KIT – Kalaignarkarunanidhi Institute of Technology

(An Autonomous Institution)

Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai
Accredited by NAAC with 'A' GRADE & NBA (AERO, CSE, ECE, EEE, MECH & MBA)
An ISO 9001 : 2015 Certified Institution
Coimbatore – 641 402.

REGULATIONS, CURRICULUM & SYLLABUS – 2019

(For the students admitted during 2019 - 2020 and onwards)

I to IV Semester

Degree of Master of Engineering /
Master of Business Administration /
Master of Computer Application

Department of Electrical and Electronics Engineering

Vision and Mission of the Department

Vision

◎	The Department strives to become one of the recognized National centres with particular focus in Electrical and Electronics Engineering.

Mission

The Mission of the EEE Department is to produce skilled and competent manpower through

◎	Quality Education
◎	Entrepreneurship Skill Development
◎	Result Oriented Research by Creating Research Centres
◎	Centre of Excellence
◎	Offering Problem Solving Community Services

Program Educational Objectives (PEO's)

PEO 1	Graduates of the programme will have successful technical or professional career.
PEO 2	Graduates will demonstrate core competence in Electrical and Electronics Engineering and leadership qualities in their chosen fields of employment.
PEO 3	Graduates will continue to learn and adapt in a world of constantly evolving technology.

Programme Outcomes (PO's)

Engineering Graduates will be able to :

PO 1	**Engineering knowledge :** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis :** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design / development of solutions :** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	**Conduct investigations of complex problems :** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 5	**Modern tool usage :** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO 6	**The engineer and society :** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability :** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics :** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work :** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication :** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance :** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-long learning :** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO's)	
After the successful completion of the U.G. programme in Electrical and Electronics Engineering, Graduates will be able to :	
PSO 1	Develop models, assess and analyze the components and systems that effectively generate, transmit and distribute electric power and protection mechanism in power systems.
PSO 2	Design and test advanced electronics systems to perform analog and digital control and deploy control strategies for Power Electronics related and other applications.

BoS Chairman

PG Regulations

1. SHORT TITLE AND COMMENCEMENT

- These Regulations shall be called the "KIT-Kalaignarkaraunanidhi Institute of Technology, Coimbatore, Regulations for the Award of M.E. / M.B.A / M.C.A., Degree".
- They have been evolved, drafted and implemented after deliberations in and approvals from UGC, Anna University and Academic Council of the Institute, and are subject to change / modifications from time to time; (major modifications at a frequency of FOUR years in synchronization with the curriculum structure revision and minor changes as and when applicable).
- The latest / first version shall be applicable for the students enrolling for M.E. / M.B.A / M.C.A.,degree programs at this Institute from Academic year 2019-2020 onwards.

2. PREAMBLE

The regulations prescribed herein have been made by KIT, an autonomous institution, approved by AICTE, New Delhi and affiliated to the Anna University, Chennai, to facilitate the smooth and orderly conduct of its academic programmes and activities at the M.E. / M.B.A / M.C.A. level. It is expected that the regulations will enable the students to take advantage of the various academic opportunities at the Institute and prepare themselves to face the challenges in their professional careers ahead. It may be noted that :

a. The provision made herein shall be applicable to all the M.E. / M.B.A / M.C.A., programmes offered at the institute, at present;

b. They shall also be applicable to all the new M.E. / M.B.A / M.C.A., programmes which may bestarted at the Institute in the future;

c. Academic and non-academic requirements prescribed by the Academic Council have to be fulfilled by a student for eligibility towards award of M.E. / M.B.A / M.C.A., Degree.

3. PRELIMINARY DEFINITIONS AND NOMENCLATURE

In these Regulations, unless the context otherwise requires :

Sl. No.	Name	Definition
1.	**Programme**	Refers to Degree Programme that is B.E. / B.Tech. Degree Programme.
2.	**Discipline**	Refers to branch or specialization of B.E. / B.Tech. Degree Programme, like Computer Science and Engineering, Mechanical Engineering etc.,
3.	**Course**	Refers to a theory or practical subject that is ormally studied in a semester, like Mathematics, Physics, etc.,
4.	**Head of the Institution**	Refers to the Principal of the College.
5.	**Controller of Examinations (CoE)**	Refers to the authority of the college who is responsible for all activities of the Examinations.

6.	**Head of the Department (HoD)**	Refers to the Head of the Department concerned.
7.	**University**	Refers to Anna University, Chennai.
8.	**College (KIT)**	Refers to KIT-Kalaignarkarunanidhi Institute of Technology, Coimbatore.
9.	**Curriculum**	Refers to the various components/courses studied in each programme that provide appropriate outcomes (knowledge, skill and behavior/attitude) in the chosen branch of study.
10.	**T– P – TU – C**	Refers to Theory, Practical, Tutorial and Credits respectively.
11.	**Foundation Courses (FC)**	May include Mathematics or other basic courses.
12.	**Professional Core (PC)**	Courses include the core courses relevant to the chosen specialization / branch.
13.	**Professional Elective (PE)**	Courses include the elective courses relevant to the chosen specialization / branch.
14.	**Project Work (PW)**	Refers to the project done by a student or a group of students during final year.
15.	**Career Enhancement Courses (CEC)**	Includes Mini Project Work and / or Internship, Seminar, Professional Practices, Case Study, soft skills and Industrial / Practical Trainings etc.,
16.	**Academic Evaluation Committee (AEC)**	The committee includes Principal, CoE, HoD concerned (For details refer **Appendix V**)
17.	**Department Evaluation Committee (DEC)**	The committee included HoD (need basis), senior faculty member(s) of department from various levels, class advisor, Mentor of the students. (For details refer **Appendix V**)

4. ADMISSION

4.1 Candidates seeking admission to M.E. / M.B.A / M.C.A., Degree Programme :

Candidates for admission to the first semester of the Post-Graduate Degree Programme shall be required to have passed an appropriate Under-Graduate Degree Examination of Anna University or equivalent as specified under qualification for admission as per the Tamil Nadu Common Admission (TANCA) criteria.

Candidates for admission to the III semester of the M.C.A Degree Programme shall be required to have passed an appropriate Under-Graduate Degree Examination of Anna University or equivalent as specified under qualification for admission as per the Government of Tamil Nadu.

Note : TANCA releases the updated criteria during the admissions every academic year. Admission shall be offered only to the candidates who possess the qualification prescribed against each programme.

Any other relevant qualification which is not prescribed against each programme shall be considered for equivalence by the committee constituted for the purpose. Admission to such degrees shall be offered only after obtaining equivalence to such degrees.

4.2 Re - admission

Students, who have discontinued for reasons other than disciplinary action, may be readmitted as per guidelines given by DoTE, Government of Tamilnadu and Anna University. Department Evaluation Committee (DEC) shall study and recommend on the exception and addition of courses to be registered for, by the student concerned during re-admission. The details shall be forward to Academic Evaluation Committee (AEC) for approval and the committee's decision shall be final.

5. PROGRAMMES OFFERED

KIT offers 2 year (4 Semesters) M.E. / M.B.A., and 3 year (6 Semesters) M.C.A., Degree programme affiliated to Anna University, under Choice Based Credit System (CBCS) for students admitted from 2019 onwards in the following branches of Engineering and Technology as in Table 1.

Table 1. List of M.E. / M.B.A / M.C.A., programmes offered

M.E., Applied Electronics
M.E., VLSI Design
M.E., Engineering Design
M.E., Computer Science and Engineering
M.E., Power Systems and Engineering
M.B.A., Master of Business Administration
M.C.A., Master of Computer Application

6. ACADEMIC STRUCTURE OF PROGRAMMES

6.1 Medium of Instruction

The medium of instruction is English for all courses, examinations, seminar presentations and project / thesis / dissertation..

6.2 Categorization of Courses

Every Post Graduate Degree Programme will have a curriculum with syllabi consisting of theory and practical courses that shall be categorized as follows :

i. **Foundation Courses (FC)** may include Mathematics or other basic courses.

ii. **Professional Core (PC)** courses include the core courses relevant to the chosen specialization / branch.

iii. **Professional Elective (PE)** courses include the elective courses relevant to the chosen specialization / branch.

iv. Project Work (PW) includes Project Work to be done in final semester.

v. Carrear Enhancement Courses (CEC) includes Mini Project Work and/or Internship, Seminar, Professional Practices, Summer Project, Case Study and Industrial / Practical Training.

Instead of two electives in the curriculum, the student may be permitted to choose a maximum of 2 courses from other PG programmes with the approval of the Head of the Department offering such courses.

6.3 Number of courses per semester

Curriculum of a semester shall normally have a blend of lecture courses and practical courses including Career Enhancement Courses. Each course may have credits assigned as per clause 6.4.

6.4 Credit Assignment

Each course offered is given a T-P-TU-C structure, depending on the number of lecture periods (T), number of periods for practical (P) and number of tutorial periods (T) required per week for an efficient teaching – learning process. A student is expected to put-in his/her own efforts in proportion with periods spent in classroom, as defined in T-P-TU-C structure. On successful completion of the course a student is said to have earned a specified number of credits defined for each course. Each course is assigned certain number of credits based on the following table :

Table 4 : Credit Assigned

Contact period per week	Credits
1 Lecture Period (**T** = Lectures given during class by the faculty)	1
1 Tutorial Periods (**TU** = Tutorial, also class based with more emphasis on problem solving)	1
2 Practical Period (**P**) (Laboratory Periods / CEC / Projects)	1

6.5 Career Enhancement Courses

6.5.1 Industrial Training / Internship

Students shall undergo industrial training/Internship if mandated in the curriculum for periods as specified in the curriculum during the summer/winter vacation, the training being taken on a continuous basis for the periods mentioned. The industry/organization is to be selected with the approval of the Department Evaluation Committee (DEC). Industrial training may also be referred to as “In-plant training”.

The Industrial Training / Internship shall carry 100 marks and shall be evaluated through CIA only. The credit will be awarded to the student after the submission of Internship / Training report to the HoD. The report will be evaluated by a team of (DEC) faculty members nominated by the HoD for awarding the Credit. Based on the recommendation by the team, the student will be awarded credits and the results will be sent to the Controller of Examinations. The awarded credit will taken for CGPA calculation. The final year project period at industry/research organization will not be considered as industrial Training / internship.

6.5.2 Industrial Visit

Every student is required to go for at least one Industrial Visit every year starting from the second year of the Programme subject to the approval of the Head of the Department and Principal. The Heads of Departments shall ensure that necessary arrangements are made in this regard.

6.5.3 Professional Certificate Courses

Students have to undergo one credit courses offered by experts from industry / research organizations and approved by academic council. Students can register such courses from his/her second year of study as and when these courses are conducted by the departments. A student is also permitted to register for these courses of other departments.

If a student does not successfully complete the registered industry supported one credit courses in a semester, the registration of that course will be considered as cancelled. Further, it will not be treated as arrear and if he/she wishes, he/she can reregister for the same course in the ensuing semesters and successfully complete it as and when it is offered subsequently.

6.5.4 Online Courses

Students may be permitted to register for online courses (which are provided with certificate after evaluation of the performance, SWAYAM / NPTEL), during third to sixth semester of his/her study. On successful completion of the course, he/she has to submit the copy of the certificates to the Head of the Department. The assemment will not be calculated for CGPA.

6.5.5 Soft Skills

Every Student is required to go for two soft skill courses during first year of study. The soft skill course includes the communication skill, interpersonal skill and career development courses. One credit will be awarded for each soft skills courses and it will be included for SGPA/CGPA calculations.

6.5.6 Career Ability Course

The career Ability courses will be designed by the respective department with approval from DEC/AEC based on the industry requirements. One credit will be awarded for each soft skills courses and it will be included for SGPA / CGPA calculations.

6.5.7 Evaluation of One Credit Courses

Students can register for one credit courses in any semester when it is offered. Experts from the industry/Institution (KIT) may design such specialized one-credit courses based on the current technical skill requirements. The Department Evaluation Committee (DEC) shall review and approve the syllabus, course plan, and pedagogy and assessment pattern for the course. One credit courses can also be offered by internal experts i.e faculty members from other departments (not belonging to the specific discipline of the programme) also can offer such courses to the students with the approval of DEC.

A one - credit course shall carry 100 marks and shall be evaluated through Continuous Internal Assessment (CIA) only. The QP pattern and scheme will be decided by the course faculty and will be approved by the DEC/AEC.

The Head of the Department may identify a faculty member as the coordinator for the course. A committee consisting of the Head of the Department, faculty handling the course (if available), coordinator and a senior Faculty member nominated by the Head of the Department shall monitor the evaluation process.

The grades shall be assigned to the students by the above committee based on their performance and included in the calculation of CGPA.

6.5.8 Industry Supported Project Work

The students satisfying the following conditions shall be permitted to carry out their final semester Project work for six months in industry/research organization.

The student should not have current arrears and shall have CGPA of 8.0 and above until 2nd semester (for MBA / ME Students), 4th semester (for MCA students) The student shall undergo the final semester courses in the Pre semester. The Head of Department, in consultation with the faculty handling the said courses shall forward the proposal recommended by the Principal to CoE after approval from AEC at least four weeks before the commencement of the pre-semester of the programme.

6.6 Course Numbering Scheme

Each course is denoted by a unique code consisting of 9 alphanumeric characters. The details of the numbering scheme are in **ANNEXURE - I**.

6.7 Credit Requirement for Programmes

The total number of credits that a student earns during the period of study is called the Total credits. The minimum prescribed credits required for the award of the degree shall be within the limits specified below :

Programme	KIT Credit Range
M.E. / M.Tech.	66 - 72

Programme	KIT Credit Range
M.B.A.	102
M.C.A. (Regular)	120
M.C.A. (Lateral)	77

7. DURATION OF THE PROGRAMMES

7.1 The minimum and maximum period for completion of the P.G. Programmes are given below :

Programme	Min. No. of Semesters	Max. No. of Semesters
M.E. / M.Tech. (Full-Time)	4	8
M.B.A. (Full Time)	4	8
M.C.A. (Full Time)	6	12
M.C.A.(Lateral)	4	8

7.2 The Curriculum and Syllabi of all the P.G. Programmes shall be approved by the Academic Council of KIT. The number of Credits to be earned for the successful completion of the programme shall be as specified in the Curriculum of the respective specialization of the P.G. Programme.

7.3 Each semester normally consists of 90 working days, including test and examination days. In any contingent situation, the number of working days per semester shall not be less than 65 days. The Principal is given the discretionary powers to decide the number of working days. In such contingencies, the Principal shall ensure that every faculty member teaches the full content of the specified syllabus for the course being taught.

7.3.1 Due to Pandemic / Abnormal situations the Scheme of Examinations and Evaluation will be followed as per the guidelines issued by the Government of Tamil Nadu and Anna University, Chennai.

7.4 The total period for completion of the programme reckoned from the commencement of the first semester to which the candidate was admitted shall not exceed the maximum period specified in clause 7.1 irrespective of the period of break of study in order that he/she may be eligible for the award of the degree.

7.5 For the purpose of regulations, the academic year will be divided into two semesters, the odd semester normally spanning from June to November and the even semester from December to May.

8. COURSE REGISTRATION

Each student, on admission shall be assigned to a mentor who shall advice and counsel the student about the details of the academic programme and choice of courses, considering the student's academic background and career objectives. Some courses require students to register through a course registration process via online.

8.1. Course Registration

Each student on admission shall register for all the courses prescribed in the curriculum in the students first semester of the study.

The registration process for the courses offered in the online registration mode in the forthcoming semester, will commence preferably 10 working days prior to the last working day of the current semester.

A department shall offer a course only if a minimum number of students register for that course. This minimum number may vary from course to course and shall be specified by the department from time to time.

After registering for a course, a student shall attend the classes, satisfy the attendance requirements, earn Continous Assessment Marks and appear for the End Semester Examination (ESE).

8.2 Credits details for Course Registration

A Each student has to register for all courses to be undergone in the curriculum of a particular semester (with the facility to drop courses to a maximum of 6 credits). The student can also register for courses for which the student has failed in the earlier semesters.

The registration details of the candidates may be approved by the Head of the Institution and forwarded to the Controller of Examinations. This registration is for undergoing the course as well as for writing the End Semester Examinations.

The courses that a student registers in a particular semester may include

- Courses of the current semester.
- The core (Theory / Lab / CEC) courses that the student has not cleared in the previous semesters.
- Elective courses which the student failed (either the same elective or a different elective instead)

8.3 Flexibility to Drop courses

A student has to earn the total number of credits specified in the curriculum of the respective programme of the study in order to be eligible to obtain the degree. From II semester to Final semesters, the student has the options for dropping an existing course. The total number of credits that a student can drop is limited to 6. Practical courses cannot be dropped.

8.4 Reappearance Registration

8.4.1 If a student fails in a theory or practical course, the student shall do reappearance registration for that course in the subsequent semester by retaining the Continuous Assessment Marks already earned.

8.4.2 If the theory course, in which the student has failed, is a Professional Elective or an Open Elective, the student may register for the same or any other Professional Elective or Open Elective course respectively in the subsequent semesters. Such changes can be done only with due approval by DEC.

8.4.3 The student who fails in Project work/ Seminar other than Practical courses shall register for the same in the subsequent semester and reappear for the End Semester Examination.

8.4.4 If a student is not eligible to appear for end semester examination of a course due to lack of attendance, the student has to register for that course again, when offered next,

attend the classes and fulfill the attendance requirements. If the course, in which the student has lack of attendance, is an elective, the student may register for the same or any other elective in the subsequent semesters.

8.4.5 If a student has completed the 8 semesters and has obtained RA grade in one or more courses, he can register and appear for arrear examination directly whenever conducted next.

8.4.6 A student who has already appeared for a course in a semester and passed the examination is not entitled to reappear the same course for improvement of Grade / Marks.

9. REQUIREMENTS FOR APPEARING FOR CIA, ESE

9.1 A student who has fulfilled the following conditions shall be deemed to be eligible to appear for the CIA-I, CIA-II, CIA-III and ESE. Ideally, every student is expected to attend all the classes and earn 100% attendance. Students who have earned not less than 75% attendance course wise taking into account the number of periods required for that course as specified in the curriculum. Table 5 illustrates the mandatory attendance requirement for CIA-I, CIA-II, CIA-III and ESE.

Table 5 : Mandatory Attendance Requirement for CIA-I, CIA-II, CIA-III and ESE.

Test / Examination Type	Period of Calculation	Minimum % of attendance required
Continuous Internal Assessment Test - I (CIA - I)	**First Semester** From the date of joining of course to three working days before the start of CIA - I	60%
	Second to Eighth semester From the date of commencement of the class to one week before the start of CIA - I	75%
Continuous Internal Assessment Test - II (CIA - II)	From the date of joining (1st semester) / date of commencement of class (2nd to 8th Semester) to one week before the start of CIA - II	75% (for students maintaining 80% or more attendance between CIA - I and CIA - II, but falls short of the 75% cumulative requirement, the requirement may be relaxed if recommended by the AEC)

Continuous Internal Assessment Test - III (CIA - III)	From the date of joining (1st semester) / date of commencement of class (2nd to 8th Semester) to one week before the start of CIA - III	75% (for students maintaining 80% or more attendance between CIA - II and CIA - III but falls short of the 75% cumulative requirement, the requirement may be relaxed if recommended by the AEC)
End Semester Examination (ESE)	From the date of joining (1st semester) / date of commencement of class (2nd to 8th Semester) to the last day of instruction.	75%

9.1.1 Students having a CGPA of 8.50 and above and with no standing arrears will be exempted from the minimum attendance requirements (from 7th Sem. onwards).

9.1.2 A student shall normally be permitted to appear for End Semester Examination of the course if he / she has satisfied the attendance requirements (vide Clause - 9.1). He /she is eligible to register for ESE in that semester by paying the prescribed fee.

9.1.3 A Candidate who has fulfilled the following conditions shall be deemed to have satisfied the requirements for completion of a semester. Ideally every student is expected to attend all classes of all the courses and secure 100% attendance. However, in order to give provision for certain unavoidable reasons such as Medical / participation in sports, the student is expected to attend atleast 75% of the classes. Therefore, he/she shall secure not less than 75%.

