ACADEMIC REGULATIONS

COURSE STRUCTURE

AND

DETAILED SYLLABI

For

MASTER OF TECHNOLOGY

In

ELECTRICAL POWER SYSTEMS

(For the batches admitted from 2014-2015)

SREE VIDYANIKETHAN ENGINEERING COLLEGE

(AUTONOMOUS)

Approved by AICTE, Accredited by NBA

Affiliated to JNT University Anantapur

Sree Sainath Nagar, A.Rangampet, Near Tirupati - 517 102. A.P.

VISION

To be one of the Nation's premier Engineering Colleges by achieving the highest order of excellence in Teaching and Research.

MISSION

- To foster intellectual curiosity, pursuit and dissemination of knowledge.
- To explore students' potential through academic freedom and integrity.
- To promote technical mastery and nurture skilled professionals to face competition in ever increasing complex world.

QUALITY POLICY

Sree Vidyanikethan Engineering College strives to establish a system of Quality Assurance to continuously address, monitor and evaluate the quality of education offered to students, thus promoting effective teaching processes for the benefit of students and making the College a Centre of Excellence for Engineering and Technological studies.

DEPARTMENT OF
ELECTRICAL AND ELECTRONICS ENGINEERING

VISION

To become the Nation's premiere centre of excellence in electrical engineering through teaching, training, research and innovation to create competent engineering professionals with values and ethics.

MISSION

- Department of Electrical Engineering strives to create human resources in Electrical Engineering to contribute to the nation development and improve the quality of life.
- Imparting Knowledge through implementing modern curriculum, academic flexibility and learner centric teaching methods in Electrical Engineering.
- Inspiring students for aptitude to research and innovation by exposing them to industry and societal needs to creating solutions for contemporary problems.
- Honing technical and soft skills for enhanced learning outcomes and employability of students with diverse background through comprehensive training methodologies.
- Inculcate values and ethics among students for a holistic engineering professional practice.

Program Educational Objectives (PEOs):

1. To impart advanced knowledge in operation and control of modern Electrical Power Systems.
2. To develop analytical, design and problem solving skills in the field of Electrical power systems.
3. To apply the concepts and techniques to provide solutions for the real time problems and to develop research competence in Electrical Power Systems.
4. To inculcate professionalism through various activities for a wholesome personality and for effective engineering practice.

Program Outcomes (POs):

1. Acquire in-depth knowledge in Electrical Power Systems with an ability to combine existing and recent practices.
2. Ability to analyze the complex problems for synthesizing information to conduct quality investigation in Electrical Power Systems.
3. Develop skills to envisage and solve problems to obtain optimal solution in power system operation and control to meet the needs of industry and society.
4. Acquire skills in collection and interpretation of literature, identify suitable methodologies, appropriate techniques for research competence in power system engineering.
5. Ability to select and apply appropriate modern tools and techniques to solve complex power engineering problems.
6. Achieve professional excellence and ability to work in groups for collaborative-multidisciplinary research and creative effort to meet common goals.
7. Ability to integrate engineering and management principles for implementation of projects in electrical power systems and allied areas.
8. Communicate effectively in all professional transactions.
9. Engage in life-long learning for knowledge and skill up gradation.
10. Ability to practice engineering in compliance with professional and ethical code.
11. Sustain and enhance an attitude for self-evaluation for personal and professional development.

The Challenge of Change

*"**M**astery of change is in fact the challenge of moving human attention from an old state to a new state. Leaders can shift attention at the right time and to the right place. The real crisis of our times is the crisis of attention. Those who lead are the ones who can hold your attention and move it in a purposeful way. Transformation is nothing but a shift in attention from one form to another. The form of a beautiful butterfly breaks free from a crawling caterpillar. If you pay enough attention, you would be able to see how the butterfly hides within the caterpillar. The leader points out a butterfly when the follower sees only a caterpillar".*

- Debashis Chatterjee

SREE VIDYANIKETHAN ENGINEERING COLLEGE

(Autonomous)

(Affiliated to J.N.T. University Anantapur, Anantapuramu)

ACADEMIC REGULATIONS

M.Tech. Regular Two Year Degree Program
(for the batches admitted from the academic year 2014–15)

For pursuing Two year degree program of study in Master of Technology (M.Tech) offered by Sree Vidyanikethan Engineering College under Autonomous status and herein after referred to as SVEC (Autonomous):

1. **Applicability** : All the rules specified herein, approved by the Academic Council, shall be in force and applicable to students admitted from the academic year 2014-2015 onwards. Any reference to "College" in these rules and regulations stands for SVEC (Autonomous).

2. **Extent:** All the rules and regulations, specified hereinafter shall be read as a whole for the purpose of interpretation and as and when a doubt arises, the interpretation of the Chairman, Academic Council is final. As per the requirements of statutory bodies, Principal, SVEC (Autonomous) shall be the Chairman, Academic Council.

3. **Admission** :

3.1. Admission into first year of Two Year M.Tech. Degree Program of study in Engineering:

3.1.1. Eligibility:

- A candidate seeking admission into the first year of two year M.Tech Degree Program should have
  - (i) Passed B.Tech / B.E or equivalent Program recognized by JNTUA, Anantapuramu, for admission as per the guidelines of Andhra Pradesh State Council of Higher Education (APSCHE).
  - (ii) a minimum percentage of marks in the qualifying degree as prescribed by the AICTE/UGC or Government at the time of admission.
- Admissions under General category & SC/ST Category shall be made either on the basis of merit rank obtained by the qualified candidates at an Entrance Test GATE / PGECET score, subject to reservations prescribed by the AICTE/UGC or Government policies from time to time.
- Sponsored category seats shall be filled-up with the candidates working in an Industry / Academic Institutions approved by AICTE/UGC. Candidate must have a minimum of one year of experience after the qualifying degree.

3.1.2. Admission Procedure: Admissions are made into the first year of two year M.Tech. Degree Program as per the stipulations of APSCHE, Government of Andhra Pradesh:

(a) By the Convener, PGECET (for Category–A Seats)

(b) By the Management (for Category-B Seats).

4. Programs of study offered leading to the award of M.Tech. Degree and Eligibility:

Following are the two year postgraduate degree Programs of study offered in various branches at in SVEC (Autonomous) leading to the award of M.Tech. degree and eligibility to get admission into the Programs:

Name of the specialization	Offered by the Department	Name of the Degree / Branch eligible for Admission
Electrical Power Systems	EEE	B.Tech / BE / AMIE in Electrical Engineering or equivalent
Digital Electronics & Communication Systems	ECE	B.Tech / BE / AMIE in ECE, AMIE (Electronics & Telecommunication Engineering) / AMIETE (Electronics & Telematics Engineering) or equivalent
VLSI		
Communication Systems		
Software Engineering	IT	B.Tech / BE / AMIE in CSE / CSIT / Electronics & Computers Engineering / IT / Computer Science and Systems Engineering or equivalent
Computer Science	CSE	B.E./B.Tech/AMIE in any Branch of Engineering / Tech. (or) equivalent Master's Degree in Physics, Statistics, Mathematics or Applied Mathematics, Applied Statistics, Applied Physics, Geophysics, M.Sc (Computer Science), M.Sc. (Information Systems), M.Sc. (Computer Applications and Electronics) and MCA (or) Equivalent (CS)
Computer Networks and Information Security	CSE	B.Tech/BE/AMIE in CSE/ECE/CSIT/IT/ETM/EEE/EIE & CSSE equivalent (or) MCA
Bio-Technology	Bio.Tech.	B.Tech / BE / AMIE in Chemical Engineering / Bio-Technology / Biochemical Engineering / Bio-Informatics / Agricultural Engineering or M.Sc. in Environmental Sciences/ Chemistry / Biochemistry / Microbiology / Biotechnology/ Life Sciences / B.V.Sc. / MBBS / BDS / B.Pharmacy/Food Technology

5. Academic Year: The College shall follow semester pattern for the two year M.Tech. Degre Program for conducting all its curricula. An academic year shall consist of two semesters with semester break after 1st & 3rd semesters and summer break after 2nd semester. The duration for each semester shall be a minimum of 16 weeks of instruction.

I SEMESTER (21 weeks)	**INSTRUCTION PERIOD**: I Spell : 7 Weeks II Spell : 9 Weeks	16 Weeks
	Internal Examinations : I Mid : 1 week II Mid : 1 week	2 Weeks
	Preparation & Practical Examinations	1 Week
	External Examinations	2 Weeks
	Semester Break	2 Weeks
II SEMESTER (21 weeks)	**INSTRUCTION PERIOD**: I Spell : 7 Weeks II Spell : 9 Weeks	16 weeks
	Internal Examinations : I Mid : 1 week II Mid : 1 week	2 Weeks
	Preparation & Practical Examinations	1 Week
	External Examinations	2 Weeks
	Summer Vacation	4 Weeks
III SEMESTER	Project Work Phase – I	18 Weeks
IV SEMESTER	Project Work Phase – II	18 Weeks

6. Course Structure: Each Program of study shall consist of:

- Professional core courses:

  The list of professional core courses are chosen as per the suggestions of the experts, to impart knowledge and skills needed in the concerned specialization of study.

- Professional elective courses:

  Professional elective courses shall be offered to the students to diversify their spectrum of knowledge. The elective courses can be chosen based on the interest of the student to broaden his individual knowledge and skills.

Contact hours: Depending on the complexity and volume of the course the number of contact hours per week shall be assigned.

7. Credit System: Credits are assigned based on the following norms given in Table 1.

Table 1

Course	Hours/Week	Credits
Theory	01	01
Practical	04	02
Seminar	--	02
Project Work Phase-I	--	04
Project Work Phase-II	--	12

i. As a norm, for the theory courses, **one credit** for one contact hour per week is assigned.
ii. As a norm, for practical courses **two credits** will be assigned for four contact hours per week.
iii. For courses like Project/Seminar, where formal contact hours are not specified, credits are assigned based on the complexity of the work to be carried out.

The two year curriculum of any M. Tech Degree Program of study shall have total of **73** credits.

8. Examination System: All components in any Program of study shall be evaluated continuously through internal evaluation and/or an external evaluation conducted as semester-end examination.

8.1. Distribution of Marks:

Sl. No.	Course	Marks	Examination and Evaluation		Scheme of examination
1.	Theory	60	Semester-end examination of 3 hours duration (External evaluation)		The examination question paper in theory courses shall be for a maximum of 60 marks. The question paper shall be of descriptive type with 5 questions taken one from each unit of syllabus with internal choice and all 5 questions shall be answered. All questions carry equal marks.
		40	Mid-term Examination of 2 hours duration (Internal evaluation).		The question paper shall be of descriptive type with 5 essay type questions out of which 4 are to be answered and evaluated. Two mid-term examinations each for 40 marks are to be conducted. For a total of 40 marks, 75% of better one of the two and 25% of the other one are added and finalized. **Mid-I:** After first spell of instruction (I to II Units). **Mid-II**: After second spell of instruction (III to V Units).
2	Laboratory	50	Semester-end Lab Examination of 3 hours duration (External evaluation)		50 marks are allotted for laboratory examination during semester-end.
		25	15	Day-to-Day evaluation	Performance in laboratory experiments and Record.

			10	Internal evaluation	Two Practical Tests shall be conducted and the average of the tests is to be finalized for 10 marks.
3	Seminar	50	Semester-end examination		Seminar shall be evaluated at semester-end by the Departmental Committee (DC) as given in 8.2.1.
4	Project Work	200	120	External evaluation	Semester-end Project evaluation shall be done by a board as detailed under 8.2.2
			80	Internal evaluation	Continuous evaluation by the DC.

8.2 Seminar/ Project Work Evaluation:

8.2.1. Seminar: For the seminar, the student shall collect information through literature survey on a specialized topic and prepare a technical report, showing his understanding over the topic, and submit to the Department a week before presentation. The report and the presentation shall be evaluated at the end of the semester by the DC consisting of Head of the Department, concerned Supervisor and two senior faculty members. The DC is constituted by the Principal on the recommendations of the Head of the Department.

