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

POWER ELECTRONICS

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	**Semester scheme** 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.
3.6	**Credit courses** 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. • 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	**Subject Course Classification** 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.
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	**Academic requirements** The following academic requirements have to be satisfied, in addition to the attendance requirements mentioned in item no.4.

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	**Internal Evaluation for Theory Course:** The total internal weightage for theory courses is 40 marks with the following distribution. ➢ 30 marks for Mid-Term Examination ➢ 10 marks for Assignment Test 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). 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. 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. The final mid-term marks obtain by the addition of these two (80% + 20%). **Example**: If a student scores 33 marks and 34 marks in the first and second mid-term examinations respectively, then Weighted Average Marks = 34 x 0.8 + 33 x 0.2 = 33.8, rounded to 34 Marks. **Note**: The marks of any fraction shall be rounded off to the next higher mark.
6.5	**Pattern of the midterm examination question paper is as follows:** ➢ A total of three questions ➢ Question paper contains six questions are to be designed taking three questions from

	each unit (Unit Wise - Either or type) of the three units. (3X10=30 Marks) **Pattern of the Assignment Test is as follows:** ➢ 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. **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.
6.6	**Internal Evaluation for Practical Course:** 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.
6.7	**Internal Evaluation for Term Paper:** 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.
6.8	**Project Work:** 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: 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.
6.9	**External Evaluation for Theory Course - Semester End Examination:** The Semester End Examination in each theory subject shall be conducted for 3 hours duration at the end of the semester for 60 marks. **Pattern of the Semester End Examination question paper is as follows:** ➢ 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) 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.
6.10	**External Evaluation for Practical Course** 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-

voce examination with **5** marks for the record.

Each Semester External Lab Examination shall be evaluated by an Internal Examiner along with an External Examiner appointed by the Principal.

A candidate shall be declared to have passed in individual lab course if he secures a minimum of 50% aggregate marks (38 marks) (Internal & Semester External Examination marks put together), subject to a minimum of 50% marks (25 marks) in the semester external examination.

6.11 Project Work Phase-I:

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.

6.12 Project Work Phase-II:

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.

6.13 <u>Re-Registration For Improvement of Internal Evaluation Marks:</u>

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

- The candidate should have completed the course work and obtained examinations results for I, II & 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 **<u>three</u>** Theory subjects for Improvement of

Internal evaluation marks.

- ❖ The candidate has to re-register for the subjects so chosen and fulfill all the academic requirements.
- ❖ For each subject, the candidate has to pay a fee equivalent to one third of the semester tuition fee and the amount is to be remitted in the form of D.D. in favour of **'The Principal, Audisankara College of Engineering & Technology' payable at Gudur** along with the requisition through the Controller of the Examinations of the college.
- ❖ In the event of availing the Improvement of Internal evaluation marks, the internal evaluation marks as well as the End Examinations marks secured in the previous attempt(s) for the reregistered subjects stand cancelled.

7.0 **SEMESTER – WISE DISTRIBUTION OF CREDITS**

Semester	Theory	Practicals	Credits
M.Tech I Semester	5	2	22
M.Tech II Semester	4	2 + Term Paper	22
M.Tech III Semester	2	Project Work Phase-I	18
M.Tech IV Semester	0	Project Work Phase-II	16
		Total	78

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:

Marks Range	Letter Grade	Grade Points
91-100	S (Superior)	10
81-90	A (Excellent)	9
70-80	B (Very Good)	8
60-69	C (Good)	7
55-59	D (Average)	6
50-54	E (Pass)	5
<50	F (FAIL)	0
Ab (Absent)	Ab	0

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 ≥5 ('E' grade or above)
8.7	➢ 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	**Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):** 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. $$SGPA = \sum_{i=1}^{n}(Ci \times Gi) / \sum_{i=1}^{n} Ci$$ 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. 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. $$CGPA = \sum_{i=1}^{n}(Ci \times Si) / \sum_{i=1}^{n} Ci$$ 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. Both SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts. While computing the SGPA the subjects in which the student is awarded Zero grade points will also be included. ***Grade Point:*** It is a numerical weight allotted to each letter grade on a 10-point scale.

	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.
9.0	**Award of Class**
9.1	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: **Class Awarded** | **CGPA Secured** First class with Distinction | >= 8 First class | >= 7 and < 8 Second class | >= 5 and < 7
10.0	**Transitory regulations**
10.1	For students detained due to shortage of attendance: 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	For students detained due to shortage of credits: 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.
10.3	For readmitted students in R18 Regulations: 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.

	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.
11.0	**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.
12.0	**Student Transfers** Student transfers shall be as per the guidelines issued by the Government of Andhra Pradesh from time to time.
13.0	**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.
12.0	**Conduct and Discipline** ➢ 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 The following acts of omission and / or commission shall constitute gross violation of the code of conduct and are liable to invoke disciplinary measures with regard to ragging. (i) Lack of courtesy and decorum; indecent behavior anywhere within or outside the college campus. (ii) Damage of college property or distribution of alcoholic drinks or any kind of narcotics to fellow students / citizens. ➢ 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

	time to time. ➢ 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	**General** ➢ 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. 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.

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

	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.	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.
7	Leaves the examination hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that course and all the other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that Semester/year. The candidate is also debarred for two consecutive Semesters from class work and all Semester end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8	Possess any lethal weapon or firearm in the examination hall	Expulsion from the examination hall and cancellation of the performance in that course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that Semester/year. The candidate is also debarred and forfeits the seat.
9	If student of the college, who is not a candidate for the particular examination or any person not connected with the college	Student of the colleges expulsion from the examination hall and cancellation of the performance in that course and all other

	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 – Power Electronics

S.No	Course Code	Course Title	Hours per Week			Marks			Credits
			L	T	P	IM	EM	T	
1	18PE101	Modern Control Theory	4	0	0	40	60	100	4
2	18PE102	Electric Drives-I	4	0	0	40	60	100	4
3	**Elective-I**								
	18PE103	Machine Modelling and Analysis	4	0	0	40	60	100	4
	18PE104	Power Electronic Converters							
	18PE105	HVDC Transmission							
4	**Elective-II**								
	18PE106	Advanced Digital Signal Processing	4	0	0	40	60	100	4
	18PE107	Advanced Microprocessors and Microcontrollers							
	18PE108	Digital Control Systems							
5	18AS101	Research Methodology and IPR	2	0	0	40	60	100	2
6	18PE110	Power Converters lab	0	0	4	25	50	75	2
7	18PE111	Simulation Lab-I	0	0	4	25	50	75	2
		Total	**18**	**0**	**8**	**250**	**400**	**650**	**22**

