiplexing (MUX) and General Purpose I/O Overview, Multiplexing and General Purpose I/O Control Registers .Introduction to Interrupts, Interrupt Hierarchy, Interrupt Control Registers, Initializing and Servicing Interrupts in Software.

UNIT–IV: ADC & Event Manager

ADC Overview , Operation of the ADC in the DSP , Overview of the Event manager (EV), Event Manager Interrupts , General Purpose (GP) Timers , Compare UNITs,

Capture UNITs And Quadrature Enclosed Pulse (QEP) Circuitry , General Event Manager Information.

UNIT – V: Introduction to Field Programmable Gate Arrays

CPLD Vs FPGA – Types of FPGA , Xilinx C3000 series , Configurable logic Blocks (CLB), Input/Output Block (IOB) – Programmable Interconnect Point (PIP) – Xilinx 4000 series – HDL programming – overview of Spartan 3E and Virtex II pro FPGA boards- case study..

Text Books

1. Microcontrollers-Theory and Applications - Ajay V Deshmukh, McGraw Hills, 2005.
2. DSP Based Electro Mechanical Motion Control -Hamid.A.Toliyat and Steven G.Campbell, CRC Press New York, 2004.

Reference Books

1. The 8051 Microcontroller-Kennith J ayala, Thomson publishers,2005.
2. Microprocessor and Microcontrollers by Prof C.R.Sarma.
3. XC 3000 series datasheets (version 3.1). Xilinx,Inc.,USA, 1998.
4. Wayne Wolf," FPGA based system design ", Prentice hall, 2004

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ELECTRIC DRIVES SIMULATION LABORATORY

II Semester

Lecture	: 4	Internal Marks	: 30
Credits	: 2	External Marks	: 70

Course Objectives

- To familiarize various simulink models for evaluating the performance of ectrical drives..
- To provide skills on speed control of electrical drives.

Course Outcomes

Upon successful completion of the course, the students will be able to

- interpret the simulink results to analyze the performance of induction motor speed control techniques.
- apply the knowledge in developing the mathematical model of electrical drives.
- evaluate the performance of induction motor drive under different operating conditions.

Any 10 of the following experiments are to be conducted:

List of Experiments:

1. Simulation of DC shunt machine as motor & generator.
2. Simulate the speed control of DC motor using chopper converter.
3. Simulation of induction motor modes using d-q model.
4. Simulate the speed control of induction motor by using V/f control.
5. Simulate the BLDC motor and observe the speed transients.
6. Simulate speed control of induction motor by using vector control.
7. Compare the transient performance of induction motor controlled by v/f control & vector control methods.
8. Simulate PMSM motor by using d-q model.
9. Simulate the multi-level inverter fed induction motor drive.
10. Simulate the re-generative braking of inverter fed induction motor.
11. Study of PWM controlled inverter fed PMSM drive.
12. Evaluation of switching frequency effect on electric drive

Reference Books

1.Power Electronics hand book Muhammad H. Rashid.
2.Powe Electronics and Drives Ned Mohan.

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ELECTRIC DRIVES LABORATORY

II Semester

Lecture	: 4	Internal Marks	: 30
Credits	: 2	External Marks	: 70

Course Objectives

- To study the speed control methods of DC & AC drives.

Course Outcomes

Upon successful completion of the course, the students will be able to

- understand the performance of DC & AC drives.

Any 10 of the following experiments are to be conducted:

List of Experiments:

1. Study of armature controlled separately excited DC drive with 1-phase full converter.
2. Study of chopper controlled separately excited DC drive.
3. Study of armature controlled separately excited DC drive with 3- phase full converter
4. Study of performance characteristics of a 3- phase induction motor using V/f control.
5. Speed control of PMSM drive with 3- phase inverter.
6. Speed control of 3 – phase slip – ring induction motor by static rotor resistance controller.
7. Close loop control of DC drive.
8. Speed control of BLDC motor.
9. Speed control of AC drive using stator voltage control method.
10. Study of armature controlled separately excited DC drive with 3 – phase semi converter.

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Audit Course - II

ENGLISH FOR RESEARCH PAPER WRITING

II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To equip the trainees with the critical thinking skills required for crafting research issues into researchable questions.
- To develop in them research paper writing skills in three areas – vocabulary, discourse, and style;
- To enhance their awareness of the referencing conventions vis-à-vis scholarly communication;
- To develop in them an understanding of the knowledge-constructing practices of their disciplines (under the guidance of a research mentor on an apprenticeship programme) and sharpen that understanding so as to enable them to identify research issues, investigate them, and then present and publish papers on them.