8.2.2. Project Work:

8.2.2.1. Student shall register for the Project work with the approval of DC in the III Semester and continue the work in the IV Semester too. The DC shall monitor the progress of the project work. In III Semester, Phase–I of the Project Work has to be completed. A Student has to identify the topic of work, collect relevant Literature, preliminary data, implementation tools/ methodologies etc., and perform a critical study and analysis of the problem identified. He shall submit status report in two different phases in addition to oral presentation before the DC for evaluation and award of internal marks at the end of Phase –I. A candidate shall continue the Project Work in IV Semester (Phase – II) and submit a Project report at the end of Phase–II after approval of the DC. During Phase–II, the student shall submit status report in two different phases, in addition to oral presentation before the DC. The DC shall evaluate the project based on the progress, presentations and quality of work. A candidate shall be allowed to submit the dissertation only after passing all the courses of 1^{st} and 2^{nd} semesters and on recommendations of the DC. The Viva-Voce examination shall be conducted as per the IV Semester examinations schedule.

8.2.2.2 Three copies of the dissertation certified in the prescribed form by the concerned Supervisor and HOD shall be submitted to the Department. One copy is to be submitted to the Chief Controller of Examinations, SVEC (Autonomous) and one

copy to be sent to the examiner. The examiner shall be nominated by the Chief Controller of the Examinations from the panel of three examiners submitted by the Department for a maximum of 5 students at a time for adjudication.

8.2.2.3 If the report of the examiner is favorable, Viva-Voce examination shall be conducted by a board consisting of the concerned Supervisor, Head of the Department and the examiner who adjudicated the dissertation. The board shall jointly evaluate the candidates work for 120 marks.

8.2.2.4 The candidates who fail in Viva-Voce examination shall have to re-appear the Viva-Voce examination after three months. If he fails in the second Viva-Voce examination, the candidate should revise and resubmit the project report followed by Viva-Voce examination. Extension of time within the total permissible limit for completing the project is to be obtained from the Chairman, Academic Council, SVEC (Autonomous).

8.2.2.5 If a candidate desires to change the topic of the project already chosen, during Phase–II, he has to re-register for Project work with the approval of the DC and repeat Phases–I & II. Marks already earned in Phase–I stand cancelled.

8.3. Eligibility to appear for the semester-end examination:

8.3.1 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 courses in a semester.

8.3.2 Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester may be granted by the College Academic Committee.

8.3.3 Shortage of attendance below 65% in aggregate shall in no case be condoned.

8.3.4 Students whose shortage of attendance is not condoned in any semester shall not be eligible to take their semester-end examination and their registration shall stand cancelled.

8.3.5 A student shall not be promoted to the next semester unless he satisfies the attendance requirements of the semester, as applicable. The student may seek readmission for the semester when offered next. He will not be allowed to register for the courses of the semester while he is in detention.

8.3.6 A stipulated fee shall be payable to the college towards condonation of shortage of attendance.

8.4. Evaluation: Following procedure governs the evaluation.

8.4.1. Marks for components evaluated internally by the faculty should be submitted to the Controller of Examinations one week before the commencement of the semester-end examinations. The marks for the internal evaluation components shall be added to the external evaluation marks secured in the semester-end examinations, to arrive at total marks for any course in that semester.

8.4.2. Performance in all the courses is tabulated course-wise and shall be scrutinized by the Examination Committee and moderation is applied if needed, and course-wise marks are finalized. Total marks obtained in each course are converted into letter grades.

8.4.3. Student-wise tabulation shall be done and individual grade sheet shall be generated and issued.

8.5. Personal verification / Revaluation / Recounting:

Students shall be permitted for personal verification/request for recounting/ revaluation of the semester-end examination answer scripts within a stipulated period after payment of prescribed fee.

After recounting or revaluation, records shall be updated with changes if any and the student shall be issued a revised grade sheet. If there are no changes, the student shall be intimated the same through a notice.

8.6. Supplementary Examination:

In addition to the regular semester-end examinations conducted, the College may also schedule and conduct supplementary examinations for all the courses of other semesters when feasible for the benefit of students. Such of the candidates writing supplementary examinations may have to write more than one examination per day.

9. Re-Registration for Improvement of Internal Marks: Following are the conditions to avail the benefit of improvement of internal evaluation marks.

9.1 The candidate should have completed the course work and obtained examinations results for I and II semesters.

9.2 Out of the courses the candidate has failed in the examinations due to internal evaluation marks secured being less than 50%, the candidate shall be given one chance for a maximum of 3 theory courses for improvement of internal evaluation marks.

9.3 He should have passed all the remaining courses for which the internal evaluation marks secured more than or equal to 50%.

9.4 The candidate has to register for the chosen courses and fulfill the academic requirements.

9.5 For each course, the candidate has to pay a fee equivalent to one third of the semester tuition fee and the amount is to be remitted in the form of D.D./ Challan in favour of the Principal, Sree Vidyanikethan Engineering College payable at Tirupati along with the requisition through the concerned Head of the Department.

9.6 In the event of availing the Improvement of Internal evaluation marks, the internal evaluation marks as well as the semester-end examinations marks secured in the previous attempt(s) for the re-registered courses stand cancelled.

10. Academic Requirements for completion of M.Tech Program of study:

The following academic requirements have to be satisfied in addition to the attendance requirements for completion of M.Tech Program of study.

10.1 A student shall be deemed to have satisfied the minimum academic requirements for each theory, practical and project if he secures not less than 40% of marks in the semester-end examination and a minimum of 50% of marks in the sum total of the internal evaluation and semester-end examination taken together. For the seminar, he should secure not less than 50% of marks in the semester-end examination.

10.2 A student shall register for all the **73** credits and earn all the **73** credits. Marks obtained in all the **73** credits shall be considered for the calculation of the DIVISION based on CGPA.

10.3 A student who fails to earn **73** credits as indicated in the curriculum within **four** academic years from the year of his admission shall forfeit his seat in M.Tech. Program and his admission stands cancelled.

11. Transitory Regulations:

Students who got detained for want of attendance (**or**) who have not fulfilled academic requirements (**or**) who have failed after having undergone the Program in earlier regulations (**or**) who have discontinued and wish to continue the Program are eligible for admission into the unfinished semester from the date of commencement of class work with the same (**or**) equivalent courses as and when courses are offered and they will be in the academic regulations into which they are presently readmitted.

A regular student has to satisfy all the eligibility requirements within the maximum stipulated period of **four years** for the award of M.Tech Degree.

12. Grades, Grade Point Average and Cumulative Grade Point Average:

12.1. Grade System: After all the components and sub-components of any course (including laboratory courses) are evaluated, the final total marks obtained shall be converted to letter grades on a "**10 point scale**" as described below.

Grades conversion and Grade points allotted

% of Marks obtained	Grade	Description of Grade	Grade Points (GP)
≥ 95	S	Superior	10
≥ 85 to < 95	O	Outstanding	9
≥ 75 to < 85	A	Excellent	8
≥ 65 to < 75	B	Very Good	7
≥ 55 to < 65	C	Good	6
≥ 50 to <55	D	Pass	5
< 50	F	Fail	0
Not Appeared	N	Absent	0

Pass Marks: A student shall be declared to have passed theory course, laboratory course and project work if he secures minimum of 40% marks in Semester-end examination, and a minimum of 50% marks in the sum total of internal evaluation and Semester-end examination taken together. For the seminar, he shall be declared to have passed if he secures minimum of 50% of marks in the semester-end examinations. Otherwise he shall be awarded fail grade - **F** in such a course irrespective of internal marks. **F** is considered as a fail grade indicating that the student has to pass the semester-end examination in that course in future and obtain a grade other than **F** and **N** for passing the course.

12.2. Grade Point Average (GPA):

Grade Point Average (GPA) shall be calculated as given below on a "10 point scale" as an index of the student's performance at the end of each semester:

$$\text{GPA} = \frac{\sum(C\ X\ GP)}{\sum C}$$

where ***C*** denotes the credits assigned to the courses undertaken in that semester and ***GP*** denotes the grade points earned by the student in the respective courses.

Note: *GPA is calculated only for the candidates who passed all the courses in that semester.*

12.3. Cumulative Grade Point Average (CGPA):

The CGPA for any student is awarded only when he completes the Program i.e., when the student passes in all the courses prescribed in the Program. The CGPA is computed on a 10 point scale as given below:

$$\text{CGPA} = \frac{\sum(C\ X\ GP)}{\sum C}$$

where ***C*** denotes the credits assigned to courses undertaken up to the end of the Program and *GP* denotes the grade points earned by the student in the respective courses.

13. Grade Sheet: A grade sheet (Marks Memorandum) shall be issued to each student indicating his performance in all courses registered in that semester indicating the GPA.

14. Transcripts: After successful completion of the entire Program of study, a transcript containing performance in all academic years shall be issued as a final record. Duplicate transcripts will also be issued, if required, after payment of requisite fee. Partial transcript will also be issued upto any point of study to a student on request.

15. Award of Degree: The Degree shall be conferred and awarded by Jawaharlal Nehru Technological University Anantapur, Anantapuramu on the recommendations of the Chairman, Academic Council, SVEC (Autonomous).

15.1. Eligibility: A student shall be eligible for the award of M.Tech Degree if he fulfills all the following conditions:

- Registered and successfully completed all the components prescribed in the Program of study to which he is admitted.
- Successfully acquired the minimum required credits as specified in the curriculum corresponding to the Program of study within the stipulated time.
- Obtained CGPA greater than or equal to 5.0 (Minimum requirement for declaring as passed).
- Has no dues to the College, Hostel, Library etc. and to any other amenities provided by the College.
- No disciplinary action is pending against him.

15.2. Award of Division: Declaration of division is based on CGPA.

Awarding of Division

CGPA	Division
> = 7.0	First Class with Distinction
> = 6.0 and < 7.0	First Class
> = 5.0 and < 6.0	Second Class

16. Additional academic regulations:

16.1 A student may appear for any number of supplementary examinations within the stipulated time to fulfill regulatory requirements for award of the degree.

16.2 In case of malpractice/improper conduct during the examinations, guidelines shall be followed as shown in the **Annexure-I**.

16.3 When a student is absent for any examination (Mid-term or Semester-end) he shall be awarded **zero** marks in that component (course) and grading will be done accordingly.

16.4 When a component is cancelled as a penalty, he shall be awarded zero marks in that component.

17. Withholding of Results:

If the candidate has not paid dues to the College/University (or) if any case of indiscipline is pending against him, the result of the candidate shall be withheld and he will not be allowed/promoted to the next higher semester

18. Amendments to regulations:

The Academic Council of SVEC (Autonomous) reserves the right to revise, amend, or change the Regulations, Scheme of Examinations, and / or Syllabi or any other policy relevant to the needs of the society or industrial requirements etc., without prior notice.

19. General:

The words such as "he", "him", "his" and "himself" shall be understood to include all students irrespective of gender connotation.

Note: ***Failure to read and understand the regulations is not an excuse.***

Annexure-I

The following are the guidelines for disciplinary action in case of Malpractice/Improper Conduct during the Examinations.

GUIDE LINES FOR DISCIPLINARY ACTION FOR MALPRACTICES / IMPROPER CONDUCT IN EXAMINATIONS

Rule No.	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 course 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 course of the examination)	Expulsion from the examination hall and cancellation of the performance in that course 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 candidate 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 course 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 course of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the courses of that Semester/year. The Hall Ticket of the candidate is to 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 for four consecutive semesters from class work and all Year-end/Semester-end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. The performance of the original candidate who has been impersonated, shall be cancelled in all the courses of the examination (including labs and project work) already appeared and shall not be allowed to appear for examinations of the remaining courses of that semester/year. The candidate is also debarred for four consecutive semesters from class work and all Year-end/Semester-end examinations, if his involvement is established. Otherwise, The candidate is debarred for two consecutive semesters from class work and all Year-end/Semester-end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter 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 additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that course and all the other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all Year-end/Semester-end 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 the performance in that course only.
6.	Refuses to obey the orders of the Chief Controller of Examinations/Controller of Examinations/any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the Controller of Examinations 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 Controller of Examinations, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result 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.	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that course and all other courses the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the courses of that semester/year. If the candidate physically assaults the invigilator/Controller of the Examinations, then the candidate is also debarred and forfeits his/her seat. 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 performance in that course and all the other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all Year-end/Semester-end 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 course and all other courses the candidate has already

		appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester/year. 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.	Student of the colleges expulsion from the examination hall and cancellation of the performance in that course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester/year. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the College will be handed over to police and, a police case will be 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 course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses 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 course only or in that course and all other courses the candidate has appeared including practical examinations and project work of that semester/year examinations, depending on the recommendation of the committee.
12.	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the Chairman, Academic Council, SVEC (Autonomous) for further action to award suitable punishment.	

