AUDISANKARA COLLEGE OF ENGINEERING & TECHNOLOGY
(AUTONOMOUS)
Gudur, Nellore Dist - 524101, A.P (India)

ACADEMIC REGULATIONS FOR THE AWARD OF FULL TIME
M.Tech DEGREE PROGRAMME
(WITH EFFECT FROM THE ACADEMIC YEAR 2014-15)

The **Audisankara College of Engineering and Technology**, Gudur, Nellore District, Andhra Pradesh shall confer M.Tech Post Graduate degree to candidates who are admitted to the Master of Technology Programs and fulfill all the requirements for the award of the degree.

1. ELIGIBILITY FOR ADMISSIONS:

Admission to the Master of Technology programme shall be made subject to the eligibility, qualifications and specialization criteria prescribed by the JNTUA, Anantapur for each programme, from time to time.

As per the norms of A.P. State Council of Higher Education (APSCHE), Government of Andhra Pradesh, admissions are made to the first year of two years M.Tech P.G. Degree Programme as follows:-

- As per the norms of Government of Andhra Pradesh, Category-A (based on the rank obtained in GATE / PGECET score) seats will be filled by the Convener, PGECET.
- As per the norms of Government of Andhra Pradesh, Category-B seats will be filled by the management.

2. COURSE WORK:

- A Candidate after securing admission must pursue the M.Tech course of study for Four Semesters duration.
- Each semester shall be of 20 weeks duration including all examinations.
- A candidate admitted to a programme should complete it within a period equal to twice the prescribed duration of the programme from the date of admission.

3.0 ATTENDANCE REGULATIONS AND CONDONATION:-

(i) A student shall be eligible to appear for end semester examinations, if he acquires a minimum of 75% attendance in aggregate of all the subjects.

(ii) Condonation of shortage of attendance in aggregate up to 10% on medical grounds (65% above and below 75%) in each semester may be granted on the recommendation of the College Academic Committee. However, granting condonation is purely at the discretion of Principal of the college.

(iii) A Student will not be promoted to the next semester unless he satisfies the attendance requirement of the present semester as applicable. They may seek re-admission for that semester as and when offered next.

(iv) Shortage of Attendance below 65% in aggregate shall in no case be condoned.

(v) Students whose shortage of attendance is not condoned in any semester are not eligible to take their end examinations of that particular semester and their registration for examination shall stand cancelled.

(vi) A stipulated fee shall be payable towards condonation of shortage of attendance if granted.

(vii) Attendance may also be condoned for those students who participate in prestigious sports and co and extracurricular activities provided their attendance is in the minimum prescribed range for the purpose and recommended by the concerned authority.

4.0. EVALUATION:-

The performance of the candidate in each semester shall be evaluated subject-wise for a maximum of 100 marks for Theory and 100 marks for practical subjects, on the basis of Internal Evaluation and End Semester Examination. For the theory & practical subjects 60% of the marks will be for the External End Examination, while 40% of the marks for Internal Evaluation.

4.1 INTERNAL EVALUATION FOR THEORY SUBJECTS:

Each course is evaluated for **40** marks **(a+b)**

a) Two Midterm Examinations each for **30 marks** with a duration of two hours each will be conducted for every theory course in a semester. First Midterm Examination is conducted in the middle of the Semester (I & II units) and second Midterm Examination immediately after the completion of instruction (III & IV units) as per academic schedule. The Midterm Examination marks shall be awarded giving a weightage of 80% in the Midterm Examination in which the student scores more marks and 20% in the remaining Midterm Examination.

Midterm Examination Pattern for 30 Marks:

- Each Midterm Examination Question Paper comprises of four questions covering the two units.
- Answering any three questions.
- Questions 1 & 2 from one unit and Questions 3 & 4 from another unit. Each question is allotted 10 marks.

b) 10 marks are allocated for **Assignment Tests.**

- There will be four Assignment Tests per subject.
- One Assignment Test is conducted from each unit.
- Five Assignment questions are given in advance from each unit out of which two questions given by the concerned teacher has to be answered during Assignment Test.
- Average of Assignment Tests marks is considered.

NOTE: A student who is absent for any Midterm Examination / Assignment Test, for any reason whatsoever, shall be deemed to have scored zero marks in that Midterm Examination/ Assignment Test and no make-up test shall be conducted.

4.2 INTERNAL EVALUATION FOR PRACTICAL SUBJECTS:

For Laboratory courses there shall be continuous evaluation during the semester for 40 internal marks. The break-up of internal marks to be awarded is as given below:

Table 1: Break-up of Internal Marks

S.No.	Criterion	Marks
1	Conduct of experiments, Observation & Results in regular class work(Day-to-Day Performance)	25
2	Viva – voce and Internal Examination	15

In any semester a minimum of 90% of the prescribed number of experiments/exercises specified in the syllabus for laboratory course shall be conducted. They shall complete these experiments/exercises in all respects and submit report and get it certified by the concerned internal lab teacher and the Head of the Department to become eligible to appear for the final end examination in the Laboratory Course.

4.3 INTERNAL EVALUATION FOR SEMINAR-I & SEMINAR-II:

There shall be two Seminars conducted in each discipline, Seminar-I in the M.Tech I Semester and the Seminar-II in M.Tech IV semester. The distribution of internal marks for seminar is given below:

Table 2: Distribution of Marks

S.No.	Criterion	Marks
1	Seminar Report & Subject content	20
2	Seminar presentation & Viva – Voce Exam	30

For the seminar, the student shall collect the information on a specialized relevant topic and prepare a report, showing his understanding over the topic, and submit the same to the department, which shall be evaluated by the Department Committee consisting of Head of the department, Seminar Supervisor and a Senior Faculty Member. Each Seminar shall be evaluated for 50 marks (10 marks for report, 10 marks for subject content, 20 marks for presentation and 10 marks for queries).

4.4 TERM PAPER:

The Term Paper is a precursor to the project work done in the 2nd year M.Tech Programme. The paper may be of 8-10 (A4 size) in length and follows the standard IEEE/Technical Journal Format.

The Term Paper helps to supplement the second year Project Work of the M.Techstudents. It helps to identify their Reserch area/topic and complete the groundwork andpreliminary research required for it comfortably. It trains the students to make use of Research Tools and Material available both in print and digital formats.
Based on the topic, a hypothesis is to be made by the student, under the supervision of the guide. The student is then required to collect literature and support information for his / her term paper from Standard Reference Books, Journals, and Magazines - both printed and online. Each student should refer to a minimum of 6 reference sources related to the topic. The student also presents his/her paper with the help of Power Point slides / OHP.
The Term Paper contains: The Aim and Objective of the study, the need for Rationale behind the study, Identify the work already done in the field, Hypothesis and Discussion, Conclusion Appendix with support data (Illustrations, Tables, Graphs, etc.).
Page Limit: minimum of eight pages.
Date of evaluation: During the Lab Internal Exam.
Method of Evaluation**:** Total 50 marks
1. Day to day work - 10 marks
2. Term Paper Report - 20 marks
3. Seminar - 20 marks

4.5 A candidate shall be deemed to have secured the minimum academic requirement in a subject if he secures a minimum of 40% of marks in the End Examination and a minimum aggregate of 50% of the total marks in the End Semester Examination and Internal Evaluation taken together.

4.6 In case the candidate does not secure the minimum academic requirement in any subject(as specified in 4.4) he has to reappear for the Semester Examination either supplementary or regular in that subject, or repeat the course when next offered or do any other specified subject as may be required.