M.Tech II Semester – Power Electronics

S.No	Course Code	Course Title	Hours per Week			Marks			Credits
			L	T	P	IM	EM	T	
1	18PE201	Flexible AC Transmission Systems	4	0	0	40	60	100	4
2	18PE202	Electric Drives-II	4	0	0	40	60	100	4
3	**Elective-III**								
	18PE203	Distributed Generation	4	0	0	40	60	100	4
	18PE204	Renewable Energy Systems							
	18PE205	Energy Auditing, Conversation and Management							
4	**Elective-IV**								
	18PE206	Programmable Logic Controllers and applications	4	0	0	40	60	100	4
	18PE207	Smart Grid							
	18PE208	Artificial Intelligence Computing Techniques and Applications							
5	18PE209	Renewable Energy Systems Lab	2	0	0	40	60	100	2
6	18PE210	Simulation Lab-II	0	0	4	25	50	75	2
7	18PE211	Term Paper	0	0	4	50	-	50	2
		Total	**18**	**0**	**8**	**275**	**350**	**625**	**22**

M.Tech III Semester – Power Electronics

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**								
	18PE304	Advanced Power Electronic Converters	4	0	0	40	60	100	4
	18PE305	Switched Mode Power Supplies(SMPS)							
	18PE306	Special Machines							
3	18PE307	Project Work Phase-I	0	0	20	Grade			10
Total			**8**	**0**	**8**	**80**	**120**	**200**	**18**

M.Tech IV Semester – Power Electronics

S.No	Course Code	Course Title	Hours per Week			Marks			Credits
			L	T	P	IM	EM	T	
1	18PE401	Project Work Phase-II	0	0	32	Grade			16
Total			**0**	**0**	**32**	**Grade**			**16**

Open Electives – Power Electronics

S.No	Course Code	Course Title
1	18PE301	Hybrid Electric Vehicles
2	18PE302	Electric Traction systems
3	18PE303	Available MOOCs

MODERN CONTROL THEORY

M.Tech I Semester: POWER ELECTRONICS								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
18EP101	**Core**	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. 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, igen 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 – Krasooviski's method.

Text Books:

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

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.

ELECTRIC DRIVES-I

M.Tech I Semester: Power Electronics								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
18PE102	**Core**	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. Students are able to understand of main principles of DC drives.
2. Students are able to understand various modes of operation, control from converters and choppers.

UNIT-I	Controlled Bridge Rectifier	Classes:12

(1-Φ) with DC Motor Load: Separately excited DC motors with rectified single phase supply-single phase semi converter and single phase full converter for continuous and discontinuous modes of operation – power and power factor.

(3-Φ) with DC Motor Load - Three phase semi converter and three phase full converter for continuous and discontinuous modes of operation – power and power factor – Addition of Freewheeling diode – Three phase double converter.

UNIT-II	DC Motor Drives	Classes:12

Three Phase Naturally Commutated Bridge Circuit as a Rectifier or as an Inverter: Three phase controlled bridge rectifier with passive load impedance, resistive load and ideal supply – Highly inductive load and ideal supply for load side and supply side quantities, shunt capacitor compensation, three phase controlled bridge rectifier inverter.

Phase Controlled DC Motor Drives - Three phase controlled converter, control circuit, control modeling of three phase converter – Steady state analysis of three phase converter control DC motor drive – Two quadrant, Three phase converter controlled DC motor drive – DC motor and load, converter.

UNIT-III	Current and Speed Controlled DC Motor Drives	Classes:12

:Current and Speed controllers -current and speed feedback — Design of controllers - Current and Speed controllers – Motor equations – Filter in the speed feedback loop speed controller – current reference generator –current controller and flow chart for simulation – Harmonics and associated problems – sixth harmonics torque.

Chopper controlled DC motor drives: Principle of operation of the chopper – Four quadrant chopper circuit – Chopper for inversion – Chopper with other power devices – model of the chopper –input to the chopper – Steady state analysis of chopper controlled DC motor drives – rating of the devices – Pulsating torque.

UNIT-IV	Closed Loop Operation of DC Motor Drives	Classes:12

Speed controlled drive system – current control loop – pulse width modulated current controller – hysteresis current controller – modeling of current controller – design of current.

UNIT-V	Simulation of DC motor Drives	Classes:12

Dynamic simulations of the speed controlled DC motor drives – Speed feedback speed controller – command current generator – current controller.

Text Books:

1. Shepherd, Hulley, Liang, Power Electronics and motor control – II Edn, CU Press.1995
2. R. Krishnan, Electric motor drives modeling, Analysis and control – I Edn, PHI.2001.

Reference Books:

1. Md.H.Rashid, Power Electronic Circuits, Devices and Applications –PHI, I Edn2004.
2. I.J. Nagarath and M.Gopal "Control Systems Engineering", New Age International (P) Ltd.
3. G. K. Dubey, Fundamentals of Electric Drives – Narosa Publications – 1995.

Web References:

1. https://www.nptel.ac.in/courses/108108077/

E-Text Books:

1. https://books.google.co.in/books/about/ELECTRIC_DRIVES.html?id=YikAs8Bp0yYC&redir_esc=y

Outcomes:

At the end of the course students able to

1. Competency in developing Dynamic model of drive system
2. Fitness' in solving typical drive issues.
3. Skill in Transient analysis of drive system

MACHINE MODELLING AND ANALYSIS
(Elective – I)

M.Tech I Semester: Power Electronics

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
18PE103	Core	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 the concept of 2-axis representation of an Electrical machine.
2. To know the concepts of representing transfer function model of a DC machine.
3. To understand the importance of 3-phase to 2-phase conversion.
4. To know the representation of 3-phase induction motor in various reference frames.

UNIT-I	Basic Concepts of Modeling	Classes:12

: Basic Two-pole Machine representation of commutator machines, 3-phase synchronous machine with and without damper bars and 3-phase induction machine, Kron's primitive Machine-voltage, current and Torque equations.