Note: Whenever the performance of a student is cancelled in any course(s) due to Malpractice, he has to register for Year-end/Semester-end Examinations in that course(s) consequently and has to fulfill all the norms required for the award of Degree.

SREE VIDYANIKETHAN ENGINEERING COLLEGE

(Autonomous)

DEPARTMENT OF ECE

COURSE STRUCTURE for M.Tech. (VLSI)

I-SEMESTER

Subject Code	Subject	L	T	P	C	Max. Marks		
						Int.	Ext.	Total
14MT10701	Power System Security and State Estimation	4	-	-	4	40	60	100
14MT10702	Static and Digital Protection of Power System	4	-	-	4	40	60	100
14MT10703	Advanced Power System Stability Analysis	4	-	-	4	40	60	100
14MT10704	Power Electronic Converters	4	-	-	4	40	60	100
14MT10705	Advanced Control Systems	4	-	-	4	40	60	100
Elective – I								
14MT10706	Microcontrollers and Applications	4	-	-	4	40	60	100
14MT10707	Reactive Power Compensation and Management							
14MT10708	Solar and Wind Energy Conversion Systems							
14MT10709	Optimization Techniques							
14MT10310	Research methodology	3	-	-	3	40	60	100
Laboratory								
14MT10721	Power Systems and Relays lab	-	-	4	2	25	50	75
	Total	**27**	**-**	**4**	**29**	**305**	**470**	**715**

II-SEMESTER

Subject Code	Subject	L	T	P	C	Max. Marks		
						Int.	Ext.	Total
14MT20701	Operation and Control of Power System	4		-	4	40	60	100
14MT20702	Flexible AC Transmission System	4		-	4	40	60	100
14MT20703	Power Quality	4		-	4	40	60	100
14MT20704	Smart Grid Technology	4		-	4	40	60	100
14MT20705	Intelligent Control	4		-	4	40	60	100
Elective – II								
14MT20706	High Voltage DC Transmission	4	-	-	4	40	60	100
14MT20707	Restructured Power System							
14MT20708	Power System Reliability							
14MT20709	Energy Audit, Conservation and Management							
Laboratory								
14MT20721	Power Systems Simulation lab	-	-	4	2	25	50	75
14MT20722	Seminar	-	-	-	2	-	50	50
	Total	**24**	**-**	**4**	**28**	**265**	**460**	**725**

III-SEMESTER

Subject Code	Course	Periods per Week			C	Int.	Ext.	Total
		L	T	P*				
14MT30721	Project Work Phase-I	-	-	-	4	40	-	40
Total		-	-	-	4	40	-	40

*Fulltime Project Work

IV-SEMESTER

Subject Code	Course	Periods per Week			C	Int.	Ext.	Total
		L	T	P*				
14MT40721	Project Work Phase-II	-	-	-	12	40	120	160
Total		**-**	**-**	**-**	**12**	**40**	**120**	**160**

*Fulltime Project Work

Total Credits: 73 **Total Marks: 1700**

SREE VIDYANIKETHAN ENGINEERING COLLEGE **(Autonomous)**

M. Tech. (EPS) I-Semester
(14MT10701) POWER SYSTEM SECURITY AND STATE ESTIMATION

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PRE-REQUISITES:
Power system Analysis at UG level

COURSE DESCRIPTION:
Power system network matrices; AC and DC Load flow studies; Balanced and unbalanced Short circuit analysis; Power system security; Methods of Power System State estimation

COURSE OBJECTIVES:
- To introduce conceptual knowledge on power system security and state estimation.
- Develop skills to carry out the Contingency analysis for various power system networks.
- To analyze security of power system network for different operational scenarios.

COURSE OUTCOMES: On successful completion of the course, the student would be able to
1. gain knowledge on:
   - formation of network matrices.
   - developing load flow solutions and fault analysis for different operating conditions.
   - state estimation and security analysis of power systems.
2. develop analytical skills to analyze power system state and security for operational contingencies.
3. apply the concepts of state estimation in designing operational strategy for secured operation of power system.

DETAILED SYLLABUS:
UNIT-I: POWER SYSTEM NETWORK MATRICES
Formation of bus admittance matrices by direct inspection method - Algorithm for formation of Bus impedance matrix: addition of a branch and addition of a link, removal element in Bus impedance matrix – Simple problems. Π-representation of off-nominal tap transformers.
UNIT-II: POWER FLOW STUDIES
Introduction to load flow analysis. Classification of buses, Load flow solution methods – Gauss-Seidal method, Newton Raphson method, Decoupled and fast decoupled load flow, Comparison of load flow methods, DC power flow method – Simple problems.

UNIT-III: FAULT ANALYSIS

Short circuit studies – introduction, short circuit calculations using Z_{bus}, Z_f^{abc}, Y_f^{abc}, Z_f^{012} and Y_f^{012} matrices for various faults. Analysis of balanced and unbalanced three phase faults – Simple problems.

UNIT-IV: POWER SYSTEM SECURITY

Introduction to power system security, Factors influencing power system security, Contingency analysis: Detection of Network problems, linear sensitivity factors, AC power flow methods, Contingency selection, concentric relaxation, bounding – simple problems.

UNIT-V: STATE ESTIMATION IN POWER SYSTEM

Power system state estimation, Methods of state estimation – method of least squares, orthogonal decomposition, Treatment of bad data – applications to power system state estimation – simple problems.

TEXT BOOKS:

1. Allen J.Wood and Wollenberg B.F., *Power Generation Operation and control*, John Wiley & Sons, 2nd Edition, 2006.
2. Nagrath I.J. and *Kothari D.P., Modern Power System Analysis,* TMH, New Delhi, 2004.

REFERENCES:

1. Grainger J.J. and Stevenson W.D., *Power System Analysis*, Tata McGraw Hill, New Delhi, 2003.
2. Stagg and El Abiad*: Computer methods in power systems analysis*, McGraw Hill ISE, 1986.

M. Tech. (EPS)I-Semester
(14MT10702) STATIC AND DIGITAL PROTECTION OF POWER SYSTEMS

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PRE-REQUISITES:
1. Switchgear and Protection at UG level
2. Microcontrollers and Applications at PG level

COURSE DESCRIPTION:
Fundamentals of static and digital relays; Amplitude and Phase Comparators; characteristics of Static over current and differential relays; Static Distance relays; Numerical relays

COURSE OBJECTIVES:
- To introduce advanced knowledge in static and digital relays for power system protection.
- To develop skills in selection of Static and Digital relays for power system protection.
- To apply Numerical relays for power system protection.

COURSE OUTCOMES: After successful completion of the course, students will be able to
1. gain advanced knowledge in
    - digital and numerical relays.
    - Operation of static and microprocessor based relays.
2. implement advanced skills in protection of power system components.
3. design and develop different power system protection schemes.
4. select and apply different relays in real time power system protection.

DETAILED SYLLABUS

UNIT-I: **INTRODUCTION TO STATIC AND DIGITAL RELAYS**

Static Relays - basic construction and advantages. Level detectors, Replica impedance, Mixing circuits, Phase and Amplitude Comparators – General equation for two input phase and amplitude comparators, Duality between Phase and Amplitude Comparators

Numerical Relays: Block diagram of typical Numerical Relay – Advantages and Disadvantages.

UNIT-II: **COMPARATORS**

Amplitude comparators: Circulating current type, opposed voltage type rectifier bridge comparators – Direct and Instantaneous comparators.

Phase comparators: Coincidence circuit type - block spike phase comparator, techniques to measure the period of coincidence – Integrating type – Rectifier and vector product type phase comparators.

Multi–Input comparators: Conic section characteristics – Three input amplitude comparator – Hybrid comparator.

UNIT-III: STATIC OVER CURRENTAND DIFFERENTIAL RELAYS

Static over current relays: Introduction, Instantaneous over current relay – Time over current relays. Basic principles – Definite time, Inverse Definite time and Directional over current relays.

Static Differential Relays: Analysis of Static differential relays – static relay schemes – Duo bias transformer differential protection – Harmonic restraint relay.

UNIT-IV: STATIC DISTANCE RELAYS

Static impedance, Reactance, MHO and angle impedance relays – sampling comparator – realization of reactance and MHO relays using a sampling comparator.

Power Swings: Effect of power swings on the performance of distance relays, Power swing analysis, Principle of out-of-step tripping and blocking relays, effect of line length and source impedance on distance relays.

UNIT-V: MICROPROCESSOR BASED PROTECTIVE RELAYS

Microprocessor based over current relays, Impedance relay, Directional relay, Reactance relay. Generalized mathematical expression for distance relays, measurement of resistance and reactance, MHO and offset-MHO relays – Realization of MHO characteristics, realization of offset MHO characteristics – Microprocessor Implementation of Digital Distance Relaying Algorithms.

TEXT BOOKS:

1. T.S. Madhava Rao, *Power system Protection static relay*, 2nd Edition, Tata McGraw Hill Publishing Company limited, 2004.
2. Badri Ram and D.N. Vishwakarma, *Power system Protection and Switchgear*, 2nd Edition, Tata McGraw Hill Publication Company limited, 2013.

REFERENCE BOOKS:

1. Bhuvanesh A Oza, Nirmal Kumar C Nair et., al., *Power system protection and switchgear*, Tata McGraw Hill Publication Company Limited.

M. Tech. (EPS)I-Semester
(14MT10703) ADVANCED POWER SYSTEM STABILITY ANALYSIS

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PRE-REQUISITES:
Power System operation and control, Power system Analysis at UG level
Control systems at UG level

COURSE DESCRIPTION:
Introduction to the synchronous machine classical model; state space models of synchronous machine; Methods of Excitation systems and modelling; Effect of excitation on stability; Analysis of Voltage stability

COURSE OBJECTIVES:
- To introduce various power system stability, control and reactive power management concepts.
- To develop skills to carry out the stability studies for large scale multi-area power systems.
- To apply, analyze and implement algorithms for power system stability enhancement.

COURSE OUTCOMES: On successful completion of the course, the student would be able to
1. gain knowledge on:
   - transient and dynamic stability studies for large power systems.
   - modeling of SMIB, multi-machine systems and excitation systems.
   - voltage control and reactive power management concepts.
2. ability to assess various control schemes for better performance of the interconnected power system with economic considerations.
3. design and develop efficient control techniques for enhancement of voltage stability, rotor-angle stability and reactive power control in large interconnected power systems.

DETAILED SYLLABUS:
UNIT-I: THE ELEMENTARY MATHEMATICAL MODEL
A Classical model of single machine connected to infinite bus – Problems. System Response to small Disturbances: Block diagram of unregulated and regulated synchronous machine, methods of studies – Effect of small changes of speed. Regulated synchronous machine – voltage regulator with one time lag – Governor with one time lag.
Classical model of multi-machine system – modes of oscillation of unregulated Multi-machine system – Problems.

UNIT-II: THE SYNCHRONOUS MACHINE MODEL

Introduction – Clarkes's and Park's Transformation – flux linkage equations, self and mutual inductances of stator and rotor, transformation of inductances – formulations of state space model of one machine system connected to infinite bus, voltage, current equations – effect of excitation on Dynamic stability – examination of dynamic stability by Routh's criterion.

UNIT-III EXCITATION SYSTEMS

Simplified view of excitation control – Control configuration – Excitation system response – Non-continuously regulated systems – continuously regulated systems – Excitation system compensation – state space description of the excitation system - simplified linear model.

Types of Excitation systems: Type-2 system: rotating rectifier system, Type-3 system: Static with terminal potential and current supplies, Type-4 system: non–continuous acting - Block diagram representation – state space representation.

