

AUDISANKARA COLLEGE OF ENGINEERING & TECHNOLOGY

(AUTONOMOUS)

(Approved by AICTE | Accredited by NAAC | Affiliated to JNTUA)

Gudur, Nellore Dist - 524101, A.P (India)



OUTCOME BASED EDUCATION

WITH

CHOICE BASED CREDIT SYSTEM

MASTER OF TECHNOLOGY

ELECTRICAL POWER SYSTEMS

ACADEMIC REGULATIONS

UNDER AUTONOMOUS STATUS

M.Tech Regular Two Year PG Programme

(for the batches admitted from the academic year 2018 - 2019)



**ACADEMIC REGULATIONS (R18) FOR M.TECH. REGULAR STUDENTS
WITH EFFECT FROM ACADEMIC YEAR 2018-2019**

1.0 Post- Graduate Degree Programme in Engineering & Technology
1.1 These academic rules and regulations are applicable to the students admitted from the academic year 2018-19 onwards into 2 year (4 Semesters) M.Tech Programmes under Choice Based Credit System(CBCS) at its autonomous institution with effect from the academic year 2018-19 in the following specializations of Engineering:

M.Tech Specializations offered

1. Embedded Systems (ES)
2. VLSI (VL)
3. Electrical Power Systems (EP)
4. Power Electronics (PE)
5. Computer Science & Engineering (CO)
6. Software Engineering (SE)
7. Structural Engineering (ST)

2.0	Eligibility for admission
2.1	Admission to the post graduate programme shall be made either on the basis of the merit rank obtained by the qualified student in entrance test PGECET conducted by the Andhra Pradesh State Government as per the norms of Andhra Pradesh State Council of Higher Education (APSCHE)
2.2	The medium of instructions for the entire post graduate programme in Engineering & Technology will be English only.
3.0	M.Tech. Programme Pattern
3.1	A student after securing admission shall pursue the post graduate programme in M.Tech in a minimum period of two academic years (4 semesters), and a maximum period of four academic years (8 semesters) starting from the date of commencement of first year first semester, failing which student shall forfeit the M.Tech course. Each semester is structured to around 20 credits, totaling to 78 credits for the entire M.Tech programme. Each student shall secure 78 credits required for the completion of the post graduate programme and award of the M.Tech degree.
3.2	A student eligible to appear for the end examination in a course, but absent or has failed in the end examination may appear for that course at the next supplementary examination when offered
3.3	When a student is detained due to lack of shortage of attendance he/she may be re-admitted when the semester is offered after fulfillment of academic regulations. In such case, he/she shall be in the academic regulations into which he/she is readmitted.

3.4	UGC/ AICTE specified definitions/ descriptions are adopted appropriately for various terms and abbreviations used in these academic regulations/ norms, which are listed below.
3.5	<p>Semester scheme</p> <p>Each under graduate programme is of 2 academic years (4 semesters) with the academic year being divided into two semesters of 16 weeks (around 90 instructional days) each and semester having – Continuous Internal Evaluation (CIE) and Semester End Examination (SEE). Choice based Credit System (CBCS) and Credit Based Semester System (CBSS) as indicated by UGC and curriculum / course structure as suggested by AICTE are followed.</p>
3.6	<p>Credit courses</p> <p>All subjects/ courses are to be registered by the student in a semester to earn credits which shall be assigned to each subject/ course in an L: T: P: C (lecture periods: Tutorial periods: Practical periods: Credits) structure based on the following general pattern.</p> <ul style="list-style-type: none"> • One credit for one hour/ week/ semester for theory/ lecture (L) courses. • One credit for two hours/ week/ semester for laboratory/ practical (P) courses or Tutorials (T).
3.7	<p>Subject Course Classification</p> <p>All subjects/ courses offered for the post graduate programme in Engineering & Technology (M.Tech. degree programmes) are broadly classified as follows. The ASCET has followed almost all the guidelines issued by AICTE/UGC.</p>
4.0	Attendance requirements:
4.1	A student shall be eligible to appear for the semester end examinations, if student acquires a minimum of 75% of attendance in aggregate of all the subjects/ courses for that semester.
4.2	Shortage of attendance in aggregate up to 10% (65% and above, and below 75%) in each semester may be condoned by the college academic committee on genuine and valid grounds, based on the student's representation with supporting evidence.
4.3	A stipulated fee shall be payable towards condonation for shortage of attendance to the institute as decided by the College Academic Committee.
4.4	Shortage of attendance below 65% in aggregate shall in no case be condoned.
4.5	Students whose shortage of attendance is not condoned in any semester are not eligible to take their end examinations of that semester. They get detained and their registration for that semester shall stand cancelled. They will not be promoted to the next semester. They may seek re-registration for all those subjects registered in that semester in which student was detained, by seeking re-admission into that semester as and when offered; in case if there are any professional electives and/ or open electives, the same may also be re-registered if offered. However, if those electives are not offered in later semesters, then alternate electives may be chosen from the same set of elective subjects offered under that category.
4.6	A student fulfilling the attendance requirement in the present semester shall not be eligible for readmission into the same class.
5.0	<p>Academic requirements</p> <p>The following academic requirements have to be satisfied, in addition to the attendance requirements mentioned in item no.4.</p>

5.1	A student shall be deemed to have satisfied the minimum academic requirements and earned the credits allotted to each theory, practical, design, drawing subject or project if he secures not less than 40% of marks (i.e., 24) in the end semester examination and a minimum of 50% of marks (i.e., 50) in the sum total of the internal evaluation and end examination taken together.
5.6	A student shall register and put up minimum attendance in all 78 credits and earn all the 78 credits. Marks obtained in all 78 credits shall be considered for the calculation of aggregate percentage of marks obtained
5.7	Students who fail to earn 78 credits as indicated in the course structure within eight academic years from the year of their admission shall forfeit their seat in M.Tech. Course and their admission shall stand cancelled
6.0	Distribution and Weightage of marks
6.1	The performance of a student in each semester shall be evaluated through internal evaluation and /or an external evaluation conducted semester wise.
6.2	The performance of a student in every theory course shall be evaluated for total of 100 marks each, of which the relative weightage for Continuous Internal Evaluation and Semester End Examination shall be 40 marks and 60 marks respectively.
6.3	The performance of a student in every practical course shall be evaluated for total of 75 marks each, of which the relative weightage for Continuous Internal Evaluation and Semester End Examination shall be 25 marks and 50 marks respectively.
6.4	<p>Internal Evaluation for Theory Course:</p> <p>The total internal weightage for theory courses is 40 marks with the following distribution.</p> <ul style="list-style-type: none"> ➤ 30 marks for Mid-Term Examination ➤ 10 marks for Assignment Test <p>While the first mid-term examination shall be conducted on the 50% of the syllabus (Unit-I, Unit-II, & 50% of Unit-III), the second mid-term examination shall be conducted on the remaining 50% of the syllabus (50 % of Unit III, Unit-IV & Unit-V).</p> <p>10 marks are allocated for assignment test (as specified by the subject teacher concerned). The first assignment should be conducted after completion of Unit-I for 5 marks and the second assignment should be conducted after completion of Unit- IV for 5 marks. The final Assignment Test marks will be the addition of these two.</p> <p>Two midterm examinations each for 30 marks with the duration of 90 minutes each will be conducted for every theory course in a semester. The midterm examination marks shall be awarded giving a weightage of 80% in the midterm examination in which the student scores better performance and 20% in the remaining midterm examination.</p> <p>The final mid-term marks obtain by the addition of these two (80% + 20%).</p> <p>Example: If a student scores 33 marks and 34 marks in the first and second mid-term examinations respectively, then Weighted Average Marks = $34 \times 0.8 + 33 \times 0.2 = 33.8$, rounded to 34 Marks.</p> <p>Note: The marks of any fraction shall be rounded off to the next higher mark.</p>
6.5	<p>Pattern of the midterm examination question paper is as follows:</p> <ul style="list-style-type: none"> ➤ A total of three questions ➤ Question paper contains six questions are to be designed taking three questions from

	<p>each unit (Unit Wise - Either or type) of the three units. (3X10=30 Marks)</p> <p>Pattern of the Assignment Test is as follows:</p> <ul style="list-style-type: none"> ➤ Five assignment questions are given in advance, out of which two questions given by the concerned teacher has to be answered during the assignment test ➤ Sum of Assignment Tests marks is considered. <p>Note: A student who is absent for any Mid-Term Examination/ Assignment Test, for any reason whatsoever, shall be deemed to have scored zero marks in that Mid-Term Examination/ Assignment Test and no make-up test shall be conducted.</p>
6.6	<p>Internal Evaluation for Practical Course:</p> <p>For practical subjects there shall be a Continuous Internal Evaluation during the semester for 25 internal marks. Out of the 25 marks for internal evaluation, day-today assessment in the laboratory shall be evaluated for 10 marks and internal practical examination shall be evaluated for 15 marks conducted by the laboratory teacher concerned.</p>
6.7	<p>Internal Evaluation for Term Paper:</p> <p>The Term Paper is a self study report and shall be carried out either during II semester along with other lab courses. Every student will take up this term paper individually and submit a report. The scope of the term paper could be an exhaustive literature review choosing any engineering concept with reference to standard research papers or an extension of the concept of earlier course work in consultation with the term paper supervisor. The term paper reports submitted by the individual students during the II semester shall be evaluated for a total of 50 marks for continuous assessment; it shall be conducted by two Examiners, one of them being term paper supervisor as internal examiner and an external examiner nominated by the Principal from the panel of experts recommended by HOD.</p>
6.8	<p>Project Work:</p> <p>The Project work is spread over to two semesters having Project Work Phase-I and Project Work Phase-II. Project Work Phase-I is included in III Semester and Project Work Phase-II in IV Semester as detailed below:</p> <p>A student has to select topic of his Project Work based on his interest and available facilities, in the III semester which he will continue through IV semester also.</p>
6.9	<p>External Evaluation for Theory Course - Semester End Examination:</p> <p>The Semester End Examination in each theory subject shall be conducted for 3 hours duration at the end of the semester for 60 marks.</p> <p>Pattern of the Semester End Examination question paper is as follows:</p> <ul style="list-style-type: none"> ➤ Question Paper contains ten questions are to be designed taking two questions from each unit (Unit Wise - Either or type) of the total five units. (5X12=60 Marks) <p>A student has to secure not less than a minimum of 40% of marks (24 marks) exclusively at the Semester End 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.</p>
6.10	<p>External Evaluation for Practical Course</p> <p>Out of 50 marks 35 marks are allocated for experiment (procedure for conducting the experiment carries 15 marks & readings, calculation and result-20) and 10 marks for viva-</p>