Course Outcomes

Upon successful completion of the course, the students will be able to

- craft research issues into researchable questions;
- write appropriate introductions and conclusions to academic / research texts;
- review research literature using the skills of analysis, synthesis, critical evaluation, paraphrasing, and summarising and avoiding the risk of plagiarism;
- use the right vocabulary for different research communication purposes, such as stating study aims, reviewing sources, describing research designs, presenting arguments, evaluating and emphasizing, and analysing and discussing results.
- organise texts following the discourse rules of coherence and cohesion;
- write research paper abstracts; and
- communicate their research in academic style with grammatical accuracy.

Course Content

UNIT–I:

Understanding Researchability: Evaluating research questions in order to gain awareness of researchability - Identifying research issues, developing research questions from them, and crafting them into researchable questions

Academic Vocabulary: Neutral, and formal vocabulary - Nominalisation - Phrases commonly used in research communication

UNIT–II: Writing and Rhetorical Conventions: Writing introductions - Writing conclusions - Discourse organization

Academic Vocabulary: Research and Study aims.

UNIT–III:

Writing and Rhetorical Conventions: Summarising - Paraphrasing -

Academic Vocabulary: Evaluating and critiquing

UNIT–IV:

Writing and Ahetorical Conventions: Writing abstracts - Varying sentence length and structure

Remedial Grammar

UNIT–V:

Writing and Rhetorical Conventions: Avoiding repetition and redundancy - Style of academic / scholarly communication - Referencing

Academic Vocabulary: Analysing and discussing results

Apprenticeship

The apprenticeship will involve each individual trainee, under the guidance of a research mentor in his/her department, developing and crafting research questions on issues of his/her concern, investigating at least one of those issues during the course of the internship, and writing a paper on it which, before its presentation or publication, will be reviewed or assessed, as part of the internal assessment, by a panel of experts in the trainees' own departments. The entire process could be broken down into the following skills:

a. Identifying research issues
b. Framing the issues – developing research questions from them, refining them, and crafting them
c. Addressing literature
d. Investigating one of those issues by selecting an appropriate research design and data collection procedures and arriving at conclusions
e. Gaining competence in disciplinary specialized discourse conventions
f. Presenting arguments which scholars anticipate
g. Writing a paper on the study, presenting it before a panel of experts, and revising the paper on the basis of feedback from the panel
h. Determining the prestige of journals
i. Establishing a paper-journal fit and submitting the revised paper for publication
j. Learning to negotiate two principal audiences in one's scholarly communication – the community of scholars and journal gate-keepers
k. Negotiating peer review and editorial commentary

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Professional Elective - V

DIGITAL SIGNAL PROCESSOR CONTROLLED DRIVES

III Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To study DSP controllers.
- To learn coding in DSP s to control the electric drive speed.
- To learn speed control methods for induction motor, PMSM, BLDC motors.

Course Outcomes

Upon successful completion of the course, the students will be able to

- interface the DSP platform with sensors such as hall-effect voltage sensors,
- use hall-effect current sensors, shaft encoder for data acquisition for motor drive applications
- scale and normalize the data to suit the requirements of the drive system
- exploit the architectural features of the DSP platform to design and implement
- use algorithms for the realization of controllers, Pulse Width Modulators and observers

Course Content

UNIT–I: Overview of TMS320LF2407 DSP Controller

Review of Instruction Set, Interrupts, normalization and number formatting.

UNIT–II: Clarke's and Park's Transformations

Review ofClarke's and Park's transformations, Implementation of Clarke's and Park's transformation using TMS320LF2407 DSP

UNIT–III: Implementation of PWM Techniques for 3-Ph VSI

Implementation of Sine-triangle and SVPWM withTMS320LF2407 DSP using the concept of imaginary switching time.

UNIT–IV: Control of Induction Motor

Implementation of field oriented control for the speed control of Induction Motor using TMS320LF2407 DSP.

UNIT – V: Control of Special Machines

Principle of operation with drive control system, implementation of control system of BLDC and PMSM using TMS320 LF2407 DSP (Elementary strategy of operation only)

Text Books

1. Hamid A. Toliyat: DSP Based Electromechanical Motion Control, 1st Edition, CRC Press, 2004
2. Ned Mohan, T.M. Undeland and William P. Robbins: Power Electronics: Converters, Applications, 3rd Edition,John Wiley & Sons, 2009.

