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 2017-18)

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 2017-18.

1. 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.

2. Minimum Instruction Days

Each semester consists of a minimum of ninety instruction days.

3. 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.

4. Attendance Regulations

4.1 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.

4.2 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.

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

4.4 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.

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

4.6   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.

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

5.   Examinations and Scheme of Evaluation

5.1 Theory Courses :

Each theory course shall be evaluated for a total of 100 marks, consisting of 40 marks for internal assessment and 60 marks for semester end examination.

Internal Assessment:

i)   Of 40 marks for internal assessment, 10 marks are for continuous assessment in the form of two assignments and 30 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 40 marks with two hours duration. Each mid-term examination consists of four questions, each for 10 marks. All the questions need to be answered.

iv)   Sum of the 75% marks of better scored mid-term examination and 25% marks of less scored mid-term examination are scaled down for 30 marks.

v)   For the project based theory course, the distribution of 40 marks for internal evaluation shall be 20 marks for theory, based on two mid- term examinations and 20 marks for project. Each mid-term examination is conducted for 40 marks with two hours duration. Each mid-term examination consists of two questions, each for 20 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 have 8 questions, each for 12 marks, out of which 5 questions are to be answered.

ii)   For the project based theory course, semester end examination will have three questions, each for 20 marks, with internal choice. All the questions need to be answered. There will be no external assessment for project component.

5.2 Laboratory Courses :

i) For practical subjects the distribution shall be 40 marks for Internal Evaluation and 60 marks for the End-Examinations. There shall be continuous evaluation by the internal subject teacher during the semester for 40 internal marks. Of the 40 marks for internal, 25 marks shall be for day-to-day performance (15 marks for day-to-day evaluation and 10 marks for Record) and 15 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 60 marks.

5.3 (a) Seminar:

i) For seminar, a student under the supervision of a faculty member, shall collect the literature on an advanced topic related to his specialization and critically review the literature and submit it to the department in a report form towards the end of semester and shall make an oral presentation before the Departmental Review Committee consisting of the supervisor and a senior faculty member / Head of the Department. There shall be an internal evaluation for 100 marks in the form of viva-voce examination and assessment of report and its presentation. There will be NO external evaluation.

ii) If a candidate fails to secure the minimum marks prescribed for successful completion, he has to re-register by paying the prescribed fee at the beginning of subsequent semester(s). He has to submit a fresh report towards the end of that semester and appear for evaluation by the committee.

(b) Term Paper:

i) For term paper, a student under the supervision of a faculty member, shall collect the literature on an advanced topic related to his specialization and critically review the research papers and submit it to the department in publication form towards the end of semester and shall make an oral presentation before the Departmental Review Committee consisting of the supervisor and a senior faculty member / Head of the Department. There shall be an internal evaluation for 100 marks in the form of viva-voce examination and assessment of paper and its presentation. There will be NO external evaluation.

ii) If a candidate fails to secure the minimum marks prescribed for successful completion, he has to re-register by paying the prescribed fee at the beginning of subsequent semester(s). He has to submit a fresh paper towards the end of that semester and appear for evaluation by the committee.

5.4 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, seminar and term paper 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.

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

6.1 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 seminar / term paper viva-voce 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.

6.2 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)

6.3 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:

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

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.

6.4 Eligibility for Award of B.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.

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

The CGPA is calculated as given below:

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

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.

6.6 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
≥ 5.5 & < 6.5	Second Class

7. Supplementary Examinations

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

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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.

8. 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/-

9. 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.

10. Transitory Regulations

A candidate, who is detained or discontinued 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.

11. 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.

12. 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.

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.	

iii)   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.

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13. 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.

17. 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 COMPONENTS

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	MA2902	Linear and Non-Linear Optimization	4	-	-	3
2	EC2901	ARM Architecture and Programming**	3	-	2	3
3	EE2902	Analysis of Power Electronic Converters	4	-	-	3
4	EE2903	Electrical Machine Modeling and Analysis	4	-	-	3
5	EE2904	Modern Control Theory	4	-	-	3
6		Professional Elective - I	4	-	-	3
7	EE2908	Power Electronic System Simulation Lab	-	-	4	2
		Total	**23**	**-**	**6**	**20**

II Semester

Sl. No.	Course Code	Name of the Course / Laboratory	No.of Periods per week			No.of Credits
			L	T	P	
1	EE2910	Research Methodology	4	-	-	3
2	EE2911	Advanced Digital Control Systems	4	-	-	3
3	EE2912	Switched Mode Power Converters **	3	-	2	3
4	EE2913	Advanced Electric Drives	4	-	-	3
5		Professional Elective - II	4	-	-	3
6		Professional Elective - III	4	-	-	3
7	EE2919	Power Electronics and Electric Drives Lab	-	-	4	2
8		Seminar	-	-	-	2
		Total	**23**	**-**	**6**	**22**

** Project Based Theory Course

L : Lecture   T : Tutorial   P : Practical

III Semester

SI. No.	Course Code	Name of the Course / Laboratory	No.of Periods per week			No.of Credits
			L	T	P	
1		Term Paper	-	-	4	2
2		Dissertation (Initiated in third semester)	-	-	-	-
		Total	**-**	**-**	**4**	**2**

IV Semester

SI. No.	Course Code	Name of the Course / Laboratory	No.of Periods per week			No.of Credits
			L	T	P	
1		Dissertation (Carried out in third & Fourth Semester	-	-	52	34
		Total	**-**	**-**	**52**	**34**

Professional Electives:

Professional Elective - I

EE2905   Power Semiconductor Devices & Protection

EE2906   Special Machines and Control

EE2907   HVDC Transmission Systems

Professional Elective - II

EE2914   Renewable Energy Storage Systems

EE2915   Application of power Electronics to Power Systems

EE2916   Custom Power Devices

Professional Elective - III

EC2902   Digital Signal Processing and Applications

EE2917   AI Techniques

EE2918   Smart Grids

SYLLABUS

LINEAR AND NON-LINEAR OPTIMIZATION
I Semester

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

Course Objectives

Students should be able to

- Familiarize different optimization techniques and approaches**.**
- Provide the concepts of various classical and modern methods of constrained and constrained problems in both single and multivariable
- Understand Non – Linear optimization problems.
- know evolutionary optimization methods

Course Outcomes

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

- apply the knowledge of Mathematics in analyzing on engineering problems.
- formulate optimization problem.
- develop an optimization problem in standard form and asses the optimality of a solution.
- solve various constrained and unconstrained problems in single variable as well as multi variable.
- apply the concepts of optimality criteria for various types of optimization problems.