9.1.4 However, a candidate who secures overall attendance between 65% and 74% in the current semester due to medical reasons (prolonged hospitalization / accident / specific illness) / Participation in Sports events may be permitted to appear for the current semester examinations subject to the condition that the candidate shall submit the medical certificate / sports participation certificate attested by the Head of the Institution. The same shall be forwarded to the Controller of Examinations for record purposes.

9.1.5 Candidates who secure less than 65% overall attendance and candidates who do not satisfy the clause 9.1.3 and 9.1.4 shall not be permitted to write the semester examination at the end of the semester and not permitted to move to the next semester. They are required to repeat the incomplete semester in the next academic year, as per the norms prescribed.

9.1.6 The students who are consistently good in academics ONLY be considered for the grant of ODL under Co-curricular activities by the competent authorities. The following activities shall be considered for the sanction of ODL;

- **Sports and Games :** TIES, Inter Collegiate, Inter Zonal, Inter University, State Level, National Level and Open Tournaments.
- **NCC :** Camps and expeditions, NSS camps
- Cultural Programme at State, National and International Level
- **Seminar / Symposia :** Paper presentation/Quiz
- Leadership courses organized by other organizations & Alumni Association activities, Association activities, Placement activities.
- Training programs/Internship at industries and Higher learning Institutions
- Personal damage incurred during the extracurricular activities
- The ODL requisition letter shall be forwarded to the Principal through the HoD of the student by the staff-in-charge of the respective activities before completion of every activity.
- The ODL sanctioned letters shall be submitted to the Department Office. The faculty-in-charge of the department office will check the eligibility for the award of attendance at the end of semester and the same may be submitted to DEC for approval.

9.1.7 The student should register all the courses of current semester and all the arrear courses in the previous semesters. If any student fails to register and pay the examination fees within the due date, he / she shall not be permitted to attend the End Semester Examinations. However, he / she will be permitted to continue their studies in the next higher semester, provided that the student satisfies the requirements as stipulated in this clause of this regulation.

9.1.8 Those students who are not deemed to have completed the semester with references to the conditions specified above shall undergo the semester again in all the courses in the respective semester during next academic year. He/she shall seek re-admission as per the norms of the affiliating University / DOTE (Directorate of Technical Education).

The days of suspension for a student on disciplinary grounds will be considered as days of absence for calculating the percentage of attendance for each individual course.

10. PROVISION FOR WITHDRAWAL FROM EXAMINATION

A student may, for valid reasons (medically unfit / unexpected family situations / Sports person representing Tamilnadu / India with prior permission for participation from Principal / CoE / DEC), be granted permission to withdraw (after registering for the examinations) from appearing for any course or courses in the End Semester Examination of a particular semester. The student may withdraw by following the due process of the CoE's office before the commencement of examination. This facility can be availed only once during the entire duration of the degree programme.

Withdrawal from ESE will be valid only if the student is, otherwise, eligible to write the examination and the application for withdrawal is made to the CoE, prior to the examination in the course or courses concerned. The application for withdrawal should be recommended by the Head of the Department concerned and approved by the Head of the Institution..

11. TEMPORARY BREAK OF STUDY FROM A PROGRAMME

11.1 Break of study is normally not permitted. However, if a student intends to temporarily discontinue the programme in the middle of a semester / year for valid reasons (such as Internships, accident or hospitalization due to prolonged ill health) and wishes to re-join the programme in the next academic year, he / she shall apply in advance to the Principal through the Head of the Department, stating the reasons. The application shall be submitted not later than the last date for registering for the semester examinations. Break of study is permitted only once during the entire period of the degree programme.

11.2 The student permitted to re-join the programme after the break shall be governed by the rules and regulations in force, at the time of re-joining.

11.3 The duration specified for passing all the courses for the purpose of classification of degree (vide clause 19) shall be increased by the period of such break of study permitted (vide clause 11).

11.4 If a student is detained for want of requisite attendance, academic progress and good conduct, the period spent in that semester shall not be considered as permitted Break of Study and Clause 11.3 is not applicable for such cases.

12. ASSESSMENT PROCEDURES FOR AWARDING MARKS

The total marks for each course generally (Theory, Practical, Project Work) will be 100, comprising of two components namely Continuous Internal Assessment (CIA) and End Semester Examination (ESE). However, there could be some open elective courses, human excellence courses, one credit industry courses, add-on courses and Mandatory courses that have only continuous assessment for 100 marks without an End Semester Examination. The Department Consultative Committee (DCC) has to approve such courses every semester. The scheme of assessment may also be decided by the faculty handling the course concerned with the approval from DCC and shall be made available to the students during the online course registration. Each course shall be evaluated for a maximum of 100 marks as illustrated in Table 6.

Table 6 : Course Evaluation

S. No.	Category of course	Continuous Internal Assessment	Semester End Examinations
1.	Theory Courses	40 Marks	60 Marks
2.	Laboratory Courses		
3.	Project Work		
4.	Career Enhancement Course (CEC) and Mandatory Course (MC)	100 Marks	–

The End Semester Examination (theory and practical) of 3 hours duration shall ordinarily be conducted between October and December during the odd semesters and between April and June during the even semesters.

The End Semester Examination for project work shall consist of evaluation of the final report submitted by the student or students of the project group (of not exceeding 4 students) by an external examiner and an internal examiner, followed by a viva-voce examination conducted separately for each student by a committee consisting of the external examiner, the supervisor of the project group and an internal examiner.

For the End Semester Examination in both theory and practical courses including project work the internal and external examiners shall be appointed by the Controller of Examinations.

13. MARKS DISTRIBUTION

13.1 Attendance Mark

Marks are awarded for the attendance earned by the students for individual courses as per the following table.

Attendance Range in %	Marks to be earned by the students
96 - 100	5
91 - 95	4
86 - 90	3
81 - 85	2
75 - 80	1

13.2 Question paper pattern

a. Table 7.1 Continuous Internal Assessment (CIA - I, CIA – II and CIA – III)

2 Marks	12 Marks	Total marks
7	3 (Either or Type)	50

b. Table 7.2 Midsem and Semester End Examinations

2 Marks	13 Marks	15 marks	Total Marks
10	5 (Either or Type)	1 (Either or Type)	100
For Mathematics paper only			
2 Marks	16 Marks		Total Marks
10	5 (Either or Type)		100

13.3 Theory Courses

Continuous Internal Assessment tests are conducted by the Office of the Controller of Examination. Continuous Internal Assessment comprises three Continuous assessment tests, Assignment / Class test / Presentation / Online Test / Mini projects / Tutorials and Attendance. By adopting this method, the students will go through a continuous and systematic study pattern. The Corresponding weightages are given below.

Table 8 : Continuous Internal Assessment Test for Theory Courses

Particulars	Syllabus	Duration	Exam Mark	Internal Mark
Continuous Internal Assessment - I	1.5 Units	1.5 hours	50 marks	10
Continuous Internal Assessment - II	1.5 Units	1.5 hours	50 marks	10
Continuous Internal Assessment - III	1.5 Units	1.5 hours	50 marks	10
Assignment / Class Test / Online Test / Mini Project / Tutorial / Presentation / Online course / Certificate Course				**5**
Attendance				5
Total				**40**

13.4 Criteria for Assessment for Lab Courses

Every exercise / experiment in all practical courses shall be valuated on a continuous basis. The criteria for Continuous Assessment (for each cycle of exercise/experiment) are given in Table 9.

Table 9 : Assessment for Lab Courses

Sl. No.	Description		Weightage
1.	Continuous Internal Assessment Marks (CIAM)		
	a.	Average of Experimental Report / Workbook	25
	b.	Model examination	10
	c.	Attendance	5
Total CIAM			**40**

2.	Semester End Exam Marks (SEEM)		
	a.	Lab Examination with Viva Voce	60
	Total ESM		**60**
		Total Marks	**100**

13.5 PROJECT WORK

For Project Work (Phase I & II) out of 100 marks, the maximum marks for Continuous Assessment is 40 marks and that for the End Semester Examination (project report evaluation and viva-voce examination) is 60 marks. Project work may be assigned to a single student or to a group of students not exceeding 4 per group, under the supervision of faculty guide(s).

The Head of the Department shall constitute a review committee for each programme. There shall be a minimum of three faculty members in the review committee. There shall be three reviews (as per Table 10) in total, during the semester by a review committee. The student shall make presentation on the progress made before the committee.

Interim project report shall be submitted before the project reviews with the approval of the guide. The Project Report, prepared according to the approved guidelines and duly signed by the guide and the Head of the Department, shall be submitted to the department as per the timeline announced by the department. The End Semester Examination for project work shall consist of evaluation of the final project report by an external examiner, followed by a viva-voce examination conducted separately for each student, by a committee consisting of the external examiner, and an internal examiner. The Controller of Examinations (CoE) shall appoint Internal and External Examiners for the End Semester Examination of the Project Work.

A candidate may, however, in certain cases, be permitted to work on projects in an Industrial/Research Organization, on the recommendations of the Head of the Department Concerned. In such cases, the Project work shall be jointly supervised by a supervisor of the department and an expert, as a joint supervisor from the organization and the student shall be instructed to meet the supervisor periodically and to attend the review committee meetings for evaluating the progress.

The Project work (Phase II in the case of M.E. / M.Tech.) shall be pursued for a minimum of 16 weeks during the final semester.

The deadline for submission of final Project Report is 60 calendar days from the last working day of the semester in which project / thesis / dissertation is done. However, the Phase-I of the Project work in the case M.E. / M.Tech. Programmes shall be submitted within a maximum period of 30 calendar days from the last working day of the semester as per the academic calendar published by the University.

The Continuous Internal Marks (CIM) and Semester End marks (SEM) for Project Work and the Viva-Voce Examination will be distributed as indicated in Table 10.

Table 10 : CIM and SEM break-up for project work

Sl.No.	Review No.		Description	Marks	Total Marks
1.	**Continuous Internal Assessment Marks**				
	a.	Review 1	Review Committee	5	10
			Guide	5	
	b.	Review 2	Review Committee	7	15
			Guide	8	
	c.	Review 3	Review Committee	7	15
				8	
Total CAM					**40**
2.	**Semester End Examinations Marks**				
	a.	Evaluation of final report and viva-voce	Internal Examiner	10	**50**
			External Examiner	40	
	b.	Outcome*	Publication of papers / prototype / patents etc.,	10	10
Total ESEM					**60**
Total Marks					**100**

Review committee consists of internal faculty members nominated by the Head of the Department. The guide of student being examined shall not be part of the committee.

* Outcome – in terms of paper publication, patents, product development and industry projects shall be awarded by both internal and external examiners, based on the document proofs submitted by the student concerned.

If a student fails to submit project report / does not appear for the ESE / fails in the End Semester Examination (ESE) / fails in Continuous Internal assessment (CIA) he/she is deemed to have failed in the project work and shall have to re-register for the same when offered next.

14. PASSING REQUIREMENTS

14.1 A student is declared to have successfully passed a theory based course if he / she has secured :

- A minimum of 50% marks in the End Semester Examinations.
- A minimum of 50% marks on combining both Continuous Internal Assessment Marks (CIAM) and End Semester Examination Marks (ESEM)..

14.2 A student is declared to have successfully passed a practical / project based course if he / she has secured :

- A minimum of 50% marks in the End Semester Examinations.
- A minimum of 50% marks on combining both Continuous Internal Assessment Marks (CIAM) and End Semester Examination Marks (ESEM).

14.3 For a student who does not meet the minimum passing requirements, the term "RA" against the course will be indicated in his/her grade sheet. He/she shall reappear in the subsequent examinations for the course as arrear or re-register for the course when offered.

14.4 For a student who is absent for end-semester theory / practical / project viva-voce, the term "RA" will be indicated against the corresponding course. He/she shall reappear for the End Semester Examination of that course as arrear in the subsequent semester or when offered next.

14.5 The letter grade "W" will be indicated for the courses for which the student has been granted authorized withdrawal (refer Clause 10).

14.6 For mandatory courses (non-credit), the student must satisfy the minimum attendance requirement & passing criteria as specified for the course as detailed in Section 16.2

15. METHODS FOR REDRESSAL OF GRIEVANCES IN EVALUATION

Students who are not satisfied with the grades awarded in the End Semester Examination of Theory for regular and arrear exams can seek redressal as illustrated in Table 11.

Table 11: Grievance Redressal Mechanism

Sl. No.	Redressal Sought	Methodology	
		Regular Exam	Arrear Exam
1.	Revaluation	⊙ Apply for photo copy of answer book ⊙ Then apply for revaluation after course expert recommendation	
2.	Challenge of Evaluation	⊙ Apply for photo copy of answer book ⊙ Then apply for revaluation after course expert recommendation ⊙ Next apply for challenge of evaluation	
Note : All applications to be made to COE along with the payment of the prescribed fee.			

Challenge of Evaluation – Flow Process

Table 12 : Evaluation – Flow Process

Step 1	A student can make an appeal to the CoE for the review of answer scripts after paying the prescribed fee.
Step 2	CoE will issue the photocopy of answer scripts to the student.
Step 3	The faculty who had handled the subject will evaluate the script and HoD will recommend.
Step 4	A committee consisting of 2 evaluators appointed by CoE will review and declare the result.
Step 5	If the result is in favour of the student, the fee collected will be refunded to the student.
Step 6	The final mark will be announced by CoE.

16. LETTER GRADE

Absolute grading system is adopted in converting marks to grads.

16.1 Absolute Grading Policy

All assessments of a course will be evaluated on absolute marks basis. However, for the purpose of reporting the performance of a candidate, letter grades, each carrying certain number of points, will be awarded as per the range of total marks (out of 100) obtained by the candidate in each subject as detailed below :

Table 13: Absolute Grading – Letter Grade and its Range

Sl.No.	Range of percentage of total marks	Letter Grade	Grade Points
1.	91 - 100	O (Outstanding)	10
2.	81 – 90	A+ (Excellent)	9
3.	71 – 80	A (Very Good)	8
4.	61 – 70	B+ (Good)	7
5.	50 – 60	B (Average)	6
6.	<50	RA (Re-appearance)	0
7.	Shortage of attendance	RA - SA (Re-appearance due to shortage of attendance)	0
8.	Absent	RA – AB (Re-appearance due to absence)	0
9.	Withdrawal from examination	W	0
10.	Pass in Mandatory non-credit courses	P	0
11.	Fail in Mandatory non-credit courses	F	0

A student is deemed to have passed and acquired the corresponding credits in a particular course if he/she obtains any one of the following grades: “O”, “A+”, “A”, “B+”,“B”. ‘RA’ indicates that Reappearance is mandatory for that course concerned. ‘SA’ denotes shortage of attendance (as per Clause 9) and hence prevented from writing the End Semester Examination. P and F are grades for mandatory, but non-credit courses.

16.2 Grading for Mandatory Courses

Mandatory Courses are courses that are required to be completed to fulfill the degree requirements (e.g. Human excellence, Environmental science, etc.). They are normally non – credit based. These courses will not be taken in to consideration for the SGPA / CGPA calculations. Each of these courses is assessed continuously and internally for a total mark of 100. The pass mark is 50%. Students, who fail to pass this course, are required to repeat the course, when offered next.

16.2.1 For Mandatory non-credit courses the student must satisfy the minimum attendance requirement & passing criteria as specified for the course. These courses do not carry credits but needs to be completed to fulfill the degree requirements.

16.2.2 For the Mandatory non-credit courses student completing the course will be awarded Pass grade (P) and those who fail to satisfy the attendance requirement or fail to satisfy the minimum passing requirement of 50% marks, will be awarded Fail (F) grade and the student must re-register for the course when it is offered next.

16.3 Formula for SGPA and CGPA calculations

After the results are declared, grade sheets will be issued to each student, which will contain the following details :

- The College Name and Affiliating University.
- The list of courses registered during the semester and the grades scored.
- The Semester Grade Point Average (SGPA) for the semester.
- The Cumulative Grade Point Average (CGPA) of all courses enrolled from first semester onwards.

On completion of a semester, each student is assigned a Semester Grade Point Average which is computed as below for all courses registered for, by the student during that semester.

$$\textbf{S}\text{emester }\textbf{G}\text{rade }\textbf{P}\text{oint }\textbf{A}\text{verage} = \frac{\sum(C_i \times GP_i)}{\sum C_i}$$

where $\mathbf{C_i}$ is the credit for a course in that semester and $\mathbf{GP_i}$ is the Grade Point earned by the student for that course. The **SGPA** is rounded off to two decimals.

The overall performance of a student at any stage of the Degree programme is evaluated by the **C**umulative **G**rade **P**oint **A**verage **(CGPA)** up to that point of time.

$$\textbf{C}\text{umulative }\textbf{G}\text{rade }\textbf{P}\text{oint }\textbf{A}\text{verage} = \frac{\sum(C_i \times GP_i)}{\sum C_i}$$

where $\mathbf{C_i}$ is the credit for each course in each of the completed semesters at that stage and $\mathbf{GP_i}$ is the grade point earned by the student for that course. The **CGPA** is rounded off to two decimals.

16.2.4 FORMULA FOR CALCULATING PERCENTAGE

CGPA X 10 = % of Marks

17. ELIGIBILITY FOR THE AWARD OF DEGREE

A student shall be declared to be eligible for the award of the B.E. / B.Tech. Degree provided the student has

i. Successfully gained the required number of total credits as specified in the curriculum corresponding to the student's programme within the stipulated time.

ii. Successfully completed the course requirements, appeared for the End Semester examinations and passed all the subjects prescribed in clause no.7.

iii. Successfully passed any additional courses prescribed by the Academic council

iv. Successfully passed any additional courses prescribed by the Department & concerned whenever readmitted under regulations 2019. (R19) (vide Clause 4.2)

v. No disciplinary action pending against the student.

vi. The award of Degree must have been approved by the Academic Council of KIT.

18. CLASSIFICATION OF M.E / MBA / MCA DEGREE

The degree awarded to eligible students will be classified as given in Table 14.

Table 14 : Classification of the M.E. / MBA / MCA Degree

Sl.No.	Class Awarded	Criteria
1.	First class with distinction	A student who satisfies the following conditions shall be declared to have passed the examination in First class with Distinction : **M.E. / M.B.A.** ⊙ Should have passed the examination in all the courses of all the four semesters in the student's First Appearance within three years, which includes authorised break of study of one year (if availed). Withdrawal from examination will not be considered as an appearance. ⊙ Should have secured a CGPA of not less than **8.50**. ⊙ Should NOT have been prevented from writing end Semester examination due to lack of attendance in any of the courses **M.C.A** ⊙ Should have passed the examination in all the courses of all the six semesters in the student's First Appearance within four years, which includes authorised break of study of one year (if availed). Withdrawal from examination will not be considered as an appearance. ⊙ Should have secured a CGPA of not less than **8.50**. ⊙ Should NOT have been prevented from writing end Semester examination due to lack of attendance in any of the courses.

2.	First Class	A student who satisfies the following conditions shall be declared to have passed the examination in **First class :** **M.E. / M.Tech. / M.B.A.** › Should have passed the examination in all the courses of all four semesters within three years, which includes one year of authorized break of study (if availed) or prevention from writing the End Semester Examination due to lack of attendance (if applicable). › Should have secured a CGPA of not less than **7.00**. **M.C.A** › Should have passed the examination in all the courses of all six semesters within four years, which includes one year of authorized break of study (if availed) or prevention from writing the End Semester Examination due to lack of attendance (if applicable). › Should have secured a CGPA of not less than **7.00**.
3.	Second Class	All other students (not covered in clauses Sl.No.1 and 2 under clause 19) who qualify for the award of the degree (vide Clause 20) shall be declared to have passed the examination in Second Class.
Note : A student who is absent for the End Semester Examination in a course / project work Viva Voce after having registered for the same will be considered to have appeared for that examination (except approved withdrawal from End Semester Examinations as per Clause 9) for the purpose of classification.		

19. AWARD OF DEGREE

The Academic Council of the institution will approve the award of Degree to all eligible students. The degree will be issued by Anna University, Chennai and the consolidated Grade Sheet will be issued by the institution. The consolidated grade sheet will specify any specializations and distinctions that the student has earned during the course of the study.

20. FACULTY MENTOR

To help the students in palnning their courses of study and for general advice on the academic progarmme, the Head of the Department will attach a certain number of students (maximum 20) to a faculty member of the department. He/She shall function as Faculty Mentor for these students throughout their period of study. The faculty mentor shall,

- › Advice the students in registering and reappearance registering of courses
- › Monitor their attendance, academic progress and discipline of the students
- › Counsel periodically or during the faculty mentor meeting scheduled in the class time table.
- › Inform the students about the various facilities and activities available to enhance the student's curricular and co-curricular activities.
- › If necessary, the faculty mentor may also discuss with or inform the parents about the progressof the students through Head of the Department or in Parent-Teacher meeting.