5.0 SEMESTER END EXAMINATIONS:-

5.1 Theory Courses: 60 marks each

The Semester end examination in each theory subject shall be conducted for 3 hours duration at the end of the semester for 60 marks. The question paper for Semester pattern shall be designed as per the following:

Question paper contains

- A total of Eight questions.
- Answer one Question from each Unit
- The Eight questions are to be designed taking one question from each unit (Unit Wise Either or Type) of the four units.
- In each question, one, two or more bits can be set, totaling 15 Marks with appropriate distribution of marks.

A student has to secure not less than a minimum of 40% of marks (24 marks) exclusively at the end semester examinations in each of the theory subjects in which the candidate had appeared. However, the candidate shall have to secure a minimum of 50% of marks (50 marks) in both external and internal components put together to become eligible for passing in the subject.

5.2 Lab Courses (Practical / Workshop): 60 marks

Out of 60 marks **40** marks are allocated for experiment (procedure for conducting the experiment carries 10 marks & readings, calculation and result-30 marks) and **15** marks for viva-voce examination with **5** marks for the record.

Each Semester External Lab Examination shall be evaluated by an Internal Examiner along with an External Examiner. External Examiner is appointed by the Principal.
A candidate shall be declared to have passed in individual lab course if he secures a minimum of 50% aggregate marks (50 marks) (Internal & Semester External Examination marks put together), subject to a minimum of 40% marks (24 marks) in the semester external examination.

5.3 EVALUATION OF PROJECT WORK:-

Every candidate shall be required to submit thesis or dissertation after taking up a topic approved by the college/ concerned department.

- **Registration of Project work**: A candidate is permitted to register for the project work after satisfying the attendance requirement of all the courses (theory and practical courses of I & II Semesters)
- An Internal Departmental Committee (I.D.C) consisting of HOD, Supervisor/ Guide and one Internal senior expert shall monitor the progress of the project work.
- The work on the project shall be initiated in the penultimate semester and continued in the final semester. The duration of the project is for two semesters. The candidate can submit Project thesis with the approval of I.D.C. after 36 weeks from the date of registration at the earliest and one calendar year from the date of registration for the project work. Extension of time within the total permissible limit for completing the programme is to be obtained from the Head of the Institution.

- The student must submit status report at least in three different phases during the project work period. These reports must be approved by the I.D.C before submission of the Project Report.
- A candidate shall be allowed to submit the thesis / dissertation only after passing in all the prescribed subjects (both theory and practical) and then take viva-voce examination of the project. The viva-voce examination may be conducted once in two months for all the candidates submitted during that period.
- Three copies of the Thesis / Dissertation certified in the prescribed form by the supervisor and HOD shall be submitted to the HOD.
- The semester end examination for project work done during III & IV Semesters shall be conducted by a Project Review Committee (PRC). The evaluation of project work shall be conducted at the end of the IV Semester.
- The PRC comprises of an External examiner appointed by the Principal, Head of the Department and Project Guide/Supervisor to adjudicate the thesis / dissertation. The PRC shall jointly evaluate candidates work and award grades as given below.

S.No	Description	Grade
1	Very Good	Grade A
2	Good	Grade B
3	Satisfactory	Grade C
4	Not satisfactory	Grade D

If the report of the viva-voce is not satisfactory (Grade D) the candidate will retake the viva-voce examination after three months. If he fails to get a satisfactory report at the second viva-voce examination he will not be eligible for the award of the degree unless the candidate is permitted to revise and resubmit the thesis.

6.0 RE-REGISTRATION FOR IMPROVEMENT OF INTERNAL EVALUATION MARKS:

Following are the conditions to avail the benefit of improvement of internal evaluation marks.

- The candidate should have completed the course work and obtained examinations results for I & II semesters.
- He should have passed all the subjects for which the internal evaluation marks secured are more than 50%.
- Out of the subjects the candidate has failed in the examination due to Internal evaluation marks secured being less than 50%, the candidate shall be given one more chance for each Theory subject and for a maximum of **three** Theory subjects for Improvement of Internal evaluation marks.
- The candidate has to re-register for the subjects so chosen and fulfill all the academic requirements.
- For each subject, 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. in favour of **'The Principal, Audisankara College of Engineering & Technology' payable at Gudur** along with the requisition through the Controller of the Examinations of the college.
- In the event of availing the Improvement of Internal evaluation marks, the internal evaluation marks as well as the End Examinations marks secured in the previous attempt(s) for the reregistered subjects stand cancelled.

7.0 SEMESTER – WISE DISTRIBUTION OF CREDITS:

Table 3: Semester –wise Credits distribution

SEMESTER	No. of Credits per semester Theory + Lab	Total credits
I Semester	24+06	30
II Semester	24+06	30
III & IV Semesters	0+18	18
TOTAL CREDITS	48+30	78

8.0 AWARD OF DEGREE AND CLASS:-

A candidate shall be eligible for the award of degree if he satisfies the minimum academic requirements in every subject, Seminar and secures 'satisfactory' or higher grade report on his thesis/dissertation and viva-voce. Based on overall percentage of marks obtained, the following class is awarded.

Table 4: Award of Division

Class Awarded	% of marks to be secured
First Class with Distinction	70% and above
First Class	Below 70% but not less than 60%
Second Class	Below 60% but not less than 50%

9.0 READMISSION CRITERIA:

A Candidate, who is detained in a semester due to lack of attendance, has to obtain written permission from the Principal for readmission into the same semester after duly fulfilling all the required norms stipulated by the college in addition to paying the required fee.

10. SUPPLEMENTARY EXAMINATIONS:

Apart from the regular End Examinations the institute may also schedule and conduct supplementary examinations for all subjects for the benefit of students with backlogs. Such students writing supplementary examinations as supplementary candidates may have to write more than one examination per day.

11.CONDUCT AND DISCIPLINE:-

(a) Students shall conduct themselves within and outside the premises of the Institute in a descent and dignified manner befitting the students of ACET.

(b) As per the order of the Honorable Supreme Court of India, ragging in any form is considered a criminal offence and is totally banned. Any form of ragging will be severely dealt with.

(c) The following acts of omission and / or commission shall constitute gross violation of the code of conduct and are liable to invoke disciplinary measures with regard to ragging.
   (i) Lack of courtesy and decorum; indecent behavior anywhere within or outside the college campus.
   (ii) Damage of college property or distribution of alcoholic drinks or any kind of narcotics to fellow students / citizens.

(d) Possession, consumption or distribution of alcoholic drinks or any kind of narcotics or hallucinogenic drugs.

(e) Mutilation or unauthorized possession of library books.

(f) Noisy and unruly behavior, disturbing studies of fellow students.
(g) Hacking in computer systems (such as entering into other person's areas without prior permission, manipulation and / or damage of computer hardware and software or any other cyber crime etc.
(h) Usage of camera /cell phones in the campus.
(i) Plagiarism of any nature.
(j) Any other act of gross indiscipline as decided by the college academic council from time to time.
(k) Commensurate with the gravity of offense, the punishment may be reprimand, fine, expulsion from the institute/ hostel, debarring from examination, disallowing the use of certain facilities of the Institute, rustication for a specified period or even outright expulsion from the Institute, or even handing over the case to appropriate law enforcement authorities or the judiciary, as required by the circumstances.
(l) For an offence committed in (i) a hostel (ii) a department or in a class room and (iii) elsewhere, the chief Warden, the concern Head of the Department and the Principal respectively, shall have the authority to reprimand or impose fine.
(m) Cases of adoption of unfair means and/ or any malpractice in an examination shall be reported to the principal for taking appropriate corrective action.
(n) All cases of serious offence, possibly requiring punishment other than reprimand, shall be reported to the Academic council of the college.
(o) The Institute Level Standing Disciplinary Action Committee constituted by the academic council shall be the authority to investigate the details of the offence, and recommend disciplinary action based on the nature and extent of the offence committed.
(p) The Principal shall deal with any problem, which is not covered under these rules and regulations.
(q) **"Grievance and Redressal Committee" (General)** constituted by the Principal shall deal with all grievances pertaining to the academic / administrative / disciplinary matters.
(r) All the students must abide by the code and conduct rules prescribed by the college from time to time.