UNIT-IV: EFFECT OF EXCITATION ON STABILITY

Introduction – effect of excitation on generator power limits – Effect of the excitation system on Transient stability. Approximate model of the complete exciter – generator system – Supplementary stabilizing signals – Block diagram of the linear system – Lead compensation – Stability aspect using Eigen value approach.

UNIT-V: VOLTAGE STABILITY ANALYSIS

Voltage stability – factors affecting voltage instability and collapse – Comparison of angle and voltage stability – Analysis of voltage instability collapse – Control of voltage instability.

Review of Lyapunov's stability theorems of non-linear systems using energy concept – Method based on first concept – Method based on first integrals – Quadratic forms – Variable gradient method – Zubov's method – Popov's method, Lyapunov function for single machine connected to infinite bus.

TEXT BOOKS:

1. P.M. Anderson, A.A. Fouad, *Power System Control and Stability*, 2nd edition, IEEE Press, 2003.
2. K.R. Padiyar, *Power System Dynamics (Stability & Control)*, 2nd edition, B.S. Publications, Hyderabad, India, 2008.

REFERENCES:

1. Prabha Kundur, Neal J.Balu, Mark G.Lauby, *Power System Stability and Control*, 2nd edition, McGraw-Hill, 1994.
2. M.A. Pai, *Power System Stability – Analysis by the direct method of Lyapunov*, North Holland Publishing Company, New York, 1981.

M. Tech. (EPS)I-Semester
(14MT10704) POWER ELECTRONIC CONVERTERS

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PRE-REQUISITES: Power Electronics at UG level.

COURSE DESCRIPTION:
Power Semiconductor Devices; Controlled Rectifiers; AC Voltage Controllers, operation and analysis of Cycloconverters; Analysis of DC-DC and Resonant Converters; Multi Level Inverters and PWM techniques

COURSE OBJECTIVES:
- To introduce the knowledge of advanced power devices and concepts of Power electronic converters.
- To develop analytical and design skills for various power converters.
- To apply various converters in industrial drives and power system applications.

COURSE OUTCOMES: After successful completion of course, the student will be able to
1. acquire in-depth knowledge in advanced Power devices and converters.
2. acquire analytical and design skills in power converter modules for various applications in power industry.
3. extend the concepts of power electronic converters for HVDC and FACTS.

DETAILED SYLLABUS
UNIT-I: MODERN POWER SEMICONDUCTOR DEVICES
Power Diode - Reverse recovery characteristics, types. Steady state characteristics and switching characteristics of Power transistors (power MOSFET, IGBT) and Thyristors(GTO, IGCT). Gate drive circuits for SCR, MOSFET, IGBT and Base drive circuit for Power BJT. Comparison of power devices.
UNIT-II: MULTI-PULSE CONTROLLEDRECTIFIERS
Six pulse SCR rectifiers – semi and full converters, operation with different firing angles-Effect of line inductance - power factor and THD. Power factor improvement – extinction angle control, symmetric angle control, PWM control – single and three phase control. Three phase dual converters. Single phase series converters. Twelve pulse SCR rectifiers – idealized 12 pulse rectifier operation, effect of line and leakage inductance, power factor and THD. 18 and *24 pulse SCR rectifiers, operation.*
UNIT-III: **AC VOLTAGE CONTROLLERS AND CYCLOCONVERTERS**
Single phase AC voltage controllers with R, RL and RLE loads. AC voltage controllers with PWM Control. Effect of source and load inductances. Synchronous tap changers – Applications. Three Phase AC Voltage Controllers – Analysis of controllers with star and delta Connection, applications, numerical problems. Single phase and three phase cycloconverters – analysis with Mid-

point and bridge configurations – Limitations – Advantages – Applications – numerical problems

UNIT-IV: ANALYSIS OF DC-DC AND RESONANT CONVERTERS

Voltage commutated chopper. Current commutated chopper. Switch mode regulators – buck, boost, buck-boost and cuk regulators – condition for continuous inductor current and capacitor voltage - design of LC filter – comparison of regulators. Multi-output boost converters – advantages, applications, Numerical problems Resonant Converters – Concept of ZVS and ZCS, principle of operation, analysis of M-type and L-type Converters

UNIT-V: PWM AND MULTI LEVEL INVERTERS

Voltage control of single phase inverters – single, multiple, sinusoidal, modified sinusoidal pulse width modulation, phase displacement control Advanced PWM techniques – trapezoidal, staircase, stepped, harmonic injection, delta modulations Voltage control of three phase inverter - sinusoidal PWM, 60 degree PWM, third harmonic PWM, space vector modulation. Harmonic reduction Multilevel inverters – Types – diode clamped, flying capacitor, cascaded – operation, features, applications.

TEXT BOOKS:

1. Rashid M.H., *Power Electronics Circuits, Devices and Applications*, 3rd edition, Prentice Hall publications, 2009.
2. Ned Mohan, Undeland and Robbin, *Power Electronics: Converters, Application and Design*, John Wiley and sons Inc., Newyork, 1995.

REFERENCE BOOKS:

1. Bin Wu, *High power converters and AC Drives,* John Wiley and Sons, 2006.
2. P.C Sen, *Modern Power Electronics*, 1stedition, Wheeler publishing Company, 1998.

M. Tech. EPS-I Semester
(14MT10705) ADVANCED CONTROL SYSTEMS

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PRE-REQUISITES: Control Systems at UG level

COURSE DESCRIPTION:
Advanced concepts of controllability, observability; Analysis of non-linear systems; Lyapunov stability and design of controllers and observers; optimal control concepts

COURSE OBJECTIVES:
- To introduce advanced concepts of linear and nonlinear systems.
- To develop skills in evaluation of stability and formulation of optimal control.
- To design applications in modal and optimal control systems.

COURSE OUTCOMES: On successful completion of the course, the students will be able to
1. gain advanced knowledge in state space analysis, controllability, observability, stability of linear and non-linear control systems.
2. apply describing function, Phase-Plane methods and Lyapunov's stability criterion for non-linear system stability analysis.
3. design of controllers and observers using state feedback techniques.

DETAILED SYLLABUS

UNIT – I: CONTROLLABILITY AND OBSERVABILITY
Review of state variable techniques – Concept of controllability and observability, Tests for Controllability and Observability for Continuous Time Systems – Principle of Duality, Controllability and Observability of State Models in Jordan Canonical Form and Other Canonical Forms – Effect of State Feedback on Controllability and Observability.

UNIT – II: ANALYSIS OF NON-LINEAR SYSTEMS
Introduction to Nonlinear Systems, Types of physical Non-linearities, Characteristics of non-linearities, properties of nonlinear systems. Describing Functions, Derivation of Describing Functions for: Dead Zone, Saturation, Backlash, Relay with Dead Zone and Hysteresis. Stability analysis of non-linear systems through describing functions. Phase-Plane Analysis, Singular Points, Isocline method, Delta method.

UNIT - III: STABILITY ANALYSIS
Stability in the Sense of Lyapunov, Lyapunov stability theorems, Definiteness, Sylvester principle, stability analysis by Lyapunov second method, Lyapunov functions, Krasovskii's Method, Variable gradient method

UNIT – IV: CONTROLLERS AND OBSERVERS DESIGN
Design of State Feedback Controller through Pole Placement - Full Order Observer and Reduced Order Observer, state regulator problem

UNIT – V: OPTIMAL CONTROL

Introduction to Optimal Control - Formulation of Optimal Control Problems - Calculus of Variations, Minimization of functional of Single Function, Euler Lagrange Equation, Constrained Minimization, Minimum Principle, Control Variable Inequality Constraints.

TEXT BOOKS:

1. M. Gopal, *Modern Control System Theory*, 2nd edition, New Age International Publishers, 1996.
2. K. Ogata, *Modern Control Engineering,* 3rdedition, Prentice Hall of India, 1998.

REFERENCE BOOKS:

1. I.J. Nagrath and M.Gopal, *Control Systems Engineering*, New Age International (P) Ltd. 2007.
2. M. Gopal, *Digital Control and State Variable Methods,* Tata Mc Graw-Hill Companies, 1997.

M. Tech. EPSI-Semester
(14MT10706) MICROCONTROLLERS AND APPLICATIONS
(Elective - I)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PRE-REQUISITES: Digital logic, Microprocessors and Microcontrollers at UG level

COURSE DESCRIPTION:
8051 Microcontroller: Architecture, Programming and Interfacing; PIC Microcontrollers: Architecture, features, programming and Interfacing

COURSE OBJECTIVES:
- To introduce concepts of Microcontrollers.
- To design and develop suitable interfaces and programs for control applications in the field of Electrical Engineering.
- To apply various Microcontrollers for real time applications.

COURSE OUTCOMES: On successful completion of the course, the student would be able to
1. gain knowledge on
    - architecture of 8051 and PIC microcontroller
    - variants of 8051 and PIC
2. critically analyze and develop a suitable interface with an appropriate Microcontroller for the control operations.
3. develop programs for stand-alone systems.

DETAILED SYLLABUS
UNIT–I: 8051 Microcontroller
Overview of 8051 microcontrollers. 8051/8052 – architecture and features. Memory – internal / external Program, Data memory and their interfacing. Data memory – Register Bank, Bit addressable space, scratch pad area. Special Function Registers (SFRs). Instruction set – Data transfer, Arithmetic, logical, branch control instructions. Addressing modes. Timers – Mode - 0, 1, 2 and 3 operations, TMOD, TCON. Timer applications – wave generation, Device control operations.
UNIT-II: Interfacing
Basics of serial communication – RS232, MAX232, Baud rate. Serial port programming - SCON, SMOD, SBUF, PCON. Interrupts – IE, TCON, IP. Applications using interrupts of 8051/8052 – wave generation, Device control operations. Interfacing – ADC, DAC, DC motor and PWM
UNNIT-III: PIC Microcontrollers
CISC Vs RISC. Harvard Vs Von Neumann architectures. PIC16F87XA architecture and features. PIC16 Memory organization – program memory, data memory. PIC Register file – General purpose registers and SFRs.

Introduction to PIC Assembly Programming, PIC Data Format and Directives. PIC programming tools. Instruction set – data transfer, arithmetic, logical, bit manipulation, branch Instructions. I/O Port Programming. Addressing modes – Immediate, Direct, Register Indirect Addressing Modes. Macros and Modules.

UNIT–IV: Serial, Interrupt, I/O Ports and Timer programming

I/O ports – Port A, TRISA, Port B, TRISB, Port C TRISC. Timer - 0, 1, 2 modules. Compare mode, capture mode. PIC Serial Port programming, PIC Interrupts, Programming Timer Interrupts, Programming the Serial Communication Interrupts, Port-B - Change Interrupt, Interrupt Priority in the PIC.

UNIT–V: PIC Interfacing

ADC Characteristics, ADC Programming in the PIC, DAC Interfacing, Sensor Interfacing and Signal Conditioning, Standard and Enhanced CCP Modules, Compare Mode Programming, Capture Mode Programming, PWM Programming, ECCP Programming, Relays and Opto-isolators, Stepper Motor Interfacing, DC Motor Interfacing and PWM, PWM Motor Control with CCP, DC Motor Control with ECCP.

TEXT BOOKS:

1. Muhammad Ali Mazidi, Jancie Gillispie Mazidi, Rolin McKinlay, *The 8051 Microcontroller and Embedded Sytems using Assembly and C*, 2nd edition, Pearson Education.
2. John B. Peatman, *Design with PIC Microcontrollers*, Pearson Education, 2007.

REFERENCE BOOKS:

1. PIC16F87XA manual.
2. Muhammad Ali Mazidi, Rolin D. McKinlay, Danny Causey, *PIC Microcontroller and Embedded Systems using assembly and C for PIC 18,* Pearson Education, 1999.
3. John B. Peatman, *Embedded design with the PIC18F452 Microcontroller*, Printice Hall, 2003.

M.Tech (EPS)I-Semester
(14MT10707)REACTIVE POWER COMPENSATION AND MANAGEMENT
(Elective - I)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PRE-REQUISITES: Power Systems at UG level

COURSE DESCRIPTION:
Reactive Power Compensation: Line and Load compensation; compensating devices; Reactive power coordination: Power Quality; Reactive power management in Domestic and Industrial Sectors

COURSE OBJECTIVES:
- To introduce advanced concepts in reactive power compensation and management.
- To develop computational skills in reactive power coordination.
- To apply different compensation methods for enhancement of voltage stability.