Reference Books

1. Application Notes from the website of Texas Instruments.

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Professional Elective - V

SMART GRID TECHNOLOGIES

III Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To understand concept of smart grid and developments on smart grid.
- To understand smart grid technologies and application of smart grid concept in hybrid electric vehicles etc.
- To have knowledge on smart substations, feeder automation and application for monitoring and protection.

Course Outcomes

Upon successful completion of the course, the students will be able to

- understand smart grids and analyze the smart grid policies and developments in smart grids.
- develop concepts of smart grid technologies in hybrid electrical vehicles etc.
- understand smart substations, feeder automation, GIS etc.
- analyze micro grids and distributed generation systems.
- analyze the effect of power quality in smart grid and to understand latest developments in ICT for smart grid.

Course Content

UNIT–I: Introduction to Smart Grid

Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid, Opportunities & Barriers of Smart Grid, Difference between conventional & smart grid, Concept of Resilient &Self-Healing Grid, Present development & International policies on Smart Grid. Case study of Smart Grid.

UNIT–II: Smart Grid Technologies: Part 1

Introduction to Smart Meters, Real Time Prizing, Smart Appliances, Automatic Meter Reading(AMR), Outage Management System(OMS), Plug in Hybrid Electric Vehicles(PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation, Phase Shifting Transformers.

UNIT–III: Smart Grid Technologies: Part 2

Smart Substations, Substation Automation, Feeder Automation. Geographic Information System(GIS), Intelligent Electronic Devices(IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro,Compressed Air Energy Storage, Wide Area Measurement System(WAMS), Phase Measurement Unit(PMU).

UNIT–IV: Micro grids and Distributed Energy Resources

Concept of micro grid, need & applications of microgrid, formation of microgrid, Issues of interconnection, protection & control of microgrid. Plastic & Organic solar cells, Thin film solar cells, Variable speed wind generators, fuel cells, microturbines, Captive power plants, Integration of renewable energy sources.

UNIT–V: Power Quality Management in Smart Grid

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.

Information and Communication Technology for Smart Grid: Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighborhood Area Network (NAN), Wide Area Network (WAN). monitoring and protection.

Text Books

1. Ali Keyhani, Mohammad N. Marwali, Min Dai “Integration of Green and Renewable Energy in Electric Power Systems”, Wiley
2. Clark W. Gellings, “The Smart Grid: Enabling Energy Efficiency and Demand Response”, CRC Press.

Reference Books

1. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, “Smart Grid: Technology and Applications”, Wiley
2. Jean Claude Sabonnadière, NouredineHadjsaïd, “Smart Grids”, Wiley Blackwell 19
3. Peter S. Fox Penner, “Smart Power: Climate Changes, the Smart Grid, and the Future of Electric Utilities”, Island Press; 1 edition 8 Jun 2010
4. S. Chowdhury, S. P. Chowdhury, P. Crossley, “Microgrids and Active Distribution Networks.” Institution of Engineering & Technology, 30 Jun 2009
5. Stuart Borlase, “Smart Grids (Power Engineering)”, CRC Press
6. Andres Carvallo, John Cooper, “The Advanced Smart Grid: Edge Power Driving Sustainability: 1", Artech House Publishers July 2011

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Open Elective

SUSTAINABLE DEVELOPMENT

III Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

To make the students

- To help the students understand the fundamental key concepts on Sustainable Development (SD),suchasintra-andinter-generational equity, economic, social and environmental,sustainability, strong and weak sustainability, natural capitalism, steady state and green economy.
- To enable students to identify and discuss in detail the key empiricalissues on sustainable development, such as renewable energy transitions, urban agriculture and green architecture.
- To empower students with the expertise to distinguish between "greeneconomy" and "sustainability" and various efforts at multiple levels ofgovernance:from individual to governments.
- To exposestudents to awide varietyof research areas to apply and therefore appropriate the oretical knowledge on public policy and international relations to the issue area of sustainable development, insuch aspects as international aid, global climate change negotiations, the importance of international regimes as opposed to voluntary private governance.
- To empower Students to make their own lives more sustainable and join social movements to bring about more of sustainable development.

Course Outcomes

Upon successful completion of the course, the students will be able to

- gainknowledgeofsustainabilityandbiodiversity
- studyaboutgreenhousegases
- learndynamicsofsustainability
- gainKnowledgeonsocio-economicsystems
- studyabouttheconventionsonsustainabledevelopment
- learnconceptofSustainableDevelopmentanditsrolein buildingofenvironment

Course Content

UNIT–I: Concept of Sustainable Development

Definition of sustainability - History and emergence of the concept of Sustainable development – Our Common Future - Objectives of Sustainable Development - Millennium Development Goals - Environment and Development linkages – Globalization and environment - Population, Poverty and Pollution –Global, Regional

and Local environmental issues–Resource Degradation–Greenhouse gases and climate Change – Desertification – Industrialization –Socialinsecurity.

