B.S. Abdur Rahman Crescent Institute of Science & Technology
Deemed to be University u/s 3 of the UGC Act, 1956

Regulations 2025
Curriculum and Syllabi
(As approved by the 24th Academic Council)
August - 2025

M.Tech.
(Power Systems Engineering)

REGULATIONS 2025 CURRICULUM AND SYLLABI

(As approved by 24th Academic Council)

August - 2025

M.TECH. POWER SYSTEMS ENGINEERING

VISION AND MISSION OF THE INSTITUTION

VISION

B.S. Abdur Rahman Crescent Institute of Science and Technology aspires to be a leader in Education, Training and Research in multidisciplinary areas of importance and to play a vital role in the Socio-Economic progress of the Country in a sustainable manner.

MISSION

- To blossom into an internationally renowned Institute.
- To empower the youth through quality and value-based education.
- To promote professional leadership and entrepreneurship.
- To achieve excellence in all its endeavors to face global challenges.
- To provide excellent teaching and research ambience.
- To network with global Institutions of Excellence, Business, Industry and Research Organizations.
- To contribute to the knowledge base through Scientific enquiry, Applied Research and Innovation.

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

VISION

To achieve excellence in the programs offered by the Department of Electrical and Electronics Engineering through quality teaching, holistic learning and innovative research.

MISSION

- To offer Under Graduate, Post Graduate & Research programs of industrial and societal relevance.
- To provide knowledge and skill in the Design and realization of Electrical and Electronic circuits and systems.
- To impart necessary managerial and soft skills to face the industrial challenges.
- To pursue academic and collaborative research with industry and research institutions in India and abroad.
- To disseminate the outcome of research and projects through publications, seminars and workshops.
- To provide conducive ambience for higher education, teaching and research.

PROGRAMME EDUCATIONAL OBJECTIVES AND OUTCOMES

M.TECH. POWER SYSTEMS ENGINEERING

PROGRAMME EDUCATIONAL OBJECTIVES

PEO 1: To prepare graduates with strong technical expertise and analytical skills in power systems engineering to effectively meet the evolving demands of national and global industries.

PEO 2: To enable graduates to address contemporary challenges in the power sector, including deregulation, grid modernization, and smart energy systems, through proficiency in advanced power system analysis tools and software.

PEO 3: To nurture engineers capable of contributing to sustainable and clean energy solutions while upholding professional ethics and environmental and social responsibilities.

PEO 4: To cultivate leadership, research aptitude, and innovation through exposure to realistic industrial environments, multidisciplinary projects, and lifelong learning in modern engineering practices.

PEO 5: Demonstrate leadership in a team by exhibiting ethical approach, good communication skills and time management.

PROGRAMME OUTCOMES

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

PROGRAMME SPECIFIC OUTCOMES

PSO1: Graduates will be able to analyze, design, and implement effective solutions for complex power system problems to meet contemporary and global energy requirements.

PSO2: Graduates will be able to proficiently use advanced power system software tools and technologies for planning, operation, control, and optimization of electrical networks.

PSO3: Graduates will demonstrate comprehensive knowledge and innovative skills in emerging domains such as power system deregulation, smart grids, renewable integration, and clean energy technologies.

B.S. ABDUR RAHMAN CRESCENT INSTITUTE OF SCIENCE AND TECHNOLOGY, CHENNAI – 600 048.

REGULATIONS 2025

M.Tech. / MCA / M.Sc. / M.Com. / M.A. DEGREE PROGRAMMES

(Under Choice Based Credit System)

1.0 PRELIMINARY DEFINITIONS AND NOMENCLATURE

In these Regulations, unless the context otherwise requires:

i) **"Programme"** means post graduate degree programme (M.Tech. / MCA / M.Sc. / M.Com. / M.A.)

ii) **"Branch"** means specialization or discipline of programme like M.Tech. in Structural Engineering, Food Biotechnology etc., M.Sc. in Physics, Chemistry, Actuarial Science, Biotechnology etc.

iii) **"Course"** means a theory / practical / laboratory integrated theory / mini project / seminar / internship / project and any other subject that is normally studied in a semester like Advanced Concrete Technology, Electro Optic Systems, Financial Reporting and Accounting, Analytical Chemistry, etc.

iv) **"Institution"** means B.S. Abdur Rahman Crescent Institute of Science and Technology.

v) **“Academic Council”** means the Academic Council, which is the apex body on all academic matters of this Institute.

vi) **"Dean (Academic Affairs)"** means the Dean (Academic Affairs) of the Institution who is responsible for the implementation of relevant rules and regulations for all the academic activities.

vii) **"Dean (Student Affairs**)" means the Dean (Students Affairs) of the Institution who is responsible for activities related to student welfare, conduct of co-curricular, extra-curricular events and discipline in the campus.

viii) **"Controller of Examinations"** means the Controller of Examinations of the Institution who is responsible for the conduct of examinations and declaration of results.

ix) **“Dean of the School”** means the Dean of the School of the department concerned.

x) **"Head of the Department"** means the Head of the Department concerned.

2.0 ADMISSION REQUIREMENTS

2.1 Students for admission to the first semester of the Master's Degree Programme shall be required to have passed the appropriate degree examination as specified in the clause 3.2 [Eligible entry qualifications for admission to programmes] of this Institution or any other University or authority accepted by this Institution.