DC Machine Modeling: Mathematical model of separately excited D.C motor – Steady State analysis-Transient State analysis-Sudden application of Inertia Load-Transfer function of Separately excited D.C Motor- Mathematical model of D.C Series motor, Shunt motor-Linearization Techniques for small perturbations.

UNIT-II	Modeling of Three Phase Induction Machine	Classes:12

Modeling of Three Phase Induction Machine-I: Transformation from Three phase to two phase and Vice Versa - Transformation from Rotating axes to stationary axes and vice versa –Park‟s Transformation and its physical concept –The Inductance matrix-Mathematical model of Induction machine –Steady State analysis.

Modeling of Three Phase Induction Machine-II: d-q model of induction machine in Stator reference Frame, Rotor reference Frame and Synchronously rotating reference Frame -Small signal equations of induction machine-d-q flux linkages model derivation- Signal flow graph of the induction machine-Per unit model –Dynamic simulation of induction machine.

UNIT-III	Modeling of Single Phase Induction Machine	Classes:12

Modeling of Single Phase Induction Machine: Comparison between single phase and poly-phase induction motor - Cross field theory of single phase induction machine, steady state analysis – steady state torque.

Modeling of Synchronous Machine Synchronous Machine: Inductances-the phase Co-ordinate model-the Space phasor (d-q) model-Steady state operation-Mathematical model of PM Synchronous motor.

UNIT-IV	Modeling of Special Machines-I:	Classes:12

Modeling of Special Machines-I: Modeling of Permanent Magnet Brushless DC Motor – Operating principle-Mathematical modeling of PM Brushless DC motor-PMDC Motor Drive Scheme.

UNIT-V	Modeling of Special Machines-II:	Classes:12

Modeling of Special Machines-II: Mathematical model of Switched Reluctance Motor-Operating principle-Construction and functional Aspects-Average torque and Energy Conversion Ratio-The Commutation windings-SRM modeling-The flux current position curve fitting.

Text Books:

1. P.S.Bimbra, Generalized Theory of Electrical Machines, Khanna publications - 5th edition-1995.
2. P.C.Krause, Analysis of Electrical Machinery – McGraw Hill- 1980.

Reference Books:

1. R.Krishnan, Electric Motor Drives - Modeling, Analysis& control Pearson Publications-1st edition – 2002.
2. C.V.jones, Butterworth, The Unified Theory of Electrical Machines - London, 1967.

Web References:

1. https://nptel.ac.in/courses/108106023/

E-Text Books:

1. https://www.ikbooks.com/books/book/engineering-computer-science/electrical-engineering/modeling-analysis-electrical-machine/9789384588267/

Outcomes:

At the end of the course students able to

1. Know-How of Electromagnetic energy conversion techniques
2. Competency in modeling asynchronous & synchronous induction machine
3. Ability to analyze steady state & dynamic operation of induction machine
4. Capability in contriving drive operation as per the industry requirements.

POWER ELECTRONIC CONVERTERS
(Elective – I)

M.Tech I Semester: Power Electronics

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
18PE104	Core	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. Learn the principles of operation of power electronic converters
2. Understand how to design dc-dc power converters.
3. Understand the principles of operation of soft switching converters.

UNIT-I	AC Voltage Controllers	Classes:12

Single Phase AC Voltage Controllers: Single Phase AC Voltage Controllers with resistive, resistive-inductive and resistive-inductive induced emf loads-ac voltage controllers with PWM control-Effects of source and load inductances-synchronous tap changers –Application- numerical problems.

Three Phase AC Voltage Controllers: Three Phase AC Voltage controllers-Analysis of Controllers with star and delta connected resistive, resistive –inductive loads-Effects of source and load inductances–Application-problems.

UNIT-II	Cycloconverters	Classes:12

Cyclo converters: Single phase to single phase cycloconverters –analysis of midpoint and bridge configurations three phase to three phase cycloconverters-analysis of Midpoint and bridge configurations-Limitations-Advantages-Applications-numerical problems.

Single phase converters: Single phase cycloconverters- Half controlled and fully controlled Converters – Evaluation of input power factor and harmonic factor-Continuous and Discontinuous load current-Single phase dual converters-Power factor improvements-Extinction angle control-symmetrical angle control-PWM single phase sinusoidal PWM-Single phase series converters-– Application- Problems.

UNIT-III	D.C. to D.C Converters	Classes:12

Three Phase Converters: Three Phase Converters- Half controlled and fully controlled Converters – Evaluation of input power factor and harmonic factor-Continuous and Discontinuous load current-three phase dual converters-Power factor improvements-three phase PWM-twelve pulse converters–Application problems

D.C. to D.C Converters: Analysis of step-down and step up dc to dc converters with resistive and resistive –inductive loads-Switched mode regulators- Analysis of Buck regulators-Boost Regulators-Buck-Boost Regulators-Cuk Regulators- Condition for continuous inductor and capacitor voltage-Comparison of regulators-Multi output boost regulators –advantages – Application- problems.

UNIT-IV	Pulse Width Modulated Inverters (Single Phase Inverter):	Classes:12

Principle of operation- Performance parameters- Single Phase bridge Inverters-Evaluation of output voltage and current with resistive, inductive and capacitive loads-Voltage control of single phase inverters – Single PWM-Multiple PWM-Sinusoidal PWM-modified PWM-phase

displacement control-Advanced Modulation techniques for improved performance , Trapezoidal, staircase ,stepped, harmonic injection and delta modulation – Advantage-Applications-problems.

UNIT-V	Pulse Width Modulated Inverters (Three Phase Inverter):	Classes:12

Three Phase inverters-analysis of 180 degree condition of output voltage and current with resistive, inductive loads-analysis of 120 degree conduction-Voltage control of three phase inverters-sinusoidal PWM-third harmonic PWM-60 degree PWM –space vector modulation comparison of PWM techniques-Space vector modulation.

Text Books:

1. Md.H.Rashid, Power Electronics Pearson Education 3rd Edition, 2004.
2. N.Mohan, Tore.M.Undeland, W.P.Robbins, Power Electronics –John Wiley, -2nd Edition. 1989.

Reference Books:

1. P.S.Bimbhra "Power Electronics", Khanna publishers-(2004).
2. M.D.Singh and K.B.Khanchandani, Power Electronics TMH-2002.