	<p>voce examination with 5 marks for the record.</p> <p>Each Semester External Lab Examination shall be evaluated by an Internal Examiner along with an External Examiner appointed by the Principal.</p> <p>A candidate shall be declared to have passed in individual lab course if he secures a minimum of 50% aggregate marks (38 marks) (Internal & Semester External Examination marks put together), subject to a minimum of 50% marks (25 marks) in the semester external examination.</p>																				
6.11	<p>Project Work Phase-I:</p> <p>Every candidate shall be required to submit thesis or dissertation after taking up a topic approved by the college/ concerned department.</p> <ul style="list-style-type: none"> ➤ Registration of Project work: A candidate is permitted to register for the project work phase-I 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 work phase-I shall be initiated in the III semester and continued in the final semester. The candidate can submit Project work phase-I dissertation with the approval of I.D.C. after 18 weeks from the date of registration at the earliest from the date of registration for the project work phase-I. • 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. • Three copies of the Dissertation certified in the prescribed form by the supervisor and HOD shall be submitted to the HOD. • The semester end examination for project work phase-I done during III Semester, shall be conducted by a Project Review Committee (PRC). The evaluation of project work shall be conducted at the end of the III Semester. • The PRC comprises of an External examiner appointed by the Principal, Head of the Department and Project Guide/Supervisor to adjudicate the dissertation. The PRC shall jointly evaluate candidates work and award grades as given below. <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;">S.No</th> <th style="text-align: center;">Description</th> <th style="text-align: center;">Grade</th> <th style="text-align: center;">Grade Point (GP) Assigned</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">Very Good</td> <td style="text-align: center;">Grade A</td> <td style="text-align: center;">10</td> </tr> <tr> <td style="text-align: center;">2</td> <td style="text-align: center;">Good</td> <td style="text-align: center;">Grade B</td> <td style="text-align: center;">9</td> </tr> <tr> <td style="text-align: center;">3</td> <td style="text-align: center;">Satisfactory</td> <td style="text-align: center;">Grade C</td> <td style="text-align: center;">8</td> </tr> <tr> <td style="text-align: center;">4</td> <td style="text-align: center;">Not satisfactory</td> <td style="text-align: center;">Grade D</td> <td style="text-align: center;">0</td> </tr> </tbody> </table> <p>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 dissertation.</p>	S.No	Description	Grade	Grade Point (GP) Assigned	1	Very Good	Grade A	10	2	Good	Grade B	9	3	Satisfactory	Grade C	8	4	Not satisfactory	Grade D	0
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6.12	<p>Project Work Phase-II:</p> <p>Every candidate shall be required to submit thesis or dissertation after taking up a topic approved by the college/ concerned department.</p> <ul style="list-style-type: none"> ➤ Registration of Project work: A candidate is permitted to register for the project work phase-I 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 work phase-II shall be initiated in the IV semester. The candidate can submit Project work phase-II dissertation with the approval of I.D.C. after 18 weeks from the date of registration at the earliest from the date of registration for the project work phase-I. • 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. • Three copies of the Dissertation certified in the prescribed form by the supervisor and HOD shall be submitted to the HOD. • The semester end examination for project work phase-I done during III Semester, 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 dissertation. The PRC shall jointly evaluate candidates work and award grades as given below <table border="1" data-bbox="442 1142 1334 1353"> <thead> <tr> <th>S.No</th><th>Description</th><th>Grade</th><th>Grade Point (GP) Assigned</th></tr> </thead> <tbody> <tr> <td>1</td><td>Very Good</td><td>Grade A</td><td>10</td></tr> <tr> <td>2</td><td>Good</td><td>Grade B</td><td>9</td></tr> <tr> <td>3</td><td>Satisfactory</td><td>Grade C</td><td>8</td></tr> <tr> <td>4</td><td>Not satisfactory</td><td>Grade D</td><td>0</td></tr> </tbody> </table> <p>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 dissertation.</p>	S.No	Description	Grade	Grade Point (GP) Assigned	1	Very Good	Grade A	10	2	Good	Grade B	9	3	Satisfactory	Grade C	8	4	Not satisfactory	Grade D	0
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6.13	<p>Re-Registration For Improvement of Internal Evaluation Marks:</p> <p>Following are the conditions to avail the benefit of improvement of internal evaluation marks.</p> <ul style="list-style-type: none"> ❖ The candidate should have completed the course work and obtained examinations results for I, II & III 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 																				

	<p>Internal evaluation marks.</p> <ul style="list-style-type: none"> ❖ 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.
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7.0	SEMESTER – WISE DISTRIBUTION OF CREDITS																											
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8.0	GRADING PROCEDURE Grades will be awarded to indicate the performance of students in each theory subject, laboratory / practicals, Term Paper and project Work Phase-I & II. Based on the percentage of marks obtained (Continuous Internal Evaluation plus Semester End Examination, both taken together) as specified in item 6 above, a corresponding letter grade shall be given.																											
8.1	As a measure of the performance of a student, a 10-point absolute grading system using the following letter grades (as per UGC/AICTE guidelines) and corresponding percentage of marks shall be followed:																											
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8.2	A student who has obtained an ‘F’ grade in any subject shall be deemed to have ‘failed’ and is required to reappear as a ‘supplementary student’ in the semester end examination, as and when offered. In such cases, internal marks in those subjects will remain the same as those obtained earlier
8.3	To a student who has not appeared for an examination in any subject, ‘Ab’ grade will be allocated in that subject, and he is deemed to have ‘failed’. A student will be required to reappear as a ‘supplementary student’ in the semester end examination, as and when offered next. In this case also, the internal marks in those subjects will remain the same as those obtained earlier.
8.4	A letter grade does not indicate any specific percentage of marks secured by the student, but it indicates only the range of percentage of marks.
8.5	A student earns grade point (GP) in each subject/ course, on the basis of the letter grade secured in that subject/ course. The corresponding ‘credit points’ (CP) are computed by multiplying the grade point with credits for that particular subject/ course. Credit points (CP) = grade point (GP) x credits For a course
8.6	A student passes the subject/ course only when $GP \geq 5$ (‘E’ grade or above)
8.7	<ul style="list-style-type: none"> ➤ A student obtaining Grade F shall be considered failed and will be required to reappear for that subject when the next supplementary examination offered. ➤ For Mandatory courses “Satisfactory” or “Unsatisfactory” shall be indicated instead of the letter grade and this will not be counted for the computation of SGPA/CGPA.
8.8	<p>Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):</p> <p>The Semester Grade Point Average (SGPA) is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e.</p> $SGPA = \frac{\sum_{i=1}^n (Ci \times Gi)}{\sum_{i=1}^n Ci}$ <p>Where, Ci is the number of credits of the i^{th} subject, Gi is the grade point scored by the student in the i^{th} course and n is the number of subjects.</p> <p>The Cumulative Grade Point Average (CGPA) will be computed in the same manner taking into account all the courses undergone by a student over all the semesters of a program, i.e.</p> $CGPA = \frac{\sum_{i=1}^n (Ci \times Si)}{\sum_{i=1}^n Ci}$ <p>Where ‘Si’ is the SGPA of the i^{th} semester, Ci is the total number of credits in that semester and n is the number of semesters.</p> <p>Both SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.</p> <p>While computing the SGPA the subjects in which the student is awarded Zero grade points will also be included.</p> <p>Grade Point: It is a numerical weight allotted to each letter grade on a 10-point scale.</p>

	<p>Letter Grade: It is an index of the performance of students in a said course. Grades are denoted by letters as mentioned in the above table.</p>								
9.0	Award of Class								
9.1	<p>After a student has satisfied the requirement prescribed for the completion of the program and is eligible for the award of M.Tech. Degree he/she shall be placed in one of the following four classes:</p> <table border="1" data-bbox="644 496 1134 707"> <thead> <tr> <th>Class Awarded</th> <th>CGPA Secured</th> </tr> </thead> <tbody> <tr> <td>First class with Distinction</td> <td>≥ 8</td> </tr> <tr> <td>First class</td> <td>≥ 7 and < 8</td> </tr> <tr> <td>Second class</td> <td>≥ 5 and < 7</td> </tr> </tbody> </table>	Class Awarded	CGPA Secured	First class with Distinction	≥ 8	First class	≥ 7 and < 8	Second class	≥ 5 and < 7
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Second class	≥ 5 and < 7								
10.0	Transitory regulations								
10.1	<p>For students detained due to shortage of attendance:</p> <ol style="list-style-type: none"> 1. A Student who has been detained in I year of R16 Regulations due to lack of attendance, shall be permitted to join I year I Semester of R18 Regulations and he is required to complete the study of M.Tech/ programme with in the stipulated period of eight academic years from the date of first admission in I year. 2. A student who has been detained in any semester of II, III and IV years of R16 regulations for want of attendance, shall be permitted to join the corresponding semester of R18 regulations and is required to complete the study of M.Tech within the stipulated period of eight academic years from the date of first admission in I Year. The R18 Academic Regulations under which a student has been readmitted shall be see rule 10.3 for further Transitory Regulations. 								
10.2	<p>For students detained due to shortage of credits:</p> <p>A student of R16 Regulations who has been detained due to lack of credits, shall be promoted to the next semester of R18 Regulations only after acquiring the required credits as per the corresponding regulations of his/her first admission. The student is required to complete the study of M.Tech. within the stipulated period of eight academic years from the year of first admission. The R18 Academic Regulations are applicable to a student from the year of readmission onwards. See rule 10.3 for further Transitory Regulations.</p>								
10.3	<p>For readmitted students in R18 Regulations:</p> <ol style="list-style-type: none"> 1. A student who has failed in any subject under any regulation has to pass those subjects in the same regulations. 2. The maximum credits that a student acquires for the award of degree, shall be the sum of the total number of credits secured in all the regulations of his/her study including R18 Regulations. 3. If a student readmitted to R18 Regulations, has any subject with 80% of syllabus common with his/her previous regulations, that particular subject in R18 Regulations will be substituted by another subject to be suggested by the College standing committee. 								

	<p>Note: If a student readmitted to R18 Regulations, has not studied any subjects/topics in his/her earlier regulations of study which is prerequisite for further subjects in R18 Regulations, the department HOD concerned shall conduct remedial classes to cover those subjects/topics for the benefit of the students.</p>
11.0	<p>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.</p>
12.0	<p>Student Transfers Student transfers shall be as per the guidelines issued by the Government of Andhra Pradesh from time to time.</p>
13.0	<p>With-Holding of Results If the candidate has any dues not paid to the institute or if any case of indiscipline or malpractice is pending against him/her, the result of the candidate shall be withheld and he/she will not be allowed / promoted into the next higher semester. The issue of awarding degree is liable to be withheld in such cases.</p>
12.0	<p>Conduct and Discipline</p> <ul style="list-style-type: none"> ➤ Students shall conduct themselves within and outside the premises of the Institute in a descent and dignified manner befitting the students of Audisankara College of Engineering & Technology. ➤ 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 <p>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.</p> <ul style="list-style-type: none"> (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. ➤ Possession, consumption or distribution of alcoholic drinks or any kind of narcotics or hallucinogenic drugs. ➤ Mutilation or unauthorized possession of library books. ➤ Noisy and unruly behavior, disturbing studies of fellow students. ➤ 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. ➤ Usage of camera /cell phones in the campus. ➤ Plagiarism of any nature. ➤ Any other act of gross indiscipline as decided by the college academic council from

	<p>time to time.</p> <ul style="list-style-type: none"> ➤ 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. ➤ 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. ➤ Cases of adoption of unfair means and/ or any malpractice in an examination shall be reported to the principal for taking appropriate corrective action. ➤ All cases of serious offence, possibly requiring punishment other than reprimand, shall be reported to the Academic council of the college. ➤ 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. ➤ The Principal shall deal with any problem, which is not covered under these rules and regulations. ➤ “Grievance and Redressal Committee” (General) constituted by the Principal shall deal with all grievances pertaining to the academic / administrative / disciplinary matters. ➤ All the students must abide by the code and conduct rules prescribed by the college from time to time.
13.0	<p>General</p> <ul style="list-style-type: none"> ➤ s/he represents “she” and “he” both ➤ Where the words ‘he’, ‘him’, ‘his’, occur, they imply ‘she’, ‘her’, ‘hers’ also. ➤ The academic regulations should be read as a whole for the purpose of any interpretation. ➤ In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Chairman, Academic Council will be final. <p>The college may change or amend the academic regulations or syllabi from time to time and the changes or amendments made shall be applicable to all the students with effect from the dates notified by the institute.</p>

**RULES FOR
DISCIPLINARY ACTION FOR MALPRACTICES / IMPROPER CONDUCT IN
EXAMINATIONS**

	Nature of Malpractices/Improper conduct	Punishment
1. (a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers, blue tooth or any other form of material concerned with or related to the course of the examination (theory or practical) in which he/she 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 examination 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/she 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 end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with for

		feature of seat. The performance of the original candidate, who has been impersonated, shall be cancelled in all the courses of the examination (including practicals 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 Semester end examinations if his involvement is established. Otherwise the candidate is 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 imposter is an outsider, he/she 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 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.
6	Refuses to obey the orders of the any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walkout or instigates others to walk out, or threatens the officer-in charge or any person on	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

	<p>duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall 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.</p>	<p>examinations of the courses of that Semester. If candidate physically assaults the invigilator or/officer in charge of the examination, then the candidate is also barred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.</p>
7	<p>Leaves the examination hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.</p>	<p>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 Semester end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.</p>
8	<p>Possess any lethal weapon or firearm in the examination hall</p>	<p>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.</p>
9	<p>If student of the college, who is not a candidate for the particular examination or any person not connected with the college</p>	<p>Student of the colleges expulsion from the examination hall and cancellation of the performance in that course and all other</p>

	indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	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 and all other courses the candidate has appeared including practical examinations and project work of that Semester 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 Principal for further action to award suitable punishment.	

Note:

- i. All malpractices cases are to be handled by the Chief Controller with a committee consist of Controller of Examinations, HOD concerned and subject expert.
- ii. Whenever the performance of a student is cancelled in any course/ courses due to Malpractice, he has to register for the End Examination in those course/courses consequently and has to fulfill all the norms required for award of Degree.