21. CLASS COMMITTEE

The objective of the Class Committee is to improve the teaching-learning process.

The functions of the class committee include :

- Resolving difficulties experienced by students in the classroom and in the laboratories.
- Clarifying the regulations of the degree programme and the details of rules therein.
- Discussing the progress of academic schedule and deviations if any.
- Evaluating the performance of the students of the class after each test and finding the ways and means of improvement.
- Every class in first year of study shall have a class committee consisting of faculty members who are teaching in that class, student representatives (cross section of students from boys and girls) and a chairperson who is a faculty not handling the course for the class.
- From III semester onwards, Class committee comprises of all the faculty members who are handling courses in that particular semester and two student representatives from each course. A chairperson who is a faculty not handling course for that particular semester, nominated by the Head of the Department shall coordinate the activities of this committee.
- The class committee shall be constituted by the Head of the Department/Chief Tutor on the first week of commencement of the semester.
- The class committee shall meet three times in a semester as specified in the academic calendar.
- The Principal may participate in any class committee of the institution.
- During these meetings, the representative of the class shall meaningfully interact and express the opinions and suggestions of the other students of the class to improve the effectiveness of the teaching-learning process.
- The Chairperson is required to prepare the minutes of the meeting, signed by the members and submit the same to Head of the Department within five working days of the meeting. Head of the Department will in turn consolidate and forward the same to the Principal, within 10 working days of the meeting.
- In each meeting, the action taken report of the previous meeting is to be presented by the Chairperson of the class committee.

22. COMMON COURSE COMMITTEE

- A theory course handled by more than one teacher shall have a “Common Course Committee” comprising of all teachers teaching that course and few students who have registered for that course. There shall be two student representatives from each batch of that course. One of the teachers shall be nominated as Course Coordinator by the HoD concerned and duly approved by the Principal
- The first meeting of the Common Course Committee shall be held within fifteen days from the date of commencement of the semester. The nature and weightage of the continuous assessments shall be decided in the first meeting, within the framework of the Regulations. Two or three subsequent meetings in a semester may be held at suitable intervals. During these meetings, the student members shall meaningfully interact and express their opinions and suggestions of all the students to improve the effectiveness of the teaching-learning

process. It is the responsibility of the student representatives to convey the proceedings of these meetings to the whole batch.

- In addition, the "Common Course Committee" (without the student representatives) shall meet to ensure uniform evaluation of continuous assessments after arriving at a common scheme of evaluation for the assessments.
- Wherever feasible, the common course committee (without the student representatives) shall also prepare a common question paper for the continuous assessment tests. The question paper for the end semester examination is common and shall be set by the Course Coordinator in consultation with all the teachers or the external member as appointed by the Controller of Examinations.

23. DETAILS OF FACULTY PEDAGOGICAL AND STUDENT ASSESSMENT RECORD

Every teacher is required to maintain a Faculty Record Book/ course file consisting of the following details as shown below;

- Time-table, course syllabus, program outcomes, course outcomes.
- Details of attendance of each student marked in each theory/practical/project work class.
- CIA marks, Midsem marks, Details of Assignment/ seminar given, course delivery details, corrective and preventive actions on test performance of students and any other additional details.

The record book should be submitted to the HOD periodically (at least three times in a semester) for checking the syllabus covered, the test marks and attendance. The HOD shall put his/her signature and date in the record book after due verification. At the end of the semester, the record book shall be verified by the Principal who will also ensure safe custody of the document for at least four years. The university or any inspection team appointed by the University / UGC / AICTE may verify the records of attendance and assessment of both current and previous semesters.

24. DISCIPLINE

Every student is required to maintain discipline and decorum both inside and outside the institution campus. They shall follow all the rules and regulations and should not indulge in any activity which can tarnish the reputation of the University or Institution. The Principal shall refer any act of indiscipline by students to the Discipline and Welfare Committee and other appropriate committees for action.

25. REVISION OF REGULATIONS AND CURRICULUM

The institution may from time to time revise, amend or change the Regulations, scheme of Examinations and syllabi, if found necessary. Academic Council assisted by Board of Studies and Standing Committee will make such revisions / changes..

Note : Any ambiguity in interpretation of this regulation is to be put up to the Standing Committee, whose decision will be final.

26. SPECIAL CASES

In the event of any clarification in the interpretation of the above rules and relations, they shall be referred to the Standing Committee. The standing committee will offer suitable interpretations / clarifications / amendments required for special case on such references and get them ratified in the next meeting of the Academic Council. The decision of the Academic Council is final..

ANNEXURE - I

COURSE NUMBERING SCHEME

M	1	9	M	E	T	7	0	9
Programme	Regulation		Department Code		Course Type	Semester	Sequence Number	

Programme : Masters Degree (M.E. / M.Tech / MBA / MCA) - M **Regulation :** R – 19 **Department Code** AE - Applied Electronics CS - Computer Science and Engineering ED - Engineering Design PS - Power System Engineering VD - VLSI Design CA - Computer Application MB - Management Studies EN - English MA - Mathematics CE - Career Enhancement MC - Mandatory Course	**Course Type** T - Theory P - Practical / Project/ Internship E - Elective O - Open Elective C - One Credit Courses N - Online courses S - Special Electives **Semester** 1 - First Semester 2 - Second Semester 3 - Third Semester 4 - Fourth Semester 5 - Fifth Semester 6 - Sixth Semester **Sequence Number** 00 - 99

ANNEXURE - II

POLICY ON MALPRACTICES

GENERAL

- It shall be the endeavour of all concerned to prevent, control and take remedial action to bring about the occurrences of malpractices to “Zero” in Examinations (both Internal and External), Assignments and in all Academic class works.
- Therefore, a comprehensive approach to the malady of malpractices has to be adopted to create a mindset of integrity and honesty, and at the same time take sufficiently stern action to make it clear that such attempts are fraught with comparably very high risk.
- In keeping with this stance, the following measures are to be taken by all concerned from class room level to the Examination Halls :

A. PREVENTION (This is the best method of tackling this malady)

a. Class room level :

All faculty members are to involve themselves in a psychological growth of students by personal example and self-respect and strive towards.

- Developing a sense of honour in the minds of students so that they look down upon earning undeserved marks.
- Imbibing a sense of self-respect and internal dignity that prevents him/her from succumbing to the temptation of easy marks by cheating.
- Generating an awareness of the risks to their character and career if convicted, while also explaining the process and strict rules and regulations adopted by the educational system to prevent malpractices.
- Taking stern view of copied assignments and attempts at malpractices in internal examinations also merits equal seriousness as external examinations.
- Setting sufficiently strong deterrent rules in place and regulations like intimation to parents and warning to students in the presence of parents etc. even in case of efforts at malpractices in internal tests and/or repeated acts despite warnings in case of assignments also.

Examination Halls :

Detailed instructions on Invigilation, question paper setting and evaluation and such other instructions will be issued for Invigilation, vigilance, which are to be brought to the notice of all students prior to the examinations.

B. PENAL ACTION FOR MALPRACTICES

All instances of malpractices will be forwarded to the Principal / Chief Superintendents. The offences will be investigated by a Standing Enquiry Committee constituted by Principal, The committee is to summon and give the student an opportunity to present / plead his/her case. The Committee may also summon anybody else, if it so deems necessary for the conduct of enquiry, in the interest of proper investigation and dispensation of the case. The tenure of the committee would be a complete Academic year.

The Committee is to be guided by the following :

- The seriousness of the malpractice, in terms of deviousness, and culpability / criminality of motive.
- The seriousness in terms of effort and degree of deviousness and culpability / criminality of effort.
- Any FIR / Police case that has been registered in the first instance by the Principal / Chief Superintendent.
- Any other special consideration either mitigating or to the contrary.

C. PENALTY FOR OFFENSES

The penalties awarded will depend on the seriousness of the Offence. A list of Offences and penalties are placed at Annexure III.

The Enquiry Report with findings and recommendations of the Committee are to be forwarded to the Controller who will undertake necessary follow up action. Based on the recommendations of the Controller of Examinations, the Principal is empowered to award penalties for offences classified as belonging to categories 1 to 7 of the offence table. The cases falling in categories from S.No. 8 onwards are to be put up to the Principal for consideration and award of suitable penalty.

ANNEXURE - III

Sl.No.	Nature of Malpractice	Maximum Punishment
1.	Appeal by the candidate in the answer script to show mercy by way of awarding more than deserving marks.	Fine of Rs. 1000/- per subject.
2.	The candidate writing his/her name in the answer script.	
3.	The candidate writing his/her registration number/college name in places other than specified in the answer script.	
4.	Any special marking in the answer script by the candidate.	
5.	The candidate communicating with neighbouring candidate orally or nonverbally; the candidate causing suspicious movement of his/her body.	
6.	Irrelevant writing by the candidate in the answer script.	
7.	The candidate writing answer on his/her question paper or making use of his/her question paper for rough work	
8.	The candidate possessing cell phones / programmable calculator(s) / any other electronic storage device(s) gadgets	Invalidating the examination of the particular subject written by the candidate
9.	The candidate possessing cell phones / programmable calculator(s) / any other electronic storage device(s) **gadgets**	Invalidating the examination of the particular subject written by the candidate

10.	The candidate possessing any incriminating material(s) (whether used or not). For example:-Written or printed materials, bits of papers containing written information, writings on scale, calculator, handkerchief, dress, part of the body, Hall Ticket, etc.	Invalidating the examination of the subject concerned and all the theory and the practical subjects of the current semester registered by the candidate. Further the candidate is not considered for revaluation of answer scripts of the arrears subjects. If the candidate has registered for arrears – subjects only, invalidating the examinations of all the arrears – subjects registered by the candidate.
11.	The candidate possessing cell phone(s)/ programmable calculator(s)/any other electronic storage device(s) gadgets and containing incriminating materials (whether used or not).	
12.	The Candidate possessing the question paper of another candidate with additional writing on it.	
13.	The candidate passing his/her question paper to another candidate with additional writing on it	
14.	The candidate passing incriminating materials brought into the examination hall in any medium (hard/soft) to other candidate(s).	
15.	The candidate copying from neighbouring candidate.	
16.	The candidate taking out of the examination hall answer booklet(s), used or unused	
17.	Appeal by the candidate in the answer script coupled with a promise of any form of consideration.	
18.	Candidate destroying evidence relating to an alleged irregularity.	Invalidating the examinations of the subject concerned and all the theory and the practical subjects of the current semester registered by the candidate. Further the candidate is not considered for revaluation of answer scripts of the arrears subjects.

		If the candidate has registered for arrears – subjects only, invalidating the examinations of all the arrears – subjects registered by the candidate. **Additional Punishment :** i. If the candidate has not completed the programme, he/she is debarred from continuing his / her studies for one year i.e., for two subsequent semesters. However the student is permitted to appear for the examination in all the arrears-subjects during the debarred period. ii. If the candidate has completed the programme, he/she is prevented from writing the examinations of the arrears subjects for two subsequent semesters.
19.	Vulgar / offensive writings by the candidate in the answer script.	Invalidating the examinations of all the theory and practical subjects of the current semester and all the arrears – subjects registered by the candidate.
20.	The candidate possessing the answer script of another candidate	
21.	The candidate passing his / her answer script to another candidate	
22.	Involved in any one or more of the malpractices of serial no. 8 to 21 for the second or subsequent times.	Invalidating the examinations of all the theory and practical subjects of the current semester and all the arrears –subjects registered by the candidate. **Additional Punishment :** i. If the candidate has not completed the programme, he/she is debarred from continuing his/her studies for one year i.e., for two subsequent semesters. However the student is permitted to appear for the examination in all the arrears-subjects during the debarred period. ii. If the candidate has completed the programme, he/she is prevented from writing the examinations of the arrearssubjects for two subsequent semesters.
23.	The candidate substituting an answer book let prepared outside the examination hall for the one already distributed to the candidate	

24.	The candidate indulge in any disruptive conduct including, but not limited to, shouting, assault of invigilator, officials or students using abusive and /or threatening language, destruction of property.	Invalidating the examinations of all the theory and practical subjects of the current semester and all the arrears –subjects registered by the candidate. **Additional Punishment :** i. If the candidate has not completed the programme, he/she is debarred from continuing his/her studies for two years i.e., for four subsequent semesters. However the student is permitted to appear for the examination in all the arrears-subjects during the debarred period. ii. If the candidate has completed the programme, he/she is prevented from writing the examinations of the arrears - subjects for four subsequent semesters.
25.	The candidate harass or engage others to harass on his/her behalf an invigilator, official, witnesses or any other person in relation to an irregularity by making telephone calls, visits, mails or by any other means.	
26.	Candidate possessing any firearm / weapon inside the examination hall.	
27.	Cases of Impersonation	(i) Handing over the impersonator to the police with a complaint to take appropriate action against the person involved in the impersonation by the Chief Supt. If a student of this University is found to impersonate a 'bonafide student', the impersonating student is debarred from continuing his/her studies and writing the examinations permanently. He/she is not eligible for any further admission to any programme of the University. Debarring the 'bonafide student' for whom the impersonation was done from continuing his/her studies and writing the examinations permanently. He/she is not eligible for any further admission to any programme of the University.

ANNEXURE - IV

Process to Consider the Application for Revocation of Detainment

The process to consider the application for revocation of detainment on account of lack of attendance in 3 or more courses, due to genuine reasons (viz. sports participation, NCC, Medical Grounds etc.) is as follows :

The student submits an application for consideration via a request letter to the CoE,not later than 3 days from the last working day, along with the HoD's recommendation, Class Advisor's report and Mentor's recommendation. A committee consisting of the Principal, CoE, HoD (Respective Department) and HoD's-2 from departments other than the student's own. The committee shall meet within 4 working days,to consider the case. Stakeholders may be called to be present in the meeting as may be required, and Decision arrived at. The decision approved by Principal shall be final.

ANNEXURE - V

Academic Evaluation Committee (AEC)

The committee includes the Principal, CoE, HoD concerned. The committee meets to carry out business related to academic matters which require central decision making and approval viz. retest approval of missed CIA, addressing the feedback collected from the various departments' class committee meetings.

Department Evaluation Committee (DEC)

The committee includes HoD (need basis), and a few faculty members of the department from various levels. The committee meets to carry out business related to academic matters that can be addressed within the department viz. course equivalence of common courses for readmitted students; approval of new courses to be offered by the department; consider and approve the credit equivalence of courses offered by industry, review the course offerings; consider the merit of applications involving lack of attendance in PE/OE courses to take up another PE or OE; approve CIAM only courses every semester; approve scheme of assessment for each course; Approval for and Mapping credits of certification courses; approval of list of nationally or internationally recognized professional certification courses with prometric testing.

Curriculum

KIT - Kalaignarkarunanidhi Institute of Technology

An Autonomous Institution

Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai
Accredited by NAAC with 'A' GRADE & NBA (AERO, CSE, ECE, EEE, MECH & MBA)
An ISO 9001 : 2015 Certified Institution, Coimbatore - 641 402.

Department of Electrical and Electronics Engineering

PG – Power Systems Engineering

Semester	Level of Course	Hours / Week	No of Courses	Range of Credits / Courses	Total Credits
PART - I					
A - Foundation Courses					
I	Foundation Courses **(FC)**	4	1	4	4
B - Professional Core Courses					
I to IV	Professional Core **(PC)**	3 - 4	12	2 - 4	36
C - Elective Courses					
I to IV	Professional Elective **(PE)**	3	5	3	15
D - Project Work					
III & IV	Project Work **(PW)**	12 - 24	2	6 - 12	18
Total Credit					**73**
PART II - Career Enhancement Courses (CEC)					
F- Career Enhancement Courses (CEC)					
II	Technical Seminar	2	1	1	1
Total Credit					**01**
Total Credit to be Earned					**74**

BoS Chairman

Scheme of Assessment and Examinations

(For Students admitted from the Academic Year 2019-20 and onwards)

Semester - I

Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (SEE)	CIA	SEE	Total	
Induction Programme											
M19MAT104	Applied Mathematics for Electrical Engineers	FC	4	3	0	1	3	40	60	100	4
M19PST101	Computer Aided Power System Analysis	PC	4	3	0	1	3	40	60	100	4
M19PST102	Power System Operation and Control	PC	3	3	0	0	3	40	60	100	3
M19PST103	Power Electronics Applications to Power Systems	PC	3	3	0	0	3	40	60	100	3
M19PST104	Systems Theory	PC	4	3	0	1	3	40	60	100	4
	Professional Elective - I	PE	3	3	0	0	3	40	60	100	3
M19PSP101	Power System Laboratory - I	PC	4	0	4	0	3	40	60	100	2
Total Contact Hours / Week			**25**	**18**	**4**	**3**	**Total Credits**				**23**

Semester - II

Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (SEE)	CIA	SEE	Total	
M19PST201	Power System Dynamics	PC	4	3	0	1	3	40	60	100	4
M19PST202	Power System Automation	PC	3	3	0	0	3	40	60	100	3
M19PST203	Digital Protection for Power System	PC	3	3	0	0	3	40	60	100	3
M19PST204	Restructured Power System	PC	3	3	0	0	3	40	60	100	3
	Professional Elective-II	PE	3	3	0	0	3	40	60	100	3
	Professional Elective-III	PE	3	3	0	0	3	40	60	100	3
M19PSP201	Power System Laboratory – II	PC	4	0	4	0	3	40	60	100	2
M19PSP202	Renewable Energy System Laboratory	PC	4	0	4	0	3	40	60	100	2
M19CEP201	Technical Seminar	CEC	2	0	2	0	-	100	-	100	1
Total Contact Hours / Week			**29**	**18**	**10**	**1**	**Total Credits**				**24**

BoS Chairman

Semester - III											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (SEE)	CIA	SEE	Total	
M19PST301	Distributed Generation and Micro-grid	PC	3	3	0	0	3	40	60	100	3
	Professional Elective - IV	PE	3	3	0	0	3	40	60	100	3
	Professional Elective - V	PE	3	3	0	0	3	40	60	100	3
M19PSP301	Project Work - Phase I	PW	12	0	12	0	3	40	60	100	6
Total Contact Hours / Week			21	9	12	0	Total Credits				15

Semester - IV											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (SEE)	CIA	SEE	Total	
M19PSP401	Project Work - Phase II	PW	24	0	24	0	3	40	60	100	12
Total Contact Hours / Week			24	0	24	0	Total Credits				12

FOUNDATION COURSES (FC)											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (SEE)	CIA	SEE	Total	
M19MAT104	Applied Mathematics for Electrical Engineers	FC	4	3	0	1	3	40	60	100	4

BoS Chairman

PROFESSIONAL CORE (PC)											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (SEE)	CIA	SEE	Total	
M19PST101	Computer Aided Power System Analysis	**PC**	4	3	0	1	**3**	40	60	100	**4**
M19PST102	Power System Operation and Control	**PC**	3	3	0	0	**3**	40	60	100	**3**
M19PST103	Power Electronics Applications to Power Systems	**PC**	3	3	0	0	**3**	40	60	100	**3**
M19PST104	Systems Theory	**PC**	4	3	0	1	**3**	40	60	100	**4**
M19PSP101	Power System Laboratory - I	**PC**	4	0	4	0	**3**	40	60	100	**2**
M19PST201	Power System Dynamics	**PC**	4	3	0	1	**3**	40	60	100	**4**
M19PST202	Power System Automation	**PC**	3	3	0	0	**3**	40	60	100	**3**
M19PST203	Digital Protection for Power System	**PC**	3	3	0	0	**3**	40	60	100	**3**
M19PST204	Restructured Power System	**PC**	3	3	0	0	**3**	40	60	100	**3**
M19PSP201	Power System Laboratory – II	**PC**	4	0	4	0	**3**	40	60	100	**2**
M19PSP202	Renewable Energy System Laboratory	**PC**	4	0	4	0	**3**	40	60	100	**2**
M19PST301	Distributed Generation and Micro-grid	**PC**	3	3	0	0	**3**	40	60	100	**3**