Web References:

1. https://ocw.tudelft.nl/courses/electronic-power-conversion/

E-Text Books:

1. https://onlinelibrary.wiley.com/doi/book/10.1002/9783527698523

Outcomes:

At the end of the course students able to

1. Students are exposed to analysis, design, and applications of power electronic converters and motor drives.
2. Become proficient with computer skills (e.g., PSPICE and MATLAB) for the simulated analysis and design of power electronic circuits
3. Ability to design, set up, and circuits in the laboratory test power electronic.

HVDC TRANSMISSION
(Elective – I)

M.Tech I Semester: Power Electronics

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
18PE105	Core	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. Mould students to acquire knowledge about HVDC Transmission systems.
2. This course gives idea about modern trends in HVDC Transmission and its application.
3. Understand about the overvoltage and its effects on power system.
4. Analysis harmonics and basis of protection for HVDC Systems.

UNIT-I	HVDC Transmission	Classes:12

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

UNIT-II	Harmonics in HVDC systems	Classes:12

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

UNIT-III	HVAC & DC systems	Classes:12

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

UNIT-IV	Transient over voltage in HVDC systems	Classes:12

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

UNIT-V	Protection of HVDC	Classes:12

Converter faults and protection in HVDC systems: Converter faults, over current protection- valve group and DC line protection. Over voltage protection of converters, surge arresters.

Text Books:

1. E.W.Kimbark: Direct current Transmission, Wiely inter Science- New York.1971.
2. J.Arillaga: H.V.D.C.Tranmission peter peregrilnus ltd., London UK 1983.

Reference Books:

1. K.R.Padiyar: High Voltage Direct current Transmission, Wiely Eastern Ltd.1990.
2. E.Uhlman: Power Transmission by Direct Current Springer Verlag, Berlin.1975.

Web References:

1. https://nptel.ac.in/courses/108104013/

E-Text Books:

1. https://books.google.co.in/books/about/HVDC_TRANSMISSION.html?id=BYSDmGC2DJYC&redir_esc=y

Outcomes:

At the end of the course students able to

1. Proficiency in HVDC converter systems design
2. Know-how of operation of Power electronics in HVDC system
3. Competency in designing filters & DC link control for HVDC System.
4. Acquaintance with MTDC system & its open challenges.

ADVANCED DIGITAL SIGNAL PROCESSING
(Elective – II)

M.Tech I Semester: POWER ELECTRONICS

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
18PE106	Core	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 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:

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:

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		
		L	T	P	C	CIA	SEE	Total
18PE107	Core	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. Expose the students to the fundamentals of microprocessor architecture.
2. Introduce the advanced features in microprocessors and microcontrollers.
3. Enable the students to understand various microcontroller architectures.

UNIT-I	High Performance CISC Architecture – PENTIUM	Classes:12

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

UNIT-II	High Performance RISC Architecture – ARM	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 boot loader – Embedded Operating systems – Integrated Development Environment- STDIO Libraries – Peripheral Interface – Application of ARM Processor – Caches – Memory protection Units – Memory Management units – Future ARM Technologies.

UNIT-IV	Motorola 68HC11 Microcontrollers	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:

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

Reference Books:

1. Steve Furber, "ARM System –On –Chip architecture", Addision Wesley, 2000.
2. Daniel Tabak, "Advanced Microprocessors", 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.html?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.

DIGITAL CONTROL SYSTEMS
(Elective – II)

M.Tech I Semester: Power Electronics

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
18PE108	Core	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 the concepts of digital control systems and assemble various components associated with it. Advantages compared to the analog type.
2. The theory of z–transformations and application for the mathematical analysis of digital control systems.
3. To represent the discrete–time systems in state–space model and evaluation of state transition matrix.
4. To study the design of state feedback control by "the pole placement method."

UNIT-I	Introduction and signal processing	Classes:12

Introduction to analog and digital control systems – Advantages of digital systems – Typical examples – Signals and processing – Sample and hold devices – Sampling theorem and data reconstruction – Frequency domain characteristics of zero order hold.

Z–transformations : Z–Transforms – Theorems – Finding inverse z–transforms – Formulation of difference equations and solving – Block diagram representation – Pulse transfer functions and finding open loop and closed loop responses.

UNIT-II	State space analysis	Classes:12

State space analysis and the concepts of Controllability and observability State Space Representation of discrete time systems – State transition matrix and methods of evaluation – Discretization of continuous – Time state equations – Concepts of controllability and observability – Tests (without proof).

UNIT-III	Stability analysis	Classes:12

Mapping between the S–Plane and the Z–Plane – Primary strips and Complementary Strips – Stability criterion – Modified routh's stability criterion and jury's stability test.

UNIT-IV	Design of discrete–time control systems	Classes:12

Conventional methods : Transient and steady state specifications – Design using frequency response in the w–plane for lag and led compensators – Root locus technique in the z– plane.

UNIT-V	State feedback controllers	Classes:12

Design of state feedback controller through pole placement – Necessary and sufficient conditions – Ackerman's formula.

Text Books:

1. Discrete–Time Control systems – K. Ogata, Pearson Education/PHI, 2nd Edition.

Reference Books:

1. Digital Control Systems, Kuo, Oxford University Press, 2nd Edition, 2003.
2. Digital Control and State Variable Methods by M.Gopal, TMH

Web References:

1. https://nptel.ac.in/courses/108103008/

E-Text Books:

1. https://books.google.co.in/books/about/Digital_control_systems.html?id=iNlSAAAAMAAJ

Outcomes:

At the end of the course students able to

1. Have in-depth knowledge and critical understanding of the theory and principles of digital control systems and their applications.
2. To distinguish the specific characteristics and differences of discrete/digital, hybrid and analog systems.
3. Transform an analog system to discrete and vice versa.
4. Apply digital control systems' principles and techniques to discrete or continuous time systems

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**	**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 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 emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
6. Understand the IOR 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 infringment 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, 2nd Edition, "Research Methodology: A step by Step Guide for beginers"	
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 CONVERTERS LABORATORY

M.Tech I Semester: POWER ELECTRONICS								
Course code	**Category**	**Hours/week**			**Credits**	**Maximum Marks**		
18PE110	**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
2. Introduce power electronics components from which the characteristics of SCR, TRIAC, IGBT and MOSFET are obtained.