2.2 The other conditions for admission such as class obtained, number of attempts in the qualifying examination and physical fitness will be as prescribed by the Institution from time to time.

3.0 BRANCHES OF STUDY

3.1 The various programmes and their mode of study are as follows:

Degree	Mode of Study
M.Tech.	Full Time
MCA	
M.Sc.	
M.Com.	
M.A.	

3.2 Programmes offered

S. No.	Name of the Department	Programmes offered
1.	Aeronautical Engineering	M.Tech. (Avionics)
2.	Civil Engineering	M.Tech. (Structural Engineering)
		M. Tech. (Construction Engineering and Project Management)
3.	Mechanical Engineering	M.Tech. (CAD/CAM)
4.	Electrical and Electronics Engineering	M.Tech. (Power Systems Engineering)

S. No.	Name of the Department	Programmes offered
5.	Electronics and Communication Engineering	M.Tech. (VLSI and Embedded Systems)
6.	Computer Science and Engineering	M.Tech. (Computer Science and Engineering)
		M.Tech. (Artificial Intelligence and Data Science)
7.	Information Technology	M.Tech. (Information Technology)
8.	Computer Applications	MCA
9.	Mathematics	M.Sc. (Actuarial Science)
10.	Physics	M.Sc.(Physics)
11.	Chemistry	M.Sc.(Chemistry)
12.	Life Sciences	M.Sc. Biochemistry & Molecular Biology
		M.Sc. Biotechnology
		M.Sc. Microbiology
		M.Sc. Stem Cell Technology
		M.Sc. Clinical Embryology
		M.Tech. Biotechnology
		M.Tech. Food Biotechnology
13.	Commerce	M.Com
14.	Arabic and Islamic Studies	M.A. Islamic Studies

3.3 Eligible entry qualifications for admission to programmes

Sl. No.	Programme	Eligibility for Admission in M.Tech. / MCA / M.Sc. / M.Com. / MA Programmes
1.	M.Tech. (Avionics)	B.E. / B.Tech. in Aeronautical Engineering / Aerospace Engineering / Mechanical Engineering / Mechatronics / EEE / ECE / EIE / or Equivalent degree in relevant field.

Sl. No.	Programme	Eligibility for Admission in M.Tech. / MCA / M.Sc. / M.Com. / MA Programmes
2.	M.Tech. (Structural Engineering)	B.E. / B.Tech. in Civil Engineering / Structural Engineering or Equivalent degree in relevant field.
	M. Tech. (Construction Engineering and Project Management)	B.Tech. in Mechanical / Civil / Electrical and Electronics / Geo Informatics / B Plan / B. Des, and B.Arch.
3.	M.Tech. (CAD/CAM)	B.E. / B.Tech. in Mechanical / Automobile / Manufacturing / Production / Industrial / Mechatronics / Metallurgy / Aerospace / Aeronautical / Material Science / Polymer / Plastics / Marine Engineering or Equivalent degree in relevant field.
4.	M.Tech. (Power Systems Engineering)	B.E. / B.Tech. in EEE / ECE / EIE / ICE / Electronics / Instrumentation Engineering or Equivalent degree in relevant field.
5.	M.Tech. (VLSI and Embedded Systems)	B.E. / B.Tech. in ECE / EIE / ICE / EEE / IT or Equivalent degree in relevant field.
6.	M.Tech. (Computer Science and Engineering)	B.E. / B.Tech. in CSE / IT / ECE / EEE / EIE / ICE / Electronics Engineering / MCA or Equivalent degree in relevant field.
	M.Tech. (Artificial Intelligence and Data Science)	B.E. / B.Tech. in CSE / IT / ECE / EEE / EIE / ICE / Electronics Engineering / MCA or Equivalent degree in relevant field.
7.	M.Tech. (Information Technology)	B.E. / B.Tech. in IT / CSE / ECE / EEE / EIE / ICE / Electronics Engineering / MCA or Equivalent degree in relevant field.
8.	MCA	BCA / B.Sc. Computer Science / B.E. / B.Tech. / B.Sc. Mathematics, B.Sc. Physics / Chemistry / B.Com. / BBA / B.A. with Mathematics at graduation level or at 10 + 2level or equivalent degree in relevant field.

Sl. No.	Programme	Eligibility for Admission in M.Tech. / MCA / M.Sc. / M.Com. / MA Programmes
9.	M.Sc. (Actuarial Science)	Any under graduate degree with Mathematics / Statistics as one of the subjects of study at 10 + 2 level.
10.	M.Sc.(Physics)	B.Sc. in Physics / Applied Science / Electronics /Electronics Science / Electronics & Instrumentation or Equivalent degree in relevant field.
11.	M.Sc.(Chemistry)	B.Sc. in Chemistry / Applied Science or Equivalent degree in relevant field.
12.	M.Sc. Biochemistry & Molecular Biology	B.Sc. in Biotechnology / Biochemistry / Botany / Zoology / Microbiology / Molecular Biology / Genetics or Equivalent degree in relevant field.
	M.Sc. Biotechnology	B.Sc. in Biotechnology / Biochemistry / Botany / Zoology / Microbiology / Molecular Biology / Genetics or Equivalent degree in relevant field.
	M.Sc. Microbiology	B.Sc.in Biotechnology / Biochemistry / Botany / Zoology / Microbiology / Molecular Biology / Genetics or Equivalent degree in relevant field.
	M.Sc. Stem Cell Technology	B.Sc.in Biotechnology / Biochemistry / Botany / Zoology / Microbiology / Molecular Biology / Genetics or Equivalent degree in relevant field.
	M.Sc. Clinical Embryology	B.Sc.in Biotechnology / Biochemistry / Botany / Zoology / Microbiology / Molecular Biology / Genetics or Equivalent degree in relevant field.
	M.Tech. Biotechnology	B.Tech. / B.E. in Biotechnology or Equivalent degree in relevant field.
	M.Tech. Food Biotechnology	B.E. / B.Tech. in Biotechnology / Food Biotechnology / Chemical Engineering / Biochemical Engineering / Industrial