PROFESSIONAL ELECTIVES (PE)											
Semester – I											
Elective – I											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (SEE)	CIA	SEE	Total	
M19PSE101	Analysis of Electrical Machines	**PE**	3	3	0	0	**3**	40	60	100	**3**
M19PSE102	Analysis and Design of Power Converters	**PE**	3	3	0	0	**3**	40	60	100	**3**
M19PSE103	Industrial Power System Analysis and Design	**PE**	3	3	0	0	**3**	40	60	100	**3**
M19PSE104	Advanced Power Semiconductor Devices	**PE**	3	3	0	0	**3**	40	60	100	**3**

BoS Chairman

Semester – II											
Elective – II											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (SEE)	CIA	SEE	Total	
M19PSE201	Smart Grid	PE	3	3	0	0	3	40	60	100	3
M19PSE202	Power Electronics for Renewable Energy Systems	PE	3	3	0	0	3	40	60	100	3
M19PSE203	Power System Reliability	PE	3	3	0	0	3	40	60	100	3
M19PSE204	Principles of Sustainable Green Energy Development	PE	3	3	0	0	3	40	60	100	3

Semester – II											
Elective – III											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (SEE)	CIA	SEE	Total	
M19PSE205	Advanced Digital Signal Processing	PE	3	3	0	0	3	40	60	100	3
M19PSE206	Soft Computing Techniques	PE	3	3	0	0	3	40	60	100	3
M19PSE207	Research Methodology & IPR	PE	3	3	0	0	3	40	60	100	3
M19PSE208	Electrical Distribution System	PE	3	3	0	0	3	40	60	100	3

Semester – III											
Elective – IV											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (SEE)	CIA	SEE	Total	
M19PSE301	Solar & Energy Storage Systems	PE	3	3	0	0	3	40	60	100	3
M19PSE302	Energy management auditing	PE	3	3	0	0	3	40	60	100	3
M19PSE303	Flexible AC Transmission Systems	PE	3	3	0	0	3	40	60	100	3
M19PSE304	Electrical Transients in Power systems	PE	3	3	0	0	3	40	60	100	3

BoS Chairman

Semester – III											
Elective – V											
Course Code	**Course Name**	**Category**	**Instructional Hours**				**Assessment**				**Credit**
			Contact Periods	**T**	**P**	**TU**	**Hours of Exam. (SEE)**	**CIA**	**SEE**	**Total**	
M19PSE305	Embedded System Design & Programming	**PE**	3	3	0	0	**3**	40	60	100	**3**
M19PSE306	Cyber Security in Smart Power Systems	**PE**	3	3	0	0	**3**	40	60	100	**3**
M19PSE307	Electric Vehicle	**PE**	3	3	0	0	**3**	40	60	100	**3**
M19PSE308	Artificial Intelligence	**PE**	3	3	0	0	**3**	40	60	100	**3**

PROJECT WORK (PW)											
Course Code	**Course Name**	**Category**	**Instructional Hours**				**Assessment**				**Credit**
			Contact Periods	**T**	**P**	**TU**	**Hours of Exam. (SEE)**	**CIA**	**SEE**	**Total**	
M19PSP301	Project Work - Phase I	**PW**	12	0	12	0	**3**	40	60	100	**6**
M19PSP401	Project Work - Phase II	**PW**	24	0	24	0	**3**	40	60	100	**12**

CAREER ENHANCEMENT COURSE (CEC)											
Course Code	**Course Name**	**Category**	**Instructional Hours**				**Assessment**				**Credit**
			Contact Periods	**T**	**P**	**TU**	**Hours of Exam. (SEE)**	**CIA**	**SEE**	**Total**	
M19CEP201	Technical Seminar	**CEC**	2	0	2	0	**-**	100	-	100	**1**

BoS Chairman

Syllabus

Semester - I

M.E.	M19MAT104 - APPLIED MATHEMATICS FOR ELECTRICAL ENGINEERS	T	P	TU	C
		4	0	0	4

Course Objectives	
1.	To extend matrix theory in the field of electrical systems.
2.	This course is designed to enrich the knowledge of calculus of variations.
3.	To understand the basic concepts of probability and random variables to introduce some standard distributions applicable to engineering which can describe real life phenomenon..
4.	Linear programming will help the students to identify, formulate, abstract, and solve problems in electrical engineering using mathematical tools.
5.	To acquaint the student with Fourier series techniques used in wide variety of situations.

UNIT - I	MATRIX THEORY	12

The Cholesky decomposition - Generalized Eigenvectors - Canonical basis - QR factorization - Least squares method - Singular value decomposition

UNIT - II	CALCULUS OF VARIATIONS	12

Concept of variation and its properties – Euler's equation – Functional dependent on first and higher order derivatives – Functional dependent on functions of several independent variables – Variational problems with moving boundaries – Isoperimetric problems - Direct methods : Ritz and Kantorovich methods

UNIT - III	ONE DIMENSIONAL RANDOM VARIABLES	12

Random variables - Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions

UNIT - IV	LINEAR PROGRAMMING	12

Formulation – Graphical solution – Simplex method – Big M method - Two phase method - Transportation and Assignment models

24/7/19

BoS Chairman

UNIT - V	FOURIER SERIES	12
Fourier trigonometric series : Periodic function as power signals – Convergence of series – Even and odd function : Cosine and sine series – Non periodic function : Extension to other intervals - Power signals : Exponential Fourier series – Parseval's theorem and power spectrum – Eigen value problems and orthogonal functions – Regular Sturm - Liouville systems – Generalized Fourier series.		
		Total Instructional hours : 60

Course Outcomes : Students will be able to	
CO1	Make use of various methods in matrix theory to solve system of linear equations.
CO2	Solve maximizing and minimizing the functional that occur in Electrical engineering disciplines.
CO3	Identify moments, standard distributions of discrete and continuous random variables.
CO4	Apply the method for solving linear programming models.
CO5	Develop Fourier transforms to initial value, initial–boundary value and boundary value problems in the power signals.

Reference Books	
1.	Bronson, R. "Matrix Operation", Schaum's outline series, 2nd Edition, McGraw Hill, 2011.
2.	B.S. Grewal , "Higher Engineering Mathematics", (Khanna Publishers), 43rd edition, 2014.
3.	Elsgolc, L.D. "Calculus of Variations", (Dover Publications), New York, 2012.
4.	Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", (Pearson Education, Asia), 8th Edition,2015.
5.	O'Neil, P.V., "Advanced Engineering Mathematics", (Thomson Asia Pvt. Ltd., Singapore), 2012.
6.	Taha, H.A., "Operations Research, An Introduction", (Pearson education, New Delhi), 9th Edition 2016.

24/7/19

BoS Chairman

M.E.	M19PST101 - COMPUTER AIDED POWER SYSTEM ANALYSIS	T	P	TU	C
		3	0	1	4

Course Objectives	
1.	To introduce different techniques of dealing with sparse matrix for large scale power systems
2.	To impart in-depth knowledge on different methods of power flow solutions.
3.	To perform optimal power flow solutions in detail.
4.	To perform short circuit fault analysis and understand the consequence of different type of faults.
5.	To Illustrate different numeric al integration methods and factors influencing transient stability

UNIT - I	SOLUTION TECHNIQUE	12

Sparse Matrix techniques for large scale power systems: Optimal ordering schemes for preserving sparsity. Flexible packed storage scheme for storing matrix as compact arrays – Factorization by Bifactorization and Gauss elimination methods; Repeat solution using Left and Right factors and L and U matrices.

UNIT - II	POWER FLOW ANALYSIS	12

Power flow equation in real and polar forms; Review of Newton‟s method for solution; Adjustment of P-V buses; Review of Fast Decoupled Power Flow method; Sensitivity factors for P-V bus adjustment.

UNIT - III	OPTIMAL POWER FLOW	12

Problem statement; Solution of Optimal Power Flow (OPF) – The gradient method, Newton‟s method, Linear Sensitivity Analysis; LP methods – With real power variables only – LP method with AC power flow variables and detailed cost functions; Contingency Analysis ,Security constrained Optimal Power Flow; Interior point algorithm; Bus Incremental costs.

UNIT - IV	SHORT CIRCUIT ANALYSIS	12

Formation of bus impedance matrix with mutual coupling (single phase basis and three phase basis) - Computer method for fault analysis using ZBUS and sequence components. Derivation of equations for bus voltages, fault current and line currents, both in sequence and phase – symmetrical and unsymmetrical faults.

BoS Chairman

UNIT - V	TRANSIENT STABILITY ANALYSIS	12
Introduction, Numerical Integration Methods: Euler and Fourth Order Runge-Kutta methods, Algorithm for simulation of SMIB and multi-machine system with classical synchronous machine model; Factors influencing transient stability, Numerical stability and implicit Integration methods.		
Total Instructional hours : 60		

Course Outcomes : Students will be able to	
CO1	Ability to apply the concepts of sparse matrix for large scale power system analysis
CO2	Solve the load flow problem with the help of flowchart
CO3	Ability to analyse power system studies that needed for the transmission system planning.
CO4	Solve the balanced & unbalanced three phase faults using various methods.
CO5	Explain the concept of single machine system under transient, steady state and dynamic condition

Reference Books	
1.	Nagrath I.J. and Kothari D.P., ‘‘Modern Power System Analysis’’, Tata McGraw-Hill, Fourth Edition, 2011.
2.	Wood A.J. and Wollen berg B.F, “Power Generation Operation and Control”, John Wiley and sons, New York, 3rd edition 2013.
3.	Hadi Saadat, ‘’Power System Analysis’’, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.
4.	Olle. I. Elgerd, ‘‘Electric Energy Systems Theory – An Introduction’’, Tata McGraw Hill Publishing Company Limited, New Delhi, Second Edition, 2012.
5.	Kundur P., ‘‘Power System Stability and Control”, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 10th reprint, 2010.

BoS Chairman

M.E.	M19PST102 - POWER SYSTEM OPERATION AND CONTROL	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the fundamentals of speed governing system and the concept of control areas.
2.	To provide knowledge about Hydro thermal scheduling, Unit commitment and solution techniques.
3.	To impart knowledge on the need of state estimation and its role in the day to day operation of power system.

UNIT - I	INTRODUCTION	9

System load variation: System load characteristics, load curves - daily, weekly and annual, load-duration curve, load factor, diversity factor. Reserve requirements: Installed reserves, spinning reserves, cold reserves, hot reserves. Overview of system operation: Load forecasting, techniques of forecasting, basics of power system operation and control.

UNIT - II	REAL POWER - FREQUENCY CONTROL	9

Fundamentals of speed governing mechanism and modelling: Speed-load characteristics – Load sharing between two synchronous machines in parallel; concept of control area, LFC control of a single - area system: Static and dynamic analysis of uncontrolled and controlled cases, Economic Dispatch Control. Multi-area systems: Two-area system modelling; static analysis, uncontrolled case; tie line with frequency bias control of two-area system derivation, state variable model.

UNIT - III	HYDROTHERMAL SCHEDULING PROBLEM	9

Hydrothermal scheduling problem: short term and long term-mathematical model, algorithm. Dynamic programming solution methodology for Hydro-thermal scheduling with pumped hydro plant: Optimization with pumped hydro plant-Scheduling of systems with pumped hydro plant during off-peak seasons: algorithm. Selection of initial feasible trajectory for pumped hydro plant- Pumped hydro plant as spinning reserve unit-generation of outage induced constraint-Pumped hydro plant as Load management plant.

BoS Chairman

UNIT - IV	UNIT COMMITMENT AND ECONOMIC DISPATCH	9
Statement of Unit Commitment (UC) problem; constraints in UC: spinning reserve, thermal unit constraints, hydro constraints, fuel constraints and other constraints; UC solution methods: Priority-list methods, forward dynamic programming approach, numerical problems. Incremental cost curve, co-ordination equations without loss and with loss, solution by direct method and λ-iteration method. Base point and participation factors.- Economic dispatch controller added to LFC control.		

UNIT - V	STATE ESTIMATION	9
Need for power system state estimation- Network observability – DC state estimation model State estimation of power system – Methods of state estimation: Least square state estimation, weighted least square state estimation, Maximum likelihood- Bad data detection and identification.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Ability to understand system load variations and get an overview of power system operations.
CO2	Illustrate the power system state estimation.
CO3	Illustrate the knowledge about hydrothermal scheduling.
CO4	Explain the significance of unit commitment and different solution methods.
CO5	Ability to understand the need for state estimation in real time operation

Reference Books	
1.	Nagrath I.J. and Kothari D.P., 'Modern Power System Analysis', Tata McGraw-Hill, Fourth Edition,2011
2.	Hadi Saadat, 'Power System Analysis', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.

BoS Chairman

3.	Wood A.J. and Wollenberg B.F, “Power Generation Operation and Control”, John
4.	Wiley and sons,New York, 3rd edition 2013.
5.	Kundur P., ‘Power System Stability and Control, Tata McGraw Hill Education Pvt. Ltd., New Delhi,10th reprint, 2010.
6.	Abhijit Chakrabarti, Sunita Halder, ‘Power System Analysis Operation and Control’,
7.	PHI learning Pvt. Ltd., New Delhi, Third Edition, 2010.
8.	Olle.I.Elgerd, ‘Electric Energy Systems theory - An introduction’, Tata McGraw Hill
9.	Education Pvt.Ltd., New Delhi, 34th reprint, 2010.

BoS Chairman

M.E.	M19PST103 - POWER ELECTRONIC APPLICATIONS TO POWER SYSTEMS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To have a thorough understanding of the construction, theory and characteristics of the Devices like MOSFET, BJT's, IGBT's and SCR.
2.	To analysis and modeling of Inverters and converters.
3.	To study in detail about the Reactive power compensation and FACTS devices.
4.	To study about the definition and issues in power quality

UNIT - I	INTRODUCTION	9

Basic Concept of Power Electronics, Different types of Power Electronic Devices - Diodes, Transistors, SCR, MOSFET, IGBT and GTO's.

UNIT - II	AC TO DC CONVERTERS	9

Single Phase and three phase bridge rectifiers, half controlled and Fully Controlled Converters With R, RL, AND RLE loads. Free Wheeling Diodes, Dual Converter, Sequence Control of Converters - inverter operation, Input Harmonics and Output Ripple, Smoothing Inductance - Power Factor Improvement effect of source impedance, Overlap, Inverter limit.

UNIT - III	DC TO AC CONVERTERS	9

General Topology of single Phase and three phase voltage source and current source inverters- Need for feedback diodes in anti-parallel with switches - Multi Quadrant Chopper viewed as a Single phase inverter- Configuration of Single phase voltage source inverter: Half and Full bridge, Selection of Switching Frequency and Switching Device, Voltage Control and PWM strategies.

UNIT - IV	STATIC REACTIVE POWER COMPENSATION	9

Shunt Reactive Power Compensation - Fixed Capacitor Banks, Switched Capacitors, Static Reactor Compensator, Thyristor Controlled Shunt Reactors (TCR) - Thyristor Controlled Transformer - FACTS Technology - Applications of static thyristor Controlled Shunt Compensators for load compensation, Static Var Systems for Voltage Control, Power Factor Control and Harmonic Control of Converter Fed Systems.

BoS Chairman

UNIT - V	POWER QUALITY	9
Power Quality - Terms and Definitions - Transients - Impulsive and Oscillatory Transients - Harmonic Distortion - Harmonic Indices - Total Harmonic Distortion - Total Demand Distortion- Locating Harmonic Sources Harmonic s from commercial and industrial Loads - Devices for Controlling Harmonics Passive and Active Filters -Harmonic Filter Design- Sources of sags and interruptions		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Analyze Inverters & Converters and Ability to model.
CO2	Analyze the custom power electronic devices.
CO3	Show the understanding of the semiconductor devices like rectifiers, Thyristors and transistors.
CO4	Explain the principle of operation of FACTS devices.
CO5	Summarize the issues like sag and harmonics in power quality.

Reference Books	
1.	Frede Blaabjerg, Tomislav Dragičevic, Pooya Davari, “Applications of Power Electronics” Volume 1 Paperback – Import, 25 Jun 2019.
2.	M.L. Soni, P.V.Gupta, U.S. Bhatnagar A.Chakrabarti “A Text Book on Power System Engineering” Dhanpat Rai and Company Private Limited; Reprint 2009 Edition (2009)
3.	M.H.Rashid, Power Electronics, Prentice Hall of India, 2006.
4.	Roger.C.Dugan, Mark.F.McGranagham, Surya Santoso, H.Wayne Beaty, ‘Electrical Power Systems Quality’ McGraw Hill, 2003
5.	B.K.Bose, Power Electronics and A.C. Drives , Prentice Hall ,2004.

BoS Chairman

M.E.	M19PST104 - SYSTEM THEORY	T	P	TU	C
		3	0	1	4

Course Objectives	
1.	To understand the fundamentals of physical systems in terms of its linear and nonlinear models.
2.	To educate on solving linear and non-linear state equations
3.	To exploit the properties of linear systems such as controllability and observability
4.	To educate on stability analysis of systems using Lyapunov's theory
5.	To educate on modal concepts and design of state and output feedback controllers and estimators

UNIT - I	STATE VARIABLE REPRESENTATION	12

Concepts of state, state variables and state model - State model for linear time invariant systems – State space representation using physical, phase and canonical variables – Transfer function from state model – Direct, cascade and parallel decomposition – Solution of state equation – State transition matrix.

UNIT - II	SYSTEM MODELS	12

Characteristic equation – Eigen values and Eigen vectors – Invariance of Eigen values – Diagonalization – Jordan canonical form – Concept of controllability and observability – Kalman‟s and Gilbert‟s tests –Controllable and Observable Phase Variable forms for SISO and MIMO systems – Effect of pole-zero cancellation on controllability and observability– Pole placement by state feedback – Full order and reduced order observers.

UNIT - III	NONLINEAR SYSTEMS	12

Types of nonlinearity – Phase plane analysis – Singular points – Limit cycles – Construction of phase trajectories – Describing function method – Derivation of describing functions.

UNIT - IV	STABILITY	12

Introduction-Equilibrium Points - Stability in the sense of Lyapunov - BIBO Stability - Stability of LTI Systems - Equilibrium Stability of Nonlinear Continuous Time Autonomous Systems - Direct Method of Lyapunov - Linear Continuous Time Autonomous Systems - Finding Lyapunov Functions for Nonlinear Continuous Time Autonomous Systems - Krasovskii and Variable - Gradient Method.

BoS Chairman

UNIT - V	ADVANCED CONTROL SYSTEMS	12
Adaptive Control: Model – Reference Adaptive Control - Fundamental concepts – Self tuning Control – Robust Control - Parameter perturbations – Design of robust control system – PID controllers – Fuzzy Logic Control – Neutral Network Controller – Genetic Algorithm.		
Total Instructional hours : 60		

Course Outcomes : Students will be able to	
CO1	Ability to represent the time-invariant systems in state space form as well as analyze, whether the system is stabilizable, controllable, observable and detectable.
CO2	Ability to design state feedback controller and state observers.
CO3	Ability to describe non-linear behaviors such as Limit cycles, input multiplicity and output multiplicity, Bifurcation and Chaos.
CO4	Use the techniques such as describing function, Lyapunov Stability, Popov's Stability Criterion and Circle Criterion to assess the stability of certain class of non-linear system.
CO5	Develop the advanced control systems using controllers.

Reference Books	
1.	Katushiko Ogata, "Modern Control Engineering", Pearson Hall of India Private Ltd, New Delhi, V Edition, 2011.
2.	Gopal.M, "Modern Control System Theory", New Age International, 2005.
3.	Roy Choudhury.D, "Modern Control Systems", New Age International, 2005.
4.	Bubnicki.Z, "Modern Control Theory", Springer, 2005.
5.	Z. Bubnicki, "Modern Control Theory", Springer, 2005.

BoS Chairman

M.E.	M19PSP101 - POWER SYSTEM LABORATORY - I	T	P	TU	C
		0	4	0	2

Course Objectives	
1.	To have hands on experience on various system studies and different techniques used for system planning using Software packages.
2.	To perform the dynamic analysis of power system.