COURSE STRUCTURE

M.Tech I Semester – Electrical Power Systems

S.No	Course Code	Course Title	Hours per Week			Marks			Credits
			L	T	P	IM	EM	T	
1	18EP101	Modern Control Theory	4	0	0	40	60	100	4
2	18EP102	Advanced Computer Methods in Power Systems	4	0	0	40	60	100	4
Elective-I									
3	18EP103	Principles of power quality	4	0	0	40	60	100	4
	18EP104	EHVAC Transmission							
	18EP105	Reactive Power Compensation and Management							
Elective-II									
4	18EP106	Advanced Digital Signal Processing	4	0	0	40	60	100	4
	18EP107	Advanced Microprocessors and Microcontrollers							
	18EP108	Restructured Power Systems							
5	18AS101	Research Methodology and IPR	2	0	0	40	60	100	2
6	18EP110	Power Systems Lab	0	0	4	25	50	75	2
7	18EP111	Power systems Simulation-I Lab	0	0	4	25	50	75	2
Total			18	0	8	250	400	650	22

M.Tech II Semester – Electrical Power Systems

S.No	Course Code	Course Title	Hours per Week			Marks			Credits
			L	T	P	IM	EM	T	
1	18EP201	Flexible AC Transmission Systems	4	0	0	40	60	100	4
2	18EP202	Advanced Power System Protection	4	0	0	40	60	100	4
Elective-III									
3	18EP203	Distributed Generation	4	0	0	40	60	100	4
	18EP204	Renewable Energy Systems							
	18EP205	Energy Auditing, Conversation and Management							
Elective-IV									
4	18EP206	Programmable Logic Controllers and applications	4	0	0	40	60	100	4
	18EP207	Smart Grid							
	18EP208	Artificial Intelligence Computing Techniques and Applications							
5	18EP209	Renewable Energy Systems Lab	2	0	0	40	60	100	2
6	18EP210	Simulation Lab-II	0	0	4	25	50	75	2
7	18EP211	Term Paper	0	0	4	50	-	50	2
Total			18	0	8	275	350	625	22

M.Tech III Semester – Electrical Power Systems

S.No	Course Code	Course Title	Hours per Week			Marks			Credits
			L	T	P	IM	EM	T	
1		Open Elective	4	0	0	40	60	100	4
2	Elective-V								
	18EP304	Power System Voltage Stability	4	0	0	40	60	100	4
	18EP305	Distribution Automation							
	18EP306	Power System Dynamics and Control							
3	18EP307	Project Work Phase-I	0	0	20	Grade			10
Total			8	0	8	80	120	200	18

M.Tech IV Semester – Electrical Power Systems

S.No	Course Code	Course Title	Hours per Week			Marks			Credits
			L	T	P	IM	EM	T	
1	18EP401	Project Work Phase-II	0	0	32	Grade			16
Total			0	0	32	Grade			16

Open Electives – Electrical Power Systems

S.No	Course Code	Course Title
1	18EP301	Hybrid Electric Vehicles
2	18EP302	Power Distribution Systems
3	18EP303	Available MOOCs



MODERN CONTROL THEORY

M.Tech I Semester: ELECTRICAL POWER SYSTEMS																				
Course Code	Category	Hours/Week			Credits	Maximum Marks														
18EP101	Core	L	T	P	C	CIA	SEE	Total												
		4	0	0	4	40	60	100												
Contact Classes:60		Tutorial Classes: 0		Practical Classes: Nil		Total Classes:60														
OBJECTIVES:																				
The course should enable the students to:																				
1. Students should know controllability, observability, state-space realizations, state feedback. 2. They should know how to design and apply observers, feedback controllers. 3. Students should know Non linear systems and stability.																				
UNIT-I	Mathematical Preliminaries					Classes:12														
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					Classes:12														
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					Classes:12														
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-I					Classes:12														
Stability in the sense of Lyapunov, Lyapunov's stability and Lyapunov's instability theorems.																				
UNIT-V	Stability Analysis-II					Classes:12														
Stability Analysis of the Linear Continuous time invariant systems by Lyapunov's second method –Generation of Lyapunov's functions – Variable gradient method – Krasoviski's method.																				
Text Books:																				
1. M. Gopal, Modern Control System Theory, New Age International – 1984 2. Ogata. K, Modern Control Engineering Prentice Hall – 1997.																				

3. Kuo, Digital Control Engineering, Oxford University.1980.
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Reference Books:

1. Stainslaw H. Zak "Systems and Control", Oxford Press, 2003
2. I.J. Nagarath and M.Gopal "Control Systems Engineering", New Age International (P) Ltd.

Web References:

1. <https://nptel.ac.in/courses/108101037/>

E-Text Books:

1. https://books.google.co.in/books/about/Modern_control_theory.html?id=qcefq7C4_WEC

Outcomes:

At the end of the course students able to

1. Student should know controllability, Observability, state-space realization, state feedback.
2. They should know how to design and apply observers, feedback controllers.
3. Students should know Non linear systems and stability.

ADVANCED COMPUTER METHODS IN POWER SYSTEMS

M.Tech I Semester: ELECTRICAL POWER SYSTEMS																			
Course code	Category	Hours/week			Credits	Maximum Marks													
18EP102	Core	L	T	P	C	CIA	SEE	TOTAL											
		4	0	0	4	40	60	100											
Contact Classes:60	Tutorial Classes:	Practical Classes:			Total Classes:60														
Nil																			
OBJECTIVES:																			
The course should enable the students to:																			
1. The required knowledge for the design and analysis of electrical power grids.																			
2. Calculation of power flow in a power system network using various techniques, formation of Zbus and its importance																			
UNIT-I	Network Matrices and Modeling						Classes:12												
Introduction, linear transformation techniques (bus branch, and loop frame of references), single phase modeling of transmission lines, off nominal transformer tap representation, phase shift representation. Three phase system analysis - use of Compound admittances. Three-phase models of transmission lines and Transformers																			
UNIT-II	Power flow solutions						Classes:12												
Review of power flow equations - GS, NR and FDC methods of solving power flow equations, Comparison of power flow methods.																			
UNIT-III	Three Phase Load Flows						Classes:12												
Formulation of three phase power flow equations, Fast-decoupled three phase algorithm and computer program structure																			
UNIT-IV	Fault System Studies						Classes:12												
Analysis of three phase faults - admittance matrix equation - impedance matrix equation - fault calculations – analysis of unbalanced faults - admittance matrices - fault calculations - short circuit faults – open circuit faults - program description and typical solutions																			
UNIT-V	ZBUS methods in Contingency Analysis						Classes:12												
Adding and removing multiple lines (current injection methods), piece wise solution of interconnected systems, analysis of single and multiple contingencies, Contingency analysis by DC Model, System reduction for contingency and fault studies																			
Text Books:																			
1. J.Arriaga and C.P.Arnold: Computer modeling of electric power systems, John McGraw Hill, ISE, 1968																			
2. Stagg G.Ward, El-Abiad: Computer methods in power system analysis																			
3. J.Grainger, W.D.Stevenson JR, Power system analysis, TMH, Delhi 2007																			
Reference Books:																			
1. Nagarath& Kothari Modern power system analysis 3rd Edition, TMH Wiley & Sons, N.Y. 1983																			
2. Nagsarkar&Sukhija, Power system analysis, Oxford press																			

Web References:

1. <https://nptel.ac.in/courses/108107028/>

E-Text Books:

1. https://books.google.co.in/.../Advanced_Power_System_Analysis_and_Dynam.html?

Outcomes:

At the end of the course students able to

1. Develop proper mathematical models for analysis of a selected problem like load flow study or fault analysis
2. Prepare the practical input data required for load flow or fault calculations
3. Select and identify the most appropriate algorithm for load-flow and short circuit studies
4. Develop power system software for static power system studies

PRINCIPLES OF POWER QUALITY
(Elective – I)

M.Tech I Semester: ELECTRICAL POWER SYSTEMS																			
Course code	Category	Hours/week			Credits	Maximum Marks													
18EP103	Core	L	T	P	C	CIA	SEE	TOTAL											
		4	0	0	4	40	60	100											
Contact Classes:60	Tutorial Classes: -	Practical Classes: Nil			Total Classes:60														
OBJECTIVES:																			
The course should enable the students to:																			
1. Assess the severity of power quality problems in power system 2. Analyze voltage sag problems and suggest preventive techniques																			
UNIT-I	POWER QUALITY - AN OVERVIEW						Classes:12												
Power Quality definition, PQ characterization: Transients, short duration and long duration voltage variations, Voltage imbalance, waveform distortion, Voltage fluctuations, Power frequency variation																			
Power acceptability curves: CBEMA, ITIC – Sources for Electric Power Quality problem in power system: poor load power factor, Non linear and unbalanced loads, DC offset in loads, Notching in load voltage, Disturbance in supply voltage, the power quality evaluation procedure																			
UNIT-II	Voltage sags and Interruptions						Classes:12												
Sources of sags and Interruptions. Estimating Voltage sag performance—Area of vulnerability, equipment sensitivity to voltage sags, transmission system sag performance evaluation, Utility Distribution system sag performance evaluation.																			
Fundamental Principles of Protection. Solutions at the end-user level. Evaluating the economics of different Ride-through Alternatives. Motor- Starting Sags.																			
UNIT-III	Fundamentals of Harmonics						Classes:12												
Voltage versus Current distortion. Harmonics versus Transients. Harmonic indexes .Harmonic sources from commercial loads. Harmonic sources from industrial loads. Locating Harmonic sources. System response characteristics. Effects of Harmonic																			
UNIT-IV	Power Quality Analysis						Classes:12												
Measurements of Voltage, Current, Power, Energy, power factor- Harmonic analysis using Fourier transform and Wavelet Transform methods																			
UNIT-V	Distributed Generation and Power Quality						Classes:12												
Resurgence of DG. DG Technologies. Interface to the Utility System. Power Quality issues. Operating conflicts. DG on distribution Networks. Sitting DG distributed Generation, Interconnection standards.																			
Power Quality Monitoring: Monitoring Consideration. Historical perspective of power quality measuring instruments. Power quality measurement equipment																			
Text Books																			
1. Electrical Power Systems Quality: Roger C. Dugan, MF McGranaghan, Surya Santoso and HW Beaty, TMH, 2/E																			
2. Jos Arrillaga, Neville R. Watson, “Power System Harmonics”- John Wiley & Sons, 2003																			

Reference Books:

1. Math H.J.Bollen, "Understanding Power Quality Problems-Voltage sag & Interruptions", IEEE Press, 2000
2. G.T.Heydt, "Electric Power Quality", Stars in a Circle Publications, 1994(2nd edition)

Web References:

1. <https://nptel.ac.in/courses/108106025>

E-Text Books:

1. https://www.cet.edu.in/noticefiles/227_Electrical_Power_Quality-PEEL5403-8th_Sem-Electrical.pdf

Outcomes:

At the end of the course students able to

1. Analyze current and voltage related power quality issues
2. Assess the effect of DG in distribution system related to power quality problems and understand the power quality monitoring

EHVAC TRANSMISSION
(Elective – I)

M.Tech I Semester: ELECTRICAL POWER SYSTEMS																			
Course code	Category	Hours/week			Credits	Maximum Marks													
18EP104	Core	L	T	P	C	CIA	SEE	TOTAL											
		4	0	0	4	40	60	100											
Contact Classes:60	Tutorial Classes: -	Practical Classes: Nil			Total Classes:60														
OBJECTIVES: The course should enable the students to:																			
1. Understand the concept of Voltage gradients of conductors. 2. develop the empirical formula to determine the Corona loss occurring in EHV AC transmission Line							Classes:12												
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						Classes:12												
Electrostatic field -calculations of electrostatic field of AC lines –effect high electrostatic field on biological organisms and human beings surface																			
UNIT-III	voltage gradients						Classes:12												
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-IV	Power Frequency Voltage control and over voltages in EHV lines						Classes:12												
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-V							Classes:12												
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																			
Text 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).																			
Reference Books:																			
1. A Chakraborti, D.P. Kothari and A.K. Mukhopadhyay: Performance, Operation and Control of EHV Power Transmission Systems, T.M.H, 1999. 2. TuranGonen: Electric Power Transmission System Engineering Analysis and Design, McGraw Hill (Pub).																			