UNIT–II: Sustainability and thetriple bottom line

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

UNIT–III: Sustainable Development and International Response

Role of developed countries in the development of developing countries–International summits–Stock holm to Johannes burg–Rio Principles–Agenda 21-Conventions–Agreements–Tokyo Declaration-Doubling Statement - Trans boundary issues – Integrated approach for resource protection and management.

UNIT–IV: Sustainable Development of Socio-Economic Systems

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

UNIT–V: Framework for Achieving Sustainability

Sustainability indicators - Hurdles to Sustainability - Operational guidelines – Inter connected pre-requisites for sustainable development – Empowerment of Women, Children, Youth, Indigenous People, Non-Governmental Organizations, Local Authorities, Business and Industry-Science and Technology for sustainable development – Performance indicators of sustainability and Assessment mechanism – Constraints and barriers for sustainable development.

Text Books

1. Austin, James and Tomas Kohn. 1990. Strategic Management in DevelopingCountries.TheFreePress.
2. Berger. 1994. “The Environment and the Economy.” In Smelser and Swedberg(eds.)
3. TheHandbookofEconomicSociology.RusselSageFoundation.D’Arcy,David. Transcript of broadcast, Dec. 5, 2002, “In Houston, a Treasure of ExiledAfghanArt,”National PublicRadio,

Reference Books

1. Elkington, John. Cannibals with Forks:TheTriple Bottom Line for 21stCenturyBusiness Oxford:Capstone Publishing,October 1997.
2. Guillen, Mauro and Sandra L. Suarez. 2002. “The Institutional Context of Multinational Activity.”In Organization Theory and the Multinational Corporation” .2ndedition. New York: St.Martin’s Press.

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Open Elective

ENERGY AUDIT, CONSERVATION & MANAGEMENT

III Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

To make the students

- To learn principle of energy audit as well as management for industries, utilities and buildings.
- To study the energy efficient motors and lighting.
- To learn power factor improvement methods and operation of different energy instruments.
- To compute depreciation methods of equipment for energy saving.

Course Outcomes

Upon successful completion of the course, the students will be able to

- understand the principle of energy audit and their economic aspects.
- recommend energy efficient motors and design good lighting system.
- understand advantages to improve the power factor.
- evaluate the depreciation of equipment.

Course Content

UNIT–I: Basic Principles of Energy Audit

Energy audit- definitions, concept , types of audit, energy index, cost index ,pie charts, Sankey diagrams and load profiles, Energy conservation schemes- Energy audit of industries- energy saving potential, energy audit of process industry, thermal power station, building energy audit.

UNIT–II: Energy Management

Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting. Energy manager, qualities and functions, language,Questionnaire – check list for top management.

UNIT–III: Energy Efficient Motors

Energy efficient motors, factors affecting efficiency, loss distribution, constructional details, characteristics – variable speed , variable duty cycle systems, RMS - voltage variation-voltage unbalanceover motoring-motor energy audit.

UNIT–IV: Power Factor Improvement and Energy Instruments

Power factor – methods of improvement, location of capacitors, Power factor with non-linear loads, effect of harmonics on p.f, p.f motor controllers – Energy Instruments- watt meter, data loggers, thermocouples, pyrometers, lux meters, tong testers,application of PLC s.

UNIT–V: Economic Aspects and their Computation

Economics Analysis depreciation Methods, time value of money, rate of return, present worth method, replacement analysis, lifecycle costing analysis – Energy efficient motors. Calculation of simple payback method, net present value method-Power factor correction, lighting – Applications of life cycle costing analysis, return on investment.

Text Books

1. Energy management by W.R.Murphy&G.Mckay Butter worth, Heinemann publications, 1982.
2. Energy management hand book by W.CTurner, John Wiley and sons, 1982.

Reference Books

1. Energy efficient electric motors by John.C.Andreas, Marcel Dekker Inc Ltd-2nd edition,1995
2. Energy management by Paul o Callaghan, Mc-graw Hill Book company-1st edition, 1998
3. Energy management and good lighting practice : fuel efficiency- booklet12-EEO.

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Open Elective

RAPID PROTOTYPING

III Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

To make the students

- familiarize with Rapid Prototype tools and techniques for design and Manufacturing.