Sl. No.	Programme	Eligibility for Admission in M.Tech. / MCA / M.Sc. / M.Com. / MA Programmes
		Biotechnology or Equivalent degree in relevant field.
13. .	M.Com	B.Com. / BBA
14. .	M.A. Islamic Studies	B.A. in Islamic Studies / Arabic (or) Afzal-ul-Ulama (or) Any under graduate degree with Part 1 Arabic (or) Any under graduate degree with Aalim Sanad / Diploma / Certificate in Arabic or Islamic Studies.

4.0. **STRUCTURE OF THE PROGRAMME**

4.1. The PG. programmes consist of the following components as prescribed in the respective curriculum:

i. Core courses
ii. Elective courses
iii. Laboratory integrated theory courses
iv. Project work
v. Laboratory courses
vi. Open elective courses
vii. Seminar
viii. Mini Project
ix. Industry Internship
x. MOOC courses (NPTEL- Swayam, Coursera etc.)
xi. Value added courses

4.1.1. The curriculum and syllabi of all programmes shall be approved by the Academic Council of this Institution.

4.1.2. For the award of the degree, the student has to earn a minimum total credits specified in the curriculum of the respective specialization of the programme.

4.1.3. The curriculum of programmes shall be so designed that the minimum prescribed credits required for the award of the degree shall be within the limits specified below:

Programme	**Range of credits**
M.Tech.	80 - 86
MCA	80 - 86
M.Sc.	80 - 85
M.Com.	80 - 88
M.A.	80 - 84

4.1.4. Credits will be assigned to the courses for all programmes as given below:

- ❖ One credit for one lecture period per week or 15 periods of lecture per semester.
- ❖ One credit for one tutorial period per week or 15 periods per semester.
- ❖ One credit each for seminar/practical session/project of two or three periods per week or 30 periods per semester.
- ❖ One credit for 160 hours of industry internship per semester for all programmes (except M.Com.)
- ❖ Four credits for 160 hours of industry internship per semester for M.Com.

4.1.5. The number of credits the student shall enroll in a non-project semester and project semester is as specified below to facilitate implementation of Choice Based Credit System.

Programme	**Non-project semester**	**Project semester**
M.Tech.	9 to 32	18 to 26
MCA	9 to 32	18 to 26
M.Sc.	9 to 32	10 to 26
M.Com.	9 to 32	16 to 28
M.A.	9 to 32	NA

4.1.6 The student may choose a course prescribed in the curriculum from any department offering that course without affecting regular class schedule. The attendance will be maintained course wise only.

4.1.7 The students shall choose the electives from the curriculum with the approval of the Head of the Department / Dean of School.

4.1.8 Apart from the various elective courses listed in the curriculum for each specialization of programme, the student can choose a maximum of two electives from any other similar programmes across departments, alter to open electives, during the entire period of study, with approval of Head of the department offering the course and parent department.

4.1.9. Online courses

Students are permitted to undergo department approved online courses under SWAYAM up to 40% of credits of courses in a semester excluding project semester (in case of M.Tech. M.Sc. & MCA programmes) with the recommendation of the Head of the Department / Dean of School and with the prior approval of Dean Academic Affairs during his/ her period of study. The credits earned through online courses shall be transferred following the due approval procedures. The online courses can be considered in lieu of core courses and elective courses.

Students shall undergo project related online course on their own with the mentoring of the project supervisor.

3.5 Project work

3.5.1 Project work shall be carried out by the student under the supervision of a faculty member in the department with similar specialization.

3.5.2 A student may however, in certain cases, be permitted to work for the project in an Industry / Research organization, with the approval of the Head of the Department/ Dean of School. In such cases, the project work shall be jointly supervised by a faculty of the Department and an Engineer / Scientist / Competent authority from the organization and the student shall be instructed to meet the faculty periodically and to attend the review meetings for evaluating the progress.

3.5.3 The timeline for submission of final project report / dissertation is within 30 calendar days from the last instructional day of the semester in which project is done.

3.5.4 If a student does not comply with the submission of project report / dissertation on or before the specified timeline he / she is deemed to have not completed the project work and shall re-register in the subsequent semester.

5.0 DURATION OF THE PROGRAMME

5.1. The minimum and maximum period for completion of the programmes are given below:

Programme	Min. No. of Semesters	Max. No. of Semesters
M.Tech.	4	8
MCA	4	8
M.Sc.	4	8
M.Com.	4	8
M.A.	4	8

5.2 Each academic semester shall normally comprise of 90 working days. Semester end examinations shall follow within 10 days of the last Instructional day.

5.3 Medium of instruction, examinations and project report shall be in English.

6.0 REGISTRATION AND ENROLLMENT

6.1 The students of first semester shall register and enroll at the time of admission by paying the prescribed fees. For the subsequent semesters registration for the courses shall be done by the student one week before the last working day of the previous semester.