Web References:

1. <https://nptel.ac.in/syllabus/108108033/>

E-Text Books:

1. https://books.google.co.in/books/about/Transmission_And_Distribution.html?id=rb96TZjcAzwC

Outcomes:

At the end of the course students able to

1. understand issues of concern with EHVAC transmission
2. identify and calculate the various parameters of EHV line for modeling
3. assess the effects of corona and methods to limit the audible noise
4. Estimate the over-voltages in EHVAC systems.
5. design grounding system for EHVAC systems

REACTIVE POWER COMPENSATION AND MANAGEMENT
(Elective – I)

M.Tech I Semester: ELECTRICAL POWER SYSTEMS																			
Course code	Category	Hours/week			Credits	Maximum Marks													
18EP105	Core	L	T	P	C	CIA	SEE	TOTAL											
		3	1	0	4	40	60	100											
Contact Classes:60	Tutorial Classes: -	Practical Classes: Nil			Total Classes: 60														
OBJECTIVES:																			
The course should enable the students to:																			
1. Identify the necessity of reactive power compensation. 2. Describe load compensation 3. Select various types of reactive power compensation in transmission systems																			
UNIT-I	Load Compensation						Classes:12												
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																			
UNIT-II	Reactive Power Compensation in Transmission System						Classes:12												
Steady – State Reactive Power Compensation in Transmission System: Uncompensated line – types of compensation – Passive shunt and series and dynamic shunt compensation –examples																			
Transient state reactive power compensation in transmission systems: Characteristic time periods – passive shunt compensation – static compensations- series capacitor compensation – compensation using synchronous condensers – examples																			
UNIT-III	Reactive Power Coordination						Classes:12												
Objective – Mathematical modeling – Operation planning – transmission benefits – Basic concepts of quality of power supply – disturbances- steady –state																			
UNIT-IV	Demand Side Management						Classes:12												
Load patterns – basic methods load shaping – power tariffs- KVAR based tariffs penalties for voltage flickers and Harmonic voltage levels																			
UNIT-V	Distribution side Reactive power Management						Classes:12												
System losses –loss reduction methods – examples – Reactive power planning – objectives – Economics Planning capacitor placement –retrofitting of capacitor banks																			
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																			
Text Books:																			
1. Reactive power Management by D. M. Tagare, Tata McGraw Hill, 2004. 2. T.J.E.Miller, John Wiley and sons, Reactive power control in Electric power systems by, 1982																			
Reference Books:																			
1. Wolfgang Hofmann, Jurgen Schlabach, Wolfgang Just “Reactive Power Compensation: A Practical Guide, April, 2012, Wiely publication																			

Web References:

1. <https://nptel.ac.in/courses/108104051/10>
2. <https://nptel.ac.in/courses/108101005/38>

E-Text Books:

1. <https://onlinelibrary.wiley.com/doi/book/10.1002/9781119967286>

Outcomes:

At the end of the course students able to

1. understand issues of concern with EHVAC transmission
2. identify and calculate the various parameters of EHV line for modeling
3. assess the effects of corona and methods to limit the audible noise
4. Estimate the over-voltages in EHVAC systems.
5. design grounding system for EHVAC systems

ADVANCED DIGITAL SIGNAL PROCESSING

(Elective – II)

M.Tech I Semester: ELECTRICAL POWER STS TEMS																					
Course Code	Category	Hours/Week			Credits	Maximum Marks															
18EP106	Core	L	T	P	C	CIA	SEE	Total													
		4	0	0	4	40	60	100													
Contact Classes:60		Tutorial Classes: -		Practical Classes: Nil		Total Classes:60															
OBJECTIVES:																					
The course should enable the students to:																					
<ol style="list-style-type: none"> 1. To understand the difference between discrete-time and continuous-time signals. 2. To understand and apply Discrete Fourier Transforms (DFT). 3. To understand and analyze FIR& IIR Filters. 4. To design FIR& IIR Filters 																					
UNIT-I	Discrete time signals				Classes:12																
Discrete time signals, Linear shift invariant systems- Stability and causality Sampling of continuous time signals- Discrete time Fourier transform- Discrete Fourier series- Discrete Fourier transform. Linear convolution using DFT, Z transforms-Properties.																					
UNIT-II	IIR and FIR Filters				Classes:12																
Computation of DFT Design of IIR digital filters from analog filters, Impulse invariance method &bilinear transformation method. FIR filter design using window functions Comparison of IIR and FIR digital filters																					
UNIT-III	IIR and FIR Analysis				Classes:12																
Basic IIR and FIR filter realization structures Signal flow graph representations, Quantization process and errors Coefficient quantisation effects in IIR and FIR filters. A/D conversion noise- Arithmetic round-off errors, Dynamic range scaling Overflow oscillations and zero Input limit cycles in IIR filters.																					
UNIT-IV	Pole-zero models				Classes:12																
All pole, All zero and Pole-zero models Power spectrum estimation- Spectral analysis of deterministic signals.																					
UNIT-V	Optimum FIR and IIR Filters				Classes:12																
Estimation of power spectrum of stationary random signals Optimum linear filters Optimum signal estimation Mean square error estimation Optimum FIR and IIR Filters																					
Text Books:																					
<ol style="list-style-type: none"> 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. 																					
Reference Books:																					
<ol style="list-style-type: none"> 1. M. Mondal and A. Asif, Continuous and Discrete Time Signals and Systems Cambridge, 2007. 2. Li Tan, Digital Signal Processing- Fundamentals and Applications Indian reprint, Elsevier, 2008. 																					

Web References:

1. <https://nptel.ac.in/courses/117101001/>

E-Text Books:

1. <https://dspguru.com/dsp/books/favorites/>

Outcomes:

At the end of the course students able to

1. Know the analysis of discrete time signals.
2. To study the modern digital signal processing algorithms and applications.
3. Have an in-depth knowledge of use of digital systems in real time applications
4. Apply the algorithms for wide area of recent applications.

ADVANCED MICROPROCESSORS AND MICROCONTROLLERS

(Elective – II)

M.Tech I Semester: ELECTRICAL POWER SYSTEMS																					
Course Code	Category	Hours/Week			Credits	Maximum Marks															
18EP107	Core	L	T	P	C	CIA	SEE	Total													
		4	0	0	4	40	60	100													
Contact Classes: 60		Tutorial Classes: -		Practical Classes: Nil		Total Classes:60															
OBJECTIVES:																					
The course should enable the students to:																					
<ol style="list-style-type: none"> 1. To expose the students to the fundamentals of microprocessor architecture. 2. To introduce the advanced features in microprocessors and microcontrollers. 3. To enable the students to understand various microcontroller architectures. 																					
UNIT-I	High Performance CISC Architecture – PENTIUM				Classes:12																
CPU Architecture- Bus Operations – Pipelining – Branch 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				Classes:12																
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				Classes:12																
Introduction to DSP on ARM –FIR filter – IIR filter – Discrete Fourier transform – Exception handling – Interrupts – Interrupt handling schemes- Firmware and bootloader – 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				Classes:12																
Instruction set addressing modes – operating modes- Interrupt system- RTC-Serial Communication Interface – A/D Converter PWM and UART.																					
UNIT-V	PIC Microcontroller				Classes:12																
CPU Architecture – Instruction set – interrupts- Timers- I2C Interfacing –UART- A/D Converter – PWM and introduction to C-Compilers.																					
Text Books:																					
<ol style="list-style-type: none"> 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:																					
<ol style="list-style-type: none"> 1. Steve Furber, “ARM System –On –Chip architecture”, Addison Wesley, 2000. 2. Daniel Tabak, “Advanced Microprocessors”, McGraw 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. 																					

Web References:

1. <https://npTEL.ac.in/courses/106108100/>

E-Text Books:

1. https://books.google.co.in/books/about/Advanced_Microprocessors_And_Microcontro.htm
l?id=cwYQMHtCDHkC

Outcomes:

At the end of the course students able to

1. State the internal organization of some popular microprocessors (8086, 8088)/ microcontrollers (8051, PIC).
2. Understand the impact of microprocessor based system in process of automation.
3. Apply knowledge of soft skill and other resources to design automated system with programming module.
4. Design interfacing circuits of various devices with the microprocessor and microcontroller.

RESTRUCTURED POWER SYSTEMS
(Elective – II)

M.Tech I Semester: ELECTRICAL POWER SYSTEMS																
Course code	Category	Hours/week			Credits	Maximum Marks										
18EP108	Core	L	T	P	C	CIA	SEE									
		4	0	0	4	40	60									
Contact Classes:60	Tutorial Classes: -	Practical Classes:		Total Classes:60												
Nil																
OBJECTIVES:																
The course should enable the students to:																
1. Generalize modeling of load frequency control of a power system																
2. Compute reactive power control of a power system.																
3. Apply the concept of deregulation and ATC.																
UNIT-I	Power System Deregulation					Classes:12										
Introduction- motivation for restructuring of power systems- Electricity market entities model- benefits of deregulation- terminology-deregulation in Indian power sector- Operations in power markets-power pools-transmission networks and electricity markets																
UNIT-II	Available Transfer Capability					Classes:12										
Introduction methods: of determination of ATC - ATC calculation considering the effect of contingency analysis- Transmission open access and pricing-cost components of transmission system- transmission pricing methods-Incremental cost based transmission pricing.																
UNIT-III	Power System Operation in Competitive Environment					Classes:12										
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					Classes:12										
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																
UNIT-V	Ancillary Services Management					Classes:12										
Introduction – Reactive Power as an Ancillary Service – a Review – Synchronous Generators as Ancillary Service Providers.																
Text Books																
1. Bhattacharya, Kankar, Bollen, Math, Daalder, Jaap E. “Operation of Restructured Power System”, 2001, Springer																
2. Venkatesh P. , Manikandan B. V., Raja S. Charles , Srinivasan A. Electrical Power Systems Analysis, Security And Deregulation, Phi Learning Pvt Ltd																
Reference Books:																
1. J. Wood & B.F. Woollenberg- John Wiley Power Generation, “Operation and Control”- 2 nd edition																
Web References:																
1. https://nptel.ac.in/courses/108101005/2																

E-Text Books:

1. https://books.google.co.in/books/about/Restructured_Electrical_Power_Systems.html?id=U7WonDR_b00C

Outcomes:

At the end of the course students able to

1. Understand Key Issues in Electric Utilities
2. Analyze ATC and the cost of transmission
3. Identify the roles and responsibilities of different entities in power market
4. Explore Ancillary Services Management.

RESEARCH METHODOLOGY AND IPR

M.Tech I Semester: Common to all Branches							
Course code	Category	Hours/week			Credits	Maximum Marks	
18AS101	Core	L	T	P	C	CIA	SEE
		4	0	0	4	40	60
Contact Classes:60	Tutorial Classes: -	Practical Classes: Nil			Total Classes:60		

OBJECTIVES:

The course should enable the students to:

1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Understand that today's world is controlled by computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasize the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
6. Understand the IPR protection provides an incentive to inventors for further research work and investment in R&D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

UNIT-I

Classes:12

Research Methodology:

Meaning of research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowledge how Research is done, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India.

Research Design:

Meaning of Research Design, Need for Research Design, Features of Good Design, Important concepts relating to Research Design, Different Research Designs, Basic principles of experimental designs.

UNIT-II

Classes:12

Methods of Data Collection:

Collection of Primary Data, Observation Method, Interview Method, Collection of Data through Questionnaires, Collection of Data through Schedules, Difference between Questionnaires and Schedules, Some other methods of data collection, Collection of secondary data, Selection of appropriate method for data collection, Case study method.

UNIT-III

Classes:12

Testing of Hypotheses:

What is a Hypothesis, Basic concepts concerning testing of hypothesis, Procedure for hypothesis testing, Flow diagram for hypothesis testing, Measuring the power of a hypothesis test, Tests of hypotheses, Importance of Parametric Tests, Hypothesis testing of means, Hypothesis testing for differences between means, Hypothesis testing for comparing two related samples, Hypothesis testing of proportions, Hypothesis testing for difference between proportions, Hypothesis testing for comparing a variance some hypothesized population variance, Testing and equality of variances of two normal populations, Hypothesis testing of correlation coefficients, Limitations of the tests of Hypotheses.