COURSE OUTCOMES: After successful completion of the course, the students will be able to
1. gain advanced knowledge on:
    a. different methods of reactive power compensation.
    b. types of load patterns and loss reduction methods in distribution lines.
    c. quality of power supply and reactive power coordination
2. analyze different types of compensations**.**
3. develop skills in designing a compensator for an industrial application**.**

DETAILED SYLLABUS

UNIT-I: Reactive Power Compensation

Need for Reactive Power compensation – reactive power characteristics. Ideal compensator, Practical compensation – power factor correction and voltage regulation. Load compensator as a voltage regulator, phase balancing and power factor correction of unsymmetrical loads– examples.

UNIT-II: Reactive power compensation in transmission systems

Steady state Reactive power compensation – Uncompensated line. Types of compensation, Passive shunt, series and dynamic shunt compensation – examples.

Transient state Reactive power compensation – Characteristic time periods. Passive shunt compensation. Static compensations – series capacitor compensation, compensation using synchronous condensers - examples.

UNIT-III: Reactive power coordination

Reactive power coordination: Objective, Mathematical modeling, Operation planning, transmission benefits. Basic concepts of quality of power supply:

Disturbances, steady – state variations, effects of under voltages, frequency, Harmonics, radio frequency and electromagnetic interferences.

UNIT-IV: Reactive power Management

Demand side management: Load patterns, basic methods of load shaping, power tariffs, KVAR based tariffs penalties for voltage flickers and Harmonic voltage levels.

Distribution side Management: System losses, loss reduction methods, examples, Reactive power planning: Objectives, Economic Planning, capacitor placement and retrofitting of capacitor banks.

UNIT-V: Reactive power management in Domestic and Industrial Sectors

KVAR requirements for domestic appliances: Purpose of using capacitors, selection of capacitors, deciding factors. Types of available capacitor – characteristics and Limitations. Typical layout of traction systems–reactive power control requirements. Distribution transformers, Electric arc furnaces, textile and plastic industries, furnace transformer, filter requirements, remedial measures, and power factor of an arc furnace.

TEXT BOOKS:

1. T.J.E.Miller, *Reactive power control in Electric power systems*, John Wiley and Sons, 1982
2. D.M. Tagare, *Reactive power Management*, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2004.

REFERENCES:

1. Wolfgang Hofmann, Jurgen Schlabbach, Wolfgang Just, *Reactive Power Compensation: A Practical Guide*, Wiley, April, 2012

M.Tech. (EPS) I-Semester
(14MT10708) SOLAR AND WIND ENERGY CONVERSION SYSTEMS
(Elective - I)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PREREQUISITES:

Power Electronics in UG
Non-Conventional Energy Resources in UG

COURSE DESCRIPTION:

Non-Conventional energy resources; Wind and Solar energy systems: design and operation; Power Conditioning Schemes for Solar and Wind Energy systems; Impact of power quality problems

COURSE OBJECTIVES:

- To introduce concepts of power electronics for renewable energy.
- To develop skills in interconnection of renewable energy systems to the grid.
- To apply line commutated converters for synchronized operation with grid**.**

COURSE OUTCOMES: After successful completion of the course, the students will be able to

1. gain advanced knowledge on role of power electronics for renewable energy.
2. analyze the power conditioning schemes for grid connected systems**.**
3. develop skills in designing wind, solar systems and their integration**.**

DETAILED SYLLABUS

UNIT I: Introduction to Renewable Energy Systems

Renewable Energy systems, Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment - Qualitative study of different renewable energy resources: Solar, wind, ocean, Biomass and Fuel cell.

UNIT II: Design and operation of Wind Power System

Wind Power System: Components, Turbine Rating, Electrical Load Matching, Variable-Speed operation, system design features, Maximum Power Operation, System Control Requirements, Speed Control, Rate Control and Environmental Aspects. Wind Energy Conversion Systems and their Classification.

UNIT III: Design and Operation of PV system

Solar Photovoltaic Power System: The PV Cell, Module and Array, Equivalent Electrical Circuit, Open Circuit Voltage and Short Circuit Current, I-V and P-V Curves, Array Design, Peak Power Point Operation, PV System Components.

Solar Thermal System: Energy Collection, Synchronous Generator, Equivalent Electrical circuit, Excitation Methods, Electrical Power Output, Transient Stability Limit, Commercial Power Plants.

UNIT IV: Power Conditioning Schemes for Solar and Wind Energy systems

Switching devices for solar energy conversion: DC power conditioning converters, maximum power point tracking algorithms, AC Power conditioners, Line commutated inverters, synchronized operation with grid supply, Harmonic reduction.

Wind energy Conversion system (WECS): Performance of Induction generators for WECS, Self excited induction generator (SEIG) for isolated power generators. Controllable DC power from SEIGs, system performance, Grid related problems, generator control, AC voltage controllers, Harmonic reduction and Power factor improvement.

UNIT V: Power Quality Issues in Integration of Renewable Energy Resources

Stand alone and Grid connected systems, Power Quality issues, Impact of power quality problems on DG, Mitigation of power quality problems, Role of custom power devices in Distributed Generation.

TEXT BOOKS:

1. Mukund. R. Patel, *Wind and Solar Power Systems*, CRC Press, 1999.
2. G.D. Rai, *Non - Conventional Energy Resources*, Khanna Publishers, 2002.

REFERENCES:

1. Daniel, Hunt. V, *Wind Power – A Hand Book of WECS*, Van Nostrend Co., New York, 1998.
2. Arindam Ghosh, Gerard Ledwich, *Power Quality Enhancement Using Custom Power Devices,* Springer, 2002.
3. Roger C. Dugan, Mark E. Mc. Granaghan, Surya Santosoh and H. Wayne Beaty, *Electrical Power Systems Quality*, 2nd edition,TATA McGraw Hill,2010.

M. Tech. EPS I-Semester
(14MT10709) OPTIMIZATION TECHNIQUES
(Elective - I)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PRE-REQUISITES:
Probability and Statistics, Mathematical Methods

COURSE DESCRIPTION:
Linear and Nonlinear programming; one dimensional and multi-dimensional search methods; Dynamic programming

COURSE OBJECTIVES:
- To gain knowledge on various optimization techniques
- To develop skills to use optimization techniques to improve ease of operation and efficiency
- To apply skills in multi stage decision problems

COURSE OUTCOMES: After successful completion of the course, the students will be able to
1. gain knowledge on:
    - Linear programming.
    - Non-linear programming
    - Dynamic Programming Assessment.
    - Univariate Estimation.
2. acquire skills to analyze problems on queuing models and develop convincing solutions.
3. apply problem solving skills in dynamic and static system.

DETAILED SYLLABUS

UNIT-I: **Linear Programming**

Formulation of LPP, Graphical Method, Basic Definitions, Simplex method, Duality theory, Fundamental theorem, Dual Simplex Method, Primal Dual method, Sensitivity analysis. Transportation and Assignment problems: Shortest path problem, Max-flow problem and Mini - cost Flow Problem.

UNIT-II: Non-linear programming

Convex sets and functions, constrained optimization methods: Introduction, Kuhn-Tucker conditions, convex optimization, Lagrange multipliers, One-dimensional minimization method, search method, unconstrained and constrained optimization.

UNIT- III: One dimensional Search Methods

Unimodal functions, simultaneous uniform search method, Sequential search method, Fibonacci search method, Golden section search method.

UNIT-IV: Multi-dimensional Search Methods

Multi-dimensional Search Methods: Univariate search method, Method of steepest descent, Conjugate gradient method, Fletcher Reeves method,

Constrained Multi-dimensional Search Methods: Rosen's Gradient projection method, Penalty function method.

UNIT V: Dynamic programming

Dynamic programming: Multistage decision problems, computation procedure and case studies. Fundamentals of queuing system, Poisson process, the birth and death process, special queuing methods.

TEXT BOOKS:

1. S.S Rao, *Optimization: Theory and Practices*, New Age Int. (P) Ltd. Publishers, New Delhi.
2. S. D. Sharma., *Operations Research*, S Chand Publications, New Delhi, 2008.

REFERENCE BOOKS:

1. TahaH.A., *Operations Research; An Introduction*, 7th edition, Mac Millan Publishing Co., 2003.
2. Pant J.C., *Introduction to Optimization techniques (Operations Research)*, 6th edition, Jain Brothers, New Delhi, 2005.
3. S. Hira and P.K.Gupta., *Problems in Operations Research*, S Chand Publications, New Delhi, 2007.

M. Tech. – I Semester
(14MT10310) RESEARCH METHODOLOGY
(Common to all M. Tech. Programmes)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	3	--	--	3

PRE-REQUISITES: --

COURSE DESCRIPTION:
Fundamentals of research work - research problem and design; Data collection, Analysis and hypothesis; Statistics in Research; Interpretation and Report Writing.

COURSE OBJECTIVES:
- To impart knowledge on literature collection, problem identification, data collection and testing of hypothesis.
- To familiarize with the skills for preparing the technical report.
- To apply statistical techniques for effective research results.

COURSE OUTCOMES: On successful completion of course, the student will be able to
1. gain knowledge on research approaches, research process and data collection.
2. identify and analyze research problem.
3. solve the research problems using statistical methods.
4. carryout literature survey and apply good research methodologies for the development of scientific/technological knowledge in one or more domains of engineering.
5. learn, select and apply modern engineering tools to complex engineering activities.
6. write effective research reports.

DETAILED SYLLABUS:

UNIT-I: INTRODUCTION TO RESEARCH METHODOLOGY
Objectives and Motivation of Research, Types of Research, Research Approaches, Research Process, Criteria of good Research.

UNIT-II: RESEARCH PROBLEM AND DESIGN
Defining and Formulating the Research Problem, Problem Selection, Necessity of Defining the Problem, Techniques involved in Defining a Problem. Features of Good Design, Research Design Concepts, Different Research Designs.

UNIT-III: DATA COLLECTION, ANALYSIS AND HYPOTHESIS
Different Methods of Data Collection, Processing Operations, Types of Analysis, Basic Concepts of Testing of Hypothesis, Hypothesis Testing Procedure.

UNIT-IV: STATISTICS IN RESEARCH
Review of Statistical Techniques - Mean, Median, Mode, Geometric and Harmonic Mean, Standard Deviation, Measure of Asymmetry. Normal Distribution, Chi-Square Test as a Test of Goodness of Fit.

UNIT-V: INTERPRETATION AND REPORT WRITING

Interpretation – Techniques and Precautions. Report Writing – Significance, Stages, Layout. Types of reports, Precautions in Writing Reports.

TEXT BOOK:

1. C.R. Kothari, *Research Methodology: Methods and Techniques*, New Age International Publishers, New Delhi, 2nd Revised Edition, 2004.

REFERENCE BOOKS:

1. Ranjit Kumar, *Research Methodology: A step-by-step guide for beginners*, Sage South Asia, 3rd edition, 2011.
2. R. Panneer selvam, *Research Methodology*, PHI learning Pvt. Ltd., 2009

M. Tech. (EPS)I-Semester
(14MT10721)POWER SYSTEMS AND RELAYS LAB

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
25	50	75	--	--	4	2

PRE-REQUISITES: Electrical Machines and Power Systems at UG Level

COURSE DESCRIPTION:
Relay testing, fault analysis, determination of sequence reactances of power system components, dielectric strength of transformer oil and synchronous machine power angle characteristic

COURSE OBJECTIVES:
- To impart practical knowledge in Electrical Power Systems and relays.
- To develop problem solving and design skills in the field of Electrical Power System protection and maintenance.
- To apply the concepts and techniques to provide solutions for the real time problems in Electrical Power Systems.

COURSE OUTCOMES: At the end of the course, students will be able to
1. acquire in-depth knowledge in power system protection and testing of relays.
2. analyze and apply protective schemes and testing methods in the field of power systems.
3. gain skills in identifying, selecting and developing suitable protection schemes for reliable operation of power system.
4. execute real time projects in the field of power system operation and control.