Course Outcomes

Upon successful completion of the course, the students will be able to

- assess the need of RPT in Product development.
- use appropriate RT Software for development of Prototype model.
- judge the correct RP Process for Product/Prototype development.
- predict the technical challenges in 3D printing.
- list the applications of RPT.

Course Content

UNIT–I: Introduction to Rapid Prototyping

Introduction to prototyping, traditional prototyping Vs. rapid prototyping (RP), need for time compression in product development, usage of RP parts, generic RP process, distinction between RP and CNC, other related technologies, classification of RP.

UNIT–II: RP Software and Software Issues of RP

RP Software: Need for RP software, MIMICS, magics, surgiGuide, 3D-doctor, simplant, velocity2, voxim, solidView, 3Dview, etc., software.

Software Issues of RP: Preparation of CAD models, problems with STI, files, STL file manipulation, RP data formats: SLC, CLI, RPI, LEAF, IGES, HP/GL, CT, STEP.

UNIT–III: Photopolymerization RP Processes, Powder Bed Fusion RP Processes and Extrusion-Based RP Systems

Photopolymerization RP Processes: Sterolighography (SL), SL resin curing process, SL scan patterns, microstereolithography, applications of photopolymerization processes.

Powder Bed Fusion RP Processes: Selective laser sintering (SLS), powder fusion mechanism and powder handling, SLS metal and ceramic part creation, electron beam melting (EBM), applications of powder bed fusion processes.

Extrusion-Based RP Systems: Fused deposition modelling (FDM), principles, plotting and path control, applications of extrusion-based processes..

UNIT–IV: Printing RP Processes, Sheet Lamination RP Processes and Beam Deposition RP Processes

Printing RP Processes: 3D printing (3DP), research achievements in printing deposition, technical challenges in printing, printing process modeling, applications of printing processes.

Sheet Lamination RP Processes: Laminated Object Manufacturing (LOM), ultrasonic consolidation (UC), gluing, thermal bonding, LOM and UC applications.

Beam Deposition RP Processes: Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD), processing – structure - properties, relationships, benefits and drawbacks.

UNIT–V: Rapid Tooling, Errors in RP Processes and RP Applications

Rapid Tooling: Conventional Tooling Vs. Rapid Tooling, classification of rapid tooling, direct and indirect tooling methods, soft and hard tooling methods.

Errors in RP Processes: Pre-processing, processing, post-processing errors, part building errors in SLA, SLS, etc.,

RP Applications: Design, engineering analysis and planning applications, rapid tooling, reverse engineering, medical applications of RP.

Text Books

1. Chua Chee Kai., Leong KahFai., Chu Sing Lim, “Rapid Prototyping: Principles and Applications in Manufacturing”, World Scientific

Reference Books

1. Ian Gibsn., David W Rosen., Brent Stucker., “Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing”, Springer, 2010
2. Pham, D.T, Dimov, S.S, Rapid Manufacturing, Springer, 2001.

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Open Elective

AUTOMIOTIVE ELECTRONICS

III Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

To make the students

- familiarize with the electronic systems inside automotive vehicle.
- introduce with the concepts of advanced safety systems

Course Outcomes

Upon successful completion of the course, the students will be able to

- learn the fundamentals of automotive technology.
- describe the operation of microcomputer systems.
- acquire knowledge in automotive sensors and control systems.
- develop communications & navigation/routing in automotive vehicles.

Course Content

UNIT–I: Automotive Fundamentals

Use of electronics in the automobile, evolution of automotive electronics, the automobile physical configuration, evolution of electronics in the automobile, survey of major automotive systems, engine control or electronic control unit, ignition system.

UNIT–II: Automotive Micro-Computer System

Binary number system, binary counters, Microcomputer fundamentals-digital versus analog computers, basic computer block diagram, microcomputer operations, CPU registers, accumulator registers, condition code register-branching; microprocessor architecture, memory-ROM, RAM; I/O parallel interface, digital to analog converter and analog to digital converters with block diagram.

UNIT–III: Basics of Electronics Engine Control

Motivation for electronic engine control, exhaust emissions, fuel economy, concept of an electronic engine control system, engine functions and control, electronic fuel control configuration, electronic ignition with sensors.

UNIT–IV: Sensors and Actuators

Introduction; basic sensor arrangement; types of sensors such as oxygen sensors, crank angle position sensors, fuel metering/vehicle speed sensors and detonation sensors, altitude sensors, flow sensors, throttle position sensors, solenoids, stepper motors, actuators – fuel metering actuator, fuel injector, and ignition actuator.