UNIT-IV	Classes:12
Interpretation and Report Writing:	
Meaning of Interpretation, Why Interpretation?, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different steps in writing report, Layout of the Research Project, Types of reports, Oral presentation, Mechanics of writing a research report, Precautions for writing research reports.	
UNIT-V	Classes:12
Intellectual Property Rights:	
Module I- Introduction	
1) Intellectual property: meaning, nature and significance	
2) Various forms of intellectual properties: copyright, patent, trademark, design, geographical indication, semiconductor and plant variety	
3) Major international instruments relating to the protection of intellectual properties	
Module II- Copyright	
1) Copyright: meaning ,scope	
2) Subject matter of copyright: original literary, dramatic, musical, artistic works; cinematograph films and sound recordings	
3) Ownership of copyright , Assignment and licence of copyright	
4) Infringement and exceptions of infringement of copyright and remedies against infringement of copyright: civil, criminal and administrative.	
Module III – Trade Marks	
1. Trade mark: meaning,scope	
2. Absolute and relative grounds of refusal	
3. Doctrine of honest concurrent user	
4. Procedure for registration and term of protection	
5. Rights of holder and assignment and licensing of marks	
6. Infringement and remedies	
7. Trade marks registry and appellate board	
Module IV- Patents	
1. Patent: meaning	
2. Criteria for patentability and non-patentable inventions	
3. Procedure for registration and term of protection	
4. Grants of patent, rights of patentee and revocation of patent	
5. Compulsory licence and government use of patent	
6. Infringement, exceptions to infringement of patent and remedies	
7. Patent office and Appellate Board	
Text Books	
1. Kothari. C.R, 1990,“Research methodology: Methods and Techniques. New Age International, 418P	
2. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”	
3. Ranjit Kumar, 2 nd Edition, “Research Methodology: A step by Step Guide for beginners”	
Reference Books:	
1. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd. 2007	
2. Mayall, “Industrial Design”, McGraw Hill, 1974.	
3. Niebel, “Product Design”, McGraw Hill, 1974.	
4. Asimov, “Introduction to Design”, Prentice Hall, 1962.	
5. Robert P.Merges, Peter S. Menell, Mark A. Lemley, “ Intellectual Property in New Technological Age”, 2016.	
6. T.Ramappa, “Intellectual Property Rights Under WTO”, S.Chand, 2008	

POWER SYSTEMS LABORATORY

M.Tech I Semester: ELECTRICAL POWER SYSTEMS															
Course code	Category	Hours/week			Credits	Maximum Marks									
18EP110	Core	L	T	P	C	CIA	SEE	TOTAL							
		0	0	4	2	25	50	75							
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes:36			Total Classes:36										
OBJECTIVES:															
The course should enable the students to:															
1. Acquire expertise in usage of modern tools															
List of experiments															
EXP 1	Determination of Transient Reactance and Sub transient Reactance of Salient Pole Synchronous Machine														
To determine X_d' and X_q' & X_d'' and X_q''															
EXP 2	Determination of Sequence Impedances of Cylindrical Rotor Synchronous Machine														
To determine negative and zero sequence reactance of an alternator															
EXP 3	Fault Analysis – I i) LG Fault ii) LL Fault														
To Perform unsymmetrical fault analysis in a power system															
EXP 4	Fault Analysis – II i) LLG Fault ii) LLLG Fault														
To perform unsymmetrical fault analysis in a power system															
EXP 5	Equivalent Circuit of a Three Winding Transformer														
Each winding is represented by its equivalent resistance and reactance by short-circuit tests and open-circuit tests															
EXP 6	Separation of No-Load Losses of Three-Phase Squirrel Cage Induction Motor														
To separate the no-load losses (iron losses and mechanical losses) of a three-phase squirrel cage induction motor															
EXP 7	Power Angle Characteristics of Salient Pole Synchronous Machine.														
Transient stability analysis of a salient pole synchronous machine															
EXP 8	Scott Connection														
This circuit used to produce two-phase electric power(2 ϕ , 90 degree phase rotation)from a three-phase (3 ϕ , 120 degree phase rotation) source, or vice versa															
EXP 9	Characteristics of IDMT Over Current Relay (Electromagnetic Type).														
To study the IDMT over current relay and determine the time current characteristics															
EXP 10	Characteristics of Negative Sequence Relay (Static Type).														
The negative sequence relay protects the generator and motor from the unbalanced load which mainly occurs because of the phase-to-phase faults.															
EXP 11	Characteristics of Over Voltage Relay. i) Electromagnetic Type ii) Microprocessor Type														
Over/under relays may have both definite time characteristic and inverse time characteristics															

EXP 12 | Characteristics of Percentage Biased Differential Relay.**i) Electromagnetic Type ii) Static Type**

The relay that operates on the phase difference of two or more similar electrical quantities

Outcomes:

At the end of the course students able to

1. Carryout experiments ensuring the safety of equipment and personnel
2. Interpret the experimental results and correlating them with the practical power system

POWER SYSTEMS SIMULATION – I LABORATORY

M.Tech I Semester: ELECTRICAL POWER SYSTEMS																							
Course code	Category	Hours/week			Credits	Maximum Marks																	
18EP111	Core	L	T	P	C	CIA	SEE	TOTAL															
		0	0	4	2	25	50	75															
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes:36			Total Classes:36																		
OBJECTIVES:																							
The course should enable the students to:																							
1. Acquire expertise in usage of modern tools																							
List of Experiments																							
EXP 1	Develop MATLAB program for Y-BUS formation.																						
To determine the bus admittance matrix using MATLAB program																							
EXP 2	Develop MATLAB program for G-S Load Flow Analysis.																						
To determine load flows for the given bus configuration																							
EXP 3	Develop MATLAB program for N-R Load Flow Analysis																						
To determine load flows for the given bus configuration																							
EXP 4	Develop MATLAB program for FDLF Load Flow Analysis																						
To determine load flows for the given bus configuration																							
EXP 5	Develop MATLAB program for Short Circuit Analysis.																						
To carry out short circuit analysis for the given power system using MATLAB program																							
EXP 6	Transient Stability Analysis for Single Machine connected to Infinite Bus by Point by Point Method																						
To observe the transient stability behavior of the synchronous machine connect to infinite bus bar																							
EXP 7	Simulation of RLC Circuit using PSPICE.																						
To plot the time response of a RLC circuit using PSPICE program																							
EXP 8	Simulation of Single Phase Full Converter with RLE Load using PSPICE																						
To obtain the output waveforms for single phase full converter for RLE load																							
EXP 9	Develop MATLAB model for Sinusoidal Pulse Width Modulation																						
To generate switching pulses using SPWM technique																							
EXP 10	Develop MATLAB program for economic load dispatch																						
To dispatch the load as per the load demand by considering economic aspects																							
Outcomes:																							
At the end of the course students able to																							
<ol style="list-style-type: none"> Analyze the power system data for load-flow and fault studies Apply computational methods for large scale power system studies Develop software for power system industry 																							

FLEXIBLE AC TRANSMISSION SYSTEMS

M.Tech II Semester: ELECTRICAL POWER SYSTEMS																			
Course code	Category	Hours/week			Credits	Maximum Marks													
18EP201	Core	L	T	P	C	CIA	SEE	TOTAL											
		4	0	0	4	40	60	100											
Contact Classes:60	Tutorial Classes: -	Practical Classes: Nil			Total Classes:60														
OBJECTIVES:																			
The course should enable the students to:																			
<ol style="list-style-type: none"> Understand the fundamentals of FACTS Controllers, Importance of controllable parameters and types of FACTS controllers & their benefits Recall the objectives of Shunt and Series compensation Explain control of STATCOM and SVC and their comparison And the regulation of STATCOM 																			
UNIT-I	FACTS Concepts						Classes:12												
Transmission interconnections power flow in an AC system, loading capability limits, Dynamic stability considerations, importance of controllable parameters basic types of FACTS controllers, benefits from FACTS controllers																			
UNIT-II	Static Shunt Compensation						Classes:12												
Objectives of shunt compensation, mid-point voltage regulation voltage instability prevention, improvement of transient stability, Power oscillation damping, Methods of controllable VAR generation, variable impedance type static VAR generators switching converter type VAR generators hybrid VAR generators.																			
UNIT-III	SVC And STATCOM						Classes:12												
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						Classes:12												
Concept of series capacitive compensation, improvement of transient stability, power oscillation damping, and functional requirements of GTO thyristor controlled series capacitor (GSC),																			
UNIT-V	TSSC and TCSC						Classes:12												
Thyristor switched series capacitor (TSSC), and thyristor controlled series capacitor (TCSC), Control schemes for GSC TSSC and TCSC.																			
Text Books:																			
<ol style="list-style-type: none"> Hingorani H G and Gyugyi. L "Understanding FACTS-Concepts and Technology of Flexible AC Transmission Systems" New York, IEEE Press, 2000. Padiyar.K.R, " FACTS Controllers in Power Transmission and Distribution" New Age Int. Publishers, 2007 																			
Reference Books:																			
<ol style="list-style-type: none"> Yong-Hua Song, Allan Johns, "Flexible AC Transmission Systems", IET,1999 Zhang, Xiao-Ping, Rehtanz, Christian, Pal, Bikash "Flexible AC Transmission Systems: Modeling and Control", Springer, 2012 																			

Web References:

1. <https://nptel.ac.in/courses/108107114/>

E-Text Books:

1. https://books.google.co.in/books/about/Flexible_Ac_Transmission_Systems_FACTS.html?id=AqPr4JyDWg0C

Outcomes:

At the end of the course students able to

1. Choose proper controller for the specific application based on system requirements
2. Interpret the control circuits of Shunt Controllers SVC & STATCOM for various functions viz. Transient stability Enhancement, voltage instability prevention and power oscillation damping
3. Detect the Power and control circuits of Series Controllers GCSC, TSSC and TCSC

ADVANCED POWER SYSTEM PROTECTION

M.Tech II Semester: ELECTRICAL POWER SYSTEMS								
Course code	Category	Hours/week			Credits	Maximum Marks		
18EP202	Core	L	T	P	C	CIA	SEE	TOTAL
		4	0	0	4	40	60	100
Contact Classes:60	Tutorial Classes: -	Practical Classes: Nil			Total Classes:60			

OBJECTIVES:

The course should enable the students to:

1. Understand concepts of different types of comparators.
2. Explicate the function of various types of static relays.
3. Elucidate the concepts of microprocessor based protective relays and digital relaying algorithms.

UNIT-I	Static Relays	Classes:12
<p>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.</p> <p>Amplitude comparators: Circulating current type and opposed voltage type rectifier bridge comparators –Direct and Instantaneous comparators</p> <p>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</p>		

UNIT-II	Over Current & distance Relays	Classes:12
<p>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.</p> <p>Static distance Relays: Static impedance –reactance-MHO and angle impedance relay sampling comparator–realization of reactance and MHO relay using a sampling comparator.</p>		

UNIT-III	Multi –Input Comparators	Classes:12
<p>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.</p> <p>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.</p>		

UNIT-IV	Microprocessor based Protective Relays-I	Classes:12
<p>Over current relays – impedance relays – directional relay – reactance relay (Block diagram and flow chart approach only).</p>		

UNIT-V	Microprocessor based Protective Relays-II	Classes:12
<p>Generalized mathematical expression for distance relays - measurement of resistance and reactance – MHO and offset MHO relays – Realization of MHO characteristics – Realization of</p>		

offset MHO characteristics (Block diagram and flow chart approach only) Basic principle of Digital computer relaying.

Text Books:

1. T.S.Madhava Rao, "Power system Protection static relay", Tata McGraw Hill Publishing Company limited, second edition, 1989.

Reference Books:

1. Badri Ram and D.N.Vishwakarma, "Power system Protection and Switchgear", Tata McGraw Hill Publication Company limited First Edition -1995.

Web References:

1. <https://nptel.ac.in/downloads/108101039/>

E-Text Books:

1. https://books.google.co.in/books/about/Power_System_Protection_and_Switchgear.html?id=QDdIonUD4xQC

Outcomes:

At the end of the course students able to

1. Understand the various types of comparators and their realization using static circuits
2. Understand the realization of over current, distance and differential relays using Comparator
3. Estimate the current and voltage magnitudes from the sampled measurements
4. Realize the various dynamic characteristics of digital relays for protection of transmission Sines, transformers
5. Identify the new developments in protective relaying and applications

DISTRIBUTED GENERATION
(Elective – III)

M.Tech II Semester: ELECTRICAL POWER SYSTEMS																			
Course code	Category	Hours/week			Credits	Maximum Marks													
18EP203	Core	L	T	P	C	CIA	SEE	TOTAL											
		4	0	0	4	40	60	100											
Contact Classes:60	Tutorial Classes: -	Practical Classes: Nil			Total Classes:60														
OBJECTIVES:																			
The course should enable the students to:																			
1 understand renewable energy sources																			
2. gain understanding of the working of off-grid and grid-connected renewable energy generation schemes																			
UNIT-I	Need for Distributed generation						Classes:12												
Renewable sources in distributed generation and current scenario in Distributed Generation. Planning of DGs. Sitting and sizing of DGs optimal placement of DG sources in distribution systems. Grid integration of DGs Different types of interfaces, Inverter based DGs and rotating machine based interfaces. Aggregation of multiple DG units.																			
UNIT-II	Technical impacts						Classes:12												
Technical impacts of DGs. Transmission systems Distribution Systems De-regulation Impact of DGs upon protective relaying. Impact of DGs upon transient and dynamic stability of existing distribution systems, Steady-state and Dynamic analysis.																			
UNIT-III	Economic and control aspects						Classes:12												
Economic and control aspects of DGs Market facts. Issues and challenges Limitations of DGs, Voltage control techniques. Reactive power control, Harmonics Power quality issues, Reliability of DG based systems.																			
UNIT-IV	Introduction to micro-grids						Classes:12												
Types of micro-grids: autonomous and non-autonomous grids Sizing of micro-grids. Modelling & analysis of Micro-grids with multiple DGs. Micro-grids with power electronic interfacing units.																			
UNIT-V	Transient analysis of microgrids						Classes:12												
Transients in micro-grids, Protection of micro-grids, Case studies.																			
Text Books:																			
1. H. Lee Willis, Walter G. Scott, “Distributed Power Generation – Planning and Evaluation”, Marcel Decker Press.																			
2. M.GodoySimoes, Felix A.Farret, “Renewable Energy Systems – Design and Analysis with Induction Generators”, CRC press.																			
Reference Books:																			
1. Stuart Borlase. “Smart Grid: Infrastructure Technology Solutions” CRC Press																			
Web References:																			
1. https://nptel.ac.in/courses/108108034/																			

E-Text Books:

1. https://books.google.co.in/books/about/Distributed_Generation_Systems.html?id=ohSKCgAAQBAJ&redir_esc=y

Outcomes:

At the end of the course students able to

1. Capability to perform preliminary evaluation of technical and economic potential of utilization of renewable energy sources at selected location
2. analyze environmental and legal aspects of distributed source

RENEWABLE ENERGY SYSTEMS
(Elective – III)

M.Tech II Semester: ELECTRICAL POWER SYSTEMS								
Course Code	Category	Hours/Week			Credits	Maximum Marks		
18EP204	Core	L	T	P	C	CIA	SEE	Total
		4	0	0	4	40	60	100
Contact Classes:60		Tutorial Classes: -		Practical Classes: Nil		Total Classes:60		

OBJECTIVES:

The course should enable the students to:

1. Provide students with the principles and devices and systems used to harness renewable energy resources in their different forms.
2. Use available and to partially develop software tools to carry out technical, economic and environmental analysis of practical renewable energy systems and interpret the results provided by such tools.
3. Develop in students an appreciation of the environmental and economic issues and how they interrelate closely in renewable energy problems and solutions.
4. Promote teamwork among students and effective communication skills through course projects and term papers.