List of Experiments	
Expt. No.	**Description of the Experiments**
1.	Power flow analysis by Newton-Raphson method and Fast decoupled method.
2.	Transient stability analysis of single machine-infinite bus system using classical machine model.
3.	Contingency analysis: Generator shift factors and line outage distribution factors.
4.	Economic dispatch using lambda-iteration method.
5.	Unit commitment: Priority-list schemes and dynamic programming.
6.	State Estimation (DC).
7.	Analysis of switching surge using EMTP: Energisation of a long distributed- parameter line.
8.	Analysis of switching surge using EMTP: Computation of transient recovery voltage.
9.	Simulation and Implementation of Voltage Source Inverter.
10.	Digital Over Current Relay Setting and Relay Coordination using Suitable software packages.
11.	Co-ordination of over-current and distance relays for radial line protection.
	Total Instructional hours : 60

Course Outcomes : Students will be able to	
CO1	Analyze the power flow using Newton-Raphson method and Fast decoupled Method.
CO2	Understand the Performs of contingency analysis & economic dispatch.
CO3	Understand the Digital Over Current Relay and Coordinate Relay.

BoS Chairman

Professional Elective – I

M.E.	M19PSE101 - ANALYSIS OF ELECTRICAL MACHINES	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To provide knowledge about the fundamentals of magnetic circuits, energy, force and torque of multi-excited systems.
2.	To provide the knowledge of theory of transformation of three phase variables to two phase variables.
3.	To analyze the steady state and dynamic state operation of DC machine through mathematical modeling and simulation in digital computer.
4.	To analyze the steady state and dynamic state operation of three-phase induction machines using transformation theory based mathematical modeling and digital computer simulation.
5.	To analyze the steady state and dynamic state operation of three-phase synchronous machines using transformation theory based mathematical modeling and digital computer simulation.

UNIT - I	PRINCIPLES OF ELECTROMAGNETIC ENERGY CONVERSION	9

Basics of magnetic circuits – General expression of stored magnetic energy – Energy and Force / Torque equations – Singly and Doubly fed excited systems – Linear and Non-linear magnetic systems – Analysis of magnetic circuits with air gap and permanent magnets.

UNIT - II	REFERENCE FRAME THEORY	9

Static and rotating reference frames – Transformation of variables - Transformation between reference frames – Transformation of a balanced set – Balanced steady state phasor and voltage equations – Variables observed from several frames of reference

UNIT - III	DC MACHINES	9

Voltage and Torque Equations – Dynamic characteristics of permanent magnet and shunt DC motors – State equations - Solution of dynamic characteristics by Laplace transformation.

BoS Chairman

UNIT - IV	INDUCTION MACHINES	9
Voltage and Torque Equations – Transformation for rotor circuits – Voltage and torque equations in reference frame variables – Analysis of steady state operation – Free acceleration characteristics – Dynamic performance for load and torque variations – Dynamic performance for three phase fault – Computer simulation in arbitrary reference frame.		

UNIT - V	SYNCHRONOUS MACHINES	9
Voltage and Torque Equation - Voltage equation in arbitrary reference frame and rotor reference frame – Park equations - Rotor angle and angle between rotor – Steady state analysis – Dynamic performance for torque variations - Dynamic performance for three phase fault – Transient stability limit – Critical clearing time – Computer simulation		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Ability to understand the various electrical parameters in mathematical form.
CO2	Ability to understand the different types of reference frame theories and transformation relationships.
CO3	Ability to find the electrical machine equivalent circuit parameters and modeling of electrical machines.
CO4	Analyze the Induction Machines using computer simulation.
CO5	Analyze the Synchronous Machines using computer simulation tools.

Reference Books	
1.	Paul C.Krause, Oleg Wasyzczuk, Scott S, Sudhoff, “Analysis of Electric Machinery and Drive Systems”, John Wiley, Second Edition, 2010.
2.	Bimbhra P S, “Generalized Theory of Electrical Machines”, Khanna Publishers, 2018
3.	Krishnan R, Electric Motor & Drives: Modeling, Analysis and Control, New Delhi, Prentice Hall of India, 2001.

BoS Chairman

M.E.	M19PSE102 - ANALYSIS AND DESIGN OF POWER CONVERTERS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To obtain the switching characteristic of Power diodes and Thyristors.
2.	To determine the operation, characteristics and performance parameters of different converters.
3.	To apply switching techniques and basic topologies of DC-DC switching regulators.
4.	To Design AC-AC converters for variable frequency applications.
5.	To Explain the Single phase and three phase Matrix Converters

UNIT - I	POWER DIODES AND THYRISTORS	9

Construction, operation, types, switching and steady state characteristics of Power Diodes, SCRs, TRIACs and GTOs - Gate circuit requirements – Protection – Series and parallel operation – Driver circuit – Design of sunbber circuits – Commutation.

UNIT - II	AC - DC CONVERTER	9

Single phase and Three phase half controlled and fully controlled converters – Dual converters - Effect of source impedance and overlap - Performance parameters: harmonics, ripple, distortion, power factor - Design of converter circuits – power factor correction rectifiers – Fourier series Analysis

UNIT - III	DC - DC CONVERTERS	9

Principles of step-down and step-up converters – Control strategies – Analysis and design of Buck - Boost, CUK, LUO and SEPIC converters - High frequency isolated DC - DC converters - resonant choppers.

UNIT - IV	AC – AC CONVERTERS	9

Principle of phase control and ON-OFF control – Single phase and three phase AC voltage controllers – Various configurations – PWM schemes – Single phase and three phase Cycloconverters - SMPS – types and design.

BoS Chairman

UNIT - V	MATRIX CONVERTER	9
Single phase and three phase Matrix Converters – types – Analysis of performance parameters: Output Voltage, input current, input and output power factors – PWM schemes for matrix converter – Applications-SVPWM schemes for Matrix converter.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Analyze various single phase and three phase power converters
CO2	Select and design dc-dc converter topologies for a broad range of power conversion applications.
CO3	Develop improved power converters for any stringent application requirements.
CO4	Design ac-ac converters for variable frequency applications.
CO5	Explain the Single phase and three phase Matrix Converters

Reference Books	
1.	Simon Ang, Alejandro Oliva, “Power-Switching Converters, Second Edition, CRC Press, Taylor & Francis Group, 2010.
2.	Marian.K.Kazimierczuk and Dariusz Czarkowski, “Resonant Power Converters”, John Wiley & Sons limited, 2011.
3.	M.D. Singh and K.B.Khanchandani, “Power Electronics”, Tata McGraw Hill, 2017.
4.	Mohan, Undeland and Robins, “Power Electronics – Concepts, Applications and Design”, John Wiley and sons, Singapore, 2000.
5.	Ned Mohan,T. MUndeland and Robbin W.P, “Power Electronics: converters, Application and design” John Wiley and sons.Wiley India edition, 2006.
6.	S. Bimbra, “Power Electronics”, Khanna Publishers, Eleventh Edition, 2014.

BoS Chairman

M.E.	M19PSE103 - INDUSTRIAL POWER SYSTEM ANALYSIS AND DESIGN	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To analyze the motor starting and power factor correction.
2.	To perform computer-aided harmonic and flicker analysis and to design filters.
3.	To expose various grid grounding methodologies
4.	To Illustrate flicker analysis and to minimize the effect of it.
5.	To Illustrate the concept of insulation coordination & minimize the effect of transient by the help of EMTP.

UNIT - I	MOTOR STARTING STUDIES	9

Introduction - Evaluation Criteria - Starting Methods - System Data - Voltage Drop Calculations - Calculation of Acceleration time - Motor Starting with Limited - Capacity Generators – Computer - Aided Analysis – Conclusions

UNIT - II	POWER FACTOR CORRECTION STUDIES	9

Introduction - System Description and Modeling - Acceptance Criteria - Frequency Scan Analysis- Voltage Magnification Analysis - Sustained Overvoltages - Switching Surge Analysis – Back – to - Back Switching - Summary and Conclusions.

UNIT - III	HARMONIC ANALYSIS	9

Harmonic Sources - System Response to Harmonics - System Model for Computer - Aided Analysis - Acceptance Criteria - Harmonic Filters - Harmonic Evaluation - Case Study - Summary and Conclusions.

UNIT - IV	FLICKER ANALYSIS	9

Sources of Flicker - Flicker Analysis - Flicker Criteria -Data for Flicker analysis - Case Study - Arc Furnace Load - Minimizing the Flicker Effects - Summary.

BoS Chairman

UNIT - V	INSULATION AND COORDINATION	9
Modeling of system; simulation of switching surges; description of EMTP - capabilities; voltage acceptance criteria; insulation coordination case study; methods of minimizing switching transients; conclusions.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Explain the motor starting techniques & design factors of it.
CO2	Develop & compare the different types of power factor corrective methods.
CO3	Explain the computer-aided harmonic analysis & filter
CO4	Illustrate flicker analysis and to minimize the effect of it.
CO5	Illustrate the concept of insulation coordination & minimize the effect of transient by the help of EMTP

Reference Books	
1.	Ramasamy Natarajan, “Computer-Aided Power System Analysis”, Marcel Dekker Inc., 2002.
2.	George L.Kusic, “Computer-Aided Power System Analysis”, CRC press, 2018.
3.	EMTP literature from www.microtran.cm

BoS Chairman

M.E.	M19PSE104 - ADVANCED POWER SEMICONDUCTOR DEVICES	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the basics of devices selection.
2.	To enable the students for the selection of devices for different power electronics applications.
3.	To get the knowledge about the datasheet of power semiconductor Devices.
4.	Study about the thermal protection of the Devices
5.	To examine heat sinks for semiconductor devices

UNIT - I	INTRODUCTION	9

Power switching devices overview; Attributes of an ideal switch, application requirements, and circuit symbols. Power handling capability, Device selection strategy – On-state and switching losses -Power diodes - Types, forward and reverse characteristics, switching characteristics – rating.

UNIT - II	SILICON POWER ELECTRONIC SEMICONDUCTORS DEVICES AND DRIVER CIRCUITS	9

Construction, static characteristics, switching characteristics and Gate characteristics of Thyristor – GTO – MOSFET - IGBTs – SIC – GAN – FCT – RCT. Converter grade and inverter grade SCR. High Speed Opto - Couplers – Zero Crossing Detectors - Optically Isolated High Voltage and High Current sensing circuits, Driver ICs: MOC series SCR, IR2XXX Series Full Bridge and Half Bridge MOSFET / IGBT Driver ICs.

UNIT - III	DATASHEET RATINGS FOR SEMICONDUCTOR DEVICES	9

Standards, Symbols and terms-Maximum ratings – Thermal Impedance and resistance- Component (type) designation system - Mechanical data – Safe Operating Area during switching and short circuit.

BoS Chairman

UNIT - IV	PROTECTION AND NOISE	9
Over voltage, Over current and gate protections and Design of snubber circuits - Noise generated due to switching-Common noise sources in SMPS - Noises Due to High frequency transformer - Measurement of Noise.		

UNIT - V	THERMAL PROTECTION	9
Heat transfer – conduction, convection and radiation, Cooling – liquid cooling, vapour – phase cooling, Guidance for heat sink selection - heat sink types and design - Electrical analogy of thermal components – Mounting types.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Explain the operation and characteristics of the semiconductor devices.
CO2	Interpret the gate drive circuits and its necessity.
CO3	Select suitable component for the particular application with the help of data sheet.
CO4	Examine protection circuit for the semiconductor devices.
CO5	Examine heat sinks for semiconductor devices.

Reference Books	
1.	Rashid M.H., “Power Electronics circuits, Devices and Applications”, Pearson education limited, Fourth Edition, 2014.
2.	M.D. Singh and K.B.Khanchandani, “Power Electronics”, Tata McGraw Hill, 2014.
3.	Vedam Subramanyam, "Power Electronics", New Age International (P) Limited, New Delhi, 2006.
4.	Ned Mohan, Undcland and Robins, “Power Electronics – Concepts, applications and Design, John Wiley and Sons, Third edition.
5.	B.W. Williams, “Power Electronics – Devices, Drivers, Applications and Passive Components”, Tata McGraw Hill, 2017.

BoS Chairman

Semester - II

M.E.	M19PST201 - POWER SYSTEM DYNAMICS	T	P	TU	C
		3	0	1	4

Course Objectives	
1.	To impart knowledge on dynamic modeling of a synchronous machine in detail.
2.	To describe the modelling of excitation and speed governing system in detail.
3.	To understand the fundamental concepts of stability of dynamic systems without controller and its classification.
4.	To understand the fundamental concepts of stability of dynamic systems with controller and its classification.
5.	To understand and enhance small signal stability problem of power systems.

UNIT - I	SYNCHRONOUS MACHINE MODELLING	9

Schematic Diagram, Physical Description: armature and field structure, machines with multiple pole pairs, mmf waveforms, direct and quadrature axes, Mathematical Description of a Synchronous Machine: Basic equations of a synchronous machine: stator circuit equations, stator self, stator mutual and stator to rotor mutual inductances, dq0 Transformation: flux linkage and voltage equations for stator and rotor in dq0 coordinates, electrical power and torque, physical interpretation of dq0 transformation, Per Unit Representations: power invariant form of Park's transformation; Equivalent Circuits for direct and quadrature axes, Steady-state Analysis: Voltage, current and flux-linkage relationships, Phasor representation, Rotor angle, Steady-state equivalent circuit, Computation of steady-state values, Equations of Motion: Swing Equation, calculation of inertia constant, Representation in system studies, Synchronous Machine Representation in Stability Studies: Simplifications for large-scale studies : Neglect of stator transients, Simplified model with amortisseurs neglected: two-axis model with amortisseur windings neglected, classical model.

BoS Chairman

UNIT - II	MODELLING OF EXCITATION AND SPEED GOVERNING SYSTEMS	9

Excitation System Requirements; Elements of an Excitation System; Types of Excitation System; Control and protective functions; IEEE (1992) block diagram for simulation of excitation systems. Turbine and Governing System Modeling: Functional Block Diagram of Power Generation and Control, Schematic of a hydroelectric plant, classical transfer function of a hydraulic turbine (no derivation), special characteristic of hydraulic turbine, electrical analogue of hydraulic turbine, Governor for Hydraulic Turbine: Requirement for a transient droop, Block diagram of governor with transient droop compensation, Steam turbine modeling: Single reheat tandem compounded type only and IEEE block diagram for dynamic simulation; generic speed- governing system model for normal speed/load control function.

UNIT - III	SMALL-SIGNAL STABILITY ANALYSIS WITHOUT CONTROLLERS	9

Classification of Stability, Basic Concepts and Definitions: Rotor angle stability, The Stability Phenomena. Fundamental Concepts of Stability of Dynamic Systems: State-space representation, stability of dynamic system, Linearization, Eigen properties of the state matrix: Eigen values and eigenvectors, modal matrices, Eigen value and stability, mode shape and participation factor. Single-Machine Infinite Bus (SMIB) Configuration: Classical Machine Model stability analysis with numerical example, Effects of Field Circuit Dynamics: synchronous machine, network and linearised system equations, block diagram representation with K- constants; expression for K-constants (no derivation), effect of field flux variation on system stability: analysis with numerical example.

UNIT - IV	SMALL - SIGNAL STABILITY ANALYSIS WITH CONTROLLERS	9

Effects Of Excitation System: Equations with definitions of appropriate K-constants and simple thyristor excitation system and AVR, block diagram with the excitation system, analysis of effect of AVR on synchronizing and damping components using a numerical example, Power System Stabilizer: Block diagram with AVR and PSS, Illustration of principle of PSS application with numerical example, Block diagram of PSS with description, system state matrix including PSS, analysis of stability with numerical a example. Multi-Machine Configuration: Equations in a common reference frame, equations in individual machine rotor coordinates, illustration of formation of system state matrix for a two-machine system with classical models for synchronous machines, illustration of stability analysis using a numerical example. Principle behind small- signal stability improvement methods: delta-omega and delta P-omega stabilizers.

BoS Chairman

UNIT - V	ENHANCEMENT OF SMALL SIGNAL STABILITY	9
Power System Stabilizer – Stabilizer based on shaft speed signal (delta omega) – Delta – P- Omega stabilizer-Frequency-based stabilizers – Digital Stabilizer – Excitation control design – Exciter gain – Phase lead compensation – Stabilizing signal washout stabilizer gain – Stabilizer limits.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Able to understand on dynamic modelling of synchronous machine.
CO2	Able to understand the modeling of excitation and speed governing system for stability analysis.
CO3	Attain knowledge about stability of dynamic systems.
CO4	Understand the significance about small signal stability analysis with controllers.
CO5	Understand the enhancement of small signal stability.

Reference Books	
1.	Sauer P. W. and Pai, M. A. “Power System Dynamics and Stability”, Stipes Publishing Co, 2018.
2.	Gupta B.R., Power System Analysis and Design, S.Chand, 2011.
3.	Ramunujam R, “Power System Dynamics Analysis and Simulation”, PHI Learning Private Limited, New Delhi, 2010.
4.	Prabha Kundur, Power System Stability and Control, Tata McGraw Hill, 2006.
5.	Anderson P.M and Fouad A.A, “Power System Control and Stability”, Wiley-IEEE Press 2003.

BoS Chairman

M.E.	M19PST202 - POWER SYSTEM AUTOMATION	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To familiarize the students with the basics of Power System Automation.
2.	To familiarize the students with the basics of Supervisory Control and Data Acquisition (SCADA) System.
3.	To familiarize the students with the basics of Remote Terminal Units (RTU) and Master Stations.

UNIT - I	INTRODUCTION TO SCADA SYSTEMS	9

Evolution of Automation systems, History of Power system Automation, Supervisory Control And Data Acquisition (SCADA) Systems, Components of SCADA systems, SCADA Applications, SCADA in power systems, SCADA basic functions, SCADA application functions in Generation, Transmission and Distribution.

UNIT - II	SCADA IN POWER SYSTEMS	9

Advantages of SCADA in Power Systems, The Power system 'Field', Types of data & signals in the Power system, Flow of Data from the field to the SCADA Control center. Building blocks of SCADA systems, Classification of SCADA systems.

UNIT - III	REMOTE TERMINAL UNIT (RTU)	9

Evolution of RTUs, Components of RTU, Communication, Logic, Termination and Test/HMI Subsystems, Power supplies, Advanced RTU Functionalities.

UNIT - IV	INTELLIGENT ELECTRONIC DEVICES (IEDS)	9

Evolution of IEDs, IED functional block diagram, The hardware and software architecture of IED, IED Communication subsystem, IED advanced functionalities, Typical IEDs, Data Concentrators and Merging Units, SCADA Communication Systems.

BoS Chairman

UNIT - V	MASTER STATION AND CASE STUDIES	9
Master Station, Master station software and hardware configurations, Server systems in the master station, Small, medium and large master station configurations, Global Positioning Systems, Master station performance, Human Machine Interface (HMI), HMI components, Software functionalities, Situational awareness, Case studies in SCADA		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Interpret the concepts of power system automation.
CO2	Interpret the components of SCADA systems.
CO3	Explain the RTU, IED and other components of automation systems
CO4	Understand the transfer of signals from the field to an operator control terminal.
CO5	Model an interoperable powers automation system.

Reference Books	
1.	Mini S. Thomas, John D McDonald, “Power Systems SCADA and Smart Grid”, CRC Press, Taylor and Francis.
2.	John D. Mc Donald, “Electric Power Substation Engineering”, CRC Press, Taylor and Francis
3.	James Northcote- Green, R Wilson, “Control and Automation of Electrical Power Distribution systems”, CRC Press, Taylor and Francis
4.	James Momoh, “Electric Power Distribution, Automation”, Protection and Control, CRC press, Taylor and Francis.
5.	Related Research papers.

BoS Chairman

M.E.	M19PST203 - DIGITAL PROTECTION FOR POWER SYSTEM	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To analysis the Characteristics and functions of relays and protection schemes.
2.	To understand the concept of overcurrent protection.
3.	To understand the concept of generator protection.
4.	To understand the concept of transformer and transmission line protection.
5.	To understand the concept of digital and numerical protection.

UNIT - I	INTRODUCTION OF A PROTECTIVE RELAYING SYSTEM AND STATIC RELAYS	9

Characteristic functions of protective relays- basic relay terminology. Advantages of static relays over Electromagnetic Relays– Limitations, Basic construction and Basic elements of static relays - Practical non-critical switching circuits and critical level detectors-Influence of protective relays on associated equipment.

UNIT - II	COMPARATORS AND ASSOCIATED ELEMENTS AND OVER CURRENT PROTECTION	9

Mixing transformers/circuits - Phase and amplitude comparators - Duality - Different types of comparators - Amplitude, Phase comparators, Vector product devices – Dynamic design of static Comparators. Introduction to over current relays – Basic principles and different types of time - over current relays - Practical circuits for time over current relays - Direct trip devices - Introduction to Relay Co-ordination - Co-ordination of over current relays in an Interconnected power system.