12.0 WITH – HOLDING OF RESULTS:

If the candidate has not paid dues to the university/college or if any case of in-discipline is pending against him, the result of the candidate shall be withheld and he will not be allowed / promoted to the next higher semester. The issuing of degree is liable to be withheld in such cases.

13.0 TRANSITORY REGULATIONS:

Candidates who have discontinued or have been detained for want of attendance or who have failed after having undergone the course in earlier regulations and wish to continue the course are eligible for admission into the unfinished semester from the date of commencement of class work with the same or equivalent subjects as and when such subjects are offered, subject to the conditions of 4.5 and 2.3 sections.

14.0MINIMUM INSTRUCTION DAYS:

The minimum instruction days for each semester shall be 90 clear instruction days excluding the days allotted for tests/examinations and preparation holidays declared if any.

15.0AMENDMENTS OF REGULATIONS-

The college may, from time to time, revise, amend or change the regulations, scheme of examinations and syllabi. However the academic regulations of any student will be same throughout the course of study in which the student has been admitted.

16.0 GENERAL:

- The academic regulations should be read as a whole for the purpose of any interpretation.
- Disciplinary action for Malpractice/improper conduct in examinations is appended.
- Where the words “he”, “him”, “his”, occur in the regulations, they include “she”, “her”, “hers”.
- In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Head of the Institute is final.

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RULES FOR DISCIPLINARY ACTION FOR MALPRACTICE / IMPROPER CONDUCT IN EXAMINATIONS

	Nature of Malpractices/Improper conduct	**Punishment**
	If the candidate	
1. (a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.
(b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any 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 subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2.	Is found copying in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that Semester/year. The Hall Ticket of the candidate will be cancelled.
3.	Comes in alcohol drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year.
4.	Smuggles the Answer book or a part there of 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 subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of

		seat.
5.	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 subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
6.	Possesses any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate will also be debarred and forfeit the seat.
7.	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate will also be debarred and forfeit the seat. The performance of the original candidate who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The candidate will also be debarred for two consecutive semesters from class work and all end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the impostor is an outsider, he will be handed over to the police and a case registered against him.
8.	Refuses to obey the orders of the Chief Superintendent/Asst.Superintendent/ 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 officer-in charge or any person on duty in or outside the examination hall causing any injury to him or to any of his relations	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The candidates also are

	whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall 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.	debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case registered against them.
9.	Is a 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 clauses 6 to 8.	In case of students of the college expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. 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.	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 subject.
11.	Is detected copying on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester/year examinations.
12.	Indulging in any malpractice which is not covered in the above clauses 1 to 11 if detected shall be reported to the College Authorities for further action to award suitable punishment.	Appropriate action will be taken as recommended by the College Authorities.

Malpractices identified by squad or special invigilators

1. Punishments to the candidates as per the above guidelines.

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Course Structure for M.Tech (EPS) Regular Programme
Applicable for students admitted from Academic Year 2014-15

M. Tech I Year (I Semester) – Electrical Power Systems

Sl. No	Course Code	Subject	Scheme of instruction(Periods / week)		Scheme of Examination			No. of Credits
			Theory	Lab	IM	EM	Total Marks	
1	13EP101	Modern Control Theory	4	-	40	60	100	4
2	13EP102	Distribution Automation	4	-	40	60	100	4
3	13EP103	Power System control & Stability	4	-	40	60	100	4
4	13EP104	EHVAC Transmission	4	-	40	60	100	4
5	13EP105	Restructured power systems	4	-	40	60	100	4
6	13EP106 13EP107 13EP108	**Elective-I** a. Advanced Digital Signal Processing b. AI Techniques in Electrical Engineering c. Advanced Microprocessors and Microcontrollers	4	-	40	60	100	4
7	13EP109	Electrical Machines and Power Systems Lab	-	3	40	60	100	2
8	13EP110	Power System Simulation Lab – I	-	3	40	60	100	2
9	13EP111	Seminar-I	-	-	50	-	50	2
Contact Periods / Week			24	6	370	480	850	
			Total Periods/ Week		**30**	**Total Credits**		**30**

M. Tech I Year (II Semester) – Electrical Power Systems

Sl. No	Course Code	Subject	Scheme of instruction(Periods / week)		Scheme of Examination			No. of Credits
			Theory	Lab	IM	EM	Total Marks	
1	13EP201	Flexible AC Transmission Systems	4	-	40	60	100	4
2	13EP202	HVDC Transmission	4	-	40	60	100	4
3	13EP203	Operation and Control of Power System	4	-	40	60	100	4
4	13EP204	Advanced Power System Protection	4	-	40	60	100	4
5	13EP205	Renewable Energy systems	4	-	40	60	100	4
6	13EP206 13EP207 13EP208	Elective-II a. Programmable Logic Controllers b. Energy Auditing, Conservation and Management c. Reactive power compensation & Management	4	-	40	60	100	4
7	13EP209	Renewable Energy Systems Lab	-	3	40	60	100	2
8	13EP210	Simulation Lab-II	-	3	40	60	100	2
9	13EP211	Term Paper	-	-	50	-	50	2
Contact Periods / Week			24	6	370	480	850	
			Total Periods/ Week		**30**	**Total Credits**		**30**

M. Tech II Year (III & IV Semesters) – Electrical Power Systems

Sl. No	Course Code	Subject	Scheme of Examination			No. of Credits
			IM	EM	Total Marks	
1	13EP401	Seminar-II	50	-	50	2
2	13EP402	Project Work	-	A/B/C/D	-	16
Contact Periods / Week						
				Total Credits		**18**

AUDISANKARA COLLEGE OF ENGINEERING & TECHNOLOGY: GUDUR
(AUTONOMOUS)

M.Tech I Semester (EPS)

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(13EP101) MODERN CONTROL THEORY

UNIT –I

Mathematical Preliminaries: Fields, Vectors and Vector Spaces – Linear combinations and Bases – Linear Transformations and Matrices – Scalar Product and Norms – Eigen values, Eigen Vectors and a Canonical form representation of linear operators – The concept of state – State Equations for Dynamic systems – Time invariance and Linearity – Non uniqueness of state model – State diagrams for Continuous – Time state models.

State Variable Analysis: Linear Continuous time model for physical systems – Existence and Uniqueness of Solutions to Continuous – Time State Equations – Solutions – Linear Time Invariant Continuous – Time State Equations – State transition matrix and it's properties.

UNIT – II

Controllability and Observability: General concept of Controllability - General concept of Observability Controllability tests for Continuous – Time Invariant systems - Observability tests for Continuous - Time Invariant systems - Controllability and Observability of state model in Jordan Canonical form - Controllability and Observability Canonical forms of State model.

State Feedback Controllers and Observers: State Feedback Controller design through Pole Assignment – state observers: Full order and reduced order.

UNIT – III

Non Linear Systems: Introduction – Non Linear Systems – Types of Non – Linearities – Saturation – Dead – Zone – Backlash – Jump Phenomenon etc; - Singular Points – Introduction to Linearization of nonlinear systems, properties of Non Linear Systems – Describing function – describing function analysis of Nonlinear systems- Stability analysis of Non – Linear systems through describing functions Introduction to phase – plane analysis, Method of Isoclines for Constructing Trajectories, singular Points, phase – plane analysis of nonlinear control systems.

UNIT – IV

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

Text Books:

1. M. Gopal, Modern Control System Theory, New Age International – 1984
2. Ogata. K, Modern Control Engineering Prentice Hall – 1997
4. Kuo, Digital Control Engineering, Oxford University.1980.