List of experiments:
Conduct any Twelve experiments from the following:
1. Determination of Sub-transient reactances of Salient Pole Synchronous Machine.
2. Determination of Sequence Impedances of Cylindrical Rotor Synchronous Machine.
3. Fault Analysis
   i) LG and LL Faults
   ii) LLG and LLLG Faults
4. Measurement of Dielectric Strength of Transformer Oil Using Variable Electrodes.
5. Reactive power compensation using Tap changing transformer.

6. Power Angle Characteristic of Three-Phase Salient Pole Synchronous Machine.
7. Long Transmission line analysis.
8. Determination of Sequence Components of Salient Pole Synchronous Machine.
9. Scott Connection of Transformers.
10. Characteristics of Over Current Relay.
11. Characteristics of Over Voltage Relay.
12. Characteristics of Percentage Biased Differential Relay.
13. Testing of Frequency Relay.
14. Testing of Reverse Power Relay.

M. Tech. (EPS) II-Semester
(14MT20701) OPERATION AND CONTROL OF POWER SYSTEMS

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	3

PRE-REQUISITES:
Power Systems operation and control, Control Systems at UG level
Power System security and state estimation at PG level

COURSE DESCRIPTION:
Economic dispatch problem with and without Transmission losses; Optimal power flow problem; Unit commitment; Hydro-thermal scheduling; Automatic generation control in an interconnected power systems.

COURSE OBJECTIVES:
- To impart advanced knowledge in Electrical power system operation and control.
- To develop analytical, design and problem solving skills in power plants scheduling and coordination for optimal operation.
- To apply the concepts of optimization techniques for economic operation of power system.

COURSE OUTCOMES: After successful completion of the course, student will be able to
1. gain knowledge on:
   - economic operations of various power plants and their scheduling methods.
   - coordination of hydro thermal power plant for optimal and secured operation.
   - automatic generation control importance and their control strategies for reliable operation of interconnected power systems.
2. develop analytical skills to envisage and solve problems to obtain optimal solution in power system operation and control for the needs of industry and society.
3. apply various optimization algorithms for:
   - optimal generation scheduling of thermal power plants.
   - scheduling and coordination of hydro thermal power plants.
   - regulation of load frequency control problems.

DETAILED SYLLABUS:
UNIT I: ECONOMIC DISPATCH OF GENERATING PLANTS
Economic operation importance – generator unit characteristics – Economic dispatch problem without transmission losses. Solution methods of economic dispatch: Gradient method, Reduced Gradient method, Newton's method, Base point and participation factor method – simple problems.

UNIT II: TRANSMISSION SYSTEM EFFECTS AND OPTIMAL POWER FLOW PROBLEM

Economic dispatch problem with transmission losses. Expression for transmission loss - Simple problems. Optimal power flow problem – Optimal power flow with inequality constraints – problem formulation, steepest descent method. Optimal power flow with equality constraints on control variables and dependent variables.

UNIT III: UNIT COMMITMENT

Characteristics of thermal units – Input-Output characteristics, Heat Rate and Incremental Heat Rate characteristics, Fuel cost and Incremental Fuel cost characteristics, Incremental production cost, start-up and shut-down costs. Unit commitment – unit commitment Vs economic dispatch, constraints in unit commitment. Unit commitment solution methods: Priority-List method, Dynamic Programming method – simple problems.

UNIT IV: HYDROTHERMAL CO-ORDINATION

Long-term and short-term hydro-scheduling problem. Short-term hydrothermal scheduling – condition for optimal operation and maximum efficiency, gradient approach. Hydro units in series. Pumped-storage hydro-scheduling – λ-γ iteration method, gradient method–hydrothermal scheduling using dynamic programming and linear programming. Security constrained unit commitment.

UNIT V: AUTOMATIC GENERATION CONTROL IN INTERCONNECTED POWER SYSTEMS

Load frequency control Vs Economic dispatch control. Review of single area load frequency control. Two area LFC – Flat frequency regulation, Parallel frequency regulation, Flat tie-line loading control, Tie-line load bias control. AGC features – AGC Implementation– static response of uncontrolled and controlled two-area system – Optimal LFC control for two area AGC. Power exchange in interconnected utilities: utility energy evaluation – Power pools – Transmission effects and Issues: Limitations –Wheeling.

TEXT BOOK:

1. Allen J. Wood & B.F. Woolenberg, *Power Generation, Operation and Control*, John Wiley & Sons, New York, 2006.
2. Nagrath, I.J. and Kothari D.P., *Modern Power System Analysis*, 3rd edition,Tata McGraw-Hill, New Delhi.

REFERENCES:

1. D.P. Kothari & J.S. Dhillon, *Power System Optimization*, Printice Hall of India, 2004.

M. Tech. (EPS) II-Semester
(14MT20702) FLEXIBLE AC TRANSMISSION SYSTEM

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PRE-REQUISITES:

Power Electronics and Power Systems at UG level
Power Electronic Converters and Microcontrollers and Applications at I-Sem. of M.Tech. EPS

COURSE DESCRIPTION:

Need for Flexible AC transmission systems; objectives of shunt and series compensation, phase angle regulators; FACTS controllers: shunt, series and combined; Coordination of various FACTS controllers.

COURSE OBJECTIVES:

- To introduce concepts of Flexible AC transmission.
- To analyze and design suitable FACTS devices for the control of appropriate parameters of power flow of transmission system.
- To apply different types of FACTS devices for reactive power compensation and power flow control.

COURSE OUTCOMES: After completion of the course, student will be able to

1. gain knowledge on:
    - compensation schemes for real and reactive power control.
    - Static Shunt, Series and Shunt-Series compensation.
    - FACTS devices
2. critically analyze and adopt a suitable FACTS device for the appropriate control operation.
3. develop skills in coordination of multiple FACTS controllers in an interconnected power systems.

DETAILED SYLLABUS

UNIT-I: INTRODUCTION TO AC TRANSMISSION SYSTEMS

Overview of interconnected power system. Power flow in AC systems – Expression for real and reactive power flow between two nodes of a power system, controllable parameters. Power flow in parallel and meshed system. Overview of uncompensated transmission lines – open circuit, short circuit. Overview of compensated transmission lines – shunt and series compensation. Conventional controllers for real and reactive power flows – merits and demerits. FACTS – benefits, types of FACTS controllers.

UNIT-II: STATIC SHUNT COMPENSATION

Objectives of shunt compensation, Expression for real and reactive power flow with mid-point voltage regulation. Variable impedance type static VAR generators - V-I characteristics and control schemes of TCR, TSR, TSC. Q_D-Q_O characteristic and control scheme of TSC-TCR. Switching converter type VAR

generators – V-I characteristics and control schemes of STATCOM. Hybrid VAR generators – V-I characteristics of SVC and STATCOM. Regulation slope of SVC and STATCOM through V-I characteristics. Applications of static shunt compensators – Voltage regulation, improvement in transient stability, prevention of voltage instability, power oscillation damping. Comparison of static shunt compensators.

UNIT-III: STATIC SERIES COMPENSATION

Objectives of series compensation, Expression for real and reactive power flow with series line compensation. Variable impedance type series compensators: V-I characteristics and control schemes of GCSC, TSSC, TCSC - modes of operation. Sub-synchronous resonance. Switching converter type series compensator – V-I characteristics, internal and external control schemes of SSSC. Applications of static series compensators – improvement in transient stability, power oscillation damping. Comparison of static series compensators.

UNIT-IV: STATIC PHASE ANGLE REGULATORS AND COMBINED COMPENSATOR

Power flow control by phase angle regulators - Concept of voltage and phase angle regulation. Operation and control of TCVR and TCPAR. Switching converter type phase angle regulators. Objectives of TCPAR - improvement of transient stability, power oscillation damping. UPFC – Principle, expression for real and reactive power between two nodes of UPFC, independent real and reactive power flow control using UPFC, control schemes of UPFC - operating principle and characteristics of IPFC.

UNIT-V: CO-ORDINATION OF FACTS CONTROLLERS

FACTS controller interactions – interaction between multiple SVC's – interaction between multiple TCSC's – SVC-TCSC interaction – coordination of multiple controllers using linear control techniques. Comparative evaluation of different FACTS controllers: performance comparison and cost comparison

TEXT BOOKS:

1. Narain G. Hingorani, Laszi Gyugyi, *Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems,* Wiley-IEEE Press, 1999.
2. R. Mohan Mathur and Rajiv k. Varma, *Thyristor based FACTS controllers for Electrical Transmission Systems,* Wiley-IEEE Press, 2002.

REFERENCE BOOKS:

1. Xiao-Ping, Rehtanz, Christian, Pal, Bikash, *Flexible AC Transmission Systems: Modeling and Control*, Springer Power Systems Series, 2006.
2. T.J.E. Miller, *Reactive Power control in electric systems*, Wiley, 1982.

M. Tech. (EPS) II-Semester
(14MT20703) POWER QUALITY

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	3

PRE-REQUISITES: Distribution of Electric Power
Power Electronics at UG level

COURSE DESCRIPTION:
Power Quality concepts; harmonics and voltage regulation using conventional methods; power quality enhancement using custom power devices; power quality issues in distributed generation

COURSE OBJECTIVES:
- To introduce Power Quality concepts, problems and their mitigation techniques.
- To develop skills in design and analysis of custom power devices.
- To apply custom Power devices for mitigating Power Quality problems.

COURSE OUTCOMES: On successful completion of the course the students will be able to
1. gain knowledge on:
    - various power quality issues and mitigation.
    - power quality issues and operating conflicts in distributed generation.
2. analyze the harmonic distortion due to commercial and industrial loads.
3. develop skills in design of various custom power devices.
4. apply the principles of interfacing distributed generation with utilities.

DETAILED SYLLABUS

UNIT-I: FUNDAMENTALS OF POWER QUALITY

Definition of Power Quality, Classification of Power Quality Issues, Power Quality Standards, Categories and Characteristics of Electromagnetic Phenomena in Power Systems: Impulsive and Oscillatory Transients, Interruption, Sag, Swell, Sustained Interruption, Under Voltage, Over Voltage and Outage. Sources and causes of different Power Quality Disturbances.

UNIT-II: HARMONICS AND APPLIED HARMONICS

Harmonic Distortion, Voltage Vs Current Distortion, Harmonics Vs Transients, Power System Qualities under Non-Sinusoidal Conditions, Harmonic Indices, Harmonic Sources from Commercial Loads, Harmonic Sources from Industrial Loads.

Applied Harmonics**:** Effects of Harmonics, harmonic distortion evaluations, principles of controlling harmonics and devices for controlling harmonic distortion.

UNIT-III: VOLTAGE REGULATION USING CONVENTIONAL METHODS

Principles of regulating the voltage, Devices for voltage regulation: utility step-voltage regulators, ferro-resonant transformers, magnetic synthesizers, on-line

UPS systems, motor-generator sets, static VAR compensators, shunt capacitors and series capacitors.

UNIT-IV: POWER QUALITY ENHANCEMENT USING CUSTOM POWER DEVICES Introduction to Custom Power Devices - Network Reconfiguring Type: Solid State Current Limiter (SSCL) - Solid State Breaker (SSB) - Solid State Transfer Switch (SSTS).

Compensating Type: Dynamic Voltage Restorer, Distribution STATCOM and Unified Power Quality Conditioner – operation, realization and control of DVR, DSTATCOM and UPQC – load compensation. Power quality monitoring - Power quality monitoring standards.

UNIT V: POWER QUALITYISSUES IN DISTRIBUTED GENERATION

DG Technologies, Perspectives on DG benefits - Interface to the Utility System - power quality issues affected by DG - Operating Conflicts: Utility fault-clearing, Reclosing, Interference with relaying, Voltage regulation issues, Islanding - siting DG.

TEXT BOOKS:

1. Roger C. Dugan, Mark E. Mc. Granaghan, Surya Santosoh and H. Wayne Beaty, *Electrical Power Systems Quality*, 2nd edition,TATA McGraw Hill,2010.
2. Arindam Ghosh, Gerard Ledwich, *Power Quality Enhancement Using Custom Power Devices,* Springer, 2002.