UNIT - III	GENERATOR PROTECTIONS	9

Different types of faults and different types of Protective schemes in Synchronous generators – Generator differential protection, Merz-Price protection, Stator earth fault protection, Stator inter-turn fault protection, Rotor earth fault protection, numerical examples for typical generator protection schemes.

BoS Chairman

UNIT - IV	TRANSFORMER AND TRANSMISSION LINE PROTECTION	9

Different types of faults and different types of Protective schemes in transformers Percentage differential protection, Protection against magnetizing in-rush current, incipient fault protection (Buchholz relay), Over-fluxing protection, High resistance ground fault in transformers numerical examples for typical transformers protection schemes. Types of line protection and selection criteria, Introduction to distance protection, Impedance relay, reactance relay, mho(admittance) relay, off-set mho relay, comparison of distance relays, Distance protection of three phase lines, Reasons for inaccuracy of distance relay reach – Three stepped distance protection – Pilot wire protection carrier current protection, numerical example for a typical distance protection scheme for a transmission line.

UNIT - V	DIGITAL / NUMERICAL PROTECTION	9

Introduction to Digital protective relays - over current relay, impedance relay, generalized mathematical expression for distance relays - mho relay, off-set mho, Quadrilateral relay characteristic realization, generalized interfacing for distance relays. Block diagram of numerical relay, Sampling theorem, correlation with a reference wave, digital filtering, numerical over current protection, numerical transformer differential protection, numerical distance protection of transmission lines, Introduction to Fast Fourier Transform (FFT) and Discrete Wavelet Transform (DWT) to digital protection Overview of different algorithms for digital protection.

Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Discuss the basic elements of static relays.
CO2	Explain the principles of amplitude and phase comparators.
CO3	Discuss the principles of time-over current relays.
CO4	Discuss the different types of faults and protection schemes of synchronous generators.
CO5	Explain the different types of faults and protective schemes of transformers.
CO6	Discuss the different types of protective schemes for transmission lines.
CO7	Discuss the basic components of a digital relay and Realization of different digital relay characteristics using microprocessor.

BoS Chairman

Reference Books	
1.	Paithankar Y.G. and Bhide S.R, “Fundamentals of Power System Protection”, Prentice-Hall of India, Second Edition 2010.
2.	Kundur P, “Power System Stability and Control”, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 10th reprint, 2010.
3.	Sunil S.Rao, Protection and switchgear, Khanna Publishers - IVth Edition, 2010
4.	Madhava Rao T.S., Digital / Numerical Relays, Tata McGraw- Hill Publishing Company, 2012.
5.	Singh L.P., Digital Protection Protective Relaying from Electromechanical to microprocessor, New Age International (P) Limited Publishers, 2018

BoS Chairman

M.E.	M19PST204 - RESTRUCTURED POWER SYSTEM	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the restructuring process in power market.
2.	To analyse the concepts and terminologies used in power pool.
3.	To understand the Indian power system, issues, regulatory and acts.
4.	To analyse the available transfer capability.
5.	To analyse the congestion management in restructured environment.

UNIT - I	POWER SYSTEM RESTRUCTURING: AN OVERVIEW	9

Introduction - Motivation for Restructuring of Power System- Electricity Market Entities and Model - Milestones of Deregulation - International Scenario – Industrialized countries - In the US - The Scene in Europe - The British power pool-Nordic Deregulation process-Developing countries - Benefits of deregulation - Basic Terminologies.

UNIT - II	POWER SYSTEM OPERATION IN COMPETITIVE ENVIRONMENT	9

Introduction - Role of Independent system operator - Structure of UK and Nordic Electricity sector market operations – power pools – explanation of single auction power pool & double auction power pool with supply bid and demand - Two bus power system – four utility joint dispatch - Transmission networks and bilateral Electricity markets - bilateral trading in a two bus power system - three bus power system with feasible transactions.

UNIT - III	TRANSMISSION OPEN ACCESS AND PRICING ISSUES	9

Introduction - power wheeling - Transmission open access - Types of Transmission services in open access – cost components in transmission – Pricing of power transactions – Embedded cost based Transmission pricing - Postage stamp method - contract path method - MW Mile method – Marginal participation method – Incremental cost based transmission pricing – SRMC and LRMC based pricing.

BoS Chairman

UNIT - IV	AVAILABLE TRANSFER CAPABILITY & CONGESTION MANAGEMENT	9
Introduction - Definition - Methods of Static ATC Determination - Method based on multiple load flow and continuation power flow - Method based on optimization power flow - method based on linear sensitivity factors. Congestion management – congestion management methods : An overview : Cluster / zone based method – Rescheduling of generation - LMP based congestion management.		

UNIT - V	INDIAN POWER MARKET	9
Introduction – Indian power sector past and present status - growth of power sector in India - overview - Time line of Indian power sector - Players in the Indian power sector - Availability based tariff - Necessity - working mechanism - Beneficiaries - Day Scheduling process - Deviation from Schedule - unscheduled interchange rate - system marginal rate - trading surplus generation - applications.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Explain the restructuring process, new entities in power market and benefits.
CO2	Apply the concepts and terminologies used in interchange evaluation, power pools and transaction issues.
CO3	Explain the Indian power system, issues, regulatory and policy developments and acts.
CO4	Demonstrate the transmission open access, congestion management and pricing issues.
CO5	Apply the available transfer capability in restructured environment.

Reference Books	
1.	Venkatesh P, Manikandan B.V, Charles Raja S, and Srinivasan A, Electrical power systems analysis, Security and Deregulation‖, PHI 2012.
2.	Kankar Bhattacharya Maath H.J. Bollen and Jaap E.Daalder, Operation of restructured power systems Kluwer academic publishers, USA, first edition, 2001.
3.	Daniel Kirschen and Goran Strbac, Fundamentals of power system economics, John Wiley sons, 2004.
4.	Loi Lei Lai, “Power System Restructuring and regulation”, John Wiley sons, 2002.
5.	M.Shahidepour, Hatim Tamin and Zuyi Li, “Market operations in electric power system forecasting, scheduling and risk management”, John Wiley sons, 2002.

BoS Chairman

M.E.	M19PSP201 – POWER SYSTEM LABORATORY – II	T	P	TU	C
		0	4	0	2

Course Objectives	
1.	To analyse the effect of FACTS controllers by performing steady state analysis.
2.	To have hands on experience on different wind energy conversion technologies.
3.	To analyse the SMIB and MMIB with classical machine model.

List of Experiments	
Expt. No.	**Description of the Experiments**
1.	Small-signal stability analysis of single machine-infinite bus system using classical machine model.
2.	Small-signal stability analysis of multi-machine configuration with classical machine model.
3.	Induction motor starting analysis.
4.	Load flow analysis of two-bus system with STATCOM.
5.	Transient analysis of two-bus system with STATCOM.
6.	Available Transfer Capability calculation using an existing load flow program.
7.	Study of variable speed wind energy conversion system- DFIG.
8.	Study of variable speed wind energy conversion system- PMSG.
9.	Computation of harmonic indices generated by a rectifier feeding a R-L load.
10.	Design of active filter for mitigating harmonics.
	Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Analyse the SMIB and MMIB with classical machine model.
CO2	Analyze the effect of FACTS controllers by performing steady state analysis.
CO3	Demonstrate the different wind energy conversion technologies using software package.
CO4	Analyze the harmonic generation and mitigation.
CO5	Analyze the induction motor and Available Transfer Capability (ATC) calculation.

BoS Chairman

M.E.	M19PSP202 - RENEWABLE ENERGY SYSTEMS LABORATORY	T	P	TU	C
		0	4	0	2

Course Objectives	
1.	To train the students in Renewable Energy Sources and technologies.
2.	To provide adequate inputs on a variety of issues in harnessing Renewable Energy.
3.	To recognize current and possible future role of Renewable energy sources.

List of Experiments	
Expt. No.	**Description of the Experiments**
1.	Simulation study on Solar PV Energy System.
2.	Simulation study on Wind Energy Generator.
3.	Simulation study on Hybrid (Solar-Wind) Power System.
4.	Simulation study on Hydel Power.
5.	Simulation study on Intelligent Controllers for Hybrid Systems.
6.	Experiment on “VI-Characteristics and Efficiency of 1kWp Solar PV System”.
7.	Experiment on “Shadowing effect & diode based solution in 1kWp Solar PV System”.
8.	Experiment on Performance assessment of Grid connected and Standalone 1kWp Solar Power System.
9.	Experiment on Performance assessment of micro Wind Energy Generator.
10.	Experiment on Performance Assessment of Hybrid (Solar-Wind) Power System.
11.	Experiment on Performance Assessment of 100W Fuel Cell.
	Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Ability to understand and analyse Renewable energy systems.
CO2	Ability to provide adequate inputs on a variety of issues in harnessing Renewable Energy.
CO3	Ability to simulate the various Renewable energy sources.
CO4	Analyse the current and possible future role of Renewable energy sources.
CO5	Analyse the basics of Intelligent Controllers.

BoS Chairman

Professional Elective – II

M.E.	M19PSE201 - SMART GRID	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To Study about Smart Grid technologies, different smart meters and advanced metering infrastructure.
2.	To familiarize the power quality management issues in Smart Grid.
3.	To familiarize the high performance computing for Smart Grid applications

UNIT - I	INTRODUCTION TO SMART GRID	9

Basics of magnetic circuits – General expression of stored magnetic energy – Energy and Force/Torque equations – Singly and Doubly fed excited systems – Linear and Non-linear magnetic systems – Analysis of magnetic circuits with air gap and permanent magnets.

UNIT - II	SMART GRID TECHNOLOGIES	9

Static and rotating reference frames – Transformation of variables - Transformation between reference frames – Transformation of a balanced set – Balanced steady state phasor and voltage equations – Variables observed from several frames of reference.

UNIT - III	SMART METERS AND ADVANCED METERING INFRASTRUCTURE	9

Voltage and Torque Equations – Dynamic characteristics of permanent magnet and shunt DC motors – State equations - Solution of dynamic characteristics by Laplace transformation.

UNIT - IV	POWER QUALITY MANAGEMENT IN SMART GRID	9

Voltage and Torque Equations – Transformation for rotor circuits – Voltage and torque equations in reference frame variables – Analysis of steady state operation – Free acceleration characteristics – Dynamic performance for load and torque variations – Dynamic performance for three phase fault – Computer simulation in arbitrary reference frame.

BoS Chairman

UNIT - V	HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS	9
Voltage and Torque Equation - Voltage equation in arbitrary reference frame and rotor reference frame – Park equations - Rotor angle and angle between rotor – Steady state analysis – Dynamic performance for torque variations - Dynamic performance for three phase fault – Transient stability limit – Critical clearing time – Computer simulation		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Learners will develop more understanding on the concepts of Smart Grid and its present developments.
CO2	Learners will study about different Smart Grid technologies.
CO3	Learners will acquire knowledge about different smart meters and advanced metering infrastructure.
CO4	Learners will have knowledge on power quality management in Smart Grids.
CO5	Learners will develop more understanding on LAN, WAN and Cloud Computing for Smart Grid applications.

Reference Books	
1.	Stuart Borlase “Smart Grid: Infrastructure, Technology and Solutions”, CRC Press 2012.
2.	Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, “Smart Grid: Technology and Applications”, Wiley 2012.
3.	Vehbi C. Güngör, DilanSahin, TaskinKocak, Salih Ergüt, Concettina Buccella, Carlo Cecati, and Gerhard P. Hancke, “Smart Grid Technologies: Communication Technologies and Standards” IEEE Transactions On Industrial Informatics, Vol. 7, No. 4, November 2011.
4.	Xi Fang, Satyajayant Misra, Guoliang Xue, and Dejun Yang “Smart Grid – The New and Improved Power Grid: A Survey” , IEEE Transaction on Smart Grids, vol. 14, 2012.

BoS Chairman

M.E.	M19PSE202 - POWER ELECTRONICS OF RENEWABLE ENERGY SOURCES	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the various Non-Conventional sources of energy.
2.	To explain the DC to DC converters for Solar PV source of energy.
3.	To explain the inverters and its control techniques for a grid connected system.
4.	To understand the characteristics of a solar PV and wind power sources.
5.	To explain the types of distributed generators and batteries in DG and micro grid system.

UNIT - I	INTRODUCTION TO RENEWABLE SOURCES	9

world energy scenario, Wind, solar, hydro, geothermal-availability and power extraction. Introduction to solar energy: Photovoltaic effect, basics of power generation, P-V & I-V characteristics, effect of insolation, temperature, diurnal variation, shading, Modules, connections, ratings, Power extraction (MPP) tracking and MPPT schemes; standalone systems, grid interface, storage, AC-DC loads.

UNIT - II	DC - DC CONVERTERS FOR SOLAR PV	9

buck / boost / buck-boost / flyback / forward / cuk, bidirectional converters, Interleaved and multi-input converters.

UNIT - III	GRID CONNECTED INVERTERS	9

1ph,3ph, H6, Multilevel Neutral point clamp, Modular multilevel, CSI; Control schemes: unipolar, bipolar, PLL and synchronization, power balancing / bypass, Parallel power processing; Grid connection issues: leakage current, Islanding, harmonics, active/reactive power feeding, unbalance.

UNIT - IV	INTRODUCTION TO WIND ENERGY	9

P-V, I-V characteristic, wind power system: turbine-generator-inverter, mechanical control, ratings; Power extraction (MPP) and MPPT schemes. Generators for wind: DC generator with DC to AC converters; Induction generator with & w/o converter.

BoS Chairman

UNIT - V	SYNCHRONOUS GENERATOR WITH BACK TO BACK CONTROLLED / UNCONTROLLED CONVERTER	9
Doubly fed induction generator with rotor side converter topologies; permanent magnet based generators. Battery : Types, charging discharging. Introduction to AC and DC microgrids.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Illustrate knowledge on Non-Conventional energy sources.
CO2	Explain the DC to DC converters for Solar PV source of energy.
CO3	Illustrate knowledge on inverters and its control techniques.
CO4	Explain the various technologies and for renewable energy systems.
CO5	Explain the stand-alone DG sets and micro grid systems from renewable energy sources.

Reference Books	
1.	Sudipta Chakraborty, Marcelo G. Simes, and William E. Kramer. Power Electronics for Renewable and Distributed Energy Systems: A Sourcebook of Topologies, Control and Integration. Springer Science & Business, 2013.
2.	Nicola Femia, Giovanni Petrone, Giovanni Spagnuolo, Massimo Vitelli, Power Electronics and control for maximum Energy Harvesting in Photovoltaic Systems, CRC Press, 2013.T3 - E.G. Janardanan, 'Special electrical machines', PHI learning Private Limited, Delhi, 2014.
3.	Chetan Singh Solanki, Solar Photovoltaics: fundamentals, Technologies and Applications, Prentice Hall of India, 2011.
4.	Remus Teodorescu, Marco Liserre, Pedro Rodriguez, Grid Converters for Photovoltaic and Wind Power Systems, John Wiley and Sons, Ltd., 2011.
5.	Muhammad H. Rashid, Power Electronics: Circuits, Devices, and Applications, Pearson Education India, fourth edition 2014.

BoS Chairman

M.E.	M19PSE203 - POWER SYSTEM RELIABILITY	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To introduces the objectives of Load forecasting.
2.	To study the fundamentals of Generation system, transmission system and distribution system reliability analysis.
3.	To illustrate the basic concepts of Expansion planning.
4.	To Illustrate the concepts of Expansion planning.
5.	To Illustrate the knowledge on the fundamental concepts of the distribution system planning.

UNIT - I	LOAD FORECASTING	9
Objectives of forecasting - Load growth patterns and their importance in planning - Load forecasting Based on discounted multiple regression technique-Weather sensitive load forecasting-Determination of annual forecasting-Use of AI in load forecasting		

UNIT - II	GENERATION SYSTEM RELIABILITY ANALYSIS	9
Probabilistic generation and load models - Determination of LOLP and expected value of demand not served – Determination of reliability of ISO and interconnected generation systems.		

UNIT - III	TRANSMISSION SYSTEM RELIABILITY ANALYSIS	9
Deterministic contingency analysis-probabilistic load flow-Fuzzy load flow probabilistic transmission system reliability analysis-Determination of reliability indices like LOLP and expected value of demand not served.		

UNIT - IV	EXPANSION PLANNING	9
Basic concepts on expansion planning - procedure followed for integrate transmission system planning, current practice in India - Capacitor placer problem in transmission system and radial distributions system.		

BoS Chairman

UNIT - V	DISTRIBUTION SYSTEM PLANNING OVERVIEW	9
Introduction, sub transmission lines and distribution substations-Design primary and secondary systems-distribution system protection and coordination of protective devices. Distribution system reliability evaluation: Reliability analysis of radial systems with perfect and imperfect switching.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Develop the ability to learn about load forecasting
CO2	Explain about reliability analysis of ISO and interconnected systems
CO3	Explain the concepts of Contingency analysis and Probabilistic Load flow Analysis
CO4	Illustrate the concepts of Expansion planning
CO5	Illustrate the knowledge on the fundamental concepts of the Distribution system planning

Reference Books	
1.	T. Gonen, “Electrical Power Distribution Engineering”, McGraw Hill Book Company 2014.
2.	B.R. Gupta, “Generation of Electrical Energy”,S.Chand Publications 2017.
3.	Roy Billinton & Ronald N. Allan, “Reliability Evaluation of Power Systems” Springer Publication

BoS Chairman

M.E.	M19PSE204 - PRINCIPLES OF SUSTAINABLE GREEN ENERGY DEVELOPMENT	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the concept of various non-conventional energy resources.
2.	To acquire in-depth knowledge on the conversion of non-conventional energy resources into electrical power.
3.	To become intellectual in new developments of renewable energy studies.
4.	To attain knowledge in green energy technologies.
5.	To Identify the new developments of renewable energy studies.

UNIT - I	SOLAR ENERGY	9

Various solar energy systems and their applications – Solar spectra-latitude and longitude, Declination angle, solar window, cosine law, seasonal variations, daily variation, hour angle – Calculation of angle of incidence – Principle of photovoltaic conversion of solar energy - Types of solar cells and fabrication – Photovoltaic - battery charger, domestic lighting, street lighting, water pumping etc - Solar Photovoltaic power plant – Net metering concept.

UNIT - II	WIND ENERGY	9

Nature of the wind – wind power– factors influencing wind -Wind data and energy estimation - wind speed monitoring - wind resource assessment - Betz limit -site selection, Types of wind turbines – Various control - Tip Speed Ratio – Solidity, Torque on wind - wind thrust calculations - Repowering concepts.

UNIT - III	BIO-ENERGY	9

Energy from Biomass - Biomass as Renewable Energy Source - Types of Biomass Fuels - Solid, Liquid and Gas - Biomass Conversion Techniques - Wet Process, Dry Process- Photosynthesis - Biogas Generation - Factors affecting Bio-digestion – Different digesters – Digesters sizing - Advantages and Disadvantages - Digesters power generated and problems - Energy Forming – Pyrolysis.

BoS Chairman

UNIT - IV	ENERGY FROM OCEANS	9
Ocean Thermal Energy Conversion (OTEC) : Principle - Lambert Law of absorption - Open and closed OTEC Cycles -.Major problems and operational experience-Tidal energy: Tide – Spring tide, Neap tide – Tidal range – Tidal Power – Types of Tidal power plant -Single and dual basin schemes - Requirements in tidal power plant-Wave Energy – Wave Characteristics, Different wave energy convertors - Saltor Duck , Oscillating water column and dolphin types.		

UNIT - V	GEOTHERMAL ENERGY	9
Geothermal Energy – Classification - Fundamentals of geophysics - Dry rock and hot aquifers energy analysis - Estimation of thermal power, Extraction techniques.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Illustrate the concept of various non-conventional energy resources.
CO2	Develop in depth knowledge on the conversion of non-conventional energy resources into Electrical power.
CO3	Build knowledge in green energy technologies.
CO4	Explain the Major problems and operational experience on various non- conventional energy resources.
CO5	Identify the new developments of renewable energy studies.