LIST OF EXPERIMENTS

EXP 1	**Speed Measurement and closed loop control using PMDC motor**
To measure the speed and to operate PMDC motor in a closed loop	
EXP 2	**Thyristorised drive for PMDC Motor with speed measurement and closed loop control.**
To measure the PMDC motor speed using Thyristorised drive	
EXP 3	**IGBT used single 4 quadrant chopper drive for PMDC motor with speed measurement and Closed loop control.**
To measure the PMDC motor speed using four quadrant chopper	
EXP 4	**Thyristorised drive for 1 HP DC motor with closed loop control.**
To control DC motor in closed loop using Thyristorised drive	
EXP 5	**3 Phase input, Thyristorised drive, 3 HP DC motor with closed loop.**
To control DC motor in closed loop using three phase Thyristorised drive	
EXP 6	**3 Phase input IGBT, 4 quadrant chopper drive for DC motor with closed loop control Equipment.**
To control DC motor in closed loop using three phase four quadrant chopper	
EXP 7	**Cycloconverter based AC Induction motor control equipment.**
To control AC induction motor using Cycloconverter	
EXP 8	**Speed control of 3 phase wound rotor Induction motor.**
To control the speed of a three phase induction motor	
EXP 9	**Single phase fully controlled converter with inductive load**
To design a single phase fully controlled converter with inductive load	
EXP 10	**Single phase half wave controlled converter with inductive load.**
To design a single phase half controlled converter with inductive load	

Outcomes:

At the end of the course students able to

1. Upon completing this lab students must be able to correlate theoretical and practical analysis of AC-AC, DC-AC converters and also converter fed to AC&DC drive Develop software for power system industry

SIMULATION LABORATORY-I

M.Tech I Semester: POWER ELECTRONICS								
Course code	**Category**	**Hours/week**			**Credits**	**Maximum Marks**		
18PE111	**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. Make the students to Simulate Programs in MATLAB
2. Make the students to design 1-phase and 3-ph circuits

List of experiments

EXP 1	**Solution of simultaneous algebraic equations of Electrical network.**
To obtain the solution for simultaneous algebraic equations of Electrical network.	
EXP 2	**Solution of simultaneous differential equations of a given network.**
To obtain the solution for simultaneous differential equations of a given network.	
EXP 3	**Formation of incidence matrices.**
To calculate incidence matrices	
EXP 4	**Formation of network matrices by singular or nonsingular transformations.**
To perform by singular or nonsingular transformations for a given network matrices	
EXP 5	**Simulation of 1-phase diode bridge rectifier.**
To design and observe the output waveforms of Single Phase diode bridge rectifier.	
EXP 6	**Simulation of 1-phase controlled rectifier.**
To design and observe the output waveforms of Single Phase controlled rectifier.	
EXP 7	**Simulation of Single Phase AC voltage Controller.**
To design and observe the output waveforms of Single Phase AC voltage Controller.	
EXP 8	**Transfer function analysis of given system using Simulink.**
To analyze the given transfer function using MATLAB program	
EXP 9	**State space analysis of a control system using MATLAB.**
To carry out the state space analysis of given control system using MATLAB program	
EXP 10	**Conversion of the given state system into a suitable diagonal form.**
To convert the given state system into a suitable diagonal form.	

Outcomes:

At the end of the course students able to

1. Upon completing this lab students must be able to correlate theoretical and practical analysis of AC-AC, DC-AC converters in MATLAB

FLEXIBLE AC TRANSMISSION SYSTEMS

M.Tech II Semester: POWER ELECTRONICS								
Course code	**Category**	**Hours/week**			**Credits**	**Maximum Marks**		
18PE201	**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 fundamentals of FACTS Controllers, Importance of controllable parameters and types of FACTS controllers & their benefits
2. recall the objectives of Shunt and Series compensation
3. 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:

1. Hingorani H G and Gyugyi. L "Understanding FACTS-Concepts and Technology of Flexible AC Transmission Systems" New York, IEEE Press, 2000.
2. Padiyar.K.R, " FACTS Controllers in Power Transmission and Distribution" New Age Int. Publishers, 2007

Reference Books:

1. Yong-Hua Song, Allan Johns, "Flexible AC Transmission Systems", IET,1999
2. 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

ELECTRIC DRIVES-II

M.Tech II Semester: Power Electronics							
Electrical& Electronics Engineering							
Course Code	Category	Hours/Week			Credits	Maximum Marks	
		L	T	P	C	CIA	SEE	Total
18PE202	Core	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 basic principles of power electronics in drives using switch-mode converters and pulse width modulation to synthesize the voltages in dc and ac motor drives.
2. Design torque, speed and position controller of motor drives.
3. Describe the operation of induction machines in steady state that allows them to be controlled in induction-motor drives.
4. Learn the basic operation of stepper motors and switched-reluctance motor drives.

UNIT-I	Introduction to AC Drives:	Classes:12

Introduction to motor drives-torque production- Equivalent circuit analysis-Speed-Torque characteristics with variable voltage operation, variable frequency operation, constant v/f operation-Induction motor characteristics in constant torque and field weakening regions. **Control of Induction Motor Drives at Stator side:** Scalar control-Voltage fed inverter control-Open loop volts/Hz Control-Speed control slip regulation- Speed control with torque and flux control-Current controlled voltage fed inverter drive-Current fed inverter control-Independent current and frequency control-Speed and flux control in current fed inverter drive-Volts/Hertz Control current fed-Inverter drive-Efficiency optimization control by flux program.

UNIT-II	Induction Motor Drives	Classes:12

Control of Induction Motor at Rotor Side: Slip power recovery drives-Static Kramer Drive-Phasor diagram-Torque expression-Speed control of Kramer Drive-Static Scheribus Drive-Modes of operation.

Vector Control of Induction Motor Drives: Principles of Vector Control-Vector Control Methods-Direct method of Vector control-Adaptive control principles-Self tuning regulator-Model referencing control.

UNIT-III	Synchronous Motor Drives	Classes:12

Control of Synchronous Motor Drives: Synchronous motor and its characteristics – control strategies – constant torque angle control-Unity power factor control-Constant mutual flux linkage control

Controllers: Flux weakening operation- Maximum speed-Direct flux weakening algorithm – Constant torque mode controller- Flux Weakening controller- Indirect flux weakening – Maximum permissible torque-Speed control scheme- Implementation strategy – Speed controller design.