REFERENCE BOOKS:

1. Math H J Bollen, *Understanding Power Quality Problems*, IEEE Press, 1998.
2. C.Sankaran, *Power Quality*, CRC press, 2000.

M. Tech. (EPS)-II Semester
(14MT20704) SMART GRID TECHNOLOGY

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PRE-REQUISITES: Power systems at UG level

COURSE DESCRIPTION:
Concept of smart grid; various information and communication technologies for Smart Grid; Smart metering; Demand side integration; Energy management systems

COURSE OBJECTIVES:
- Gain knowledge in advanced information and communication technologies for smart grid.
- To develop skills in fault calculation, state estimation and use of communication technology.
- To apply smart grid concepts for improved energy efficiency with the integration of renewable energy sources.

COURSE OUTCOMES: After completion of the course, student will be able to
1. gain knowledge in:
   - Smart grid initiatives and technologies
   - Information and communication technologies for the smart grid.
   - Sensing, measurement, control and automation.
2. develop skills in fault calculation and state estimation.
3. apply various information security tools in the smart grid technology.

DETAILED SYLLABUS
UNIT – I: SMART GRID
Introduction, Ageing assets and lack of circuit capacity, thermal constraints, operational constraints, security of supply, national initiatives, early smart grid initiatives, active distribution networks, virtual power plant, other initiatives and demonstrations, overview of the technologies required for the smart grid.
UNIT – II: COMMUNICATION TECHNOLOGIES FOR THE SMART GRID
Data Communications: Introduction, Dedicated and Shared Communication Channels, Switching Techniques, Circuit Switching, Message Switching, Packet Switching, Communication Channels, Wired Communication, Optical Fiber, Radio Communication, Cellular Mobile Communication, Layered Architecture and Protocols, the ISO/OSI Model, TCP/IP
Communication Technologies: IEEE 802 Series, Mobile Communications, Multi Protocol Label Switching, Power line Communication, Standards for Information Exchange, Standards For Smart Metering, Modbus, DNP3, IEC61850

UNIT – III: INFORMATION SECURITY FOR THE SMART GRID

Introduction, Encryption and Decryption, Symmetric Key Encryption, Public Key Encryption, Authentication, Authentication Based on Shared Secret Key, Authentication Based on Key Distribution Center, Digital Signatures, Secret Key Signature, Public Key Signature, Message Digest, Cyber Security Standards, IEEE 1686: IEEE Standard for Substation Intelligent Electronic Devices(IEDs) Cyber Security Capabilities, IEC 62351: Power Systems Management and Association Information Exchange – Data and Communication Security.

UNIT – IV: SMART METERING AND DEMAND SIDE INTEGRATION

Introduction, smart metering – evolution of electricity metering, key components of smart metering, smart meters: an overview of the hardware used – signal acquisition, signal conditioning, analogue to digital conversion, computation, input/output and communication.

Communication infrastructure and protocols for smart metering - Home area network, Neighborhood Area Network, Data Concentrator, meter data management system, Protocols for communication. Demand Side Integration- Services Provided by DSI, Implementation of DSI, Hardware Support, Flexibility Delivered by Prosumers from the Demand Side, System Support from DSI.

UNIT – V: TRANSMISSION AND DISTRIBUTION MANAGEMENT SYSTEMS

Data Sources, Energy Management System, Wide Area Applications, Visualization Techniques, Data Sources and Associated External Systems, SCADA, Customer Information System, Modelling and Analysis Tools, Distribution System Modelling, Topology Analysis, Load Forecasting, Power Flow Analysis, Fault Calculations, State Estimation, Applications, System Monitoring, Operation, Management, Outage Management System, Energy Storage Technologies, Batteries, Flow Battery, Fuel Cell and Hydrogen Electrolyser, Flywheels, Super conducting Magnetic Energy Storage Systems, Super capacitors.

TEXT BOOKS:

1. Janaka Ekanayake, Liyanage, Wu, Akihiko Yokoyama, Jenkins, *Smart Grid*, Wiley Publications, 2012.
2. James Momoh, *Smart Grid: Fundamentals of Design and Analysis*, Wiley, IEEE Press, 2012.

REFERENCE BOOKS:

1. Raj Samani, *Applied Cyber Security and the Smart Grid*, Syngress Publishers, 2012.

M. Tech. EPS II-Semester
(14MT20705) INTELLIGENT CONTROL

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PRE-REQUISITES:
Engineering Mathematics, Power Systems, Power Electronic Drives and Electrical machines at UG level

COURSE DESCRIPTION:
Neural Networks; Fuzzy Logic Systems; Genetic Algorithms; Hybrid Intelligent Systems; Applications

COURSE OBJECTIVES:
- To impart advanced knowledge on computational intelligence for Electric drives and power systems.
- To apply skills in design and development of intelligent control systems.
- To apply the concepts of neural networks, Fuzzy logic and genetic algorithms in engineering.

COURSE OUTCOMES: After completion of the course, student will be able to
1. acquire in depth knowledge to identify and describe soft computing techniques and their roles in building intelligent systems.
2. design and analyze intelligent control systems for electrical engineering problems.
3. develop skills to identify and apply suitable soft computing techniques for engineering problems.

DETAILED SYLLABUS

UNIT I: NEURAL NETWORKS
Neural network Architectures, Perceptron model, Learning strategies – Supervised Learning – Radial basis function network, Back propagation Network–Unsupervised Learning – Kohonen's SOM, Full counter propagation Network – Reinforced learning.

UNIT II: FUZZY LOGIC SYSTEMS
Fuzzy sets– Relations & Operations, Membership functions, Fuzzification, Rule base, Inference Mechanism, Defuzzification and design of Fuzzy control system.

UNIT III: GENETIC ALGORITHMS
Introduction to evolutionary computation, History of genetics, Genetic algorithms(GA) – main components of GA – selection, crossover, mutation, survival of the fittest, population size, Evaluation of the fitness function and benefits of genetic algorithms.

UNIT IV: HYBRID INTELLIGENT SYSTEMS
Introduction to hybrid intelligent systems – Adaptive Neuro-Fuzzy Inference Systems – Architecture and Learning. Fuzzy GA systems – rules generation. ANN Learning Using GA – Optimization of weights.

UNIT V: APPLICATIONS

Speed control of separately excited DC motor using neural networks and fuzzy logic, Load forecasting problem using GA and Neuro-fuzzy approach, Load frequency control using fuzzy logic.

TEXT BOOKS:

1. Fakhreddine O. karray, Clarence De Silva, *Soft computing & intelligent systems design, Theory, tools and applications,* Pearson Education Limited, 2009.
2. S.N.Sivanandam, S.N.Deepa, *Principles of soft computing*, Wiley–India Edition, 2008

REFERENCE BOOKS:

1. Devendra K. Chaturvedi, *Soft Computing: Techniques and Its Applications in Electrical Engineering*, Springer.
2. J.S.R.Jang, C.T.Sun, E.Mizutani, *Neuro-Fuzzy & Soft computing*, Pearson Education Limited, 2004.

M. Tech. (EPS)II-Semester
(14MT20706) High Voltage DC TRANSMISSION
(Elective-II)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PRE-REQUISITES:
Power Electronics and Power Systems at UG level
Power Electronic converters at PG level

COURSE DESCRIPTION:
HVDC Transmission: capabilities, applications, planning, faults and Protection; Analysis and Control of Power Converter; Harmonics and Filters; Types of Multi-Terminal DC systems and control

COURSE OBJECTIVE:
- To impart advanced knowledge in HVDC Transmission.
- To develop skills in HVDC Converters, Harmonics, filters and their characteristics.
- To apply concepts of static converter control strategies in power system faults & protection and to develop research competence in HVDC Transmission.

COURSE OUTCOMES: After successful completion of the course, the students will be able to
1. gain advanced knowledge on:
    a. HVDC transmission systems.
    b. operation of static converters and analysis.
    c. different types of faults and protection schemes in HVDC systems.
2. analyze various static converters in HVDC systems, filters and MTDC systems.
3. develop skills in design, control and analysis of HVDC systems.

DETAILED SYLLABUS
UNIT-I: Introduction to HVDC Transmission
H.V.D.C Transmission – Comparison of HVAC and HVDC transmission, Power Handling Capabilities of HVDC lines, Applications of HVDC Transmission, Planning for HVDC Transmission, Modern trends in DC Transmission.
UNIT-II: Static Power Converter Analysis and Control
Static Power Converters – 6 pulse & 12 pulse converters, converter station and terminal equipment. Converter Bridge characteristics, equivalent circuit for converter
Control of HVDC converter: Principle of DC link control – constant current, constant extinction angle and constant ignition angle control. Individual phase control and equidistant firing angle control.

UNIT-III: Harmonics and Filters

Generation of Harmonics in HVDC systems, methods of harmonics elimination, harmonic instability problems, Causes for instability, remedies for instability problems. Design of AC & DC filters

UNIT-IV: Multi-Terminal DC link and systems

Introduction – Potential applications of MTDC systems – Types of MTDC systems – series, parallel and series-parallel systems, their principle of operation and control - Protection of MTDC systems.

UNIT-V: Faults and Protection

Over voltages due to disturbance on DC side, over voltages due to DC and AC side line faults – Converter faults, over current protection – Valve group and DC line protection. Over voltage protection of converters – surge arresters.

TEXT BOOKS:

1. K.R. Padiyar, *High Voltage Direct current Transmission*, New Age International (P) Ltd. Publishers, 2004.
2. S. Rao, *EHV-AC, HVDC Transmission & Distribution Engineering*, Khanna Publishers, 2006.

REFERENCES:

1. E.Uhlman, *Power Transmission by Direct Current*, Springer Verlag, Berlin, 2000.
2. E. W. Kimbark, *Direct current Transmission*, John Wiely& sons, New York.
3. J. Arillaga, *H.V.D.C. Tranmission*, peter peregrilnus Ltd., London UK, 1983.

M. Tech. (EPS)-II Semester
(14MT20707) RESTRUCTURED POWER SYSTEM
(Elective-II)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PRE-REQUISITES:
Power Systems at UG level

COURSE DESCRIPTION:
Features of Restructured Power systems; Market models; Information and transmission services; Electricity pricing and forecasting; Ancillary services management

COURSE OBJECTIVES:
- To introduce advanced knowledge in power system restructuring.
- To analyze and design various market models for reliable operation of the restructured power system.
- To apply the concepts of forecasting and pricing techniques in deregulated power system for procuring ancillary services.

COURSE OUTCOMES: After completion of the course, student will be able to
1. gain advanced knowledge on:
   - Operation of deregulated electricity market systems.
   - Key issues of electricity market models and their functionalities in different scenarios.
   - Electricity pricing methods and ancillary service management in competitive market.
2. develop analytical skills to envisage market models to provide power exchange among various entities of deregulated power system.
3. implement forecasting methods for minimizing energy price and regulate congestion in interconnected deregulated power system.

DETAILED SYLLABUS:
UNIT I: OVERVIEW OF KEY ISSUES IN ELECTRIC UTILITIES
Introduction – Deregulation, need for deregulation, Advantages of deregulation in power system. Restructuring Models: POOLCo Model, Bilateral Model, Hybrid Model – independent system operator (ISO) – Role of ISO – power exchange – market operations – market power – standard cost – transmission pricing – congestion pricing – management of congestion.
UNIT II: MARKET MODELS IN RESTRUCTURED POWER SYSTEMS
Introduction - Market models based on contractual arrangements: Monopoly model, Single buyer model, Whole sale competition model, Retail competition model. Comparison of various market models. Market architecture: Day-ahead and Hour-Ahead Markets, Block forwards Market, Transmission Congestion Contracts (TCCs), Ancillary service market.

UNIT III: OASIS: OPEN ACCESS SAME-TIME INFORMATION SYSTEM

Structure of OASIS: Functionality and Architecture of OASIS – Information requirement of OASIS - Transfer Capability on OASIS: Definitions, Transfer Capability Issues, ATC Calculation, TTC Calculation, TRM Calculation, CBM Calculation – Transmission Services – Methodologies to Calculate ATC.