Course Content

Unit-I: Linear Optimization

Formulation of LPP, Graphical solution, Standard form of linear programming problem , Simplex method, Big-M method

Unit-II: Classical Optimization Techniques

Introduction -Single-Variable Optimization-Multivariable Optimization, Nonlinear Programming One-Dimensional Minimization Methods Introduction – Unimodal Function –Elimination Methods Unrestricted Search - Exhaustive Search- Dichotomous Search - Interval Halving Method- Fibonacci Method - Golden Section Method.

Unit-III: Nonlinear Programming I Unconstrained Optimization Techniques

Introduction –Direct search methods Random Search Methods -Univariate Method-Pattern Directions- Powell's Method- Indirect search (Descent) methods Gradient of a Function -Steepest Descent (Cauchy) Method - Conjugate Gradient (Fletcher–Reeves) Method

Unit-IV: Nonlinear Programming II constrained Optimization Techniques

Optimization with equally and inequality constraints, Direct methods, Indirect methods using penalty functions, Lagrange multipliers, Geometric programming Introduction - unconstrained minimization problems.

Unit- V: Modern Methods of Optimization

Genetic Algorithms Introduction – Representation of Design Variables, Representation of Objective function and constraints, Genetic operators - Ant Colony Optimization Introduction , Basic concepts, Ant searching behavior, Path retracing and pheromone updating, pheromone trail evaporation algorithm.

Text Books:

1. Singiresu S.Rao, Engineering Optimization, Theory and Practice 4th edition. New Age Interntional (P) Limited, Publishers. (Unit-I 3.1 to 3.9; Unit-II 2.1 to 2.5 and 5.1 to 5.8; Unit-III 6.1,6.2,6.4,6.7,6.10,6.11 and 6.12; Unit-IV 7.5 to 7.8, 7.12,7.13 and 7.15; Unit-V 12.7).
2. Kalyan moy Deb, Optimization for Engineering Design, PHI, Delhi, 2014.

Reference Books:

1. S.D. Sharma, Operations Research, 8th edition, Kedarnath Publishers, 2007.
2. E.J. Haug and J. S. Arora, Applied Optimal Design, Wiley, New York.
3. Marco Dorigo and Thomas stutzle, Ant colony optimization MIT press, 2004. (Unit-V 4.1 to 4.4)
4. S.N.Sivanandan, S.N. DeepaSpringer Introduction to genetic Algorthms, Springer.

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ARM ARCHITECTURE AND PROGRAMMING
I Semester

Lecture	: 3	Practical	: 2	Internal Marks	: 40
Credits	: 3			External Marks	: 60

Pre - requisite

Basic knowledge on Microcontroller 8051, Programming (preferably C), Computer Architecture and Computer logic design.

Course Objectives

To make the students

- To introduce the basic concepts of ARM architecture and processor families.
- To familiarize the various concepts of Registers, Instruction sets, Interrupts and vector tables.
- To impart the ARM programming skills.

Learning Outcomes

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

- Understand the architecture of the ARM microcontrollers and ARM Processor Families.
- Apply the concepts of Registers, Thumb Instruction sets, Memory organization and Interrupts.
- Develop a real time application using ARM.

Course Content

UNIT - I: ARM Architecture

ARM Design Philosophy, Registers, Program Status Register, Instruction Pipelines, Interrupts and Vector Table, Cache Architecture, Polices, Flushing and Caches, MMU, Page Tables, Translation, Access Permissions, Context Switch.[Textbook1,2]

UNIT- II: ARM Programming Model – I

Instruction Set Data Processing Instructions, Addressing Modes, Branch, Load, Store Instructions, PSR Instructions, Conditional Instructions. [Textbook1]

UNIT - III: ARM Programming Model – II

Thumb Instruction Set Register Usage, Other Branch Instructions, Data Processing Instructions, Single and Multi-Register Load-Store Instructions, Stack, Software Interrupt Instructions [Textbook1]

UNIT - IV: ARM Programming

C Programs using Function Calls, Pointers, Structures, Integer and Floating Point Arithmetic, Assembly Code using Instruction Scheduling, Register Allocation, Conditional Execution and Loops. [Textbook1]

UNIT- V: Embedded ARM Applications

ARM Processor Families, VLSI Ruby II Advanced Communication Processor, ISDN Subscriber Processor, One C™ VWS22100 GSM chip, Ericsson -VLSI Bluetooth Baseband Controller, ARM 7500 and ARM 7500FE. [Textbook 1]

Text Books:

1. ARM Systems Developers Guide- Design & Optimizing System Software - Andrew N. Sloss, Dominic Symes, Chris Wright, 2004, Elsevier. (Unit I to V)
2. ARM System-on-Chip Architecture, Addison Wesley – 2 Edition. (Unit I to V)

References:

1. Embedded Microcomputer Systems, Real Time Interfacing – Jonathan W. Valvano – Brookes / Cole, 1999, Thomas Learning.
2. Embedded Systems - Architecture Programming and Design – Raj Kamal, 2nd ed., 2008, TMH.
3. Designing with PIC Microcontrollers- John B. Peatman, 1998, PH Inc.

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ANALYSIS OF POWER ELECTRONIC CONVERTERS
I Semester

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

Course Objectives

To make the students

- familiarize the concepts of power factor improvement methods in both single phase and three phase converters.
- familiarize with Voltage control methods in single phase and Three phase AC voltage controllers and inverters.

Learning Outcomes

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

- Analyze various types of power electronic converters with different loads.
- Identify appropriate AC voltage controller for a particular application.
- apply different power factor improvement methods for converters.
- Select an appropriate voltage control technique for an inverter.
- Analyze different types of multilevel inverter topologies.
- Design a suitable power electronic converter for a given application

Course Content

UNIT - I: AC Voltage Controllers

Single Phase AC Voltage Controllers with PWM control only –synchronous tap changers - Three Phase AC Voltage controllers-Analysis of Controllers with star and delta connected resistive, Resistive –inductive loads-Effects of source andload inductances –Application- numerical Problems.