UNIT-I	SOLAR RESOURCE	Classes:12
Introduction: Energy Economics; Simple payback period, Internal (simple) rate of return, Net present value, Internal rate of return (IRR), NPV and IRR with Fuel Escalation. 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	PHOTOVOLTAICS	Classes:12
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. Photovoltaic 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- numerical		

UNIT-III	WIND AND TIDAL POWER	Classes:12
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	Classes:12
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.

UNIT-V	WAVE ENERGY CONVERSION	Classes:12
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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, 2011.

Reference Books:

1. Klass, Donald L. Biomass for renewable energy, fuels, and chemicals. Elsevier, 1998.
2. Johansson, Thomas B., et al., eds. Renewable energy: sources for fuels and electricity. Island press, 1993.

Web References:

1. <https://nptel.ac.in/courses/112104225/22>

E-Text Books:

1. https://en.wikipedia.org/wiki/List_of_books_about_renewable_energy

Outcomes:

At the end of the course students able to

1. Aptitude & proficiency in grid interconnection requirements for wind farms.
2. Ability of integrating power electronics device with Renewable Energy Sources.
3. Know-how of Wind Power Control.
4. Skill in developing MPPT techniques.

ENERGY AUDITING, CONVERSATION AND MANAGEMENT

(Elective – III)

M.Tech II Semester: ELECTRICAL POWER SYSTEMS								
Course Code	Category	Hours/Week			Credits	Maximum Marks		
18EP205	Core	L	T	P	C	CIA	SEE	Total
		4	0	0	4	40	60	100
Contact Classes:60		Tutorial Classes: 5		Practical Classes: Nil		Total Classes:60		

OBJECTIVES:

The course should enable the students to:

1. To impart knowledge in the domain of energy conservation.
2. To bring out Energy Conservation Potential and Business opportunities across different user segments under innovative business models.
3. To inculcate knowledge and skills about assessing the energy efficiency of an entity/ establishment

UNIT-I	Basic Principles of Energy Audit	Classes:12
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	Classes:12
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.		
UNIT-III	Power Factor Improvement	Classes:12
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-IV	Energy Instruments	Classes:12
Energy Instruments , Energy Instruments watt meter, data loggers, thermocouples, pyrometers, lux meters, tongue testers, application of PLC's		
UNIT-V	Economic Aspects	Classes:12
Computation of Economic Aspects Calculation of simple payback method , net present worth method		
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.		
Text Books:		
1. W.R. Murphy & G. McKay Butter worth, Energy management, Heinemann publications.1992. 2. Paul o' Callaghan, Energy management, Mc-Graw Hill Book company-1st edition, 1998.		
Reference Books:		
1. John C. Andreas &Marcel Dekker Energy efficient electric motors, Inc Ltd-2/e, 1995. 2. W.C.Turner, john Wiley and sons, Energy management hand book.2007.		

3. Fuel efficiency- booklet12, Energy management and good lighting practice: -EEO.
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Web References:

1. https://nptel.ac.in/courses/108106022/
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E-Text Books:

2. http://www.npcindia.gov.in/wp-content/uploads/2014/07/BrochureL-Practitioners-Course1A.pdf
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Outcomes:

At the end of the course students able to

1. Acquaintance with conservation of energy and its management, energy planning, and energy economics.
2. Know-How of energy efficient machinery systems, energy losses and their management.
3. Competency in Energy analysis techniques and methods & Energy conservation planning and practices
4. Know-How of Energy forecasting, Energy economics, Energy pricing and incentives for energy conservation

PROGRAMMABLE LOGIC CONTROLLERS AND APPLICATIONS

(Elective – IV)

M.Tech II Semester: ELECTRICAL POWER SYSTEMS																				
Course Code	Category	Hours/Week			Credits	Maximum Marks														
18EP206	Core	L	T	P	C	CIA	SEE	Total												
		4	0	0	4	40	60	100												
Contact Classes:60		Tutorial Classes: -		Practical Classes: Nil		Total Classes:60														
OBJECTIVES:																				
The course should enable the students to:																				
<ol style="list-style-type: none"> 1. To Describe the function of a programmable logic controller and name various applications 2. To Identify and describe the functions of the five basic components of a PLCs 3. To Describe the basic operation of a PLCs 																				
UNIT-I	PLC Basics					Classes:12														
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 Circuits					Classes:12														
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					Classes:12														
Timer functions and industrial applications, counters, counter function industrial applications, arithmetic functions, number comparison.																				
UNIT-IV	Analog PLC operation					Classes:12														
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.																				
UNIT-V	Data Handling Functions					Classes:12														
SKIP, master control relay, jump, move, FIFO, FAL, ONS, CLR and SWEEP functions and their applications.																				
Text Books:																				
<ol style="list-style-type: none"> 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. 																				
Reference Books:																				
<ol style="list-style-type: none"> 1. Hackworth, John R., and Frederick D. Hackworth. Programmable Logic Controllers: Programming Methods and Applications. Pearson, 2004. 																				

Web References:

1. <https://npTEL.ac.in/courses/112102011/11>

E-Text Books:

1. https://books.google.co.in/books/about/Programmable_Logic_Controllers.html?id=Bs4eAQAAIAAJ&redir_esc=y

Outcomes:

At the end of the course students able to

1. Describe the function of and the relationship between the various hardware components of a programmable logic controller.
2. Design logic circuits to perform industrial control functions of medium complexity.
3. Develop coded programs for the programmable logic controller.
4. Demonstrate the correct operation of logic circuits by programming them into the programmable logic controller.

SMART GRID
(Elective – IV)

M.Tech II Semester: ELECTRICAL POWER SYSTEMS																			
Course code	Category	Hours/week			Credits	Maximum Marks													
18EP207	Core	L	T	P	C	CIA	SEE	TOTAL											
		4	0	0	4	40	60	100											
Contact Classes:60	Tutorial Classes: -	Practical Classes: Nil			Total Classes:60														
OBJECTIVES:																			
The course should enable the students to:																			
1 To understand various aspects of smart grid 2. study various smart transmission and distribution technologies 3. appreciate distribution generation and smart consumption 4. know the regulations and market models for smart grid																			
UNIT-I	Introduction to Smart Grids						Classes:12												
Definition, justification for smart grids, smart grid conceptual model, smart grid architectures, Interoperability, communication technologies, role of smart grids standards, intelligrid initiative, national smart grid mission (NSGM) by Govt. of India																			
UNIT-II	Smart Transmission Technologies						Classes:12												
Substation automation, Supervisory control and data acquisition (SCADA), energy management system (EMS), phasor measurement units (PMU), Wide area measurement systems (WAMS)																			
UNIT-III	Smart Distribution Technologies:						Classes:12												
Distribution automation, outage management systems, automated meter reading (AMR), Automated metering infrastructure (AMI), fault location isolation and service restoration (FLISR), Outage Management Systems (OMS), Energy Storage, Renewable Integration																			
UNIT-IV	Distributed Generation and Smart Consumption						Classes:12												
Distributed energy resources (DERs), smart appliances, low voltage DC (LVDC) distribution in homes / buildings, home energy management system (HEMS), Net Metering, Building to Grid B2G, Vehicle to Grid V2G, Solar to Grid, Microgrid																			
UNIT-V	Regulations and Market Models for Smart Grid						Classes:12												
Demand Response, Tariff Design, Time of the day pricing (TOD), Time of use pricing (TOU), Consumer privacy and data protection, consumer engagement etc Cost benefit analysis of smart grid projects.																			
Text Books:																			
1. Clark W Gellings, “The Smart Grid, Enabling Energy Efficiency and Demand Side Response”-CRC Press, 2009. 2. Jean Claude Sabonnadière, Nouredine Hadjsaïd, “Smart Grids”, Wiley-ISTE, IEEE Press, May 2012																			
Reference Books:																			
1. Janaka Ekanayake, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, Nick Jenkins, “Smart Grid: Technology and Applications”- Wiley, 2012. 2. James Momoh, “Smart Grid: Fundamentals of Design and Analysis” - Wiley, IEEE Press, 2012. 3. India Smart Grid Knowledge Portal																			

Web References:

1. <https://nptel.ac.in/courses/108107113/7>

E-Text Books:

1. https://books.google.co.in/books/about/Smart_Power_Grids_2011.html?id=fAwbW6rkntUC&redir_esc=y

Outcomes:

At the end of the course students able to

1. Understand concepts of smart grid and various issues related to smart grid technology deployment
2. Perform real time electricity pricing calculation
3. Understand key technologies in distribution systems that enable smart grid
4. Understand key technologies in transmission systems that enable smart grid

**ARTIFICIAL INTELLIGENCE COMPUTING TECHNIQUES AND
APPLICATIONS
(Elective – IV)**

M.Tech II Semester: ELECTRICAL POWER SYSTEMS																				
Course Code	Category	Hours/Week			Credits	Maximum Marks														
18EP208	Core	L	T	P	C	CIA	SEE	Total												
		4	0	0	4	40	60	100												
Contact Classes:60		Tutorial Classes: -		Practical Classes: Nil		Total Classes:60														
OBJECTIVES:																				
The course should enable the students to:																				
<ol style="list-style-type: none"> 1. Understand the role of neural networks in engineering, artificial intelligence, and cognitive modeling. 2. Provide knowledge of supervised learning in neural networks. 3. Provide knowledge of computation and dynamical systems using neural networks. 4. Provide knowledge of reinforcement learning using neural networks. 																				
UNIT-I	Introduction to Neural Networks					Classes:12														
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	Neural Networks Learning					Classes:12														
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.																				
UNIT-III	Associative Memories					Classes:12														
Paradigms of Associative Memory, Hebbian Learning, General Concepts of Associative Memory, , Bidirectional Associative Memory (BAM) Architecture, BAM Training Algorithms Hopfield Network.																				
Fuzzy Logic System Components: Fuzzification, Membership Value assignment, development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods.																				
UNIT-IV	Classical & Fuzzy Sets					Classes:12														
Introduction to classical sets – properties, Operations and relations; Fuzzy sets, Membership, Uncertainty, Operations, Properties, fuzzy relations, cardinalities, membership functions.																				
UNIT-V	AI Applications					Classes:12														
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. Rajasekharan and Rai, Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications - PHI Publication.2003.
2. JacekM.Zurada, Introduction to Artificial Neural Systems Jaico Publishing House, 1997

Reference Books:

1. N. Yadaiah and S. BapiRaju, Neural and Fuzzy Systems: Foundation, Architectures and Applications Pearson Education.2010.
2. BrokKosko, Neural Netwroks and Fuzzy Logic System PHI Publications.
3. Timothy . J. Ross “Fuzzy logic for engineering applications”,3rd edition , University of New Mexico, John Wiley & Sons Ltd, 2010.