6.2 Change of a Elective Course

A student can change an enrolled elective course within 10 working days from the commencement of the course, with the approval of the Dean (Academic Affairs), on the recommendation of the Head of the Department of the student.

6.3 Withdrawal from a Course

A student can withdraw from an enrolled course at any time before the first continuous assessment test for genuine reasons, with the approval of the

Dean (Academic Affairs), on the recommendation of the Head of the Department of the student.

6.4 A student can enroll for a maximum of 36 credits during a semester including Redo / Predo courses.

7.0 BREAK OF STUDY FROM PROGRAMME

7.1 A student may be allowed / enforced to take a break of study for two semesters from the programme with the approval of Dean (Academic Affairs) for the following reasons:

7.1.1 Medical or other valid grounds

7.1.2 Award of 'I' grade in all the courses in a semester due to lack of attendance

7.1.3 Debarred due to any act of indiscipline

7.2 The total duration for completion of the programme shall not exceed the prescribed maximum number of semesters (vide clause 3.1).

7.3 A student who has availed a break of study in the current semester (odd/even) can rejoin only in the subsequent corresponding (odd/even) semester in the next academic year on approval from the Dean (Academic affairs).

7.4 During the break of study, the student shall not be allowed to attend any regular classes or participate in any activities of the Institution. However, he / she shall be permitted to enroll for the 'I' grade courses and appear for the arrear examinations.

8.0 CLASS ADVISOR AND FACULTY ADVISOR

8.1 CLASS ADVISOR

A faculty member shall be nominated by the HOD/ Dean of School as Class Advisor for the class throughout their period of study.

The class advisor shall be responsible for maintaining the academic, curricular and co-curricular records of students of the class throughout their period of study.

8.2 FACULTY ADVISOR

To help the students in planning their courses of study and for general counseling, the Head of the Department / Dean of School of the students shall attach a maximum of 20 students to a faculty member of the department who shall function as faculty advisor for the students throughout their period of study. Such faculty advisor shall guide the students in taking up the elective courses for registration and enrolment in every semester and also offer advice to the students on academic and related personal matters.

9.0 COURSE COMMITTEE

9.1 Each common theory / laboratory course offered to more than one group of students shall have a “Course Committee” comprising all the teachers handling the common course with one of them nominated as course coordinator. The nomination of the course coordinator shall be made by the Head of the Department / Dean (Academic Affairs) depending upon whether all the teachers handling the common course belong to a single department or from several departments. The Course Committee shall meet as often as possible to prepare a common question paper, scheme of evaluation and ensure uniform evaluation of the assessment tests and semester end examination.

10.0 CLASS COMMITTEE

10.1 A class committee comprising faculty members handling the courses, student representatives and a senior faculty member not handling any courses for that class as chairman will be constituted in every semester:

10.2 The composition of the class committee will be as follows:

i) One senior faculty member preferably not handling courses for the concerned semester, appointed as chairman by the Head of the Department

ii) Faculty members of all courses of the semester

iii) All the students of the class

iv) Faculty advisor and class advisor

v) Head of the Department – Ex officio member

10.3 The class committee shall meet at least three times during the semester. The first meeting shall be held within two weeks from the date of commencement of classes, in which the nature of continuous assessment for various courses and the weightages for each component of assessment shall be decided for the first and second assessment. The second meeting shall be held within a week after the date of first assessment report, to review the students' performance and for follow up action.

10.4 During these two meetings the student members, shall meaningfully interact and express opinions and suggestions to improve the effectiveness of the teaching-learning process, curriculum and syllabi of courses.

10.5 The third meeting of the class committee, excluding the student members, shall meet within 5 days from the last day of the semester end examination to analyze the performance of the students in all the components of assessments and decide their grades in each course. The grades for a common course shall be decided by the concerned course committee and shall be presented to the class committee(s) by the concerned course coordinator.

11.0 CREDIT REQUIREMENTS TO REGISTER FOR PROJECT WORK

11.1 A student is permitted to register for project semester, if he/she has earned the minimum number of credits specified below:

Programme	Minimum no. of credits to be earned to enroll for project semester
M.Tech.	18
MCA	22
M.Sc.	18
M.Com	NA
M.A.	NA

11.2 If the student has not earned minimum number of credits specified, he/she has to earn the required credits, at least to the extent of minimum credits specified in clause 9.1 and then register for the project semester.

12.0 ASSESSMENT PROCEDURE AND PERCENTAGE WEIGHTAGE OF MARKS

12.1 Every theory course shall have a total of three assessments during a semester as given below:

Assessments	**Weightage of Marks**
Continuous Assessment 1	25%
Continuous Assessment 2	25%
Semester End Examination	50%

12.2 Theory Course

Appearing for semester end theory examination for each course is mandatory and a student shall secure a minimum of 40% marks in each course in semester end examination for the successful completion of the course.

12.3 Laboratory Course

Every practical course shall have 75% weightage for continuous assessments and 25% for semester end examination. However, a student shall have secured a minimum of 50% marks in the semester end practical examination for the award of pass grade.