UNIT- II: Single Phase and Three Phase AC-DC Converters

Single phase full and half Converters with inductive load – Power factor improvements Extinction angle control-symmetrical angle control - single phase sinusoidal PWM-Single phase series converters. Three Phases full and half Converter with inductive load –Harmonic analysis -Power factor improvements-three phase PWM-twelve pulse converters-Numerical problems

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 phases boost PFC converter.

UNIT - IV: PWM Inverters

Single phase full bridge inverters - sinusoidal PWM – modified PWM – phase displacement Control – Trapezoidal, staircase, stepped, harmonic injection and delta modulation – numerical Problems - Three-Phase Inverters- Sinusoidal PWM-600 PWM- Third Harmonic PWM- Space Vector Modulation- Comparison of PWMTechniques-current source inverters-Variable dc link Inverter - numerical problems..

UNIT - V: Multi Level Inverters

Multilevel Concept, Types of Multilevel Inverters- Diode-Clamped Multilevel Inverter,Features of Diode-Clamped Inverter, Improved Diode-Clamped Inverter-Flying-Capacitors Multilevel Inverter-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-Md.H.Rashid –Pearson Education Third Edition- First Indian Reprint- 2008   (Units – I to VI).

Reference Books:

1. Power Electronics – Lander –Mc.Graw Hill ,2009.

2. Modern power Electronics and AC Drives – B.K.Bose- Prentice Hall; First edition , October 2001.

3. Power Converter Circuits – William Shepherd & Li Zhang ,CRC Press, 12-Mar-2004.

4. Power Electronics- Ned Mohan, Tore Mundelein and William P.Robbins – JohnWiley& Sons -2ndEdition,2002.

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ELECTRICAL MACHINE MODELING AND ANALYSIS
I Semester

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

Course Objectives

To make the students

- know the concepts of Kron's primitive machine
- familiarize with modeling of Electrical Machines.

Learning Outcomes

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

- Represent basic two pole electrical machine
- Analyze the steady state and transient behavior of D.C. machine.
- Apply transformation techniques for modeling of an electrical machine.
- Develop a mathematical model to an electrical machine for specific application.
- Selection of reference frame for a particular application

Course Content

UNIT - I: Basic concepts of Modeling

Introduction to generalized theory of electrical machines – Conventions used in generalized theory of electrical machines–Basic two-pole machine representation of commutator machines, 3-phase synchronous machine with and without damper bars and 3-phase induction machine–Kron's primitive Machine voltage, current and torque equations – Steps to apply the generalized theory to rotating electrical machines.

UNIT - II: Modeling of DC Machine

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.

UNIT - III: Reference Frame Theory

Linear transformation –Invariance of power –Phase transformations three phase to two phase transformation (a, b, c to á, â, 0), two phase to three phase transformation (á, â, 0 to a, b, c) – Transformation from rotating axes (á, â, 0) to stationary axes (d, q, 0) –Park's transformations three phase to two phase transformation (a, b, c to á, â, 0), two phase to three phase transformation (á, â, 0 to a, b, c).

UNIT - IV: Modeling of Three Phase Induction Machine

Generalized model in arbitrary reference frame-Electromagnetic torque-Derivation of commonly used Induction machine models-Stator reference frame model-Rotor reference frame model-Synchronously rotating reference frame model – State space model with flux linkages as variables.

UNIT - V: Modeling of Synchronous Machine

Synchronous machine inductances –voltage equations in the rotor's dq0 reference frame-electromagnetic torque-current in terms of flux linkages- three phase synchronous machine model - modeling of MBLDC motor.

Textbooks

1. P.S.Bimbra, "Generalized Theory of Electrical Machines", Khanna Publications, 5th edition,1995 (Units - I, II, III).

2. P.C.Krause, Oleg Wasynczuk, and Scott D.Sudhoff, " Analysis of Electrical Machinery and Drive Systems", IEEE Press, Third Edition, 2013 (Units - III, IV, V).

Reference Books

1. R.Krishnan, "Electric Motor Drives - Modeling, Analysis & control", Pearson Publications, First Edition, 2002 (Units - II, IV, V).

2. Chee Mun Ong, "Dynamic simulation of Electric machinery using Matlab / Simulink",Prentice Hall Publications,1998 (Units-II, IV, V).

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MODERN CONTROL THEORY
I Semester

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

Course Objectives

To make the students

- To understand the concept of stability, controllability and observability of LTI systems.
- To understand the use of classical nonlinear techniques such as phase plane, describing functions.
- To familiarize with the design of state feedback controllers and observers for a given system.

Learning Outcomes

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

- Construct state diagram for a given continuous time state model.
- Compute the solution for a given state model of linear continuous systems.
- Select an appropriate stability criterion for the design of non linear systems.
- Analyze controllability and observability from state model.
- Design a state feedback controller and observer to meet the desired specifications.

Course Content

UNIT - I: State Variable Analysis

State space representation of Linear Continuous time models for physical systems – Existence and Uniqueness of Solutions to Continuous Time State Equations, Solution of Linear Time invar ying continuous-Time State Equations, State transition matrix and it's properties. Conversion of state space model to transfer function model. Canonical Forms – Controllable Canonical Form, Observable Canonical Form, Jordan Canonical Form.

UNIT- II: Controllability and Observability

General concept of Controllability, and Observability, Controllability tests for Continuous – Time Invariant systems, - Observability tests for Continuous - Time Invariant systems. Controllability and observability form Jordan canonical form and other canonical forms.

UNIT - III: Describing Function Analysis

Introduction to nonlinear systems, Types of nonlinearities, describing functions, describing function analysis of nonlinear control systems- stability analysis of non – linear systems. Singular points – Introduction to linearization of nonlinear systems.

UNIT - IV: Stability Analysis

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

UNIT - V: State Feedback Controllers and Observers

Effect of state feedback on controllability and observability, Design of State Feedback Control through Pole placement. Full order observer and reduced order observer.

Text Books

1. Modern Control System Theory – by M. Gopal, New Age International Publishers, 2nd edition, 1996. (Unit I,II,V)
2. Modern control engineering – K.Ogata, prentice Hall Of India, 3rd edtion, 1998. (Unit III,IV,V)

Reference books

1. Control system Engineering – I.J. Nagarath, M.Gopal. New Age International Publications, 5th edition.
2. Systems and Control - Stainslaw H. Zak, Oxford Press, 2003.
3. Automatic feedback control system synthesis – Truxal, International student edition.
4. Modern Control Systems - Richard C. Dorf and Robert H. Bishop, 11th Edition Pearson Edu,India, 2009.