UNIT IV: ELECTRICITY PRICING - VOLATILITY, RISK AND FORECASTING

Electricity pricing – introduction – electricity price volatility, electricity price indexes – Challenges to Electricity Pricing: Pricing Models, Reliable Forward Curves – Construction of Forward Price Curves: Time frame for Price Curves, Types of Forward Price Curves – Short-term Price Forecasting: Factors Impacting Electricity Price, Forecasting Methods, Analyzing Forecasting Errors.

UNIT V: ANCILLARY SERVICES MANAGEMENT

Introduction – Types of ancillary services, Classification of ancillary services– Load - generation balancing related services: Frequency regulation, Load following, Spinning reserve services – Voltage control and reactive power support services: Generators, Synchronous condensers, Capacitors and inductors, SVCs, STATCOMs – Black start capability service

TEXT BOOKS:

1. Kankar Bhattacharya, Math H.J. Bollen, Jaap E. Daalder, *Operation of Restructured Power System*, Klumer Academic Publisher – 2001.
2. Mohammad Shahidehpour, and Muwaffaqalomoush, - *Restructured electrical Power systems,* Marcel Dekker, Inc. 2001.

REFERENCES:

1. Loi Lei Lai, *Power system Restructuring and Deregulation*, Jhon Wiley & Sons Ltd., England.

M. Tech. (EPS)-II Semester
(14MT20708) POWER SYSTEM RELIABILITY
(ELECTIVE-II)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PRE-REQUISITES:
Probability and Statistics at UG level

COURSE DESCRIPTION:
Fundamentals of Reliability Engineering; Evaluation of Power system operating capacity reserve; Evaluation of Frequency and Duration Techniques; Reliability Analysis of Interconnected Systems; Power Distribution System Reliability Analysis

COURSE OBJECTIVES:
- To impart various probability concepts in power system reliability.
- To develop analytical skills for analyzing various failures and system risks.
- To develop skills on implementation of
  - various power system reliability evaluation techniques for better planning and operation of power system.
  - reliability engineering algorithms for assessment of overall power system.

COURSE OUTCOMES: after completion of the course, student will be able to
1. gain knowledge on
   i. conceptual algorithms for planning and operation of secured power system
   ii. system risks during normal and adverse weather conditions.
2. evaluate complex network configurations using reliability indices.
3. design and develop efficient algorithms for analyzing power system network reliability in real time.

DETAILED SYLLABUS
UNIT–I: **FUNDAMENTALS OF RELIABILITY ENGINEERING**
Probability Concept, Random variables, Probability Density and Distribution functions– Probability Distributions: time dependent and independent, mean, SD, Variance. Reliability function, hazard rate, types of failures, bath tub curve and reliability cost and worth.
Network and Markov Modeling: redundant and non-redundant configuration – complex systems – conditional probability approach, Decomposition Method, cut-set, tie-set approaches – Standby redundant systems – Event trees. Markov chain – Markov Process, STPM, LSP – one, two and three component repairable models

UNIT–II: **EVALUATION OF GENERATING CAPACITY RESERVE**

Introduction – Generation system model – determination of capacity outage probability table – identical units, non-identical units – Determination of transitional rates – deterministic and probabilistic criteria – Sequential addition method– Recursive relation for unit addition, unit removal - LOLP, LOLE and EIR.

UNIT–III: EVALUATION OF FREQUENCY AND DURATION TECHNIQUES

Frequency and duration concepts – Two component repairable model (with & without identical components) – Evaluation of cumulative probability and cumulative frequency by using recursive relation – Equivalent transition rates – non-equivalent transition rates.

System risk indices: Daily load model – Two level representation of daily load modeling– evaluation of probabilities, transitional rates.

UNIT–IV: RELIABILITY ANALYSIS OF INTERCONNECTED SYSTEMS

Introduction – probability array method in two interconnected systems – evaluation techniques – equivalent assisting approach – factors affecting interconnections, effect of tie capacities, tie lines.

Weather effects on transmission lines – common mode failures – circuit breaker model – Preventive maintenance

UNIT–V: DISTRIBUTION SYSTEM RELIABILITY ANALYSIS

Distribution system reliability analysis – Basic indices – Customer oriented indices – Load and energy indices – active and passive failures – open circuit & short circuit failures – simple problems on above indices.

TEXTBOOKS:

1. Roy Billinton and Ronald NAllen, *Reliability Evaluation of Power Systems*, 2nd edition, Springer, New York, 1996.
2. J. Endrenyi, *Reliability Modelling in Electric Power Systems*, 1st Edition, John Willey and Sons, US, 1978.

REFERENCES:

1. Roy Billinton and Ronald NAllen, *Reliability Evaluation of Engineering Systems*, 2nd Edition, Springer, NewYork, 2013.
2. Charles Eebeling, *An Introduction to Reliability and Maintainability Engineering*, Tata McGraw Hill, India, 2004.

M. Tech. (EPS)-II Semester
(14MT20709) ENERGY AUDIT, CONSERVATION & MANAGEMENT
(ELECTIVE-II)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PRE-REQUISITES:
Managerial Economics and Financial Analysis and Generation of Electric Power at UG level

COURSE DESCRIPTION:
Energy Audit; Energy Management; Energy Efficient Motors and Lighting; Energy Instruments; Computation of Economic Aspects and Analysis

COURSE OBJECTIVES:
- To introduce concepts of energy audit, conservation and management.
- To develop different computational techniques in economic aspects.
- To carry out energy audit and conservation for industry and buildings.

COURSE OUTCOMES: After completion of the course, student will be able to
1. gain knowledge on:
    - Energy management, Energy conservation management.
    - Computation of economic aspects and analysis.
    - Energy efficient motors and lighting system.
    - Energy audit instruments.
2. analyze life cycle estimation and cost analysis methods for various components**.**
3. acquire skills in design of energy efficient motors and lighting schemes.
4. apply Energy instruments in analysis of economic aspects.

DETAILED SYLLABUS

UNIT-I: BASIC PRINCIPLES OF ENERGY AUDIT

Energy audit – definitions, concept, types of audit, energy index, cost index, pie charts, Sankey diagrams, 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 manger, Qualities and functions, language, Questionnaire – check list for top management.

UNIT-III: ENERGY EFFICIENT MOTORS AND LIGHTING

Energy efficient motors, factors affecting efficiency, loss distribution, constructional details, characteristics – variable speed, variable duty cycle systems, RMS hp- voltage variation– voltage unbalance – over motoring –

motor energy audit. Good lighting system design and practice, lighting control, lighting energy audit

UNIT-IV: ENERGY INSTRUMENTS

Energy Instruments: watt meter, data loggers, thermocouples, pyrometers, lux meters, tongue testers, application of PLC's.

UNIT-V: COMPUTATION OF ECONOMIC ASPECTS AND ANALYSIS

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

TEXT BOOKS:

1. W.R. Murphy & G. Mckay Butterworth, *Energy Management*, Heinemann publications.
2. Paul o' Callaghan, *Energy Management*, 1st edition, McGraw Hill Book company.

REFERENCE BOOKS:

1. John C. Andreas, *Energy Efficient Electric Motors*, 2nd edition, Marcel Dekker Inc. Ltd.,
2. W.C. Turner, *Energy management Hand Book*, John Wiley and sons.

M. Tech. (EPS)-II Semester
(14MT20721) POWER SYSTEMS SIMULATION LABORATORY

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
25	50	75	--	--	4	2

PRE-REQUISITES:
Power system, Power electronics, Control Systems and Electrical Machines at UG level
Economic operation and control of power system at PG level

COURSE DESCRIPTION:
Modelling, simulation and analysis of multi area power system, load flows, load frequency control, power system stability, power quality problems and power electronic converters

COURSE OBJECTIVES:
- To introduce programming and simulation concepts for the modeling and analysis of Power System operation.
- To develop computational skills using advanced software packages in the field of Electrical Power System engineering.
- To apply various tools for realizing the power system behavior in real time.

COURSE OUTCOMES: After completion of the course, student will be able to
1. acquire knowledge in analyzing the power system behavior using simulation / programming tools.
2. design and perform experiments, as well as analyze and interpret results for better understanding of power system operation.
3. develop skills in designing various power system networks through programming and simulation for better functionality.
4. select and apply modern software tools for solving real time problems in the existing power system.

DETAILED SYLLABUS
Conduct any Twelve experiments from the following:
1. Formation of bus admittance matrix with and without off-nominal ratios of transformer of a power system network using MATLAB
2. Formation of Bus Impedance matrix with and without mutual coupling of a power system network using MATLAB
3. Load flow studies using
   (a) Gauss Seidal Method
   (b) Newton Rahpason Method
   (c) Fast Decoupled Method
4. Transient stability analysis
5. Economic Dispatch using MATLAB

6. Modeling of standard test system with generator excitation and governor action using SIMULINK
7. Modeling and analysis of automatic load frequency control of multi-area power system using SIMULINK
8. Simulation of power quality problems (like Sag/Swell, interruption, transients, harmonics, flickers etc.) using SIMULINK
9. Single phase half-controlled converter using R- and RL- loads using MATLAB/ SIMULINK.
10. Single phase full-controlled converter using R- and RL- loads using MATLAB/ SIMULINK
11. Analysis of Transmission line parameters using PSCAD
12. Simulation of Capacitor switching transient using PSCAD
13. Transformer inrush currents measurement using PSCAD
14. Analysis of Short circuit studies with and with fault impedance using PSCAD
15. Simulation of FACTS controllers using PSCAD

M.Tech. (EPS) – II Semester
(14MT20722) SEMINAR

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
--	50	50	--	--	--	2

PRE-REQUISITES: --

COURSE DESCRIPTION:
Identification of seminar topic; Literature survey; Preparation of technical report and Presentation.

COURSE OBJECTIVES:
- To impart knowledge on an advanced topic in the Programme domain and interdisciplinary area through literature survey.
- To facilitate students to explore and develop the following skills:
  i. Analysis
  ii. Problem solving
  iii. Research methodologies, tools and techniques and
  iv. Management and costing.
- To acquire knowledge and skills required for undertaking project work.
- To provide opportunity to work with a strong sense of professionalism in a specific area.

COURSE OUTCOMES: At the end of the course, the student will be able to
1. Acquire in-depth knowledge in core and allied areas of interest.
2. Analyze and synthesize information related to the areas.
3. Conceptualize and construct research problems.
4. Extract information pertinent to a specific area through literature survey to conduct research.
5. Identify the applicability of modern software and tools.
6. Contribute positively to multidisciplinary groups in emerging areas with objectivity and rational analysis.
7. Plan, organize, prepare and present effective written and oral technical reports.
8. Engage in lifelong learning to improve competence.
9. Acquire awareness on professional code of conduct in the chosen area.
10. Develop independent and reflective learning.

M. Tech. (EPS) – III & IV Semesters
(14MT30721 & 14MT40721) PROJECT WORK

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
80	120	200	--	--	--	16

PRE-REQUISITES: --

COURSE DESCRIPTION:
Identification of topic for the project work; Literature survey; Collection of preliminary data; Identification of implementation tools and methodologies; Performing critical study and analysis of the topic identified; Time and cost analysis; Implementation of the project work; Writing of thesis and presentation.

COURSE OBJECTIVES:
- To impart access to advanced knowledge on a chosen topic in the Programme domain and interdisciplinary areas through literature survey.
- To develop analytical, problem solving, programming, design and development skills for effective project implementation.
- To apply knowledge and skills to develop research competence in core and interdisciplinary areas.
- To provide opportunity to work with a strong sense of professionalism in a specific area.

COURSE OUTCOMES: On completion of project work the student will be able to
1. Acquire in-depth knowledge in the areas of interest.
2. Analyze critically chosen project topic for conducting research.
3. Apply knowledge gained through Programme, self learning and experience for solution of a given problem efficiently.
4. Undertake research confidently in the project domain.
5. Use the techniques, skills and modern engineering tools necessary for project work.
6. Perform harmonically in multi-disciplinary, multi-cultural groups, and develop a high level of interpersonal skills.
7. Manage projects in respective disciplines and multidisciplinary environments with due consideration to cost and time efficiency.
8. Develop communication skills, both oral and written for preparing and presenting reports.
9. Engage in lifelong learning to improve knowledge and competence continuously.
10. Understand professional and ethical responsibility for sustainable development of society.
11. Develop independent and reflective learning.