12.4 Laboratory Integrated Theory (LIT) Courses

For laboratory integrated theory courses, the theory and practical components shall be assessed separately for 100 marks each and consolidated by assigning a weightage of 75% for theory component and 25% for practical component (for a 4 credit LIT Course). Grading shall be done for this consolidated mark. Assessment of theory components shall have a total of three assessments with two continuous assessments carrying 25% weightage each and semester end examination carrying 50% weightage. The student shall secure a separate minimum of 40% in the semester end theory examination. The evaluation of practical components shall be through continuous assessment.

Component	Maximum Marks	Weightage for Final Grade	Mode of Assessment
Theory Component	100	75%	CAT1 (25%) + CAT2 (25%) + SEE (50%)
Practical Component	100	25%	Continuous assessment only
Final Grade Basis	Consolidated	100%	75% Theory + 25% Practical
Pass Requirement	-	-	Minimum 40% in Semester-End Theory Exam (SEE)

Note:

1. Proportionate weightage shall be assigned to LIT courses based on their credit value, whether 2 or 3 credits.
2. In Lab-Integrated Professional Elective courses, the laboratory component shall be assessed by the course faculty.

12.5 The components of continuous assessment for theory/practical/laboratory integrated theory courses shall be finalized in the first class committee meeting.

12.6 Industry Internship

In the case of industry internship, the student shall submit a report, which shall be evaluated along with an oral examination by a committee of faculty members constituted by the Head of the Department. The student shall also submit an internship completion certificate issued by the industry / research / academic organisation. The weightage of marks for industry internship report and viva voce examination shall be 60% and 40% respectively.

12.7 Project Work

Mini project work, shall be carried out individually or as a group activity involving a maximum of three students.

Each group shall identify a suitable topic within their domain, either disciplinary or interdisciplinary, based on the students' abilities and in consultation with the faculty mentor. The topic must lead to the development of a small-scale system or application.

The progress of the mini project shall be evaluated through three periodic reviews: two interim reviews and one final review. A project report shall be submitted by the end of the semester. The reviews shall be conducted by a committee of faculty members constituted by the Head of the Department / Dean of the School.

An oral examination (viva voce) shall be conducted as the semester-end examination by an internal examiner approved by the Controller of Examinations, based on the project report.

The weightage for assessment shall be as follows:

• Periodic Reviews: 50%

- 25% by the Project Guide
- 25% by the Review Committee

• Project Report: 20%

• Viva Voce Examination: 30%

The Project shall be carried out individually or as a group activity, involving a maximum of two or three students.

A committee of faculty members, constituted by the Head of the Department / Dean of the School, shall conduct three periodic reviews during the semester to monitor and assess the progress of the project.

At the end of the semester, students shall submit a project report, based on which a semester-end oral examination (viva voce) shall be conducted by an external examiner approved by the Controller of Examinations.

The assessment weightage shall be as follows:

• Periodic Reviews – 50%

- 25% by the Project Guide
- 25% by the Review Committee

• Project Report – 20%

• Viva Voce Examination – 30%

12.8 The assessment of seminar course including its component and its weightage shall be decided by a committee of faculty members constituted by the Head of the Department. This committee shall ensure the conduct of assessment of components and award marks accordingly.

12.9 For the first attempt of the arrear theory examination, the internal assessment marks scored for a course during first appearance shall be used for grading along with the marks scored in the arrear examination. From the subsequent appearance onwards, full weightage shall be assigned to the marks scored in the semester end examination and the internal assessment marks secured during the course of study shall become invalid.

In case of laboratory integrated theory courses, after one regular and one arrear appearance, the internal mark of theory component is invalid and full weightage shall be assigned to the marks scored in the semester end examination for theory component. **There shall be no arrear or improvement examination for lab components**.

13.0 SUBSTITUTE EXAMINATIONS

13.1 A student who is absent, for genuine reasons, may be permitted to write a substitute examination for any one of the two continuous assessment tests of a course by paying the prescribed substitute examination fee. However, permission to take up a substitute examination will be given under exceptional circumstances, such as accidents, admission to a hospital due to illness, etc. by a committee constituted by the Head of the Department / Dean of School for that purpose. However, there is no substitute examination for semester end examination.

13.2 A student shall apply for substitute exam in the prescribed form to the Head of the Department / Dean of School within a week from the date of assessment test. However, the substitute examination will be conducted only after the last working day of the semester and before the semester end examination.

14.0 ATTENDANCE REQUIREMENT AND SEMESTER / COURSE REPETITION

14.1 A student shall earn 100% attendance in the scheduled contact hours (such as lectures, tutorials, labs, etc.) for that course. However, a relaxation of up to 25% in attendance may be granted to account for valid reasons such as medical emergencies, participation in co-curricular or extracurricular activities with prior approval, or other genuine circumstances.

If a student's attendance falls below 75% in a particular course, even after considering the permissible relaxation, they will not be allowed to appear for the semester-end examination in that course. Instead, the student will be awarded an “I” grade (Incomplete) for the course

14.2 The faculty member of each course shall cumulate the attendance details for the semester and furnish the names of the students who have not earned the required attendance in the concerned course to the class advisor. The class advisor shall consolidate and furnish the list of students who have earned less than 75% attendance, in various courses, to the Dean (Academic Affairs) through the Head of the Department / Dean of the School. Thereupon, the Dean (Academic Affairs) shall officially notify the names of such students prevented from writing the semester end examination in each course.