AUDISANKARA COLLEGE OF ENGINEERING & TECHNOLOGY: GUDUR
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M.Tech I Semester (EPS)	L	T	P	[C]
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(13EP102) DISTRIBUTION AUTOMATION

UNIT-I

Distribution Automation and the Utility System: Introduction to Distribution Automation (DA), control system interfaces, control and data requirements, centralized (Vs) decentralized control, DA System (DAS), DA Hardware, DAS software.

Distribution Automation Functions: DA capabilities, Automation system computer facilities, management processes, Information management, system reliability management, system efficiency management, voltage management, Load management.

UNIT-II

Communication Systems for DA: DA communication requirements, Communication reliability, Cost effectiveness, Data rate Requirements, Two way capability, Ability to communicate during outages and faults, Ease of operation and maintenance, Conforming to the architecture of data flow.

Communication Systems used in DA : Distribution line carrier (Power line carrier), Ripple control, Zero crossing technique, telephone, cable TV, Radio, AM broadcast, FM SCA, VHF Radio, UHF Radio, Microwave satellite. Fiber optics, Hybrid Communication systems, Communication systems used in field tests.

UNIT-III

Technical Benefits: DA benefit categories, Capital deferred savings, Operation and Maintenance savings, Interruption related savings, Customer related savings, Operational savings, improved operation, Function benefits, Potential benefits for functions, and function shared benefits, Guidelines for formulation of estimating equations Parameters required, economic impact areas, Resources for determining benefits impact on distribution system, integration of benefits into economic evaluation.

UNIT-IV

Economic Evaluation Methods: Development and evaluation of alternate plans, Select study area, Select study period, Project load growth, Develop Alternatives, Calculate operating and maintenance costs, Evaluate alternatives. Economic comparison of alternate plans, Classification of expenses and capital expenditures, Comparison of revenue requirements of alternative plans, Book Life and Continuing plant analysis, Year by year revenue requirement analysis, short term analysis, end of study adjustment, Break even analysis, Sensitivity analysis computational aids.

Reference Books:

1. IEEE Tutorial Course “Distribution Automation”.
2. IEEE Working Group on “Distribution Automation”.
3. Control and Automation of Electrical Distribution Systems, James. Northcote – Green Robert Wilson, CRC Press.2006.
4. Electric Power Distribution Automation, Dr. M. K. Khedkar, Dr. G.M.Dhole, University Science press.2010.

AUDISANKARA COLLEGE OF ENGINEERING & TECHNOLOGY: GUDUR
(AUTONOMOUS)

M.Tech I Semester (EPS)

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(13EP103) POWER SYSTEM CONTROL AND STABILITY

UNIT-I

The Elementary Mathematical Model: A Classical model of one machine connected to an infinite bus – Classical model of multi machine system –Problems – Effect of the excitation system on Transient stability.

System Response to small Disturbances: The unregulated synchronous Machine – Effect of small changes of speed – modes of oscillation of an unregulated Multi-Machine system – regulated synchronous machine – voltage regulator with one time lag – Governor with one time lag – Problems.

UNIT-II

Dynamic Stability: Concept of Dynamic stability – state space model of one machine system connected to infinite bus – effect of excitation on Dynamic stability – examination of dynamic stability by Routh's criterion.

Power System Stabilizers: Introduction to supplementary stabilizing signals- Block diagram of the linear system- Approximate model of the complete exciter – generator system – Lead compensation – Stability aspect using Eigen value approach.

UNIT-III

Excitation Systems: Excitation system response – Non-continuously regulated systems – continuously regulated systems – Excitation system compensation – state space description of the excitation system simplified linear model – effect of excitation on generator power limits.

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 modeling equations of these types.

UNIT-IV

Stability Analysis using Direct Method of Lyapunov: Review of Lyapunov's stability theorems of non-liner 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.

Introduction to Voltage Stability: What is voltage stability –Factors affecting voltage instability and collapse – Comparison of Angle and voltage stability – Analysis of voltage instability and collapse – Integrated analysis of voltage and Angle stability – Control of voltage instability.

Reference Books:

1. P.M.Anderson, A.A.Fouad, "Power System Control and Stability", IOWA State University Press, Galgotia Publications, Vol-I, 1st Edition.
2. M.A.Pai, Power System Stability – Analysis by the direct method of Lyapunov. North Holland Publishing Company, Newyork, 1981.
3. K.R. Padiyar, Power System Dynamics (Stability & Control), 2nd Edition B.S.Publications, 2002.

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M.Tech I Semester (EPS)

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(13EP104) EHVAC TRANSMISSION

UNIT I

E.H.V.A.C. Transmission line trends and preliminary aspect standard transmission voltages – Estimation at line and ground parameters Bundle conductor systems inductance and capacitance of E.H.V. lines – positive, negative and zero sequence impedance – Line Parameters for Modes of Propagation.

UNIT II

Electrostatic field and voltage gradients – calculations of electrostatic field of AC lines – effect high electrostatic field on biological organisms and human beings surface voltage gradients and maximum gradients of actual transmission lines – voltage gradients on sub conductor Electrostatic induction in un energized lines – measurements of field and voltage gradients for three phase single and double circuit lines – un energized lines.

UNIT III

Power Frequency Voltage control and over voltages in EHV lines : No load voltage – charging currents at power frequency - voltage control – shunt and series compensation – static VAR compensation. Corona in E.H.V. lines – Corona loss formulae attention of traveling waves due to Corona– Audio noise due to Corona, its generation, characteristic and limits

UNIT IV

Measurements of audio noise radio interference due to Corona RF properties of radio noise – frequency spectrum of RI fields – Measurements of RI and RIV. Design of EHV lines based on steady state and transient limits. EHV cables and their characteristics.

Reference Books:

1. Rokosh Das Begamudre, Extra High Voltage AC Transmission Engineering, Wiley Eastern Ltd., New Delhi – 1987.
2. Edison Electric Institution, EHV Transmission line reference Books (GEC 1968).

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(AUTONOMOUS)

M.Tech I Semester (EPS)

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(13EP105) RESTRUCTURED POWER SYSTEM

UNIT - I

Key Issues in Electric Utilities: Introduction – Restructuring models – Independent System Operator (ISO) – Power Exchange - Market operations – Market Power – Standard cost – Transmission Pricing – Congestion Pricing – Management of Inter zonal/Intra zonal Congestion.

Open Access Same-Time Information System (OASIS) & Market Power: Structure of OASIS - Posting of Information – Transfer capability on OASIS. Market Power: Introduction - Different types of market Power – Mitigation of Market Power - Examples.

UNIT-II

Available Transfer Capability (ATC) & Electricity Pricing: Transfer Capability Issues – ATC – TTC – TRM – CBM Calculations – Calculation of ATC based on power flow. Electricity Pricing: Introduction – Electricity Price Volatility Electricity Price Indexes – Challenges to Electricity Pricing – Construction of Forward Price Curves – Short-time Price Forecasting.

UNIT - III

Power System Operation in Competitive Environment: Introduction – Operational Planning Activities of ISO- The ISO in Pool Markets – The ISO in Bilateral Markets – Operational Planning Activities of a GENCO.

UNIT- IV

Transmission Cost Allocation Methods & Ancillary Services Management: Introduction - Transmission Cost Allocation Methods : Postage Stamp Rate Method - Contract Path Method - MW-Mile Method – Unused Transmission Capacity Method - MVA-Mile method – Comparison of cost allocation methods. Ancillary Services Management: Introduction – Reactive Power as an Ancillary Service – a Review – Synchronous Generators as Ancillary Service Providers.

Text Books:

1. Kankar Bhattacharya, Math H.J. Boller and Jaap E.Daalder, Operation of Restructured Power System, Kulwer Academic Publishers, 2001.
2. Mohammad Shahidehpour and Muwaffaq alomoush, Restructured Electrical Power Systems, Marcel Dekker, Inc., 2001.