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POWER SEMICONDUCTOR DEVICES AND PROTECTION
I Semester

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

Course Objectives

To make the student

- Know the static and dynamic characteristics of current and voltage controlled power semiconductor devices
- Familiar with the selection of devices for different power electronics applications,

Learning Outcomes

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

- Understand the static-dynamic characteristics of voltage controlled power semiconductor devices
- Understand the driver circuit operation of various devices
- Understand the control and firing circuits required for different switching devices.
- Understand the protection of switching devices

Course Content

UNIT - I: Overview of Power Switching Device

Introduction to power switching device classification of device, controlled and un-controlled device, I-V characteristics of idea and real switching device

Power Diodes Device structure and i - v characteristics, rating & specifications, switching characteristics, reveres recovery, classifications of various diode schotky diode, line frequency diodes, fast recovery diodes

UNIT- II: Power Transistors

Device structure and i-v characteristics, rating & specifications, switching characteristics, on to off and off to on state transitions, on/off transition loss analysis, driver circuits

UNIT - III: Power MOSFETs

Device structure and i - v characteristics, rating & specifications, switching characteristics, on to off and off to on state transitions, on/off transition loss analysis, driver circuits.

UNIT - IV: IGBT

Device structure and i - v Characteristics, rating & specifications, switching Characteristics, ON to OFF and OFF to ON state transitions, ON/OFF transitions, loss analysis, Comparison of all the above device with reference to power handling capability, frequency of operation, driver circuit, emerging power switching device

UNIT- V: Protection of the Switching Device

Device protection against over voltage/current, di/dt and dv/dt; safe operating area, design of snubbers for power devices.

Text Books:

1. Williams, B. W. "Power electronics Devices, drivers, and applications" Mc.Graw hill 2nd edition,1992. (Unit I to V)
2. Power Electronics-Md.H.Rashid –Pearson Education Third Edition- First Indian Reprint- 2008 (Unit I to V)

References:

1. MD Singh and K.B Khanchandani, "Power Electronics", Tata McGraw Hill, 2001.
2. Mohan, Undeland and Robins, "Power Electronics – Concepts, applications and Design,John Wiley and Sons, Singapore, 2000.

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SPECIAL MACHINES AND CONTROL
I Semester

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

Course Objectives

To make the students

- To familiarize the students with the constructional details, operating principles, theory of torque production and characteristics of various electrical machines.
- To expose the students to different power controllers and control practices associated with various electrical machines.

Learning Outcomes

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

- Demonstrate the knowledge and understanding of constructional details, working principles and control practices associated with various electrical machines.
- Describe the process of e.m.f. generation and torque production in various electrical machines.
- Analyze the speed-torque characteristics of various electrical machines.
- Apply the knowledge of Mathematics and Physical Science in designing the closed loop control strategy for various electrical machines to meet specified performance requirements.
- Suggest and select an appropriate electrical machine for a specified application.

Course Content

UNIT – I: Stepper Motors

Introduction – Classification of stepper motors - Constructional features andprinciple of operation – Torque equation of variable reluctance stepper motor– Open loop control - Closed loop control – Applications.

UNIT – II: Switched Reluctance Motors

Constructional features – Principle of operation – Torque equation –Speed and torque characteristics – Power converter switching circuits –Current control schemes –Closed loop control– Applications.

UNIT–III: Synchronous Reluctance Motors

Constructional features – Principle of operation–Phasor diagram –Torque Equation– Speed and torque characteristics– Control of synchronous reluctance motor – Applications.

UNIT–IV: Permanent Magnet Brushless D.C. Motors

Constructional features – Electronic commutation –Principle of operation – EMF and Torque equations – Torque and Speed characteristics – Power controller – Comparison between conventional dc motor and PMBLDC motor – Applications.

UNIT–V: Permanent Magnet Synchronous Motors

Constructional features – Principle of operation – Phasor diagram – EMF and Torque equations – Torque and Speed characteristics – Power controllers – Comparison of permanent magnet excitation and electromagnet excitation – Applications.

UNIT-VI: Linear Motors

Comparison between a linear electric motor and rotary motor –Classification of linear induction motor (LIM) – Constructional details – Principle of operation– Linear Synchronous motor (LSM) – Types – Constructional details – Principle of operation– Control of LSM – Applications of Linear Motors.

Textbooks:

1) 'Stepping Motors A Guide to Modern theory and practice', P.P.Acarnley, Peter Peregrines, London, 2002.(UNIT-I)
2) 'Stepping Motors and their Microprocessor Controls', Kenjo, T., ClarendonPress, 1984(UNIT-I,II)
3) 'Brushless Permanent Magnet & Reluctance Motor Drives', T.J.E. Miller, Clarenden press, Oxford, 1989.(UNIT-IV)
4) 'Linear Electric Motors Theory Design and Practical Applications', Naser, A.and Boldea.L, Prentice Hall of India, 1987.(UNIT-VI)

References

1) 'Special Electrical Machines', E.G.Janardanan, PHI Learning Private Limited, First Edition, 2015(UNIT-I,II,III,IV,V,VI).
2) 'Principles of Special Electrical Machines', J.Gnanavadivel, Dr.S.Muralidharan, Dr.J.Karthikeyan, Anuradha Publications, Fourth Edition, 2014.(UNIT-I,II,III,IV,V,VI)
3) 'Special Electrical Machines', K.Dhayalini, Anuradha Publications, Third Edition, 2011.(UNIT-I,II,III,IV,V)

'Electric Motor Drives - Modeling, Analysis, and Control', R.Krishnan, PrenticeHall of India, 2003.(UNIT-V).

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HVDC TRANSMISSION SYSTEMS
I Semester

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

Course Objectives

To make the students

- To introduce the concepts of HVDC Transmission.
- To familiarize with various converters , controllers and networks used in HVDC Transmission.

Learning Outcomes

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

- Design the voltage level and ratings of the HVDC system for a given amount of power transfer.
- Identify the suitable converter and its control scheme in HVDC Transmission.
- Estimate the amount of reactive power to be compensated for a given HVDC Transmission system.
- Develop a suitable model for a given AC- DC network.
- Choose appropriate protecting device for various faults in HVDC stations.
- Design a suitable filter to eliminate harmonics in the HVDC System.