14.3 If a student’s attendance in any course falls between 65% and 75% due to medical reasons (e.g., hospitalization, illness) or participation in institution-approved events, they may be granted exemption from the minimum attendance requirement and allowed to appear for the semester-end exam. The student must submit valid documents to the class advisor upon rejoining, with approval from the HoD/Dean. Final approval for **condonation** will be granted by the Vice Chancellor based on the Dean (Academic Affairs)’s recommendation.

14.4 A student who has obtained an “I” grade in all the courses in a semester is not permitted to move to the next higher semester. Such students shall **repeat** all the courses of the semester in the subsequent academic year. However, he / she is permitted to redo the courses awarded with 'I' grade / arrear in previous semesters. They shall also be permitted to write arrear examinations by paying the prescribed fee.

14.5 The student awarded “I” grade, shall enroll and repeat the course when it is offered next. In case of “I” grade in an elective course either the same elective course may be repeated or a new elective course may be taken with the approval of the Head of the Department / Dean of the School.

14.6 A student who is awarded "U" grade in a course shall have the option to either write the semester end arrear examination at the end of the subsequent semesters, or to **redo** the course when the course is offered by the department. Marks scored in the continuous assessment in the redo course shall be considered for grading along with the marks scored in the semester end (redo) examination. If any student obtains "U" grade in the redo course, the marks scored in the continuous assessment test (redo) for that course shall be considered as internal mark for further appearance of arrear examination.

14.7 If a student with "U" grade, who **prefers to redo** any particular course, fails to earn the minimum 75% attendance while doing that course, then he / she is not permitted to write the semester end examination and his / her earlier "U" grade and continuous assessment marks shall continue.

15.0 REDO / PRE-DO COURSES

15.1 A student can register for a maximum of three redo courses per semester without affecting the regular semester classes, whenever such courses are offered by the concerned department, based on the availability of faculty members and subject to a specified minimum number of students registering for each of such courses.

15.2 The number of contact hours and the assessment procedure for any redo course shall be the same as regular courses, except there is **no provision for any substitute examination and withdrawal from a redo course**.

15.3 A student shall be permitted to pre-do a course offered by the concerned department, provided it does not affect the regular semester class schedule. Such permission shall be granted based on the availability of faculty members, the maximum permissible credit limit of the semester, and the student's fulfillment of the necessary prerequisites for the course. The proposal shall be recommended by the Dean of the School and the Head of the Department, and shall require final approval from the Dean

(Academic Affairs).

16.0 PASSING AND DECLARATION OF RESULTS AND GRADE SHEET

16.1 All assessments of a course shall be made on absolute marks basis. The class committee without the student members shall meet to analyse the performance of students in all assessments of a course and award letter grades following the relative grading system. The letter grades and the corresponding grade points are as follows:

Letter Grade	Grade Points
S	10
A	9
B	8
C	7
D	6
E	5
U	0
W	-
I	-
PA	-
FA	-

"W"- denotes withdrawal from the course

“I” - denotes “Incomplete” ie. inadequate attendance in the course and prevention from appearance of semester end examination

“U” - denotes unsuccessful performance in the course.

“PA” - denotes the ‘Pass’ of the zero credit courses.

“FA” - denotes the ‘Fail’ of the zero credit courses.

16.2 A student who earns a minimum of five grade points (‘E’ grade) in a course is declared to have successfully completed the course. Such a course cannot be **repeated by the student for improvement of grade**.

16.3 Upon awarding grades, the results shall be endorsed by the chairman of the class committee and Head of the Department / Dean of the School. The Controller of Examinations shall further approve and declare the results.

16.4 **Within one week** from the date of declaration of result, a student can apply for revaluation of his / her semester end theory examination answer scripts of one or more courses, on payment of prescribed fee, through proper application to the Controller of Examinations. Subsequently, the Head of the Department / Dean of the School offered the course shall constitute a revaluation committee consisting of chairman of the class committee as convener, the faculty member of the course and a senior faculty member having expertise in that course as members. The committee shall meet within a week to revalue the answer scripts and submit its report to the Controller of Examinations for consideration and decision.

16.5 After results are declared, grade sheets shall be issued to each student, which contains the following details: a) list of courses enrolled during the semester including redo courses / arrear courses, if any; b) grades scored; c) Grade Point Average (GPA) for the semester and d) Cumulative Grade Point Average (CGPA) of all courses enrolled from the first semester onwards.

GPA is the ratio of the sum of the products of the number of credits of courses registered and the grade points corresponding to the grades scored in those courses, taken for all the courses, to the sum of the number of credits of all the courses in the semester.

If C_i, is the number of credits assigned for the i^{th} course and GP_i is the Grade Point in the i^{th} course,

$$GPA = \frac{\sum_{i=1}^{n}(C_i)(GPi)}{\sum_{i=1}^{n} C_i}$$

Where n = number of courses

The Cumulative Grade Point Average (CGPA) is calculated in a similar manner, considering all the courses enrolled from first semester.

"I", "W", "PA" and **"FA"** grades are excluded for calculating GPA.

"U", "I", "W", "PA" and **"FA"** grades are excluded for calculating CGPA.

The formula for the conversion of CGPA to equivalent percentage of marks shall be as follows:

Percentage equivalent of marks = CGPA X 10

16.6 After successful completion of the programme, the degree shall be awarded to the students with the following classifications based on CGPA.