Reference Books:

1. Loi Lei Lai, Power System Restructuring and Deregulation, John Wiley & Sons Ltd., England.

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M.Tech I Semester (EPS)

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(13EP106) ADVANCED DIGITAL SIGNAL PROCESSING
(Elective-I)

UNIT-I

Short introduction, Analog to digital and Digital to Analog conversion, sampled and Hold circuit, Continuous time Fourier Transforms. Discrete-time signals and systems, Discrete-time Fourier transform- its properties and applications, Fast Fourier Transform (in time-domain and Frequency domain), IDFT and its properties.

UNIT-II

Z- Transform: Definition and properties, Rational z-transforms, Region of convergence of a rational z- Transform, The inverse z- Transform, Z-Transform properties, Computation of the convolution sum of finite-length sequences, The transfer function, Digital filter structures: Block Diagram representation, Equivalent structures, Basic FIR Digital Filter structures, Basic IIR Digital Filter structures, Realization of Basic structures using MATLAB, All pass filters, Computational complexity of Digital filter structures.

UNIT III

IIR Digital Filter Design: Preliminary considerations, Bilinear transformation method of IIR Filter design, Design of low pass IIR Digital filters, Design of High pass, Band pass and band stop IIR digital filters, Spectral Transformations of IIR filter, IIR digital filter design using MATLAB, Computer aided design of IIR digital filters.

FIR Digital Filter Design: Preliminary considerations, FIR filter design based on windowed Fourier series, Computer aided design of Equiripple Linear phase FIR filters, Design of Minimum phase FIR filters, FIR digital filter design using MATLAB, Design of computationally efficient FIR digital filters.

UNIT IV

Analysis of Finite Word Length Effects: The quantization process and errors, quantization of Fixed point numbers, Quantization of floating point numbers, Analysis of coefficient quantization effects, Analysis of arithmetic round off errors, Low sensitivity digital filters, Reduction of product round off errors using error feedback, Round off errors in FFT algorithms. The basic sample rate alteration devices, Multi rate structures for sampling rate conversion, Multistage design of decimator and interpolator, The Polyphone decomposition, Arbitrary-rate sampling rate converter, Nyquist Filters and some applications of digital signal processing.

TEXT BOOKS:

1. S.K. Mitra, Digital Signal Processing Tata McGraw-Hill, Third Edition, 2006.
2. B.P. Lathi, Principle of Signal Processing and Linear Systems Oxford International Student Version, 2009.
3. M. Mondal and A. Asif, Continuous and Discrete Time Signals and Systems Cambridge, 2007.
4. Li Tan, Digital Signal Processing- Fundamentals and Applications Indian reprint, Elsevier, 2008.

AUDISANKARA COLLEGE OF ENGINEERING & TECHNOLOGY: GUDUR
(AUTONOMOUS)

M.Tech I Semester (EPS)

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(13EP107) AI TECHNIQUES IN ELECTRICAL ENGINEERING
(Elective-I)

UNIT-I

Introduction to Neural Networks: Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Hodgkin-Huxley Neuron Model, Integrate-and-Fire Neuron Model, Spiking Neuron Model, Characteristics of ANN, McCulloch-Pitts Model, Historical Developments, Potential Applications of ANN.

Essentials of Artificial Neural Networks: Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN-Connectivity, Neural Dynamics (Activation and Synaptic), Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules, Types of Application.

UNIT-II

Feed Forward Neural Networks: Introduction, Perceptron Models: Discrete, Continuous and Multi-Category, Training Algorithms: Discrete and Continuous Perceptron Networks, Perceptron Convergence theorem, Limitations of the Perceptron Model, Applications.

Multilayer Feed Forward Neural Networks: Credit Assignment Problem, Generalized Delta Rule, Derivation of Back propagation (BP) Training, Summary of Back propagation Algorithm, Kolmogorov Theorem, Learning Difficulties and Improvements.

Associative Memories: Paradigms of Associative Memory, Pattern Mathematics, Hebbian Learning, General Concepts of Associative Memory (Associative Matrix, Association Rules, Hamming Distance, The Linear Associator, Matrix Memories, Content Addressable Memory), Bidirectional Associative Memory (BAM) Architecture, BAM Training Algorithms: Storage and Recall Algorithm, BAM Energy Function, Proof of BAM Stability Theorem. Architecture of Hopfield Network: Discrete and Continuous versions, Storage and Recall Algorithm, Stability Analysis, Capacity of the Hopfield Network.

UNIT-III

Self-Organizing Maps (SOM) and Adaptive Resonance Theory (ART): Introduction, Competitive Learning, Vector Quantization, Self-Organized Learning Networks, Kohonen Networks, Training Algorithms, Linear Vector Quantization, Stability- Plasticity Dilemma, Feed forward competition, Feedback Competition, Instar, Outstar, ART1, ART2, Applications.

Classical & Fuzzy Sets: Introduction to classical sets – properities, Operations and relations; Fuzzy sets, Membership, Uncertainity, Operations, Properities, fuzzy relations, cardinalities, membership functions.

Unit-IV

Fuzzy Logic System Components: Fuzzification, Membership Value assignment, development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods.

Applications Neural Network Applications: Process identification, Fraction Approximation, Control and Process Monitoring, Fault diagnosis and Load forecasting.
Fuzzy logic applications: Fuzzy logic control and Fuzzy classification.

Text Books:

1. Rajasekharam and Rai, Neural Networks, Fuzzy logic, Gnenetic algorithms: synthesis and applications - PHI Publication.2003
2. Jacek M.Zurada, Introduction to Artificial Neural Systems Jaico Publishing House, 1997.
3. N. Yadaiah and S. Bapi Raju, Neural and Fuzzy Systems: Foundation, Architectures and Applications Pearson Education.2010.
4. Brok Kosko, Neural Netwroks and Fuzzy Logic System PHI Publications.

AUDISANKARA COLLEGE OF ENGINEERING & TECHNOLOGY: GUDUR
(AUTONOMOUS)

M.Tech I Semester (EPS)

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(13EP108) ADVANCED MICROPROCESSORS AND MICROCONTROLLERS
(Elective-I)

Objectives:

- To expose the students to the fundamentals of microprocessor architecture.
- To introduce the advanced features in microprocessors and microcontrollers.
- To enable the students to understand various microcontroller architectures.

UNIT-I

High Performance CISC Architecture – PENTIUM:

CPU Architecture- Bus Operations – Pipelining – Brach predication – floating point unit- Operating Modes –Paging – Multitasking – Exception and Interrupts – Instruction set – addressing modes – Programming the Pentium processor.

UNIT-II

High Performance RISC Architecture – ARM: Arcon RISC Machine – Architectural Inheritance – Core & Architectures – Registers – Pipeline – Interrupts – ARM organization – ARM processor family – Co-processors – ARM instruction set- Thumb Instruction set – Instruction cycle timings – The ARM Programmer's model – ARM Development tools – ARM Assembly Language Programming – C programming – Optimizing ARM Assembly Code – Optimized Primitives.

UNIT III

ARM Application Development: Introduction to DSP on ARM –FIR filter – IIR filter – Discrete fourier transform – Exception handling – Interrupts – Interrupt handling schemes- Firmware and boot loader – Embedded Operating systems – Integrated Development Environment- STDIO Libraries – Peripheral Interface – Application of ARM Processor – Caches – Memory protection Units – Memory Management units – Future ARM Technologies.

UNIT IV

Motorola 68HC11 Microcontrollers: Instruction set addressing modes – operating modes- Interrupt system- RTC-Serial Communication Interface – A/D Converter PWM and UART.