Course Content

UNIT- I: Basic Concepts

Economics & Terminal equipment of HVDC transmission systems Types of HVDC Links – Apparatus required for HVDC Systems – Comparison of AC &DC Transmission, Application of DC Transmission System – Planning & Modern trends in D.C. Transmission.

UNIT- II: Analysis Of HVDC Converters

Choice of Converter configuration – analysis of Graetz – characteristics of 6 Pulse & 12 Pulse converters –Cases of two 3 phase converters in star –star mode – their performance. Principal of DC Link Control – Converters Control Characteristics – Firing angle control – Current and extinction angle control – Effect of source inductance on the system; Starting and stopping of DC link; Power Control.

UNIT- III: Reactive Power Control And In HVDC

Reactive Power Requirements in steady state-Conventional control strategies-Alternate control strategies sources of reactive power-AC Filters – shunt capacitors-synchronous condensers.

UNIT- IV: Power Flow Analysis in AC/DC Systems

Modelling of DC Links-DC Network-DC Converter-Controller Equations-Solution of DC load flow –solution of AC-DC Power flow-Simultaneous method-Sequential method.

UNIT- V: Converter Faults, Harmonics & Protection

Converter faults – protection against over current and over voltage in converter station – surge arresters – DC breakers –Audible noise-space charge field-corona effects on DC lines-Radio interference. Generation of Harmonics, Characteristics and Non- Characteristics harmonics, Calculation of voltage & Current harmonics – Effect of Pulse number on harmonics. Types of AC filters, Design of Single tuned filters –Design of High pass filters.

Text Books:

1. HVDC Power Transmission Systems Technology and system Interactions – by K.R.Padiyar, New Age International (P) Limited Publishers, First Edition, 2005.(Unit I to V)
2. EHVAC and HVDC Transmission Engineering and Practice – S.Rao. Khanna Publishers, 1990. (Unit I,II,IV,VI)

Reference Books:

1. HVDC Transmission – J.Arrillaga. published by the institution of electrical engineering, London, UK, 1998.
2. Direct Current Transmission – by E.W.Kimbark, John Wiley & Sons, First Edition.
3. Power Transmission by Direct Current – by E.Uhlmann, B.S.Publications, First Edition

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POWER ELECTRONIC SYSTEM SIMULATION LAB
I Semester

Practical	: 4	Internal Marks	: 40
Credits	: 2	External Marks	: 60

Course Objectives

To make the students

- Get the requisite knowledge necessary to appreciate the dynamical equations involved in the analysis of different PED configurations.
- Design and simulate different power converters studied in the core courses on power converters, Inverters and dynamics of electrical machines.

Learning Outcomes

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

- Simulate different dynamical equations for modeling of converters and machines.
- Model and Analyze the dynamics of basic DC converters and their closed loop operation.
- Analyze various load phenomena of different converters.
- Analyze the operation of various Inverter topologies with relevant switching schemes.

List of experiments

1. Simulation of Numerical solution of ordinary and partial differential equations.
2. Simulation of dynamic performance of Buck boost, SEPIC DC Converters using State space modelling.
3. Simulation of Buck and boost converters for closed loop voltage control mode control.
4. Simulation of Buck and boost converters for closed loop current mode control mode.
5. Simulation of single phase half wave controlled converter fed RLE load.
6. Simulation of single phase fully controlled converter fed RLE load.
7. Simulation of three phase half-controlled converter fed RL load.
8. Simulation of single phase ac phase controlled fed RL load.
9. Simulation of three phase to single phase cyclo - converter fed RL load
10. Simulation of various PWM techniques for inverter topologies

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11. Simulation of i) LC tank circuit resonance, ii) Basic / modified series inverter and iii) Series loaded series resonant inverter

12. Simulation of multi-level inverter topologies.

Text Books

1. Rashid, Muhammad H. *Spice for power electronics and electric power*. CRC Press, 2012.

2. Shaffer, Randall. *Fundamentals of power electronics with MATLAB*. Firewall Media, 2013.

Reference

1. Robert W. Erickson &Dragon Maksimovic, " Fundamentals of Power Electronics" Second Edition, 2001 Springer science and Business media.

2. Ned Mohan, T. M. Udeland and W.P Robbin, "Power Electronics converters, Application and design" John Wiley and sons. Wiley India edition, 2006.

3. Rashid M.H., "Power Electronics Circuits, Devices and Applications ", Prentice Hal India, New Delhi, 1995.

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RESEARCH METHODOLOGY

II Semester

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

Course objectives

To make the students

- familiarize with the objectives, motivation and significance of research.
- know research methodologies.
- define research problem and perform data analysis.
- write a research paper and report.

Learnaing Outcomes

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

- understand research approaches
- understand various research methodologies
- define a research problem
- perform data analysis
- write research papers and reports

Course Content

UNIT – I Introduction

Introduction, objectives and motivation of research, types of research, research approaches, significance of research methods.

UNIT – II Research Methodology

Research methods versus methodology, research and scientific method, importance of knowing how research is done, research process. criteria for good research.

UNIT – III Defining Research Problem

The research problems, necessity of defining the problem, technique involved in defining a problem, review of related literature, purpose of literature survey, identifying the current status, presentation of literature survey findings. critique, survey and peer review process.

UNIT – IV: Research Design and Data Analysis

Meaning of research design, features of good design, important concepts relating to research design, different research designs, basic principles of experimental designs.

Methods of data collection - collection of primary data, observation method, interview method, collection of data through questionnaires, collection of data through schedules, difference between questionnaires and schedules, some other methods of data collection, collection of secondary data, selection of appropriate method for data collection, case study method.

Processing and analysis of data **-** processing operations, some problems in processing, elements, types of analysis, statistics in research.

UNIT – V: Research Paper and Report Writing

Final paper presentation. significance of report writing, different steps in writing report, layout of the research report, types of report, precautions for writing research reports.

Textbooks

1. C.R.Kothari, "Research Methodology Methods and Techniques", Wishwa Prakashan Publishers, Second Edition (Units – I,II….).