UNIT-IV	Variable Reluctance Motor Drive	Classes:12

Variable reluctance motor drives- Torque Production in the variable reluctance motor- Drive characteristics and control principles- Current control variable reluctance servo drive.

UNIT-V	Brushless DC motor Drives	Classes:12

Three phase full wave Brushless dc motor – Sinusoidal type of Brushless dc motor

Text Books:

1. R.Krishnan, Electric Motor Drives modeling, analysis and control Pearson Publication.
2. B.K Bose- Modern Power Electronics and AC drives Pearson Publication -1ST Edition.2002.
3. MD Murphy & FG Turn Bull, Power Electronic Control of AC motors Pergman Press.

Reference Books:

1. Power Electronics Circuits, Devices and Application- M.H Rashid –PHI 1995.
2. GK Dubey, Fundamentals of Electric Drives Narora Publications -1995.
3. B.K.Bose, Power Electronics and Variable Frequency drives IEEE press-Standard publication-1st Edition-2002.

Web References:

1. https://nptel.ac.in/syllabus/108104011/

E-Text Books:

1. https://onlinelibrary.wiley.com/doi/book/10.1002/9781118910962

Outcomes:

At the end of the course students able to

1. Competency in developing Dynamic model of drive system.
2. Fitness' in solving typical drive issues.
3. Ability in control strategy of cycloconverter based Drives.
4. Skill in Transient analysis of drive system

DISTRIBUTED GENERATION
(Elective – III)

M.Tech II Semester: POWER ELECTRONICS								
Course code	**Category**	**Hours/week**			**Credits**	**Maximum Marks**		
18PE203	**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. Modeling & analysis of Micro-grids with multiple DGs. Micro-grids with power electronic interfacing units.

UNIT-V	**Transient analysis of micro grids**	**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: POWER ELECTRONICS								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
18PE204	**Core**	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 valve, 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**
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: POWER ELECTRONICS

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
18EP205	Core	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. Impart knowledge in the domain of energy conservation.
2. Bring out Energy Conservation Potential and Business opportunities across different user segments under innovative business models.
3. 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.

Web References:

1. https://nptel.ac.in/courses/108106022/

E-Text Books:

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

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: POWER ELECTRONICS

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
18PE206	Core	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 function of a programmable logic controller and name various applications
2. Identify and describe the functions of the five basic components of a PLCs
3. 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:

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:

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: POWER ELECTRONICS								
Course code	**Category**	**Hours/week**			**Credits**	**Maximum Marks**		
18PE207	**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 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. 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: POWER ELECTRONICS								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
18PE208	**Core**	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 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, Genenetic 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:

1. https://nptel.ac.in/courses/106106126/

E-Text Books:

1. https://www.isibang.ac.in/~dst-ss-mmg/Deekshatulu-20ISI%20Bengul%20IC%206Aprl%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: POWER ELECTRONICS								
Course code	**Category**	**Hours/week**			**Credits**	**Maximum Marks**		
18PE209	**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 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 trough 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

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: POWER ELECTRONICS								
Course code	**Category**	**Hours/week**			**Credits**	**Maximum Marks**		
18PE210	**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	**Simulation of firing schemes: Ramp, Cosine, PWM.**
To generate the firing pulses for ramp and cosine using PWM	
EXP 2	**Simulation of Single phase fully controlled converter with R and R-L load.**
To design a simulink model and observe the output wave form of Single phase fully controlled converter with R and R-L load.	
EXP 3	**Simulation of Three phase fully controlled converter with R and R-L load.**
To design a simulink model and observe the output wave form of Three phase fully controlled converter with R and R-L load.	
EXP 4	**Simulation of Three phase AC Voltage controller with R and R-L Load.**
To design a simulink model and observe the output wave form of Three phase AC Voltage controller with R and R-L Load.	
EXP 5	**Simulation of three phase inverter in 120^0 conduction mode load connected both in star & delta**
To design a simulink model and observe the output wave form of three phase inverter in 120^0 conduction mode load connected both in star & delta	
EXP 6	**Simulation of three phase inverter in 180^0 conduction mode load connected both in star & delta**
To design a simulink model and observe the output wave form of three phase inverter in 180^0 conduction mode load connected both in star & delta	
EXP 7	**Simulation of step-down & step-up choppers**
To design a simulink model and observe the output wave form of step-down & step-up choppers	
EXP 8	**Simulation of buck & boost converter**
To design a simulink model and observe the output wave form of buck & boost converter	
EXP 9	**Simulation of cuk converter**
To design a simulink model and observe the output wave form of cuk converter	
EXP 10	**Simulation of Z-source inverter**
To design a simulink model and observe the output wave form of Z-source inverter	
EXP 11	**Simulation of Single phase Cycloconverter**
To design a simulink model and observe the output wave form of Single phase Cycloconverter	
EXP 12	**PWM pulse generation through MATLAB program**
To develop a MATLAB program that generate firing pulses using PWM method	

Outcomes:

At the end of the course students able to

1. Designing of Power electronics circuits in MATLAB.

TERM PAPER

M.Tech II Semester: POWER ELECTRONICS								
Course code	**Category**	**Hours/week**			**Credits**	**Maximum Marks**		
18PE211	**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: POWER ELECTRONICS								
Course code	**Category**	**Hours/week**			**Credits**	**Maximum Marks**		
18PE301	**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

ELECTRIC TRACTION SYSTEMS
(Open Elective)

M.Tech III Semester: POWER ELECTRONICS								
Course code	**Category**	**Hours/week**			**Credits**	**Maximum Marks**		
18PE302	**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 Students can able to understand traction motors.

2 Students can understand urban, suburban and express train movements.

UNIT-I	INTRODUCTION TO ELECTRIC TRACTION	Classes:12

Present scenario of Indian Railways – High speed traction, Metro, Latest trends in traction-Metro, monorail, Magnetic levitation Vehicle, Steam, diesel, diesel-electric, Battery and electric traction systems, General arrangement of D.C.,A.C. single phase,3phasehase,Composite systems, Choice of traction system - Diesel- Electric or Electric

UNIT-II	URBAN AND SUB URBAN TRACTION	Classes:12

Analysis of speed time curves for main line, suburban and urban services, Simplified speed time curves., Relationship between principal quantities in speed time curves, Requirement of tractive effort, Specific energy consumption and Factors affecting it.