PIC Microcontroller: CPU Architecture – Instruction set – interrupts- Timers- I2C Interfacing –UART-A/D Converter –PWM and introduction to C-Compilers.

Text Book:

1. Andrew N.Sloss, Dominic Symes and Chris Wright "ARM System Developer's Guide: Designing and Optimizing System Software", First edition, Morgan Kaufmann Publishers, 2004.

Reference Books:

1. Steve Furber , "ARM System –On –Chip architecture", Addision Wesley, 2000.
2. Daniel Tabak, "Advanced Microprocessors", Mc Graw Hill. Inc., 1995.
3. James L. Antonakos, "The Pentium Microprocessor", Pearson Education, 1997.
4. Gene .H.Miller, "Micro Computer Engineering", Pearson Education, 2003.
5. John .B.Peatman, "Design with PIC Microcontroller", Prentice Hall, 1997.

AUDISANKARA COLLEGE OF ENGINEERING & TECHNOLOGY: GUDUR
(AUTONOMOUS)

M.Tech I Semester (EPS)

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(13EP109) ELECTRICAL MACHINES AND POWER SYSTEMS LAB

List of experiments:

1. Determination of Sub transient Reactance of Salient Pole Synchronous Machine.
2. Determination of Sequence Impedances of Cylindrical Rotor Synchronous Machine.
3. **Fault Analysis – I**

i) LG Fault

ii) LL Fault

4. **Fault Analysis – II**

i) LLG Fault

ii) LLLG Fault

5. Equivalent Circuit of a Three Winding Transformer.
6. Separation of No-Load Losses of Three-Phase Squirrel Cage Induction Motor.
7. Power Angle Characteristics of Salient Pole Synchronous Machine.
8. Scott Connection.
9. Characteristics of IDMT Over Current Relay (Electromagnetic Type).
10. Characteristics of Negative Sequence Relay (Static Type).
11. **Characteristics of Over Voltage Relay.**

i) Electromagnetic Type

ii) Microprocessor Type

12. **Characteristics of Percentage Biased Differential Relay**.

i) Electromagnetic Type

ii) Static Type

AUDISANKARA COLLEGE OF ENGINEERING & TECHNOLOGY: GUDUR
(AUTONOMOUS)

M.Tech I Semester (EPS)	L	T	P	[C]
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(13EP110) SIMULATION LAB-I

List of experiments:

1. Develop MATLAB program for Y-BUS formation.
2. Develop MATLAB program for G-S Load Flow Analysis.
3. Develop MATLAB program for N-R Load Flow Analysis.
4. Develop MATLAB program for FDLF Load Flow Analysis.
5. Develop MATLAB program for Short Circuit Analysis.
6. Transient Stability Analysis for Single Machine connected to Infinite Bus by Point by Point Method.
7. Develop PSPICE Program for Generation System Reliability Analysis.
8. Develop PSPICE Program for Distribution System Reliability Analysis.
9. Simulation of RLC Circuit using PSPICE.
10. Simulation of Single Phase Full Converter with RLE Load using PSPICE
11. Develop MATLAB model for Closed Loop Speed Control of Separately Excited D.C Motor.
12. Develop MATLAB model for Sinusoidal Pulse Width Modulation

AUDISANKARA COLLEGE OF ENGINEERING & TECHNOLOGY: GUDUR
(AUTONOMOUS)

M.Tech I Semester (EPS)	L	T	P	[C]
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(13EP111) SEMINAR-I

Objectives: To get involved with the latest advancements and developments to enhance communication and presentation skills, exchange of ideas, greater connectivity to develop a research bent of mind.

For the seminar, the student shall collect the information on a specialized relevant topic and prepare a report, showing his understanding over the topic, and submit the same to the department, which shall be evaluated by the Department Committee consisting of Head of the department, Seminar Supervisor and a Senior Faculty Member. Each Seminar shall be evaluated for 50 marks (10 marks for report, 10 marks for subject content, 20 marks for presentation and 10 marks for queries).

AUDISANKARA COLLEGE OF ENGINEERING & TECHNOLOGY: GUDUR
(AUTONOMOUS)

M.Tech II Semester (EPS)

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(13EP201) FLEXIBLE A.C TRANSMISSION SYSTEMS

UNIT-I

FACTS Concepts: Transmission interconnections power flow in an AC system, loading capability limits, Dynamic stability considerations, importance of controllable parameters basic types of FACTS controllers, benefits from FACTS controllers. Voltage source converters: Single phase three phase full wave bridge Converters transformer connections for 12 pulse 24 and 48 pulse operation.

UNIT II

Three level voltage source converter, pulse width modulation converter, basic concept of current Source Converters and comparison of current source converters with voltage source converters. Static shunt compensation: Objectives of shunt compensation, mid point voltage regulation voltage instability prevention, improvement of transient stability, Power oscillation damping.

UNIT III

Methods of controllable Var generation, variable impedance type static Var generators switching Converter type Var generators hybrid Var generators. **SVC and STATCOM**: The regulation and slope transfer function and dynamic performance, transient stability enhancement and power oscillation damping operating point control and summary of compensator control.

UNIT IV

Static Series Compensators: concept of series capacitive compensation, improvement of transient stability, power oscillation damping. Functional requirements, GTO thyristor controlled series capacitors (GSC), thyristor switched series capacitor (TSSC).and thyristor controlled series capacitor (TCSC) control schemes for GSC TSSC and TCSC.

Text Book:

1. N. G. Hingorani and L. Guygi. “Understanding FACTS Devices” IEEE Press Publications 2000.

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M.Tech II Semester (EPS)

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(13EP202) HVDC TRANSMISSION

Unit-I

HVDC Transmission: General consideration, Power Handling Capabilities of HVDC lines, Basic Conversion principles, static converter configuration. Static Power Converters: 3 pulse, 6 pulse & 12 pulse converters, converter station and terminal equipment communication process, Rectifier and inverter operation, equivalent circuit for Converter- special futures of converter transformers.

Unit-II

Harmonics in HVDC systems, harmonicas elimination, AC & DC filter Control of HVDC converter and systems: constant current, constant extinction angle and constant ignition angle control. Individual phase control and equidistant firing angle control, DC power flow control.

Unit-III

Interaction between HVAC & DC systems –voltage interaction, harmonic instability problems and DC power modulation. Multi-terminal DC link and systems; series, parallel and series parallel systems, their operation and control.

Unit-IV

Transient over voltage in HVDC systems: Over voltages due to disturbance on DC side, over voltages due to DC and AC side line faults. Converter faults and protection in HVDC systems: Converter faults, over current protection- valve group and DC line protection. Over voltage protection of converters, surge arresters.

Reference Books:

1. E.W.Kimbark: Direct current Transmission, Wiely inter Science- New York.1971
2. J.Arillaga: H.V.D.C.Tranmission peter peregrilnus ltd., London UK 1983.
3. K.R.Padiyar: High Voltage Direct current Transmission, Wiely Eastern Ltd.1990.
4. E.Uhlman: Power Transmission by Direct Current Springer Verlag, Berlin.1975.

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M.Tech II Semester (EPS)

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(13EP203) OPERATION AND CONTROL OF POWER SYSTEM

UNIT-I

Economic Operation: Load forecasting - Unit commitment – Economic dispatch problem of thermal units – Gradient method- Newton's method –Base point and participation factor method.

Unit Commitment and Solution Methods: Optimal Unit Commitment, Constraints in unit commitment, spinning reserve, Thermal Unit Constraints, Other constraints, Hydro constraints, Must Run, Fuel constraints, Unit commitment Solution methods: Priority-List methods, Dynamic Programming solution. Backward DP Approach, Forward DP Approach, Restricted Search Ranges, Strategies- Reliability considerations.