Reference Books:

1. Template of ASCE/ASME/IEEE for paper writing.

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ADVANCED DIGITAL CONTROL SYSTEMS
II Semester

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

Course objectives

To make the students

- The theory of z–transformations and application for the mathematical analysis of digital control systems.
- Examine the stability of the system using different tests.
- Represent the discrete–time systems in state–space model and evaluation of state transition matrix.
- Study the design of state feedback control by "the pole placement method."

Learning Outcomes

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

- Understand z–transformations and their role in the mathematical analysis of different systems (like Laplace transforms in analog systems).
- Stability criterion for digital systems and methods adopted for testing.
- 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)

References 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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SWITCHED MODE POWER CONVERTERS
II Semester

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

Course objectives

To make students

- Familiarize the modern power electronic converters and its applications in electric power utility.
- Get acquainted to the design of closed loop operation of DC-DC Converters

Learning Outcomes

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

- Acquire and apply knowledge of mathematics and converter/machine dynamics in Electrical engineering.
- Design essential magnetic circuits in power supplies and drive systems.
- Design and conduct experiments towards developing new Converter designs.

Course Content

UNIT - I: Steady - State ConverterAnalysis

Buck, Boost, Buck- Boost and Cuk converters Principles of operation – Continuous conduction mode – Concepts of volt-sec balance and charge balance – Analysis and design based on steady-state relationships – Introduction to discontinuous conduction mode – Isolation topologies.

UNIT - II: Converter Dynamics

AC equivalent circuit analysis – State space averaging – Circuit averaging – Averaged switch modeling – Transfer function model for buck, boost, buck-boost, SEPIC and cuk converters – Input filters.

UNIT - III: Controller Design

Review of P, PI, and PID control concepts – gain margin and phase margin – Bode plot based analysis – Design of controller for buck, boost, buck-boost, SEPIC and cuk converters.

UNIT- IV: Design of Magnetics

Basic magnetic theory revision – Inductor design – Design of mutual inductance – Design of transformer for isolated topologies – Ferrite core table and selection of area product – wire table – selection of wire gauge.

UNIT- V: Resonant Converters

Introduction- classification- basic concepts- Resonant switch- Load Resonant converters- ZVS, Clamped voltage topologies- Series and parallel Resonant converters- Voltage control.

Text Books:

1. Robert W. Erickson &Dragon Maksimovic" Fundamentals of Power Electronics" Second Edition, 2001 Springer science and Business media (Unit I to V)

2. Wu Keng C Wu, "Switch-Mode Power Converters Design and Analysis. (Unit I to V).

References Books:

1. John G.Kassakian, Martin F. Schlecht, George C. Verghese, "Principles of Power Electronics"Pearson, India, New Delhi, 2010.

2. Simon Ang and Alejandra Oliva, "Power Switching Converter" Yesdee publishers, New Delhi, 2nd edition (first Indian Reprint), 2010.

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ADVANCED ELECTRIC DRIVES
II Semester

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

Course objectives

To make the students

- To familiarize with the speed control of DC motors with choppers
- To familiarize with the speed control methods of different AC drives

Learning Outcomes

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

- Identify & study the operational problems of chopper controlled DC motor drives
- Analyze steady state operation and control schemes of Induction motor.
- Describe the operational characteristics of slip power recovery schemes.
- Describe the flux weakening methodology scheme for PMSM drives
- Select an appropriate ac and dc drive for particular application.

Course Content

UNIT - I: Chopper controlled DC motor drives

Closed loop control of chopper fed DC motor Drives-Speed controlled drive system – current control loop – pulse width modulated current controller

UNIT - II: Inverter Fed Induction motor drives

Voltage Source Inverter Fed Induction motor drives

Scalar control- Voltage fed Inverter Control-Open loop volts/Hz control-Speed control with slip regulation Speed control with torque and Flux Control.

Current Source Inverter Fed Induction motor drives

Current-Fed Inverter Control-Independent current and frequency control-Speed and flux control in Current-Fed Inverter drive-

UNIT - III: Slip power recovery scheme

Slip power recovery schemes Slip-power recovery Drives-Static Kramer drive-Phasor diagram-Torque expression.

UNIT - IV: Vector control of Induction Motor Drive

Vector control of Induction Motor Principles of vector control, Direct vector control, derivation of indirect vector control, implementation – block diagram flux weakening operation.

UNIT - V Control of Permanent magnet Synchronous motor drives

PMSM and its characteristics- Control strategies-Constant torque angle control-power factor control, constant flux control, flux weakening operation

Text Books:

1. Electric Motor Drives Modeling, Analysis & control -R. Krishnan First Edition - Pearson Education 2010. (Unit – II,III,IV,V)

2. Modern Power Electronics and AC Drives –B. K. Bose- First Edition Pearson Publications,2010. (Unit – II,III,IV,V)

Reference Books:

1. Fundamentals of Electric Drives – G. K. Dubey –Second Edition, Narosa Publications –2010. (Unit – I)

2. Power Semiconductor Controlled drives – G. K. Dubey First.

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RENEWABLE ENERGY SYSTEMS ENERGY STORAGE
II Semester

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

Course objectives

To make the students

- Develop an overview of Solar Power Generation, related MPPT methodologies
- Knowledge on different renewable energy sources and storage devices to deal with grid connected PV systems

Learning Outcomes

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

- 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 (Unit I to V)

2. S. Chowdhury, S. P. Chowdhury, P. Crossley, "Microgrids and Active Distribution Networks", IET Power Electronics Series, 2012 (Unit I to V)

References:

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.

3. G. Masters, "Renewable and Efficient Electric Power Systems", IEEE-Wiley Publishers, 2013.

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Professional Elective - II

APPLICATIONS OF POWER ELECTRONICS TO POWER SYSTEMS
II Semester

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

Course objectives

To make the students

- 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

Learning Outcomes

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

- apply the knowledge of FACTS devices for enhancing power handling capacity in the transmission network.
- understand the fundamental principles and control practices associated with FACTS controllers.
- analyze different types of FACTS controllers.
- identify the operational related problems of transmission system and suggest suitable remedial measures.
- select an appropriate FACTS controller to meet specified performance requirements.

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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Professional Elective - II

CUSTOM POWER DEVICES
II Semester

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

Course Objectives

To make the students

- familiarize the various power quality problems, their origin and mitigation methods.
- familiarize students with Operation of custom power devices and their applications.
- introduce the concept of compensation by custom power devices.