Classification	CGPA
First Class with Distinction	8.50 and above and passing all the courses in first appearance and completing the programme within the prescribed period of 8 semesters for all students (except lateral entry students) and 6 semesters for lateral entry students
First Class	6.50 and above and completing the programme within a maximum of 10 semesters for all students (except lateral entry students) and 8 semesters for lateral entry students
Second Class	Others

16.6.1 Eligibility for First Class with Distinction

- A student should not have obtained 'U' or 'I' grade in any course during his/her study
- A student should have completed the UG programme within the minimum prescribed period of study (except clause 7.1.1)

16.6.2 Eligibility for First Class

- A student should have passed the examination in all the courses not more than two semesters beyond the minimum prescribed period of study (except clause 7.1.1)

16.6.3 The students who do not satisfy clause 16.6.1 and clause 16.6.2 shall be classified as second class.

16.6.4 The CGPA shall be rounded to two decimal places for the purpose of classification. The CGPA shall be considered up to three decimal places for the purpose of comparison of performance of students and ranking.

17.0 SUPPLEMENTARY EXAMINATION

Final year students and passed out students can apply for supplementary examination for a maximum of **three** courses thus providing an opportunity to complete their degree programme. Likewise, students with less credit can also apply for supplementary examination for a maximum of **three** courses to enable them to earn minimum credits to move to higher semester. The students can apply for supplementary examination within three weeks of the declaration of results in both odd and even semesters.

18.0 DISCIPLINE

18.1 Every student is expected to observe discipline and decorum both inside and outside the campus and not to indulge in any activity which tends to affect the reputation of the Institution.

18.2 Any act of indiscipline of a student, reported to the Dean (Student Affairs), through the Head of the Department / Dean of the School concerned shall be referred to a Discipline and Welfare Committee constituted by the

Registrar for taking appropriate action.

19.0 MULTI ENTRY AND MULTI EXIT (MEME) FRAMEWORK *

In accordance with the provisions of the National Education Policy (NEP) 2020, the programme shall support a Multi Entry – Multi Exit (ME-ME) framework to provide flexibility in the academic pathway of students.

*** At present (AY 2025-26), it is applicable only for all M.Tech. Programmes.**

19.1. Exit Option:

19.1.1 Credit Requirement for Award of M.Tech. Degree

To qualify for the award of a M.Tech. degree from the Institute, a student must successfully complete the total credit requirements as prescribed in the approved curriculum of the respective programme. The specific credit requirements are determined by the programme curriculum.

19.1.2 Provision for Multiple Exit

In alignment with NEP 2020 guidelines, the Institute provides students enrolled in postgraduate programmes with the option of multiple exits, subject to the following conditions:

a. Exit at the End of First Year

Students may choose to exit the programme at the end of the first year, provided they have fulfilled the prescribed academic requirements.

b. Application for Exit

A student intending to exit must submit a formal written application in the prescribed format at least **eight weeks prior to the scheduled end of the academic year.**

c. Departmental Recommendation

1. Upon receipt of the application, the concerned Department shall evaluate the academic record of the student and recommend the award of a **Post Graduate Diploma**, based on the credits earned.

2. In the case of arrear courses, the post graduate diploma will be conferred only after successful clearance of all pending arrears.

d. Notification of Completion

Once a student has fulfilled the requirements for the award of post graduate diploma, the Department shall notify the same to controller of examinations for further processing and issuance.

19.1.3 Award of Qualifications under Multiple Exit Scheme

Post graduate diploma: Awarded after successful completion of the first year, subject to earning the prescribed cumulative credits as per the respective programme curriculum (e.g., 44 credits from the first year) along with 3 credits of Skill Based Courses.

19.1.4 Conditions Governing Exit

1. The multiple exit facility is intended strictly for **genuine and exceptional circumstances,** such as prolonged illness, or securing an employment opportunity necessitating a temporary withdrawal from the programme.
2. Students opting for a temporary exit after the first year must obtain **prior approval from the Registrar through Dean (Academics),** based on the recommendation of the respective Head of the Department.

19.1.5 Expectation of Programme Continuity

While the option for multiple exits exists, it is generally expected that students admitted to a post graduate programme shall pursue their studies continuously until completion of the final degree requirements.

19.2. Entry Option:

Students seeking re-entry into the programme (multi-entry) must submit an application through the proper channel at the beginning of the odd semester. Admission shall be subject to fulfilment of institutional guidelines, credit mapping, and availability of seats.

19.3. Credits Requirement for the Certifications

Name of the Certificate Programme	Required Credits
Post graduate Diploma (Level 6.5 as per NEP 2020)	40* - 45

* The minimum number of credits that a student must earn (as per the respective curriculum) in order to get the above certification program

20.0 ELIGIBILITY FOR THE AWARD OF THE MASTER'S DEGREE

20.1 A student shall be declared to be eligible for the award of the Master's Degree, if he/she has:

i. Successfully acquired the required credits as specified in the curriculum corresponding to his/her programme within the maximum period of 8 semesters from the date of admission, including break of study.

ii. No disciplinary action is pending against him/her.

iii. Enrolled and completed at least one value added course.

iv. Enrollment in at least one MOOC / SWAYAM course (non-credit) before the final semester.

20.2 The award of the degree must have been approved by the Institute.

21.0 POWER TO MODIFY

Notwithstanding all that have been stated above, the Academic Council has the right to modify any of the above regulations from time to time.