Web References:

2. <https://nptel.ac.in/courses/106106126/>

E-Text Books:

3. <https://www.isibang.ac.in/~dst-ss-mmg/Deekshatulu-F%20ISI%20Bengul%20IC%206Apr%2015.pdf>

Outcomes:

At the end of the course students able to

1. Ability to contrive optimum NN architecture for specific engineering problem.
2. Competency in applying NN technology in control problems.
3. Skill in framing fuzzy rules & employing fuzzy technique in solving engineering problems
4. Dexterity in contriving neuro –fuzzy based solutions

RENEWABLE ENERGY SYSTEMS LABORATORY

M.Tech II Semester: ELECTRICAL POWER SYSTEMS															
Course code	Category	Hours/week			Credits	Maximum Marks									
18EP209	Core	L	T	P	C	CIA	SEE	TOTAL							
		0	0	4	2	25	50	75							
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes:36			Total Classes:36										
OBJECTIVES:															
The course should enable the students to:															
1. Acquire expertise in usage of modern tools															
List of experiments															
EXP 1	The I-V and P-V characteristics of two modules in series and parallel														
To determine the solar PV characteristics															
EXP 2	Plot charging and discharging characteristics of battery														
To determine the charging and discharging of a alkaline or lithium ion battery															
EXP 3	Perform the experiment of manually finding the MPP by varying the resistive load across the PV panel.														
To track the Maximum power point of a PV panel															
EXP 4	Perform the experiment of finding the MPP by varying the duty cycle of DC-DC converter														
To track the Maximum power point of a PV using DC-DC converter															
EXP 5	Observation of current for linear & nonlinear loads and voltage waveform at PCC.														
To observe the current waveform for different types of load at PCC															
EXP 6	Synchronization of grid tied inverter, observation of current waveform and calculations for distortion, displacement and power factor of grid tied inverter														
To Observe the synchronization of grid tied inverter															
EXP 7	Evaluation of the active, reactive power and net energy flow between grid tied inverter,														
To observe the power flows between the inverter and the grid															
EXP 8	MPPT Algorithm for SOLAR PV Panel Testing														
To track the Maximum power using P&O/ I&C methods															
EXP 9	P, V and F measurement of output of wind generator														
To measure the output power generated, voltage and frequency of a wing generators															
EXP 10	Impact of load and wind speed on power output and its quality.														
To observe the behavior of wind turbine on changing of wind speed and the load															
EXP 11	Performance of Frequency drop characteristic of induction generator at different loading conditions.														
To plot the frequency characteristics of induction generator at different loading conditions															

EXP 12	Design of DC –DC Converter for different types of variable DC Loads through SIMULINK/MATLAB.
	To design a Simulink model for DC-DC converter for variable DC loads
EXP 13	Design of DC –AC Converter for different types of variable AC Loads through SIMULINK/MATLAB
	To design a Simulink model for DC-DC converter for variable AC loads
Outcomes:	
At the end of the course students able to	
<ol style="list-style-type: none"> 1. Carryout experiments ensuring the safety of equipment and personnel 2. Interpret the experimental results and correlating them with the practical power system 	

SIMULATION LABORATORY-II

M.Tech II Semester: ELECTRICAL POWER SYSTEMS															
Course code	Category	Hours/week			Credits	Maximum Marks									
18EP210	Core	L	T	P	C	CIA	SEE	TOTAL							
		0	0	4	2	25	50	75							
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes:36			Total Classes:36										
OBJECTIVES:															
The course should enable the students to:															
1. Acquire expertise in usage of modern tools															
LIST OF EXPERIMENTS															
EXP 1	Contingency studies using load flows for generator & line outages														
To carry out contingency studies for generator and line outages															
EXP 2	Solution of Economic load dispatch problem														
To obtain a solution for load dispatch for load demand by considering economic constraints															
EXP 3	Transient stability study of SMIB														
To Obtain the power angle curve under transient condition of a synchronous machine connected to infinite bus bar															
EXP 4	Contingency studies using ZBUS														
To carry out contingency studies using Z bus															
EXP 5	State estimation algorithm using WLS method														
To obtain the state estimation of power system using least square method															
EXP 6	Simulation of single area load frequency control														
To plot the variation of frequency with the load															
EXP 7	Simulation of two area load frequency control														
To plot the variation of frequency with the load															
EXP 8	Simulation of power system stabilizer														
To design power system stabilizer in MATLAB															
EXP 9	Simulation of voltage stability problem														
To simulate the voltage stability problem for the given system															
EXP 10	Design of LQR state feedback for a given system														
To Design of LQR state feedback for a given system															
EXP 11	Design of State feedback controller and observer through Pole assignment														
To Design of State feedback controller and observer through Pole assignment															
EXP 12	Simulation of Three phase full converter using RL & E loads														
To design a Simulink model of Three phase full converter using RL & E loads															
EXP 13	Simulation of Three phase inverter with PWM controller														
To design a Simulink model of Three phase inverter with PWM controller															
EXP 14	Simulation of resonant pulse commutation circuit.														
To design a Simulink model of resonant pulse commutation circuit															

Outcomes:

At the end of the course students able to

1. Apply computational methods for large scale power system studies
2. Develop software for power system industry

TERM PAPER

M.Tech II Semester: ELECTRICAL POWER SYSTEMS								
Course code	Category	Hours/week			Credits	Maximum Marks		
18EP211	Core	L	T	P	C	CIA	SEE	TOTAL
		0	0	4	2	50	-	50
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes:20			Total Classes:20			
The Term Paper is a self study report and shall be carried out either during II semester along with other lab courses. Every student will take up this term paper individually and submit a report. The scope of the term paper could be an exhaustive literature review choosing any engineering concept with reference to standard research papers or an extension of the concept of earlier course work in consultation with the term paper supervisor. The term paper reports submitted by the individual students during the II semester shall be evaluated for a total of 50 marks for continuous assessment; it shall be conducted by two Examiners, one of them being term paper supervisor as internal examiner and an external examiner nominated by the Principal from the panel of experts recommended by HOD.								

HYBRID ELECTRIC VEHICLES
(Open Elective)

M.Tech III Semester: ELECTRICAL POWER SYSTEMS																			
Course code	Category	Hours/week			Credits	Maximum Marks													
18EP301	Core	L	T	P	C	CIA	SEE	TOTAL											
		4	0	0	4	40	60	100											
Contact Classes:60	Tutorial Classes: -	Practical Classes: Nil			Total Classes:60														
OBJECTIVES:																			
The course should enable the students to:																			
1 study the concepts and drive train configurations of electric drive vehicles																			
2 provide different electric propulsion systems and energy storage devices																			
3. explain the technology, design methodologies and control strategy of hybrid electric vehicles																			
UNIT-I	Introduction to Electric Vehicles						Classes:12												
Sustainable Transportation - EV System - EV Advantages – Vehicle Mechanics - Performance of EVs - Electric Vehicle drive train - EV Transmission Configurations and components-Tractive Effort in Normal Driving - Energy Consumption - EV Market - Types of Electric Vehicle in Use Today - Electric Vehicles for the Future.																			
UNIT-II	Electric Vehicle Modeling						Classes:12												
Consideration of Rolling Resistance - Transmission Efficiency - Consideration of Vehicle Mass - Tractive Effort - Modeling Vehicle Acceleration - Modeling Electric Vehicle Range - aerodynamic Considerations - Ideal Gearbox Steady State Model - EV Motor Sizing - General Issues in Design.																			
UNIT-III	Electric vehicle batteries						Classes:12												
Introduction to electric vehicle batteries - electric vehicle battery efficiency - electric vehicle battery capacity - electric vehicle battery charging - electric vehicle battery fast charging - electric vehicle battery discharging - electric vehicle battery performance – testing. Hybrid Electric Vehicles - HEV Fundamentals -Architectures of HEVs- Interdisciplinary Nature of HEVs - State of the Art of HEVs - Advantages and Disadvantages - Challenges and Key Technology of HEVs																			
UNIT-IV	Hybridization of the Automobile						Classes:12												
Concept of Hybridization of the Automobile-Plug-in Hybrid Electric Vehicles - Design and Control Principles of Plug-In Hybrid Electric Vehicles - Fuel Cell Hybrid Electric Drive Train Design - HEV Applications for Military Vehicles.																			
UNIT-V	Advanced topics						Classes:12												
- Battery Charger Topologies, Charging Power Levels, and Infrastructure for Plug- In Electric and Hybrid Vehicles - The Impact of Plug-in Hybrid Electric Vehicles on Distribution Networks – Sizing Ultra capacitors for Hybrid Electric Vehicles																			
Text Books:																			
1. Modern Electric, Hybrid Electric and Fuel Cell Vehicles – Fundamentals, Theory and Design – Mehrdad Ehsani, Uimin Gao and Ali Emadi - Second Edition - CRC Press, 2010.																			
2. Electric Vehicle Technology Explained - James Larminie, John Lowry - John Wiley & Sons Ltd, - 2003.																			
3. Electric Vehicle Battery Systems – Sandeep Dhameja – Newnes - New Delhi – 2002.																			

Reference Books:

1. Hybrid electric Vehicles Principles and applications With practical perspectives -Chris Mi, Dearborn - M. Abul Masrur, David Wenzhong Gao - A John Wiley & Sons, Ltd., - 2011.
2. Electric & Hybrid Vehicles – Design Fundamentals - Iqbal Hussain, Second Edition, CRC Press, 2011.

Web References:

1. <https://nptel.ac.in/courses/108103009/>

E-Text Books:

1. https://books.google.co.in/books/about/Electric_and_Hybrid_electric_Vehicles.html?id=tx4qYAAACAAJ&redir_esc=y

Outcomes:

At the end of the course students able to

1. Understand the concepts and drive train configurations of electric drive vehicles
2. Interpret different electric propulsion systems and energy storage devices
3. Appreciate the technology, design methodologies and control strategy of hybrid electric vehicles
4. Realize battery charger topologies for plug in hybrid electric vehicles

POWER DISTRIBUTION SYSTEMS
(Open Elective)

M.Tech III Semester: ELECTRICAL POWER SYSTEMS																			
Course code	Category	Hours/week			Credits	Maximum Marks													
18EP302	Core	L	T	P	C	CIA	SEE	TOTAL											
		4	0	0	4	40	60	100											
Contact Classes:60	Tutorial Classes: -	Practical Classes: Nil			Total Classes:60														
OBJECTIVES:																			
The course should enable the students to:																			
<ol style="list-style-type: none"> 1. Understand the importance of power distribution 2. Implement, analyse and propose systems changes and make recommendations depending on network calculation. 																			
UNIT-I	Distribution systems planning						Classes:12												
Planning and forecast techniques - Present and future role of computers in distribution system planning - Load characteristics, Definitions load growth – tariffs -Diversified demand method.																			
UNIT-II	Distribution transformers						Classes:12												
Types - Regulation and Efficiency - Use of monograms for obtaining efficiency - distribution factors – KW KVA Method of determining regulation.																			
Design of sub transmission lines and distribution substations: Introduction – sub transmission systems - distribution substation – Substation bus schemes - description and comparison of switching schemes – substation location and rating - Application of network flow techniques in rural distribution networks to determine optimum location of sub-station																			
UNIT-III	Design considerations on primary systems						Classes:12												
Introduction - types of feeders - voltage levels – Radial type feeders - feeders with uniformly distributed load and non-uniformly distributed loads. Design considerations of secondary systems: Introduction - secondary voltage levels – Secondary banking - existing systems improvement.																			
Distribution system Protection: Basic definitions - over current protection devices - fuses, automatic circuit reclosures, automatic line sectionalizers - objectives of distribution system protection - coordination of protective devices - Fuse to Fuse co-ordination, Fuse to circuit breaker coordination, Reclosure to circuit breaker co-ordination																			
UNIT-IV	Voltage drop and power loss calculations						Classes:12												
Three phase primary lines - non 3 phase primary lines – 4 wire multi grounded primary lines - copper loss - Distribution feeder costs - loss reduction and voltage improvement in rural distribution networks																			
UNIT-V	Distribution System Voltage Regulation						Classes:12												
Basic definitions - Quality of service - voltage control - line drop compensation																			
Applications of Capacitors to distribution systems: Effect of series and shunt capacitors – Power factor correction - economic justification for capacitors - a computerized method to determine the economic power factor - Procedure to determine the best and optimum capacitor location																			
Text Books:																			
<ol style="list-style-type: none"> 1. Turan Gonen —Electric Power Distribution system Engineering, MGH. 2. Dr. V. Kamaraju —Electrical distribution systems, Right Publishers 																			

Reference Books:

1. A.S. Pabla —Electric Power Distribution| TMH, 4th Ed., 1997.

Web References:

1. https://nptel.ac.in/noc/individual_course.php?id=noc18-ee15

E-Text Books:

1. https://books.google.co.in/books/about/ELECTRICAL_PW_DIST_SYS.html?id=QPCB76NuaLAC&redir_esc=y

Outcomes:

At the end of the course students able to

1. Student will able to calculate different distribution factors.
2. Understand classification of load, types of load curves.
3. Control of voltage and reactive power in distribution system

**Available MOOCs
(Open Elective)**

M.Tech III Semester: ELECTRICAL POWER SYSTEMS								
Course code	Category	Hours/week			Credits	Maximum Marks		
18EP303	Core	L	T	P	C	CIA	SEE	TOTAL
		4	0	0	4	40	60	100
Contact Classes:-	Tutorial Classes: -	Practical Classes: Nil			Total Classes:-			

Meeting with the global requirements, to inculcate the habit of self learning and in compliance with UGC guidelines, MOOC (Massive Open Online Course) courses have been introduced as electives. The main intention to introduce MOOCs is to obtain enough exposure through online tutorials, self-learning at one's own pace, attempt quizzes, discuss with professors from various universities and finally to obtain certificate of completion for the course from the MOOCs providers

Regulations for MOOCs

- The respective departments shall give a list from NPTEL or any other standard providers, whose credentials are endorsed by the HOD.
- Each department shall appoint Coordinators/Mentors and allot the students to them who shall be responsible to guide students in selecting online courses and provide guidance for the registration, progress and completion of the same.
- A student shall choose an online course (relevant to his/her programme of study) from the given list of MOOCs providers, as endorsed by the teacher concerned, with the approval of the HOD.
- The details of MOOC(s) shall be displayed in Grade card of a student, provided he/she submits the proof of completion of it to the department concerned through the Coordinator/Mentor.
- Student can get certificate from SWAYAM/NPTEL or any other standard providers, whose credentials are endorsed by the HOD. The course work should not be less than 12 weeks or student may appear for end examination conducted by the Institute.
- There shall be one Mid Continuous Internal Examination (Quiz exam for 40 marks) after 9 weeks of the commencement of the course and semester end examination (Descriptive exam for 60 marks) shall be done along with the other regular courses.
- Three credits will be awarded upon successful completion of each MOOC courses having minimum of 8 weeks duration.