Reference Books	
1.	Rai ,G.D., “Non Conventional sources of Energy”, Khanna Publishers ,5th Edition 2016.
2.	Khan. B.H, “Non-Conventional Energy Resources”, The McGraw Hills, 2nd Edition, 2016.
3.	Rao. S. & Pamlekar Dr.B.B. “Energy Technology ”, Khanna Publishers, 3rd Edition, 2016.
4.	John W Twidell and Tony D Weir, “Renewable Energy Resources”, Taylor and Francis, 2nd Edition 2006.
5.	S. N. Bhadra, D.Kastha, S.Banerjee, “Wind Electrical Systems”, Oxford University Press, 2005.

BoS Chairman

Professional Elective – III

M.E.	M19PSE205 - ADVANCED DIGITAL SIGNAL PROCESSING	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To expose the students to the fundamentals of digital signal processing in frequency domain & its application.
2.	To teach about the concept of transforms and properties.
3.	To expose the adaptive filters and multi signal processing.
4.	To explain the application of multirate signal processing

UNIT - I	INTRODUCTION	9

Review of DFT, FFT, IIR Filters and FIR Filters: Introduction to filter structures (IIR & FIR). Implementation of Digital Filters, specifically 2nd Order Narrow Band Filter and 1st Order All Pass Filter. Frequency sampling structures of FIR, Lattice structures, Forward prediction error, Back ward prediction error, Reflection coefficients for lattice realization, Implementation of lattice structures for IIR filters, Advantages of lattice structures.

UNIT - II	TRANSFORMS AND PROPERTIES	9

Discrete Fourier transform (DFT) : properties, Fast Fourier transform (FFT), DIT-FFT, and DIF - FFT. Wavelet transforms:Introduction, wavelet coefficients – orthonormal wavelets and their relationship to filter banks, multi-resolution analysis, and Haar and Daubechies wavelet.

UNIT - III	ADAPTIVE FILTERS	9

Wiener filters – an introduction. Adaptive filters: Fundamentals of adaptive filters, FIR adaptive filter – steepest descent algorithm, LMS algorithm, NLMS, applications – channel equalization. Adaptive recursive filters – exponentially weighted RLS algorithm.

UNIT - IV	MULTI RATE SIGNAL PROCESSING	9

Introduction, Decimation by a factor D, Interpolation by a factor I, Sampling rate conversion by a rational factor I/D, Multistage Implementation of Sampling Rate Conversion, Filter design & Implementation for sampling rate conversion. Examples of up-sampling using an All Pass Filter.

BoS Chairman

UNIT - V	APPLICATIONS OF MULTI RATE SIGNAL PROCESSING	9
Design of Phase Shifters, Interfacing of Digital Systems with Different Sampling Rates, Implementation of Narrow Band Low Pass Filters, Implementation of Digital Filter Banks, Subband Coding of Speech Signals, Quadrature Mirror Filters, Transmultiplexers, Over Sampling A/D and D/A Conversion.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Explains the fundamentals of digital signal processing in time-frequency domain& its application
CO2	Comprehend the DFTs and FFTs, design and Analyze the digital filters, comprehend the Finite word length effects in Fixed point DSP Systems.
CO3	Illustrate the function of filters with algorithm.
CO4	Compare Architectures & features of Programmable DS processors & develop logical functions of DS Processors
CO5	Solve various types of practical problems in DSP

Reference Books	
1.	Lonnie C.Ludeman ,"Fundamentals of Digital Signal Processing", Wiley, 2013.
2.	S.K. Mitra, 'Digital Signal Processing – A Computer Based Approach', McGraw Hill Edu, 2013.
3.	Poorna Chandra S, Sasikala. B, Digital Signal Processing, Vijay Nicole / TMH,2013.
4.	Robert Schilling & Sandra L.Harris, Introduction to Digital Signal Processing using Matlab", Cengage Learning, 2014.
5.	SenM.kuo, woonseng s.gan, "Digital Signal Processors, Architecture, Implementations & Applications, Pearson,2013.
6.	Dimitris G. Manolakis, Vinay K. Ingle, applied Digital Signal Processing, Cambridge, 2012.

BoS Chairman

M.E.	M19PSE206 - SOFT COMPUTING TECHNIQUES	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To expose the concepts of feed forward neural networks.
2.	To provide adequate knowledge about feedback neural networks.
3.	To teach about the concept of fuzziness involved in various systems.
4.	To expose the ideas about genetic algorithm. To provide adequate knowledge about of FLC and NN toolbox.

UNIT - I	INTRODUCTION AND ARTIFICIAL NEURAL NETWORKS	9

Introduction to intelligent systems - Soft computing techniques - Conventional Computing versus Swarm Computing - Classification of meta-heuristic techniques - Properties of Swarm intelligent Systems - Application domain - Discrete and continuous problems - Single objective and multi-objective problems - Neuron - Nerve structure and synapse - Artificial Neuron and its model - activation functions - Neural network architecture - single layer and multilayer feed forward networks - Mc Culloch Pitts neuron model - perceptron model - Adaline and Madaline - multilayer perception model - back propogation learning methods - effect of learning rule coefficient - back propagation algorithm - factors affecting back propagation training - applications.

UNIT - II	ARTIFICIAL NEURAL NETWORKS AND ASSOCIATIVE MEMORY	9

Counter propagation network - architecture - functioning & characteristics of counter Propagation network - Hopfield / Recurrent network configuration - stability constraints associative memory and characteristics - limitations and applications - Hopfield v/s Boltzman machine - Adaptive Resonance Theory - Architecture - classifications - Implementation and training - Associative Memory.

UNIT - III	FUZZY LOGIC SYSTEM	9

Introduction to crisp sets and fuzzy sets - basic fuzzy set operation and approximate reasoning. Introduction to fuzzy logic modeling and control - Fuzzification inferencing and defuzzification - Fuzzy knowledge and rule bases - Fuzzy modeling and control schemes for nonlinear systems. Self organizing fuzzy logic control - Fuzzy logic control for nonlinear time delay system.

BoS Chairman

UNIT - IV	GENETIC ALGORITHM	9
Evolutionary programs – Genetic algorithms, genetic programming and evolutionary programming - Genetic Algorithm versus Conventional Optimization Techniques - Genetic representations and selection mechanisms; Genetic operators - different types of crossover and mutation operators - Optimization problems using GA-discrete and continuous - Single objective and multi-objective problems - Procedures in evolutionary programming.		

UNIT - V	HYBRID CONTROL SCHEMES	9
Fuzzification and rule base using ANN – Neuro fuzzy systems - ANFIS – Fuzzy Neuron - Optimization of membership function and rule base using Genetic Algorithm – Introduction to Support Vector Machine - Evolutionary Programming - Particle Swarm Optimization - Case study – Familiarization of NN, FLC and ANFIS Tool Box.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Understand the basic ANN architectures, algorithms and their limitations. Also will be able to know the different operations on the fuzzy sets.
CO2	Analyze the ANN based models and control schemes for non-linear system. Will get expertise in the use of different ANN structures and online training algorithm.
CO3	Understand the Fuzzy logic for modeling and control of non-linear systems.
CO4	Understand the genetic algorithm and optimization technoquies.
CO5	Understand the hybrid control schemes and P.S.O and support vector Regressive.

Reference Books	
1.	S.N.Sivanandam, and S.N.Deepa, Principles of Soft computing, Second Edition, Wiley India Pvt. Ltd,2013
2.	Zimmermann H.J. "Fuzzy set theory and its Applications" Springer international edition, 2011.
3.	Ethem Alpaydin, “Introduction to Machine learning (Adaptive Computation and Machine Learning series)’, MIT Press, Second Edition, 2010.
4.	George J.Klir and, Bo Yuan, Fuzzy sets and Fuzzy Logic, Second Edition, PHI, 2006
5.	J.M.Zurada, Introduction to artificial neural systems, Jaico Publishing House, 2006

BoS Chairman

M.E.	M19PSE207 - RESEARCH METHODOLOGY AND IPR	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	The course has been developed with orientation towards research related activities and recognizing the ensuing knowledge as property. It will create consciousness for Intellectual Property Rights and its constituents. Learners will be able to perform documentation and administrative procedures relating to IPR in India as well as abroad.

UNIT - I	RESEARCH PROBLEM	9

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

UNIT - II	LITERATURE STUDIES	9

Effective literature studies approaches, analysis Plagiarism, Research ethics.

UNIT - III	TECHNICAL WRITING	9

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

UNIT - IV	INTELLECTUAL PROPERTY	9

Nature of Intellectual Property : Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario : International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT - V	PATENT RIGHTS & NEW DEVELOPMENTS IN IPR	9

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Total Instructional hours : 45

BoS Chairman

Course Outcomes : Students will be able to	
CO1	Understand research problem formulation.
CO2	Analyze research related information follow research ethics
CO3	Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
CO4	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.
CO5	Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Reference Books	
1.	Deborah E. Bouchoux, "Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets", Cengage Learning, Third Edition, 2012.
2.	Prabuddha Ganguli, "Intellectual Property Rights: Unleashing the Knowledge Economy", McGraw Hill Education, 2011.
3.	Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.
4.	Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
5.	Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
6.	T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008.

BoS Chairman

M.E.	M19PSE208 - ELECTRICAL DISTRIBUTION SYSTEM	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To provide knowledge about the distribution system electrical characteristics.
2.	To gain knowledge about planning and designing of distribution system.
3.	To analyze power quality in distribution system.
4.	To analyze the power flow in balanced and unbalanced system.

UNIT - I	INTRODUCTION	9

Distribution System - Distribution Feeder Electrical Characteristics - Nature of Loads : Individual Customer Load, Distribution Transformer Loading and Feeder Load-Approximate Method of Analysis : Voltage Drop, Line Impedance, “K” Factors, Uniformly Distributed Loads and Lumping Loads in Geometric Configurations.

UNIT - II	DISTRIBUTION SYSTEM PLANNING	9

Factors effecting planning, present techniques, planning models (Short term planning, long term planning and dynamic planning), planning in the future, future nature of distribution planning, Role of computer in Distribution planning. Load forecast, Load characteristics and Load models.

UNIT - III	DISTRIBUTION SYSTEM LINE MODEL	9

Exact Line Segment Model - Modified Line Model - Approximate Line Segment Model - Modified “Ladder” Iterative Technique - General Matrices for Parallel Lines.

UNIT - IV	VOLTAGE REGULATION	9

Standard Voltage Ratings - Two-Winding Transformer Theory - Two-Winding Autotransformer - Step - Voltage Regulators : Single-Phase Step-Voltage Regulators - Three-Phase Step - Voltage Regulators - Application of capacitors in Distribution system.

BoS Chairman

UNIT - V	DISTRIBUTION FEEDER ANALYSIS	9
Power - Flow Analysis - Ladder Iterative Technique - Unbalanced Three - Phase Distribution Feeder - Modified Ladder Iterative Technique - Load Allocation - Short-Circuit Studies.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Ability to understand the concepts of distribution system for utility systems
CO2	Ability to understand the concepts of planning of distribution system for utility systems
CO3	Ability to understand the design of distribution system line model.
CO4	Ability to implement the concepts of voltage control in distribution system.
CO5	Ability to analyze the power flow in balanced and unbalanced system

Reference Books	
1.	William H. Kersting, " Distribution System Modeling and Analysis " CRC press 3rd edition, 2012.
2.	Turan Gonen, "Electric Power Distribution System Engineering", Second Edition CRC Press 2007.
3.	James Northcote – Green, Robert Wilson, "Control and Automation of Electrical Power Distribution Systems", CRC Press, New York, 2007.
4.	Pabla H S, "Electrical Power Distribution Systems", Tata McGraw Hill, 2004

BoS Chairman

Semester - III

M.E.	M19PST301- DISTRIBUTED GENERATION AND MICRO-GRID	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To illustrate the concept of conventional generation
2.	To illustrate the concept of distributed generation
3.	To analyze the impact of grid integration
4.	To understand the concept of microgrid and its configuration
5.	To analyze the control and operation of microgrid

UNIT - I	INTRODUCTION	9

Energy Sources and their availability - Trends in Energy Consumption ,Conventional power generation : advantages and disadvantages, Energy crises, Nonconventional energy (NCE) resources : review of Solar PV, Wind Energy systems, Fuel Cells, micro-turbines, biomass, tidal sources, energy storage Batteries, ultra capacitors and captive power plants.

UNIT - II	DISTRIBUTED GENERATIONS (DG)	9

Concept of distributed generations, topologies, selection of sources, regulatory standards / framework, Standards for interconnecting Distributed resources to electric power systems: IEEE 1547. DG installation, sitting and sizing of DGs, optimal placement, Optimal Renewable Resources Mix, security issues in DG implementations.

UNIT - III	ISSUES IN GRID INTEGRATION	9

Requirements for grid interconnection, limits on operational parameters: voltage, frequency, THD, response to grid abnormal operating conditions, islanding issues. Impact of grid integration with NCE sources on existing power system: reliability, stability and power quality issues. Impact of DGs on Protective Relaying and islanding issues in existing distribution Grid.

UNIT - IV	MICROGRIDS	9

Concept and definition of microgrid, microgrid drivers and benefits, review of sources of microgrids, typical structure and configuration of a microgrid, AC and DC microgrids, Power Electronics interfaces in DC and AC microgrids, Energy Management and Protection Control Strategies of a Microgrid - Case Studies.

BoS Chairman

UNIT - V	CONTROL AND OPERATION OF MICROGRID	9
Modes of operation and control of microgrid: grid connected and islanded mode, Active and reactive power control, protection issues, anti-islanding schemes: passive, active and communication based techniques, microgrid communication infrastructure, Power quality issues in microgrids, regulatory standards, Microgrid economics, Introduction to smart microgrids.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Explain the various schemes of conventional and nonconventional power generation
CO2	Recognize the need of sitting of distributed generation along with their effect on distribution system
CO3	Explain the requirements for grid interconnection and its impact with NCE sources
CO4	Understand the fundamental concept of Microgrid
CO5	Explain the control and operation of microgrid, islanded ,anti-islanding modes, communication based techniques and regulatory schemes.

Reference Books	
1.	Gregory W. Massey, “Essentials of Distributed Generation Systems”, Jones & Bartlett Publishers, 2011.
2.	Math H. Bollen, “Integration of Distributed Generation in the Power System”, John Wiley & Sons, 2011.
3.	Ali Keyhani, “Design of Smart Power Grid Renewable Energy Systems”, John Wiley & Sons, 2011.
4.	Amirnaser Yezdani, and Reza Iravani, “Voltage Source Converters in Power Systems: Modeling, Control and Applications”, IEEE John Wiley Publications, 2010.
5.	J.F. Manwell, J.G. McGowan “Wind Energy Explained, theory design and applications”, Wiley publication 2010.

BoS Chairman

Professional Elective – IV

M.E.	M19PSE301 - SOLAR & ENERGY STORAGE SYSTEMS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To Study about solar modules and PV system design and their applications
2.	To Deal with grid connected PV systems
3.	To Discuss about different energy storage systems

UNIT - I	INTRODUCTION	9

Characteristics of sunlight – semiconductors and P-N junctions – behaviour of solar cells – cell properties – PV cell interconnection- Solar cell arrays, system analysis and performance prediction, shadow analysis, reliability.

UNIT - II	STAND ALONE PV SYSTEM	9

Solar modules – array sizing - storage systems – power conditioning and regulation - MPPT - protection – standalone PV systems design – sizing

UNIT - III	GRID CONNECTED PV SYSTEMS	9

PV systems in buildings – Grid - Tie Inverter - design issues for central power stations – safety – Economic aspect – Efficiency and performance - International PV programs

UNIT - IV	ENERGY STORAGE SYSTEM	9

Impact of intermittent generation – Battery energy storage – solar thermal energy storage – Super capacitor, Fuel cells, its operation, types, applications - battery sizing.

UNIT - V	APPLICATIONS	9

Water pumping – battery chargers – solar car – direct-drive applications – Space – Simulation of energy storage systems and its management, smart park, Electric Vehicle charging facility.

Total Instructional hours : 45

BoS Chairman

Course Outcomes : Students will be able to	
CO1	Illustrate the solar energy & storage systems.
CO2	Develop basic knowledge on standalone PV system.
CO3	Explain the issues in grid connected PV systems.
CO4	Explain the power converters used for solar energy conversion and the modeling of different energy storage systems.
CO5	Outline the different applications of solar energy.

Reference Books	
1.	Solanki C.S., “Solar Photovoltaics: Fundamentals, Technologies And Applications”, PHI Learning Pvt. Ltd., 2015.
2.	A.G.Ter-Gazarian, “Energy Storage for Power Systems”, Second Edition, The Institution of Engineering and Technology (IET) Publication, UK, (ISBN - 978-1- 84919-219-4), 2011
3.	Francisco Díaz-González, Andreas Sumper, Oriol Gomis-Bellmunt,” Energy Storage in Power Systems” Wiley Publication, ISBN : 978-1-118-97130-7, Mar 2016
4.	Eduardo Lorenzo G. Araujo, “Solar electricity engineering of photovoltaic systems”, Progensa, 1994.
5.	John Wiley and sons., “Fuel cell fundamentals”, Willey 2016.
6.	Francois Beguin and Elzbieta Frackowiak ,“Super capacitors”, Wiley, 2013.

BoS Chairman

M.E.	M19PSE302 - ENERGY MANAGEMENT AND AUDITING	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To study the concepts behind energy management and auditing.
2.	To emphasize the need and type of instruments for energy audit and management.
3.	To illustrate the benefits of different energy management techniques.

UNIT - I	INTRODUCTION AND DEMAND SIDE MANAGEMENT (DSM) IN POWER UTILITIES	9

Energy Scenario & Conservation - Demand Forecasting Techniques - Integrated Optimal Strategy for Reduction of T&D Losses - DSM Techniques and Methodologies - Loss Reduction in Primary and Secondary Distribution system and capacitors.

UNIT - II	ENERGY AUDIT	9

Energy Management – Role of Energy Managers - Energy Audit concepts – Metering. Basic elements and measurements - Mass and energy balances - Scope of energy auditing in industries.

UNIT - III	ENERGY AUDIT OF ELECTRICAL EQUIPMENT	9

Evaluation of energy conservation opportunities and environmental management - Preparation and presentation of energy audit reports, case studies for Induction motors, Transformers, Cables, Lighting, AC systems, Pumps, Capacitor banks and potential energy savings.

UNIT - IV	ENERGY CONSERVATION	9

Energy conservation in HVAC systems and thermal power plants, Solar systems, Fan and Lighting Systems - Different light sources and luminous efficacy, Energy conservation in electrical devices and systems, Economic evaluation of energy conservation measures, Electric motors and transformers, Inverters and UPS, Voltages stabilizers.

UNIT - V	INSTRUMENTATION	9

Evaluation and instrumentation techniques for renewable energy systems (solar thermal, photovoltaic and wind energy); energy management devices; micro controller based systems.

Total Instructional hours : 45

BoS Chairman

Course Outcomes : Students will be able to	
CO1	Understand the need and significance of energy audit and management
CO2	Explain basic concepts of energy audit.
CO3	Identify the equipment for audit in power system
CO4	Assess the need and type of instruments for energy audit and energy Management.
CO5	Analyse the domain of energy conservation and benefits of different energy management techniques.

Reference Books	
1.	Amlan Chakrabarti - Energy Engineering and management, PHI, 2018.
2.	Rajiv Shanker - Energy auditing in Electrical utilities, Viva books Pvt. Ltd., 2015.
3.	Barney L. Capehart, Wayne C. Turner and William J. Kennedy, “Guide to Energy Management”, Seventh Edition, The Fairmont Press Inc., 2012.
4.	Craig B. Smith, “Energy Management Principles”, Pergamon Press, 2015.
5.	Reay D.A, “Industrial Energy Conservation”, 1st edition, Pergamon Press, 1977.
6.	IEEE Recommended Practice for Energy Management in Industrial and Commercial Facilities, IEEE, 1996.

BoS Chairman

M.E.	M19PSE303 - FLEXIBLE AC TRANSMISSION SYSTEMS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To emphasis the need for FACTS controllers.
2.	To learn the characteristics, applications and modeling of series and shunt FACTS controllers.
3.	To analyze the interaction of different FACTS controller and perform control coordination and UPFC
4.	To understand the knowledge about voltage and phase angle regulators

UNIT - I	INTRODUCTION	9

Reactive power control in electrical power transmission lines – Uncompensated transmission line – Fixed series and shunt compensation – Basic types of FACTS controllers – Brief description and definitions of FACTS controllers.