UNIT-III	TRACTION MOATORS	Classes:12

Features of traction motors., Significance of D.C. series motor as traction motor, A. C. Traction motors-single phase, Three phase, Linear Induction Motor, Comparison between different traction motors, Series-parallel control, Open circuit, Shunt and bridge transition, Pulse Width Modulation control of induction motors, Types of electric braking system.

UNIT-IV	CONTROLLING METHODS IN TRACTION	Classes:12

Important features of electric locomotives, Different types of locomotives, Current collecting equipment, Coach wiring and lighting devices, Power conversion and transmission systems, Control and auxiliary equipment.

UNIT-V	TRACTION SUBSTATIONS	Classes:12

Distribution systems pertaining to traction (distributions and feeders), Traction sub-station requirements and selection, Method of feeding the traction sub- station

Text Books:

1. Modern Electric Traction, H. Partab, Dhanpat Rai and Sons, New Delhi
2. Electric Traction, J. Upadhyay S. N. Mahendra, Allied Publishers Ltd., Dhanpat Rai and Sons
3. Electric Traction, A.T. Dover, Mac millan, Dhanpat Rai and Sons, New Delhi.

Reference Books:

1. Electric Traction Hand Book, R. B. Brooks, Sir Isaac Pitman and sons ltd. London

Web References:

1. https://nptel.ac.in/courses

E-Text Books:

1. https://books.google.co.in

Outcomes:

At the end of the course students able to

1. Distinguish different traction systems and latest trends in traction systems
2. Differentiate services of traction system based on speed time curve.
3. Control different types of traction motors
4. Use various traction system auxiliaries.
5. Explain the distribution system of a traction system.

Available MOOCs
(Open Elective)

<table>
<tr><td colspan="9">M.Tech III Semester: Power Electronics</td></tr>
<tr><td>Course code</td><td>Category</td><td colspan="3">Hours/week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">18PE303</td><td rowspan="2">Core</td><td>L</td><td>T</td><td>P</td><td>C</td><td>CIA</td><td>SEE</td><td>TOTAL</td></tr>
<tr><td>4</td><td>0</td><td>0</td><td>4</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="2">Contact Classes:-</td><td colspan="2">Tutorial Classes: -</td><td colspan="2">Practical Classes: Nil</td><td colspan="3">Total Classes:-</td></tr>
<tr><td colspan="9">Meeting with the global requirements, to inculcate the habit of self learning and incompliance with UGC guidelines, MOOC (Massive Open Online Course) courses have been introduced as electives. The main intension 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.</td></tr>
</table>

ADVANCED POWER ELECTRONIC CONVERTERS
(Elective – V)

M.Tech III Semester: Power Electronics							
Electrical& Electronics Engineering							
Course Code	Category	Hours/Week			Credits	Maximum Marks	
		L	T	P	C	CIA	SEE	Total
18PE304	Core	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. Deepen understanding of power converters in both theoretical and practical aspects.
2. Design power electronics converters.
3. Solve complex problems related to different applications of power electronics converters.

UNIT-I	Modern Power Semiconductor Devices	Classes:12

Modern power semiconductor devices- MOS Turn Off Thyristor (MTO) – Emitter Turn Off Thyristor (ETO) – Integrated Gate – Commutated thyristor (IGCTs) – MOS – Controlled thyristors (MCTs) – Static induction Thyristors (SITHs) – Power integrated circuits (PICs) –Symbol, structure and equivalent circuit- comparison of their features.

UNIT-II	Resonant Pulse Inverters	Classes:12

Resonant pulse inverters – series resonant inverters- series resonant inverters with unidirectional switches – series resonant inverters with bidirectional switches- analysis of half bride resonant inverter- evaluation of currents and Voltages of a simple resonant inverter – analysis of half bridge and full bridge resonant inverter with bidirectional switches – Frequency response of series resonant inverter- for series loaded inverter – for parallel resonant inverters – Voltage control of resonant inverters-class E resonant inverter – class E resonant rectifier- evaluation of values of capacitor and inductor for class E inverter and Class E rectifier – numerical problems

UNIT-III	Resonant Converters	Classes:12

Resonant converters- zero current switching resonant converters – L type ZCS resonant converter- M type ZCS resonant converter – zero voltage switching resonant converters – comparison between ZCS and ZVS resonant converters- Two quadrant ZVS resonant converters – resonant dc – link inverters- evaluation of L and C for zero current switching inverter –problems.

UNIT-IV	Multilevel Inverters	Classes:12

Multilevel concept- Classification of multilevel inverters – Diode clamped multilevel inverter- Principle of operation – main features- improved diode clamped inverter – principle of operation – Flying capacitors multilevel inverter – principle of operation – main features. Cascaded multilevel inverter – principle of operation – main features- multilevel inverter applications – reactive power compensation – back to back intertie system – adjustable drives –switching device currents – dc link capacitor voltage balancing –features of Multilevel inverters –comparisons of multilevel converters.

UNIT-V	Power Supplies	Classes:12

DC Power Supplies: DC power supplies – classification- switched mode dc power supplies – fly back Converter forward converter- push –pull converter –half bridge converter –Full bridge converter – Resonant DC power supplies- bidirectional power supplies- Application.

AC Power Supplies: AC power supplies – classification – switched mode ac power supplies Resonant AC power supplies-bidirectional ac power supplies – multistage conversions- control circuits- applications.

Text Books:

1. Mohammed H.Rashid- Power Electronics Pearson Education- Third Edition –first Indian reprint- 2004.
2. Ned Mohan, Tore M.Undeland and William P.Robbind – Power Electronics John wiley& Sons – Second Edition.1989.

Reference Books:

1. P.C Sen, Power Electronics, Tata McGraw-Hill Education, 1987.
2. Advanced Power Electronics, Euzelidodsantos, Edison R.dasilva, wiley-IEEE press, Nov 2014.

Web References:

1. https://nptel.ac.in/courses/108107128/

E-Text Books:

1. https://onlinelibrary.wiley.com/doi/book/10.1002/9781118886953

Outcomes:

At the end of the course students able to

1. Capability in designing isolated converters.
2. Ability to dynamic analysis of power Converters.
3. Competency in operation of resonant converter
4. Know-how of multilevel converter.