UNIT–V: Electronic Vehicle Management System and Automotive Instrumentation System

Cruise control system, antilock braking system, electronic suspension system, electronic steering control, and transmission control, safety: air bags, collision avoidance radar warning system with block diagram, low tire pressure warning system, advanced cruise control system.

Speech synthesis, sensor multiplexing, control signal multiplexing with block diagram, fibre optics inside the car, automotive internal navigation system, GPS navigation system, voice recognition cell phone dialling.

Text Books

1. William B. Ribbens, "Understanding Automotive Electronics", SAMS/Elsevier Publishing, 6th Edition. (UNITS I -V).
2. Robert Bosch Gambh, "Automotive Electrics Automotive Electronics Systems and Components", John Wiley& Sons Ltd., 5th edition, 2007.

Reference Books

1. Ronald K Jurgen, "Automotive Electronics Handbook", 2nd Edition, McGraw-Hill, 1999.
2. G. Meyer, J. Valldorf and W. Gessner, "Advanced Microsystems for Automotive Applications", Springer, 2009.
3. Robert Bosch, "Automotive Hand Book" SAE, 5th Edition, 2000.

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Open Elective

SOFT COMPUTING TECHNIQUES

III Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

To make the students

- Develop the skills to gain a basic understanding of neural network theory and fuzzy logic theory.
- Introduce students to artificial neural networks and fuzzy theory from an engineering perspective

Course Outcomes

Upon successful completion of the course, the students will be able to

- comprehend the fuzzy logic and the concept of fuzziness involved in various systems and fuzzy set theory.
- understand the concepts of fuzzy sets, knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic
- understand the fundamental theory and concepts of neural networks, Identify different neural network architectures, algorithms, applications and their limitations
- understand appropriate learning rules for each of the architectures and learn several neural network paradigms and its applications
- reveal different applications of these models to solve engineering and other problems.

Course Content

UNIT–I: Fuzzy Set Theory

Introduction to Neuro – Fuzzy and Soft Computing, Fuzzy Sets, Basic Definition and Terminology, Set-theoretic Operations, Member Function Formulation and Parameterization, Fuzzy Rules and Fuzzy Reasoning, Extension Principle and Fuzzy Relations, Fuzzy If-Then Rules, Fuzzy Reasoning, Fuzzy Inference Systems, Mamdani Fuzzy Models, Surgeon Fuzzy Models, Tsukamoto Fuzzy Models, Input Space Partitioning and Fuzzy Modeling.

UNIT–II: Optimization

Derivative based Optimization, Descent Methods, The Method of Steepest Descent, Classical Newton's Method, Step Size Determination, Derivative-free Optimization, Genetic Algorithms, Simulated Annealing and Random Search – Downhill Simplex Search..

UNIT–III: Artificial Intelligence

Introduction, Knowledge Representation, Reasoning, Issues and Acquisition: Prepositional and Predicate Calculus Rule Based knowledge Representation Symbolic Reasoning under Uncertainty Basic knowledge Representation Issues Knowledge acquisition, Heuristic Search: Techniques for Heuristic search Heuristic Classification State Space Search: Strategies Implementation of Graph Search based on Recursion Patent directed Search Production System and Learning.

UNIT–IV: Neuro Fuzzy Modeling

Adaptive Neuro-Fuzzy Inference Systems, Architecture – Hybrid Learning Algorithm, Learning Methods that Cross-fertilize ANFIS and RBFN – Coactive Neuro Fuzzy Modeling, Framework Neuron Functions for Adaptive Networks – Neuro Fuzzy Spectrum.

UNIT–V: Applications of Computational Intelligence

Printed Character Recognition, Inverse Kinematics Problems, Automobile Fuel Efficiency Prediction, Soft Computing for Color Recipe Prediction.

Text Books

1. J.S.R.Jang, C.T.Sun and E.Mizutani, "Neuro-Fuzzy and Soft Computing", PHI, 2004, Pearson Education 2004.
2. N.P.Padhy, "Artificial Intelligence and Intelligent Systems", Oxford University Press, 2006.

Reference Books

1. Elaine Rich & Kevin Knight, Artificial Intelligence, Second Edition, Tata Mcgraw Hill Publishing Comp., 2006, New Delhi.
2. Timothy J.Ross, "Fuzzy Logic with Engineering Applications", McGraw-Hill, 1997.
3. Davis E.Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, N.Y., 1989.

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