Learning Outcomes

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

- identify various power quality problems in power system.
- analyze different types of custom power devices.
- analyze different types of multilevel converters.
- analyze different power factor improvement methods in converters.
- select suitable switching and breaking devices for a given application.
- apply various control methods in inverters for reactive power compensation.
- select and design a suitable custom power device for a given application.

Course Content

UNIT – I : Introduction and Characterization of Electric Power Quality

Electric Power Quality, Power Electronic applications in Power Transmission Systems, Power Electronic applications in Power Distribution Systems. Power Quality terms and Definitions, Power Quality Problems.

Custom Power, Classification of Custom Power Devices - Network reconfiguration type, compensating Type.

UNIT – II: Overview of Custom Power Devices

Compensation Devices for Voltage Sags and Momentary Interruptions - Backup Energy Supply Devices - Battery UPS - Super Conducting Magnetic Energy Storage systems - Flywheel - Voltage Source Converter - Multi-level converters, Multilevel Inverter, SPWM in Multilevel Inverter.

UNIT – III: Reactive Power and Harmonic Compensation Devices

Reactive power and harmonic compensation devices - Static Var Compensator - Topologies - Direct Connected Static Var Compensation for Distribution Systems - Static Series Compensator - Static Shunt Compensator (DSTATCOM) - Interaction with Distribution Equipment and System - Installation Considerations.

UNIT – IV: Source Transfer Switches, Solid State Limiting and Breaking Devices

Source Transfer Switch - Static Source Transfer Switch (SSTS) - Advantages of STS - Hybrid source transfer switch - High-speed mechanical source transfer switch - Solid state current limiter - Solid state breaker.

UNIT - V: Application of Custom Power Devices In Power Systems

P-Q theory - Control of P and Q - Dynamic Voltage Restorer (DVR) - Operation and control - Interline Power Flow Controller (IPFC) - Operation and control - Unified Power Quality Conditioner (UPQC) - Operation and control.

Text Books:

1. Power Quality Enhancement Using Custom Power Devices - Power Electronics and Power Systems, Gerard Ledwich,Arindam Ghosh, Kluwer Academic Publishers, 2002, 1st edition (Unit – I,II).

2. Guidebook on Custom Power Devices, Technical Report, Published by EPRI, Nov 2000 (Units – III,IV,V).

Reference Books:

1. Custom Power Devices - An Introduction, Arindam Ghosh and Gerard Ledwich, Springer, 2002, 1st edition (Unit- II,III,IV)

2. Roger C Dugan, et.al, "Electrical Power Systems Quality", 3rd Edition, TMH, 2012.)(Unit-I)

3. "Power Quality in Power System and Electrical Machines" by Ewald Fuchs, Mohammad A. S. Masoum Academic Press, Elsevier, 2009. 1st edition. (Unit-I)

4. Instantaneous Power Theory and Applications to Power Conditioning By Hirofumi Akagi, Edson Hirokazu Watanabe, Mauricio Aredes, Published by jhon wiley & sons, 2007, 1st edition. (Unit-VI).

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DIGITAL SIGNAL PROCESSING AND APPLICATIONS
II Semester

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

Course Objectives

To make the students

- To familiarize with the concepts of DFT, FFT, IIR and FIR filters.
- To understand the architecture of TMS320F281x processor.

Learning Outcomes

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

- Perform the DFT and FFTof a sequence.
- Design IIR and FIR Filters for given specifications.
- Analyze the decimation and interpolation on signals.
- Use TMS320F281x processor for Signal Processing applications.

Course Content

UNIT - I: Introduction to Digital Signal Processing

Digital signal processing system, sampling theorem, discrete time sequences, Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT) Radix-2, Decimation and Interpolation.

UNIT - II: IIR Filter Design

Design of IIR Filters from Analog Filters, Analog Filters Approximations Butterworth and Chebyshev; Frequency Transformations, General Considerations in Digital Filter Design, Bilinear Transformation Method, and Impulse Invariance Technique.

UNIT - III: FIR Filter Design

Symmetric and Anti Symmetric FIR Filters, properties of FIR digital filters, design of Linear–Phase FIR Filters using Fourier series Method and Rectangular, Hanning, Hamming, Blackman and Keiser Windows;

UNIT - IV: Effects of Finite Word Length in Digital Filters

Introduction, Rounding and Truncation Errors, Quantization Effects in Analogto-Digital Conversion of Signals, Coefficient Quantization effects in Direct Form Realization of IIR Filters and FIR filters, Scaling.

UNIT - V: TMS320F281x- Digital Signal Processor

Features of TMS320F281x, functional overview, memory map , brief description of C28x CPU, memory bus(Harvard Architecture), interrupt sources, System Control.

Text Books:

1. John G.Proakis, DimitrisG.Manoliks, "Digital signal processing principles, Algorithms and Applications", 3rd Edition, 2000, PHI. (Units I to III)

2. S Salivahanan, A Vallavaraj, and C Gnanapriya, "Digital Signal Processing",Tata McGraw Hill (Unit-IV)

Reference Books:

1. TMS320F2812 – Digital Signal Processors, Data Manual of Texas Instruments.(Unit-V)

2. Alan Oppenheim and Ronald W.Schafer, "DigitalSignalProcessing", PHI 2000.

3. Sanjit K.Mithra, "Digital Signal Processing A computer Based approach", Tata McGraw Hill, 2nd Edition, 2000.*M.*

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Professional Elective - III

AI TECHNIQUES
II Semester

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

Pre - Requisite:

Basic Knowledge on Structure and function of human brain and classical sets and conventional and PID controller techniques.

Course Objectives

To make the students

- To introduce the concept of Artificial Intelligence (AI).
- To familiarize with the architecture, principle of operation of Artificial Neural Networks,
- To introduce Fuzzy mathematics and fuzzy controllers design

Learning Outcomes:

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

- understand the concepts of Neural Networks.
- apply various learning methods to train Neural Network architectures.
- differentiate the crisp and fuzzy sets.
- design Fuzzy logic Controller for an Engineering application]
- select an appropriate AI technique for a specific application.