UNIT-II

Hydro-thermal Co-Ordination: Short-term hydrothermal scheduling problem -gradient approach – Hydro units in series - pumped storage hydro plants-hydro-scheduling using Dynamic Programming and linear programming.

Automatic generation control: Review of LFC and Economic Dispatch control (EDC) using the three modes of control viz. Flat frequency – tie-line control and tie-line bias control.

UNIT-III

AGC implementation: AGC features - static and dynamic responses of uncontrolled & controlled two-area system. Interchange of Power & Energy: Economic interchange between interconnected utilities- Inter utility energy evaluation – Power pools – Transmission effects and Issues: Limitation-Wheeling.

UNIT-IV

Power System Security-Contingency Analysis: Linear sensitivity factors – AC power flow methods – contingency selection – concentric relaxation – bounding-security constrained optimal power flow-Interior point algorithm-Bus incremental costs**.** Introduction – Maximum likelihood Weighted least squares equation – orthogonal Decomposition estimation method – Algorithm.

Reference Books:

1. Allen J.Wood and Wollenberg B.F., 'Power Generation Operation and control', John Wiley & Sons, Second Edition.2013.
2. Nagrath, I.J. and Kothari D.P., 'Modern Power System Analysis', TMH, New Delhi, 1980.
3. D.P.Kothari & J.S.Dhillon, Power System Optimization, PHI, 2004.

AUDISANKARA COLLEGE OF ENGINEERING & TECHNOLOGY: GUDUR
(AUTONOMOUS)

M.Tech II Semester (EPS)

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(13EP204) ADVANCED POWER SYSTEM PROTECTION

UNIT-I

Static Relays: Advantages of static relays- Basic construction of static relays – Level detectors – Replica impedance-mixing circuits-general equation for two input phase and amplitude comparators –Duality between amplitude and phase comparator.

Amplitude comparators: Circulating current type and 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.

UNIT-II

Static Over Current Relays: Introduction-Instantaneous over current relay – Time over current relays-basic principles-Definite time and Inverse definite time over current relays.

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

Static distance Relays: Static impedance –reactance-MHO and angle impedance relay sampling comparator–realization of reactance and MHO relay using a sampling comparator.

UNIT-III

Multi –Input Comparators: Conic section characteristics – Three input amplitude comparator – Hybrid comparator – switched distance schemes –Polyphase distance schemes-Phase fault scheme– Three phase scheme – combined and ground fault scheme.

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-IV

Microprocessor based Protective Relays-I: Over current relays – impedance relays – directional relay – reactance relay (Block diagram and flow chart approach only).

Microprocessor based Protective Relays-II: 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 (Block diagram and flow chart approach only) Basic principle of Digital computer relaying.

References Books:

1. T.S.Madhava Rao, “Power system Protection static relay”, Tata McGraw Hill Publishing Company limited, second edition, 1989.
2. Badri Ram and D.N.Vishwakarma, “Power system Protection and Switchgear “, Tata McGraw Hill Publication Company limited First Edition -1995.

AUDISANKARA COLLEGE OF ENGINEERING & TECHNOLOGY: GUDUR
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M.Tech II Semester (EPS)

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(13EP205) RENEWABLE ENERGY SYSTEMS

UNIT-I

Introduction: Energy Economics: Simple pay back period, Internal (simple) arte of return, Net present valve, Internal rate of return (IRR), NPV and IRR with Fuel Escalation.

Solar Resource: Solar spectrum, Altitude angle of sun at solar noon, solar position at any time of day, solar time, sun rise and sunset, solar radiation-direct beam, diffuse radiation, reflected radiation, and radiation measurements.

Semiconductor Physics: Band gap energy, solar spectrum, Band gap impact on Photo voltaic efficiency, P-n junction diode.

UNIT-II

Photo Voltaics: Generic photo voltaic cell- Simple equivalent circuits, accurate equivalent circuit, Cells to modules to arrays, I-V curve under STC, Impacts of temperature & insolation on I-V curves, Shading impacts on i-V curves, Crystalline silicon technologies, thin film photovoltaics.

Photo Voltaic Systems: Introduction to major Photovoltaic systems types, current-voltage curves for loads, Maximum power point trackers.

Grid Connected Systems: Interfacing with utility, DC and AC rated power, Peaks hours approach to estimate PV performance, Grid connected system sizing.

Stand Alone PV Systems: Load estimation, Batteries- storage capacity, Sizing, Coulomb efficiency instead of energy, Blocking diodes, Sizing of PV array, Stand alone system design.

PV Powered Water Pumping: Hydraulic system curves, Hydraulic curves, Hydraulic system curve and pump curve, a simple directly coupled PV-pump design approach.

UNIT – III

Wind and Tidal Power: Wind power-Wind power- Historical development, types of wind turbines, power in wind, Temperature and altitude correction, Impact of tower height, Maximum rotor efficiency, wind turbine generators, Average power in the wind, wind turbine- Aerodynamics.

Tidal power: Tides and tidal power stations, modes of operation, Tidal power calculation, Tidal project examples, turbines and generators for tidal power generation.

UNIT – IV

Fuel Cells & Wave Energy: Fuel Cells – Historical Development, Basic Operation of Fuel cells, Fuel cell Thermodynamics: Enthalpy, Entropy and theoretical efficiency of Fuel Cells, Gibbs free energy and Fuel cell efficiency, Electrical output of an ideal cell electrical characteristics.

Wave Energy Conversion: Wave power calculation, Properties of waves and power content, vertex motion of Waves, device applications. Types of ocean thermal energy conversion systems. Application of OTEC systems examples.

Text Books:

1. Renewable and Efficient Electric Power systems: Gilbert M. Masters, John Wiley & Sons, Inc., Publication.2013.
2. Renewable Energy Sources and Emerging Technologies, D.P. Kothari, K. C. Singal, Rakesh Ranjan, Kothari D.P., singal K. C., ranjan Rakesh.2011.

AUDISANKARA COLLEGE OF ENGINEERING & TECHNOLOGY: GUDUR
(AUTONOMOUS)

M.Tech II Semester (EPS)

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(13EP206) PROGRAMMABLE LOGIC CONTROLLERS
(Elective-II)

UNIT- I

PLC Basics: PLC system, I/O modules and interfacing, CPU processor, programming equipment, programming formats, construction of PLC ladder diagrams, devices connected to I/O modules. PLC programming: Input instructions, Outputs, operational procedures, programming examples using contacts and coils, drill press operation.

UNIT- II

Digital logic gates, programming in the Boolean algebra system, conversion examples. Ladder diagrams for process control: Ladder diagrams and sequence listings, ladder diagram constructions and flow charts for spray process system. PLC registers: characteristics of registers module addressing, holding registers, Input registers, Output registers.

UNIT- III

PLC Functions: Timer functions and industrial applications, counters, counter function industrial applications, arithmetic functions, number comparison. Data handling functions: SKIP, master control relay, jump, move, FIFO, FAL, ONS, CLR and SWEEP functions and their applications.

UNIT- IV

Bit pattern and changing a bit shift register, sequence functions and applications, controlling of two axis and three axis robots with PLC, matrix functions. Analog PLC operation : Analog modules and systems, analog signal processing, multi bit data processing, analog output application examples, PID principles, position indicator with PID control, PID modules, PID tuning, PID functions.

Reference Books:

1. John W.Webb and Ronald A. Reiss, Programmable logic controllers-Principle and applications , Fifth edition, PHI.2003.
2. JR Hackworth and F.D Hackworth Jr, Programmable logic controllers- Programming Method and applications - Pearson, 2004.

AUDISANKARA COLLEGE OF ENGINEERING & TECHNOLOGY: GUDUR
(AUTONOMOUS)

M.Tech II Semester (EPS)

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(13EP207) ENERGY AUDITING, CONSERVATION AND MANAGEMENT
(Elective-II)

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.