SWITCHED MODE POWER SUPPLIES
(Elective – V)

M.Tech III Semester: Power Electronics

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
18PE305	Core	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 modes of operation of DC-DC Converter
2. To analyze control aspects of converter
3. To design various Switched Mode Power Supply components
4. To get awareness on EMI, Protection of converter system

UNIT-I	Basic Converter Circuits	Classes:12

Buck Regulator, Buck- Boost Regulator, Boost Regulator, Cuk Converters and Resonant Converters. Choice of switching frequency.

Isolated SMPS: Fly back Converter, Forward Converter, Half-Bridge and Full Bridge Converters, Push-Pull Converter and SMPS with multiple outputs. Choice of switching frequency.

UNIT-II	Control Aspects	Classes:12

PWM Controllers, Isolation in feedback loop, Power Supplies with multiple output. Stability analysis using Bode Diagrams.

UNIT-III	Design Considerations	Classes:12

Selection of output filter capacitor, Selection of energy storage inductor, Design of High Frequency Inductor and High frequency Transformer, Selection of switches. Snubber circuit design, Design of driver circuits.

UNIT-IV	Electro Magnetic Interference (EMI)	Classes:12

EMI Filter Components, Conducted EMI suppression,
Radiated EMI suppression, Measurement.

Protection: Over current protection, over voltage protection, Inrush current protection.

UNIT-V	Thermal Model	Classes:12

Thermal Resistance, Cooling Considerations, Selection of Heat sinks, Simple Heat sink calculations.

Text Books:

1. Switched Mode Power Supplies, Design and Construction, H. W. Whittington, B. W. Flynnand D. E. MacPherson, Universities Press, 2009 Edition.
2. Mohan N. Undeland . T & Robbins W., Power Electronics Converters, Application and Design.John Wiley, 3rd edition, 2002
3. Umanand L., Bhat S.R., Design of magnetic components for switched Mode Power Converters. , Wiley Eastern Ltd.,1992
4. Robert. W. Erickson, D. Maksimovic .Fundamentals of Power Electronics., Springer International Edition, 2005
5. Course Material on Switched Mode Power Conversion, V. Ramanarayanan.

Reference Books:

1. Krein P.T .Elements of Power Electronics., Oxford University Press
2. M. H. Rashid, Power Electronics. Prentice-Hall of India

Web References:

1. https://nptel.ac.in/courses/108105066/21

E-Text Books:

1. https://www.smps.us/books.html

Outcomes:

At the end of the course students able to

1. Explain the purpose and principles of operation of power electronic converters
2. Analyze the voltage and current waveforms resulting from a power electronic converter
3. Compare and contrast different converter topologies
4. Design the parameters of a power supply
5. Compare different converters (e.g., different dc-dc converters) based on the application

SPECIAL MACHINES
(Elective – V)

M.Tech III Semester: Power Electronics

Electrical& Electronics Engineering

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
18PE306	Core	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 impart knowledge on Construction, principle of operation and performance of Synchronous reluctance motors.
2. To impart knowledge on the Construction, principle of operation, control and performance of stepping motors.
3. To impart knowledge on the Construction, principle of operation, control and performance of switched reluctance motors.
4. To impart knowledge on the Construction, principle of operation, control and performance of permanent magnet brushless DC motors
5. To impart knowledge on the Construction, principle of operation and performance of permanent magnet synchronous motors

UNIT-I	SYNCHRONOUS RELUCTANCE MOTORS	Classes:12

Constructional features – Types – Axial and Radial flux motors – Operating principles – Variable Reluctance Motors – Voltage and Torque Equations - Phasor diagram - performance characteristics – Applications.

UNIT-II	STEPPER MOTORS	Classes:12

Constructional features – Principle of operation – Variable reluctance motor – Hybrid motor – Single and multi stack configurations – Torque equations – Modes of excitation – Characteristics – Drive circuits – Microprocessor control of stepper motors – Closed loop control-Concept of lead angle– Applications.

UNIT-III	SWITCHED RELUCTANCE MOTORS	Classes:12

Constructional features – Rotary and Linear SRM - Principle of operation – Torque production – Steady state performance prediction- Analytical method -Power Converters and their controllers – Methods of Rotor position sensing – Sensor less operation – Characteristics and Closed loop control – Applications.

UNIT-IV	PERMANENT MAGNET BRUSHLESS D.C. MOTORS	Classes:12

Permanent Magnet materials – Minor hysteresis loop and recoil line-Magnetic Characteristics – Permeance coefficient -Principle of operation – Types – Magnetic circuit analysis – EMF and torque equations –Commutation - Power Converter Circuits and their controllers – Motor characteristics and control– Applications.

UNIT-V	Motor Applications	Classes:12

Recent developments, Selection of Motor, Application oriented design and developments.

Text Books:

1. K.Venkataratnam, 'Special Electrical Machines', Universities Press (India) Private Limited, 2008.

2. T.J.E.Miller, 'Brushless Permanent Magnet and Reluctance Motor Drives', Clarendon Press, Oxford, 1989.
3. T. Kenjo, 'Stepping Motors and Their Microprocessor Controls', Clarendon Press London, 1984

Reference Books:

1. R.Krishnan, 'Switched Reluctance Motor Drives – Modeling, Simulation, Analysis, Design and Application', CRC Press, New York, 2001.
2. P.P. Aearnley, 'Stepping Motors – A Guide to Motor Theory and Practice', Peter Perengrinus London, 1982.
3. T. Kenjo and S. Nagamori, 'Permanent Magnet and Brushless DC Motors', Clarendon Press, London, 1988.
4. E.G. Janardanan, 'Special electrical machines', PHI learning Private Limited, Delhi, 2014.

Web References:

1. https://www.academia.edu/9885014/SPECIAL_ELECTRICAL_MACHINES_NPTEL_NOTES

E-Text Books:

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

Outcomes:

At the end of the course students able to

1. Ability to model and analyze electrical apparatus and their application to Power electronics

PROJECT WORK PHASE – I

M.Tech III Semester: Power Electronics								
Course code	**Category**	**Hours/week**			**Credits**	**Maximum Marks**		
18PE307	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**TOTAL**
		0	0	20	10	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 IVSemester: Power Electronics								
Course code	**Category**	**Hours/week**			**Credits**	**Maximum Marks**		
18PE401	**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
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