Course Content

UNIT I: Introduction to Neural Networks

Introduction to Neural Networks: Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Essentials of Neural Networks: Neural network Architectures-knowledge representation learning process-learning tasks and their rules

UNIT II: Feed Forward Neural Networks (FFN)

Perceptron Models: Discrete, Continuous and Multi-Category, Training Algorithms: Discrete and Continuous Perceptron Networks, Perceptron Convergence theorem, Limitations of the Perceptron Model, Applications. Multi Layer Feed Forward Neural Networks (MLFFN) Generalized delta rule, delta rule for Multi Layer Feed Forward

Neural Networks, Concept of Back Propagation, Back Propagation algorithm, Advantages and Disadvantages of Back Propagation.

UNIT III: ANN Memories and Applications

ANN Paradigms, Hebbian Learning, Bidirectional Associative Memory (BAM) architecture, BAM training and Hope field networks.

Neural Network Applications: load forecasting, fault identification, process control and identification.

UNIT IV: Introduction to Fuzzy Logic

Introduction to classical sets - properties, Operations and relations; Fuzzy sets, Membership, operations, properties, fuzzy relations, cardinalities, membership functions.

UNIT V: Fuzzy Logic System Components and Applications

Fuzzification, Membership value assignment, development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods. Fuzzy Logic Applications: Speed control of Drives, Process Control -P, PI, PD, and PID Controllers.

Text Books:

1. Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications by Rajasekharan and Rai – 6th impression, PHI Publication. (Unit I to V)

2. Introduction to Artificial Neural Systems - Jacek M. Zuarda, Jaico Publishing House, 6th impression 1997. (Unit I to V)

Reference Books:

1. Neural Networks-James Freeman and Davis Skapura, Pearson Education, 2002.

2. Neural Networks-Simon Hakins, 2nd impression Pearson Education.

3. Neural Engineering by C.Eliasmith and CH.Anderson, PHI.

4. Neural Networks and Fuzzy logic System by Bart kosko, PHI Publications.

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Professional Elective - III

SMART GRIDS
II Semester

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

Course Objectives

To make the students

- To Study about Smart Grid technologies.
- To study different smart meters and advanced metering infrastructure.
- To familiarize the power quality management issues in Smart Grid.
- To familiarize the high performance computing for Smart Grid applications

Learning Outcomes

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

- **Develop** more understanding on the concepts of Smart Grid and its present developments.
- **Explain** about different Smart Grid technologies.
- **Build** knowledge about different smart meters.
- **Build** knowledge about and advanced metering infrastructure.
- **Build** knowledge on power quality management in Smart Grids.
- **Develop** more understanding on LAN, WAN and Cloud Computing for Smart Grid applications.

Course Content

UNIT- I Introduction To Smart Grid 10

Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, Functions, opportunities, challenges and benefits, Difference between conventional & Smart Grid, National and International Initiatives in Smart Grid.

UNIT- II Smart Grid Technologies (Transmission) 10

Technology Drivers, Smart energy resources, Smart substations, Substation Automation, Feeder Automation, Transmission systems EMS, FACTS and HVDC, Wide area monitoring, Protection and control

UNIT- III: Smart Grid Technologies (Distribution) 10

DMS, Volt/VAr control, Fault Detection, Isolation and service restoration, Outage management, High-Efficiency Distribution Transformers, Phase Shifting Transformers, Plug in Hybrid Electric Vehicles (PHEV).20

UNIT- IV: Smart Meters And Advanced Metering Infrastructure 10

Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI protocols, standards and initiatives and AMI needs in the smart grid.

UNIT- V: Smart Meters And Advanced Metering Infrastructure 8

Phasor Measurement Unit (PMU), Intelligent Electronic Devices (IED) & their application for monitoring & protection.

UNIT-VI: High Performance Computing For Smart Grid Applications 12

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

Text Books:

1. Stuart Borlase "Smart Grid Infrastructure, Technology and Solutions",CRC Press 2012. (Unit I to V)
2. Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid Technology and Applications", Wiley. (Unit I to V)

Reference Books:

1. Vehbi C. Güngör, DilanSahin, TaskinKocak, Salih Ergüt, Concettina Buccella, Carlo Cecati,and Gerhard P. Hancke, Smart Grid Technologies Communication Technologies and Standards IEEE Transactions on Industrial Informatics, Vol. 7, No. 4, November 2011.
2. Xi Fang, Satyajayant Misra, Guoliang Xue, and Dejun Yang "Smart Grid – The New and Improved Power Grid A Survey", IEEE Transaction on Smart Grids.

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POWER ELECTRONICS AND ELECTRIC DRIVES LAB
II Semester

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

Course Objectives

To make the students

- To provide hands-on- experience on various Power Electronic converters.
- To expose students to various motion control schemes of electric machines.

Learning Outcomes

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

- Test, measure and determine the various parameters of three phase converters and provide valid conclusions
- Observe and understand the performance of different power converters to select suitable DC drive for an application
- Diagnose the various causes of harmonics and design a PWM converter
- Design converter fed dc drives and chopper fed dc drives
- Understand the behavior of inverter topologies for operating AC drives
- Use advanced signal processing systems to understand the closed loop operation of drives

List of Experiments

Any 10 experiments from the following list are required to be conducted

1. 3 -Ö Ac Voltage Controller on Motor Load.
2. 3 -Ö Full Converter with R & RL Loads
3. 3 -Ö Full Converter with Dc Motor Drive
4. Four Quadrant Chopper Drive Using Dc Motor
5. 1-Ö IGBT based PWM Inverter on R& RL Loads
6. 3 -Ö IGBT based PWM Inverter on R & RL Load
7. 3 -Ö SCR based Inverter Drive for AC Motor Module
8. Speed Controller Of 3 -Ö Slip-ring Induction Motor by Static Rotor Resistance Controller
9. 3 -Ö PWM Pulse Generator Module
10. DSP Based V/F Control Of Induction Motor

11. 3 -Ö PWM Pulse Generation using FPGA

12. FPGA based 3 -Ö IGBT inverter.

Reference Books:

1. Robert W. Erickson &Dragon Maksimovic" Fundamentals of Power Electronics" Second Edition, 2001 Springer science and Business media

2. Ned Mohan,T.MUndeland and W.P Robbin, "Power Electronics converters, Applicationand design" John Wiley and sons.Wiley India edition, 2006.

3. Fundamentals of Power Electronics With MATLAB Randall Sbaffer.

4. Rashid M.H., "Power Electronics Circuits, Devices and Applications ", Prentice Hal India,New Delhi, 1995.

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