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- II

Energy Efficient Motors: 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.

Power Factor Improvement: Lighting Power factor – methods of improvement, location of capacitors, p.f with non linear loads, effect of harmonics on p.f. , p.f motor controllers - Good lighting system design and practice , lighting control ,lighting energy audit.

UNIT- III

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

Economic Aspects and Analysis: Economics Analysis-Depreciation Methods, time value of money, rate of return, present worth method, replacement analysis, life cycle costing analysis - Energy efficient motors.

UNIT-IV

Computation of Economic Aspects: Calculation of simple payback method , net present worth method - Power factor correction, lighting - Applications of life cycle costing analysis, return on investment.

Reference Books:

1) W.R. Murphy & G. McKay Butter worth, Energy management, Heinemann publications.1982.
2) Paul o' Callaghan, Energy management, Mc-Graw Hill Book company-1st edition, 1998.
3) John C. Andreas &Marcel Dekker Energy efficient electric motors, Inc Ltd-2/e, 1995.
4) W.C.Turner, john Wiley and sons, Energy management hand book.2007.
5) Fuel efficiency- booklet12, Energy management and good lighting practice: -EEO.1993.

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I M.Tech II Semester (EPS)	L	T	P	[C]
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(13EP208) REACTIVE POWER COMPENSATION AND MANAGEMENT
(Elective-II)

UNIT -I

Load Compensation: Objectives and specifications – reactive power characteristics – inductive and capacitive approximate biasing – Load compensator as a voltage regulator – phase balancing and power factor correction of unsymmetrical loads- examples.

Steady-State Reactive Power Compensation in Transmission System: Uncompensated line – types of compensation – Passive shunt and series and dynamic shunt compensation – examples.

UNIT- II

Transient State Reactive Power Compensation in Transmission Systems: Characteristic time periods - passive shunt compensation – static compensations- series capacitor compensation -compensation using synchronous condensers – examples.

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-III

Demand Side Management: Load patterns – basic methods load shaping – Power tariffs- KVAR based tariffs penalties for voltage flickers and Harmonic voltage levels.

Distribution side Reactive power Management: System losses –loss reduction methods – examples - Reactive power planning – objectives –Economics Planning capacitor placement – retrofitting of capacitor banks.

UNIT-IV

User Side Reactive Power Management: KVAR requirements for domestic appliances – Purpose of using capacitors – selection of capacitors – deciding factors – types of available capacitor, characteristics and Limitations.

Reactive Power Management in Electric Traction Systems and Arc furnaces: Typical layout of traction systems – reactive power control requirements – distribution transformers- Electric arc furnaces – basic operations- furnaces transformer –filter requirements –remedial measures –power factor of an arc furnace.

Reference Books:

1. T.J.E.Miller, John Wiley and sons, Reactive power control in Electric power systems by, 1982 (Units I to IV).
2. D.M.Tagare, Reactive power Management, Tata McGraw Hill, 2004. (Units V toVIII).

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M.Tech II Semester (EPS)

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(13EP209) RENEWABLE ENERGY SYSTEMS LAB

List of Experiments:

1. The I-V and P-V characteristics of two modules in series and parallel.
2. Plot charging and discharging characteristics of battery.
3. Perform the experiment of manually finding the MPP by varying the resistive load across the PV panel.
4. Perform the experiment of finding the MPP by varying the duty cycle of DC-DC converter.
5. Observation of current for linear & nonlinear loads and voltage waveform at PCC.
6. Synchronization of grid tied inverter, observation of current waveform and calculations for distortion, displacement and power factor of grid tied inverter.
7. Evaluation of the active, reactive power and net energy flow between grid tied inverter, artificial grid & load.
8. MPPT Algorithm for SOLAR PV Panel Testing.
9. P, V and F measurement of output of wind generator.
10. Impact of load and wind speed on power output and its quality.
11. Performance of Frequency drop characteristic of induction generator at different loading conditions.
12. Design of DC –DC Converter for different types of variable DC Loads through SIMULINK/MATLAB.
13. Design of DC –AC Converter for different types of variable AC Loads trough SIMULINK/MATLAB.

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(AUTONOMOUS)

M.Tech II Semester (EPS)	L	T	P	[C]
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(13EP210) SIMULATION LAB-II

List of Experiments:

1. Power flow solution by NR method.
2. Power flow solution by FDC.
3. Contingency studies using load flows for generator & line outages.
4. Solution of Economic load dispatch problem.
5. Transient stability study of SMIB.
6. Contingency studies using ZBUS.
7. Simulation of State Estimator for power flow using WLSE method
8. Simulation of single area load frequency control.
9. Simulation of two area load frequency control.
10. Simulation of power system stabilizer.
11. Simulation of voltage stability problem.
12. Design of LQR state feed back for a given system
13. Design of State feedback controller and observer through Pole assignment.
14. PSPICE Simulation of Three phase full converter using RL &E loads.
15. PSPICE Simulation of Three phase inverter with PWM controller.
16. PSPICE Simulation of resonant pulse commutation circuit.

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(AUTONOMOUS)

M.Tech II Semester (EPS)

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(13EP211) TERM PAPER

The Term Paper is a precursor to the project work done in the 2nd year M.Tech Programme. The paper may be of 8-10 (A4 size) in length and follows the standard IEEE/Technical Journal Format.

The Term Paper helps to supplement the second year Project Work of the M.Techstudents. It helps to identify their Reserch area/topic and complete the groundwork andpreliminary research required for it comfortably. It trains the students to make use of Research Tools and Material available both in print and digital formats.

Based on the topic, a hypothesis is to be made by the student, under the supervision of the guide. The student is then required to collect literature and support information for his / her term paper from Standard Reference Books, Journals, and Magazines - both printed and online. Each student should refer to a minimum of 6 reference sources related to the topic. The student also presents his/her paper with the help of Power Point slides / OHP.

The Term Paper contains: The Aim and Objective of the study, The need for Rationale behind the study, Identify the work already done in the field, Hypothesis and Discussion, Conclusion Appendix with support data (Illustrations, Tables, Graphs, etc.).

Page Limit: minimum of eight pages.

Date of evaluation: During the Lab Internal Exam.

Method of Evaluation**:** Total 50 marks

1. Day to day work - 10 marks
2. Term Paper Report - 20 marks
3. Seminar - 20 marks

AUDISANKARA COLLEGE OF ENGINEERING & TECHNOLOGY: GUDUR
(AUTONOMOUS)

M.Tech III & IV Semesters (EPS)	L	T	P	[C]
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(13EP401) SEMINAR-II

Objectives: To get involved with the latest advancements and developments to enhance communication and presentation skills, exchange of ideas, greater connectivity to develop a research bent of mind.

For the seminar, the student shall collect the information on a specialized relevant topic and prepare a report, showing his understanding over the topic, and submit the same to the department, which shall be evaluated by the Department Committee consisting of Head of the department, Seminar Supervisor and a Senior Faculty Member. Each Seminar shall be evaluated for 50 marks (10 marks for report, 10 marks for subject content, 20 marks for presentation and 10 marks for queries).

AUDISANKARA COLLEGE OF ENGINEERING & TECHNOLOGY: GUDUR
(AUTONOMOUS)

M.Tech III & IV Semesters (EPS)	L	T	P	[C]
	0	0	0	[16]

(13EP402) PROJECT WORK

Students are required to take up a project work, in which the student can choose any specific problem of Industry or Industry based project work. Alternatively it can be secondary source based or Field based project work. Before the commencement of the project work each student is required to submit a synopsis indicating the objectives, Methodology, Framework for analysis, Action plan with milestones in order to have clarity for the subsequent work. The project should have an internal faculty as guide. The student can initiate the project work in the penultimate semester of the course.