UNIT - II	SHUNT COMPENSATORS	9

Objectives of shunt compensation, Variable impedance Devices (TSR, TCR, TSC, FC-TCR, TSC-TCR), Switched converter (STATCOM) and Hybrid shunt compensators.

UNIT - III	SERIES COMPENSATORS	9

Concepts of Controlled Series Compensation- Operation of TCSC - Analysis of TCSC operation - Modelling of TCSC for load flow studies - Static synchronous series compensator(SSSC) - Operation of SSSC - Modelling of SSSC for power flow – SSR Mitigation – Introduction to Unified power flow controllers (UPFC).

UNIT - IV	VOLTAGE AND PHASE ANGLE REGULATORS	9

Principles of operation - types - Steady state model and characteristics of a static voltage regulators and phase shifters - Thyristor controlled Voltage and phase angle regulators. Switching converter based voltage and phase angle regulators-applications.

UNIT - V	MODELLING OF FACTS CONTROLLERS	9

Modelling of Shunt and Series Controllers for Power Flow and Transient stability. Modelling of UPFC.

Total Instructional hours : 45

BoS Chairman

Course Outcomes : Students will be able to	
CO1	Explain the basic principles, characteristics of different types of FACTS controllers.
CO2	Ability to understand the concept about shunt compensator
CO3	Ability to understand the concept about series compensator
CO4	Ability to analyze the performance of voltage regulaors
CO5	Model FACTS controller for power flow and stability applications.

Reference Books	
1.	Narain G. Hingorani, 'Understanding FACTS -Concepts and Technology of Flexible AC Transmission Systems', Standard Publishers Distributors, Delhi - 110006, 2011.
2.	R.Mohan Mathur, Rajiv K.Varma,"Thyristor–Based Facts Controllers for Electrical
3.	Transmission Systems", IEEE press and John Wiley & Sons, Inc, 2002.
4.	Padiyar.K.S., 'FACTS Controllers in Power Transmission and Distribution', New Age International (P) Limited, Publishers, New Delhi, 2008
5.	Sood. V.K,HVDC and FACTS controllers, 'Applications of Static Converters in Power System', Kluwer Academic Publishers, 2004.

BoS Chairman

M.E.	M19PSE304 - ELECTRICAL TRANSIENTS IN POWER SYSTEM	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the various types of transients and its analysis in power system.
2.	To learn about modelling and computational aspects transients computation

UNIT - I	REVIEW OF TRAVELLING WAVES ON TRANSMISSION LINE	9

Lumped and Distributed Parameters – Wave Equation – Reflection, Refraction, Behaviour of Travelling waves at the line terminations – Lattice Diagrams – Attenuation and Distortion - Multi conductor system and Velocity wave.

UNIT - II	LIGHTNING, SWITCHING AND TEMPORARY OVERVOLTAGES	9

Lightning: Physical phenomena of lightning – Interaction between lightning and power system – Factors contributing to line design – Simple and Abnormal Switching Transients – Transients in three phase circuits – Very Fast Transient Over voltage (VFTO) – IEC standards and wave models.

UNIT - III	TRANSMISSION SYSTEM RELIABILITYANALYSIS	9

Deterministic contingency analysis-probabilistic load flow - Fuzzy load flow probabilistic transmission system reliability analysis - Determination of reliability indices like LOLP and expected value of demand not served.

UNIT - IV	EXPANSION PLANNING	9

Basic concepts on expansion planning - procedure followed for integrate transmission system planning, current practice in India - Capacitor placer problem in transmission system and radial distributions system.

UNIT - V	DISTRIBUTION SYSTEMPLANNING OVERVIEW	9

Introduction, sub transmission lines and distribution substations - Design primary and secondary systems - distribution system protection and coordination of protective devices. Distribution system reliability evaluation: Reliability analysis of radial systems with perfect and imperfect switching.

Total Instructional hours : 45

BoS Chairman

Course Outcomes : Students will be able to	
CO1	Explain the concept of travelling waves on transmission line.
CO2	Illustrate the concept of lightning and overvoltages.
CO3	Explain the concepts of transmission system reliability analysis.
CO4	Illustrate the concepts of Expansion planning.
CO5	Illustrate the knowledge on the Overview of Distribution system planning.

Reference Books	
1.	Allan Greenwood, “Electrical Transients in Power System”, Wiley & Sons Inc. New York, 1991.
2.	R. Ramanujam, “Computational Electromagnetic Transients: Modeling, Solution Methods and Simulation”, I.K. International Publishing House Pvt. Ltd, New Delhi, 2014.
3.	Naidu M S and Kamaraju V, “High Voltage Engineering”, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2004.

BoS Chairman

Professional Elective – V

M.E.	M19PSE305 – EMBEDDED SYSTEM DESIGN & PROGRAMMING	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To study about the real time examples of embedded systems.
2.	To impart the concepts and architecture of embedded systems and to make the students capable of designing Embedded systems.
3.	To achieve the architecture and programming of Embedded Software Development Environments.
4.	To achieve and apply the Development For Embedded Systems

UNIT - I	INTRODUCTION AND EXAMPLES OF EMBEDDED SYSTEMS	9

Concept of Embedded System Design : Design challenge, Processor technology, IC technology, Design technology, Trade-offs.

UNIT - II	CUSTOM SINGLE PURPOSE PROCESSOR HARDWARE, GENERAL PURPOSE PROCESSO AND MEMORY	9

Introduction, basic architecture, operation, super-scalar and VLSIIW architecture, application. Specific instruction set processors (ASIPS), microcontrollers, digital signal processors, selecting a microprocessor. Introduction, Memory writes ability, Storage performance, Tradeoff s, Common memory types Memory hierarchy and cache.

UNIT - III	AVR 8515 MICROCONTROLLER	9

Architecture and Programming in assembly and C. Interfacing Analog and digital blocks : Analog-to-Digital Converters (ADCs), Digital to-Analog, Converters (DACs). Communication basics and basic protocol concepts, Microprocessor interfacing : I/O addressing, Port and Bus based, I/O, Memory mapped I/O, Standard I/O interrupts, Direct memory access, Advanced communication principles parallel, serial and wireless, Serial protocols I2C, Parallel protocols PCI bus, Wireless protocol IrDA, blue tooth.

UNIT - IV	EMBEDDED SOFTWARE DEVELOPMENT ENVIRONMENTS	9

Real time operating systems, Kernel architecture : Hardware, Task/process control subsystem, Device drivers, File subsystem, system calls, Embedded operating systems, Task scheduling in embedded systems : task scheduler, first in first out, shortest job first, round robin, priority based scheduling, Context switch: Task synchronization : mutex, semaphore, Timers, Types of embedded operating systems, Programming languages: assembly languages, high level language.

BoS Chairman

UNIT - V	DEVELOPMENT FOR EMBEDDED SYSTEMS	9
Embedded system development process, Determine the requirements, Design the system architecture, Choose the operating system, Choose the processor, Choose the development platform, Choose the programming language, Coding issues, Code optimization, Efficient input/output, Testing and debugging, Verify the software on the host system, Verify the software on the embedded system.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Understand the real time examples of embedded systems
CO2	Explain about processor and memory
CO3	Explain the concepts of AVR 8515 microcontroller
CO4	Analyses the Embedded Software Development Environments
CO5	Apply the Development For Embedded Systems

Reference Books	
1.	Frankvahid / Tony Givargis, “Embedded System Design - A unified Hardware / software Introduction”. John Wiley Publications, 2009.
2.	David E Simon, “An embedded software primer”, Pearson education Asia, 2001.
3.	Dreamteach Software team, “Programming for Embedded Systems” AVR 8515 manual
4.	J.W. Valvano, "Embedded Microcomputor System: Real Time Interfacing" John Wiley & Sons, 2011.
5.	Jack Ganssle, "The Art of Designing Embedded Systems", Newnes, 1999.

BoS Chairman

M.E.	M19PSE306 - CYBER SECURITY IN SMART POWER SYSTEMS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To secure the power system using cyber security in near future.
2.	To understand the new techniques for providing secured power system.
3.	To understand the regulatory bodies of IOT physical infrastructure

UNIT - I	INTRODUCTION TO POWER SYSTEMS CONTROL	9

Characteristics of Power Generating Units and Economic Dispatch-Unit Commitment (Spinning Reserve, Thermal, Hydro and Fuel Constraints) - Solution techniques of Unit Commitment-Generation Scheduling with Limited Energy - Energy Production Cost – Cost Models, Budgeting and Planning, Practical Considerations - Interchange Evaluation for Regional Operations, Types of Interchanges-Exchange Costing Techniques - literature survey on Development of Smart grid.

UNIT - II	ENERGY MANAGEMENT SYSTEMS (EMS) & SCADA	9

Energy Management Centers and Their Functions - Architectures - recent Developments. Introduction to Supervisory Control and Data Acquisition - SCADA Functional requirements and Components - General features, Functions and Applications, Benefits - Configurations of SCADA - RTU (Remote Terminal Units) Connections - Power Systems SCADA and SCADA in Power System Automation - SCADA Communication requirements - SCADA Communication protocols : Past Present and Future - Structure of a SCADA Communications Protocol.

UNIT - III	DIGITAL & IT SECURITIES	9

Introduction - Types of Attacks - Digital Privacy - Online Tracking - Privacy Laws - Types of Computer Security risks (Malware, Hacking, Pharming, Phishing, Ransomware, Adware and Spyware, Trojan, Virus, Worms, WIFI Eavesdropping, Scareware, Distributed Denial - Of - Service Attack, Rootkits, Juice Jacking) - Antivirus and Other Security solution - Password - Secure online browsing - Email Security - Social Engineering - Secure WIFI settings - Track yourself online - Cloud storage security - IOT security - Physical Security Threads.

UNIT - IV	ONLINE ANONYMITY	9

Online Anonymity - Anonymous Networks, Protocols - http - https - FTP Tor Network - I2P Network - Freenet - Darknet - Anonymous OS – Tails - Secure File Sharing - VPN - Proxy Server - Connection Leak Testing - Secure Search Engine - Web Browser Privacy Configuration - Anonymous Payment.

BoS Chairman

UNIT - V	SMART GRID & SMART METERS	9
Smart grid : Introduction - Representative Architecture - Components - Microgrid - Smart grid Communications and Measurement Technology - Renewable energy resources - modeling and basic architecture of wind generation systems - Fuel cell - Small and micro hydropower - Plug in Hybrid vehicles - Demand response and Demand side management - Computational tools for smart grid design - Interoperability - standards - cyber security - Advanced metering infrastructure (AMI) and a meter data management system (MDMS) are basic smart grid components - AMI collects and transmits smart meter data between devices and MDMS facilitates data collection - storage and management..		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Able to know about the control techniques for power system.
CO2	Understand the concepts & applications of EMS, SCADA.
CO3	Ability to identify the digital attacks and provide security for power system.
CO4	Able to know about the online anonymity.
CO5	Ability to understand the concept of smart grid & usage of smart meters.

Reference Books	
1.	John R. Vacca (2013) : Computer and Information Security Handbook (second edition).
2.	Tyson Macaulay & Bryan Singer (2012) : Cyber security for Industrial Control Systems.
3.	Eric D. Knapp & Joel Thomas Langill (2015):Industrial Network Security : Securing Critical Infrastructure, Network for Smart Grid, SCADA, and other Industrial Control Systems
4.	Cyber security for Industrial Control Systems Ralph Langner (2012) : Robust Control System Networks.
5.	Power Generation, Operation, and Control Hardcover – by Allen J. Wood (Author), Bruce F. Wollenberg (Author) 6 March 1996

BoS Chairman

M.E.	M19PSE307 - ELECTRIC VEHICLE	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To present a comprehensive overview of Electric and Hybrid Electric Vehicles.
2.	To understand the concept of electrical vehicles and its operations.
3.	To understand the need for energy storage in hybrid vehicles.
4.	To provide knowledge about various possible energy storage technologies that can be used in electric vehicles.

UNIT - I	INTRODUCTION TO ELECTRIC VEHICLES AND VEHICLE MECHANICS	9

Electric Vehicles (EV), Hybrid Electric Vehicles (HEV), Engine ratings, Comparisons of EV with internal combustion Engine vehicles, Fundamentals of vehicle mechanics.

UNIT - II	ARCHITECTURE OF EV's AND POWER TRAIN COMPONENTS	9

Architecture of an Electric Vehicles(EV)'s and Hybrid Electric Vehicles (HEV's), essentials and performance of electric vehicles – Traction motor characteristics, tractive effort, transmission requirements, vehicle performance, energy consumption, advantage and limitations – Plug-n Hybrid Electric Vehicles (PHEV) - Power train components and sizing, Gears, Clutches, Transmission and Brakes.

UNIT - III	ELECTRIC PROPULSION SYSTEMS	9

DC motor drives, induction motor drives, permanent magnet motor drives and switched reluctance motor drives.

UNIT - IV	ENERGY STORAGE DEVICES	9

Electrochemical batteries – Reactions, thermodynamic voltage, Lead-acid batteries, nickel based batteries, lithium based batteries, flywheel and ultra-capacitors, Battery management systems.

BoS Chairman

UNIT - V	ALTERNATIVE ENERGY STORAGE SYSTEMS	9
Fuel cell thermodynamics, operating principle, fuel cell technologies, fuel reforming, hydrogen production and storage. Photovoltaic cell, maximum power point tracking, solar powered accessories, hybrid solar vehicles, Ultra capacitors. Case study: Volvo XC90 T8 Plug-In Hybrid, Nissan X-Trial hybrid		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Explain about the working principle and operation of electric vehicles and Hybrid Electric vehicles.
CO2	Explain the architecture of Electric vehicles, Hybrid Electric vehicles, PHEV and power train components in electric vehicles.
CO3	Explain the construction and working principle of various motors used in electric vehicles.
CO4	Choose a suitable drive scheme for developing an electric hybrid vehicle depending on resources.
CO5	Explain the various energy storage devices for electrical vehicles.
CO6	Illustrate the various types and working principle of fuel cells.
CO7	Explain the various types and working principle of Ultracapacitors.

Reference Books	
1.	Iqbal Husain, “Electric and Hybrid Vehicles : Design Fundamentals”, CRC Press, 2011.
2.	Mehrdad Ehsani, Yi mi Gao, Sebastien E. Gay and Ali Emadi, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design”, CRC Press, 2009.
3.	Seref Soylu, “Electric Vehicles - The Benefits and Barriers”, InTech Publishers, Croatia, 2011.
4.	AuliceScibioh M. and Viswanathan B., “Fuel Cells – Principles and Applications”, University Press, India, 2006.
5.	Barbir F., “PEM Fuel Cells : Theory and Practice” Elsevier, Burlington, 2005.

BoS Chairman

M.E.	M19PSE308 - ARTIFICIAL INTELLIGENCE	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To expose the history and foundations of artificial intelligence.
2.	To illustrate how heuristic approaches provide a good solution mechanism.
3.	To provide the mechanisms for simple knowledge representation and reasoning.
4.	To highlight the complexity in working with uncertain knowledge.
5.	To discuss the current and future applications of artificial intelligence.

UNIT - I	HISTORY AND FOUNDATIONS	9

History – Scope – Influence from life – Impact of computing domains - Agents in environments - Knowledge representation – Dimensions of Complexity – Sample application domains – Agent structure.

UNIT - II	SEARCH	9

Problem solving as search – State spaces – Uninformed Search – Heuristic search – Advanced search – Constraint satisfaction - Applications.

UNIT - III	KNOWLEDGE REPRESENTATION AND REASONING	9

Foundations of knowledge representation and reasoning, representing and reasoning about objects, relations, events, actions, time, and space predicate logic, situation calculus, description logics, reasoning with defaults, reasoning about knowledge, sample applications.

UNIT - IV	REPRESENTING AND REASONING WITH UNCERTAIN KNOWLEDGE	9

Probability, connection to logic, independence, Bayes rule, Bayesian networks, probabilistic inference, sample applications.

BoS Chairman

UNIT - V	CASE STUDY AND FUTURE APPLICATIONS	9
Design of a game / Solution for problem in student's domain. Natural Language processing, Robotics, Vehicular automation – Scale, Complexity, Behaviour – Controversies.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Summarize the history, current applications, future challenges and the controversies in artificial intelligence.
CO2	Apply the principle of AI in the design of an agent & model its actions and heuristic algorithm for search problems.
CO3	Analyze and represent the fact using logic for a given scenario
CO4	Analyze and represent uncertainty using probabilistic models
CO5	Develop a simple game or solution using artificial intelligence techniques.

Reference Books	
1.	Keith Frankish, William M. Ramsey (eds) The Cambridge Handbook of Artificial Intelligence, Cambridge University Press, 2014.
2.	Nils J. Nilsson, The Quest for Artificial Intelligence, Cambridge University Press, Online edition, 2013.
3.	Stuart Russell and Peter Norvig, Artificial Intelligence : A Modern Approach, Prentice Hall, Third Edition, 2010.
4.	David Poole, Alan Mackworth, Artificial Intelligence: Foundations of Computational Agents, Cambridge University Press, 2010.

BoS Chairman

M.E.	M19PSP301 - PROJECT WORK (PHASE I)	T	P	TU	C
		0	12	0	6

Course Objectives	
1.	To enable a student to do an individual project work which may involve design, modelling, simulation and/or fabrication.
2.	To analyse a problem both theoretically and practically.
3.	To motivate the students to involve in research activities leading to innovative solutions for industrial and societal problems.

Course Description

Project work shall be carried out by each and every individual student under the supervision of a faculty of this department. A student may however, in certain cases, be permitted to work for the project in association with other departments or in an Industrial/Research Organization, on the recommendation of the Head of the Department. In such cases, the project work shall be jointly supervised by a faculty of the Department and an Engineer / Scientist from the organization. The student shall meet the supervisor periodically and attend the periodic reviews for evaluating the progress.

Project work will be carried out in two phases, Phase-I during the third semester and Phase-2 during the final semester. Phase-I shall be pursued for a minimum of 12 periods per week and Phase – II in 24 periods per week. In each phase, there will be three reviews for continuous internal assessment and one final review and viva voce at the end of the semesters. The Project Report prepared according to approved guidelines and duly signed by the supervisor(s) and the Head of the Department shall be submitted to the concerned department.

Course Outcomes : Students will be able to	
CO1	Identify the area, narrow dine the problem and understand the problem thoroughly and provide an appropriate solution.
CO2	Conducting a systematic literature survey which helps to build the knowledge in the chosen field by using the existing journal references .
CO3	Derive a mathematical model for the system under study.
CO4	Choose and get proficiency over the software for simulation and analysis.
CO5	Present the findings of the phase I work in conferences/journals.

BoS Chairman

M.E.	M19PSP401 - PROJECT WORK (PHASE II)	T	P	TU	C
		0	24	0	12

Course Objectives	
1.	To enable a student to do an individual project work which may involve design, modelling, simulation and/or fabrication.
2.	To analyse a problem both theoretically and practically.
3.	To motivate the students to involve in research activities leading to innovative solutions for industrial and societal problems.

Course Description

Project work shall be carried out by each and every individual student under the supervision of a faculty of this department. A student may however, in certain cases, be permitted to work for the project in association with other departments or in an Industrial/Research Organization, on the recommendation of the Head of the Department. In such cases, the project work shall be jointly supervised by a faculty of the Department and an Engineer / Scientist from the organization. The student shall meet the supervisor periodically and attend the periodic reviews for evaluating the progress.

Project work will be carried out in two phases, Phase-I during the third semester and Phase-2 during the final semester. Phase-II shall be pursued for 24 periods per week. In phase II also, there will be three reviews for continuous internal assessment and one final review and viva voce at the end of the semesters. The Project Report prepared according to approved guidelines and duly signed by the supervisor(s) and the Head of the Department shall be submitted to the concerned department.

Course Outcomes : Students will be able to	
CO1	Design and develop the project, creativity and choose the most appropriate option for the Phase I project.
CO2	Effectively communicate technical project information in writing / Seminar Presentation / Technical Discussion.
CO3	Apply modern engineering tools for simulation, analysis and Solution.
CO4	Present the findings of the project by attending conference and communicate to journals for publication.
CO5	Engage in continuously learning the new practices, principles, and techniques in electric Power system.

BoS Chairman