POWER SYSTEM VOLTAGE STABILITY
(Elective – V)

M.Tech III Semester: ELECTRICAL POWER SYSTEMS																			
Course code	Category	Hours/week			Credits	Maximum Marks													
18EP304	Core	L	T	P	C	CIA	SEE	TOTAL											
		4	0	0	4	40	60	100											
Contact Classes:60	Tutorial Classes: -	Practical Classes: Nil			Total Classes:60														
OBJECTIVES:																			
The course should enable the students to:																			
1. estimate Reactive Power Control in Generation/Transmission Interconnected Networks																			
2. apply stability/Instability in Generation/Transmission Interconnected Networks																			
3. Detect reactive power compensation techniques & their practical importance																			
UNIT-I	Introduction to Voltage Stability						Classes:12												
Definitions: Voltage Stability, Voltage Collapse, Voltage Security; Physical relation indicating dependency of voltage on reactive power flow; Factors affecting Voltage collapse and instability; Previous cases of voltage collapse incidences																			
UNIT-II	Analysis of Voltage Stability						Classes:12												
Analysis of voltage stability on SMLB system: Analytical treatment and analysis.																			
Voltage Stability Indices: Voltage collapse proximity indicator; Determinant of Jacobin as proximity indicators; Voltage stability margin																			
UNIT-III	Power System Loads						Classes:12												
Loads that influences voltage stability: Discharge lights, Induction Motor, Air conditioning, heat pumps, electronic power supplies, OH lines and cables																			
UNIT-IV	Reactive Power Compensation						Classes:12												
Generation and Absorption of reactive power; Series and Shunt compensation; Synchronous condensers																			
UNIT-V	Voltage Stability& Security						Classes:12												
Voltage Stability Margin: Stability Margin: Compensated and un-compensated systems.																			
Voltage Security: Definition; Voltage security; Methods to improve voltage stability and its practical aspects																			
Text Books:																			
1. “Performance, operation and control of EHV power transmission system”-A. CHAKRABARTHY, D. P. KOTARI and A. K. MUKOPADYAY, A. H. Wheeler Publishing, I Edition, 1995.																			
2. “Power System Dynamics: Stability and Control” – K. R. PADIYAR, II Edition, B. S. Publications.																			
Reference Books:																			
1. “Power System Voltage Stability”- C. W. TAYLOR, McGraw Hill, 1994.																			
Web References:																			
1. https://nptel.ac.in/courses/108106026/																			

E-Text Books:

1. https://books.google.co.in/books/about/Power_system_voltage_stability.html?id=CPtSAA_AAMAAJ

Outcomes:

At the end of the course students able to

1. Understand issues related to power system stability and control.
2. Demonstrate various load models in voltage stability analysis.
3. Detect reactive power compensation techniques & their practical importance

DISTRIBUTION AUTOMATION
(Elective – V)

M.Tech III Semester: ELECTRICAL POWER SYSTEMS																			
Course code	Category	Hours/week			Credits	Maximum Marks													
18EP305	Core	L	T	P	C	CIA	SEE	TOTAL											
		4	0	0	4	40	60	100											
Contact Classes:60	Tutorial Classes: -	Practical Classes: Nil			Total Classes:60														
OBJECTIVES:																			
The course should enable the students to:																			
1. Describe the substation automation 2. Describe the feeder Automation 3. Describe the test remote metering and energy management																			
UNIT-I	Distribution System Planning and Automation						Classes:12												
Power Sector Reforms, Basic Distribution Systems, Short-Term Load Forecasting, Long-Term Energy Forecasting, Technological Forecasting, Problems of existing Distribution System, Need for Distribution Automation, Characteristics of Distribution System, Distribution Automation (Objectives, Functions, Benefits), Feeder Automation, Communication Requirements for DA, Remote Terminal Unit (RTU), Communication Technologies for DA																			
UNIT-II	SCADA System						Classes:12												
Introduction, Block Diagram, Components of SCADA, Functions of SCADA, and SCADA applied to Distribution Automation, Advantages of DA through SCADA, Requirements and Feasibility, DA Integration Mechanisms, Communication Protocols in SCADA Systems																			
UNIT-III	Substation Automation						Classes:12												
Introduction, Definition of Substation Automation, Functions of Substation Automation System, State and Trends of Substation Automation, Intelligent Affordable Substation Monitoring and Control, Advantages of an EEM (Enterprise Energy Management)																			
UNIT-IV	Substation Automation Solution: Feeder Automation						Classes:12												
Losses in Distribution Systems, System Losses and Loss Reduction, Network Reconfiguration, Improvement in Voltage Profile, Capacitor Placement in Distribution System for Reactive Power Compensation, Algorithm for location of capacitor.																			
UNIT-V	Remote Metering and Energy Management						Classes:12												
Background for Automatic Meter Reading (AMR) for Utility, Components of AMR Systems, Communications Methods used for Meter Reading, AMR System, Services and Functions, Financial Analysis, Planning for AMR Implementation. Energy Management, Need Based Energy Management (NBEM), Demand Side Management (DSM).																			
Text Books:																			
1. D. Bassett, K. Clinard, J. Grainger, S. Purucker, and D. Ward, “Tutorial Course:Distribution Automation”, IEEE Tutorial Publication 88EH0280-8-PWR, 1988. 2. Dr M K Khedkar and Dr G M Dhole, “A Textbook of Electric Power Distribution Automation”, University Science Press (Laxmi Publications Pvt. Ltd.), 2011.																			
Reference Books:																			
1. A. Momoh, “Electric Power Distribution, Automation, Protection, and Control”, CRC Press, Taylor and Francis Group, 2007																			

Web References:

1. <https://nptel.ac.in/courses/108106022/LECTURE%2011.pdf>
2. <https://nptel.ac.in/courses/108106022/11>

E-Text Books:

1. https://books.google.co.in/books/about/Power_Distribution_Automation.html?id=g0YxDAAAQBAJ&redir_esc=y

Outcomes:

At the end of the course students able to

1. Understand and distinguish characteristics of distribution systems from transmission systems
2. design, analyze and evaluate distribution system design based on forecasted data
3. Identify and select appropriate sub-station location
4. Design and evaluate a distribution system for a given geographical service area from alternate design alternatives

POWER SYSTEM DYNAMICS AND CONTROL
(Elective – V)

M.Tech III Semester: ELECTRICAL POWER SYSTEMS																			
Course code	Category	Hours/week			Credits	Maximum Marks													
18EP306	Core	L	T	P	C	CIA	SEE	TOTAL											
		4	0	0	4	40	60	100											
Contact Classes:60	Tutorial Classes: -	Practical Classes: Nil			Total Classes:60														
OBJECTIVES:																			
The course should enable the students to:																			
1 remember the dynamic characteristics of power system equipment, 2 recognize dynamic performance of power systems 3. illustrate the system stability and controls																			
UNIT-I	Basic Concepts					Classes:12													
Power system stability states of operation and system security - system dynamics - problems system model analysis of steady State stability and transient stability – simplified representation of Excitation control.																			
UNIT-II	Modeling of Synchronous Machine					Classes:12													
Synchronous machine - park's Transformation-analysis of steady state performance per - unit quantities-Equivalent circuits of synchronous machine determination of parameters of equivalent circuits																			
UNIT-III	Excitation System					Classes:12													
Excitation system modeling-excitation systems block Diagram – system representation by state equations- Dynamics of a synchronous generator connected to infinite bus - system model Synchronous machine model-stator equations rotor equations																			
UNIT-IV	Synchronous machine model					Classes:12													
Synchronous machine model with field circuit - one equivalent damper winding on q axis (model 1.1) - calculation of Initial conditions																			
UNIT-V	Application of Power System Stabilizers					Classes:12													
Basic concepts in applying PSS - Control signals - Structure and tuning of PSS - Washout circuit - Dynamic compensator analysis of single machine infinite bus system with and without PSS.																			
Text Books:																			
1. K. R. PADIYAR," Power system dynamics "- B.S. Publications 2. R. Ramanujam, "Power Systems Dynamics"- PHI Publications																			
Reference Books:																			
1. P.M. Anderson and A. A. Fouad, "Power system control and stability", IEEE Press																			
Web References:																			
1. https://nptel.ac.in/downloads/108101040/																			
E-Text Books:																			
1. https://books.google.co.in/books/about/Power_System_Dynamics.html?id=wZv92UdKxi4C&redir_esc=y																			

Outcomes:

At the end of the course students able to

1. Choose the fundamental dynamic behavior and controls of power systems to perform basic stability analysis
2. Comprehend concepts in modeling and simulating the dynamic phenomena of power systems Interpret results of system stability studies

PROJECT WORK PHASE – I

M.Tech III Semester: ELECTRICAL POWER SYSTEMS							
Course code	Category	Hours/week			Credits	Maximum Marks	
18EP307	Core	L 0	T 0	P 20	C 10	CIA	SEE Grade
Contact Classes:-	Tutorial Classes: -	Practical Classes: 40			Total Classes:40		

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 phase-I 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 work phase-I shall be initiated in the III semester and continued in the final semester. The candidate can submit Project work phase-I dissertation with the approval of I.D.C. after 18 weeks from the date of registration at the earliest from the date of registration for the project work phase-I.
- 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.
- Three copies of the Dissertation certified in the prescribed form by the supervisor and HOD shall be submitted to the HOD.
- The semester end examination for project work phase-I done during III Semester, shall be conducted by a Project Review Committee (PRC). The evaluation of project work shall be conducted at the end of the III Semester.
- The PRC comprises of an External examiner appointed by the Principal, Head of the Department and Project Guide/Supervisor to adjudicate the dissertation. The PRC shall jointly evaluate candidates work and award grades as given below.

S.No	Description	Grade	Grade Point (GP) Assigned
1	Very Good	Grade A	10
2	Good	Grade B	9
3	Satisfactory	Grade C	8
4	Not satisfactory	Grade D	0

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 dissertation.

PROJECT WORK PHASE – II

M.Tech IV Semester: ELECTRICAL POWER SYSTEMS								
Course code	Category	Hours/week			Credits	Maximum Marks		
18EP401	Core	L	T	P	C	CIA	SEE	TOTAL
		0	0	32	16	Grade		
Contact Classes:-	Tutorial Classes: -	Practical Classes: 60			Total Classes:60			

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 phase-I 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 work phase-II shall be initiated in the IV semester. The candidate can submit Project work phase-II dissertation with the approval of I.D.C. after 18 weeks from the date of registration at the earliest from the date of registration for the project work phase-I.
- 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.
- Three copies of the Dissertation certified in the prescribed form by the supervisor and HOD shall be submitted to the HOD.
- The semester end examination for project work phase-I done during III Semester, 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 dissertation. The PRC shall jointly evaluate candidates work and award grades as given below

S.No	Description	Grade	Grade Point (GP) Assigned
1	Very Good	Grade A	10
2	Good	Grade B	9
3	Satisfactory	Grade C	8
4	Not satisfactory	Grade D	0

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 dissertation.