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B. S. ABDUR RAHMAN CRESCENT INSTITUTE OF SCIENCE AND TECHNOLOGY

M.TECH. POWER SYSTEMS ENGINEERING
CURRICULUM & SYLLABI, REGULATIONS 2025
(Choice Based Credit System)

SEMESTER I

Sl. No.	Course Category	Course Code	Course Title	L	T	P	C
1	BS	MAF 6187	Applied Mathematics for Electrical Engineers	3	1	0	4
2	PCC	EEF 6101	System Theory	3	0	0	3
3	PCC	EEF 6102	Advanced Power System Analysis	3	0	2	4
4	PCC	EEF 6103	Advanced Power System Protection	3	0	0	3
5	PCC	EEF 6104	Flexible AC Transmission System	3	0	0	3
7	PEC		Professional Elective Course 1	3	0	0	3
			Credits				**20**

SEMESTER II

Sl. No.	Course Category	Course Code	Course Title	L	T	P	C
1	ES	GEF 6201	Research Methodology and IPR for Engineers	2	0	0	2
2	PCC	EEF 6201	Advanced Power System and Operation Control	3	0	0	3
3	PCC	EEF 6202	Power System Dynamics	3	0	2	4
4	PCC	EEF 6203	Smart Grid	3	0	0	3
5	PEC		Professional Elective Course 2	3	0	0	3
6	PEC		Professional Elective Course 3 (One can be MOOC)	3	0	0	3
7	HS	ENF 6281	Professional Communication	0	0	2	1
8	PCC	EEF 6204	Mini Project	0	0	3	3
			Credits				**22**

SEMESTER III

Sl. No.	Course Category	Course Code	Course Title	L	T	P	C
1	OEC		Open Elective	3	0	0	3
2	PCC	EEF 7101	Renewable Energy Systems	3	0	2	4
3	PEC		Professional Elective Course 4	3	0	0	3
4	PEC		Professional Elective Course 5	3	0	0	3
5	Internship	EEF 7102	Industry Internship *	0	0	2	2
6	Project	EEF 7103	Project Work – Phase I #	0	0	14	7
7	MOOC		MOOC(Related to project) **				
			Credits				**15**

SEMESTER IV

Sl. No.	Course Code	Course Title	L	T	P	C
1	EEF 7103	Project Work – Phase II	0	0	35	18
		Total Credits				**25 (7 +18)**
		Overall Total Credits				**82**

* Industrial training will be undertaken during the summer vacation of first-year for 30 days. The credit will be awarded in the 3rd Semester.

Credits for Project Work Phase I to be accounted along with Project Work Phase II in IV Semester

** The students shall pursue a MOOC course related to the project in the third semester, and the progress in this regard shall be monitored during Project Phase – I reviews.

Enrollment and completed at least one value-added course is mandatory.

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PROFESSIONAL ELECTIVE COURSES

S.No	Course Code	Course Name	L	T	P	C
1.	EEFY 001	Restructured Power Systems	3	0	0	3
2.	EEFY 002	EHV Power Transmission	3	0	0	3
3.	EEFY 003	Power Quality	3	0	0	3
4.	EEFY 004	Power System Planning and Reliability	3	0	0	3
5.	EEFY 005	Advanced Digital Signal Processing	3	0	0	3
6.	EEFY 006	Industrial Power System Analysis and Design	3	0	0	3
7.	EEFY 007	High Voltage Direct Current Transmission	3	0	0	3
8.	EEFY 008	Wind Energy Conversion Systems	3	0	0	3
9.	EEFY 009	Power Distribution Systems	3	0	0	3
10.	EEFY 010	Electrical Transients in Power Systems	3	0	0	3
11.	EEFY 011	Distributed Generation and Micro-grid	3	0	0	3
12.	EEFY 012	State Estimation and Contingency Analysis in Smart-grid	3	0	0	3
13.	EEFY 013	Special Electrical Machines and Controllers	3	0	0	3
14.	EEFY 014	Fundamentals of Grid Connected Photo Voltaic Power Electronic Converter Design	3	0	0	3
15.	EEFY 015	Advanced Power Semiconductor Devices	3	0	0	3
16.	EEFY 016	Analysis of Power converters	3	0	0	3
17.	EEFY 017	Electric Drives	3	0	0	3
18.	EEFY 018	Energy Management and Auditing	3	0	0	3
19.	EEFY 019	Electric Vehicles	3	0	0	3

SEMESTER I

MAF 6186	**APPLIED MATHEMATICS FOR ELECTRICAL**	**L**	**T**	**P**	**C**
SDG: 4	**ENGINEERS**	**3**	**1**	**0**	**4**

COURSE OBJECTIVES:

COB1: To develop a working knowledge of the central ideas of linear algebra.

COB2: To study and understand the concepts of probability and random variable of the various functions and Markov chain.

COB3: To formulate and solve real-world optimization problems using linear programming and related techniques.

COB4: To formulate problems suitable for dynamic programming, and to design efficient recursive and iterative algorithms to solve them.

COB5: To introduce the foundational principles of the calculus of variations and their applications to functional optimization problems.

MODULE I LINEAR ALGEBRA 9+3

Vector spaces – Norms – Inner Products – Eigenvalues using QR transformations – QR factorization – Generalized eigenvectors – Canonical forms – Singular value decomposition and applications – Pseudo inverse – Least square approximations – Toeplitz matrices and some applications.

MODULE II RANDOM VARIABLES AND RANDOM PROCESSES 9+3

Random variables – Probability function – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions – Random processes – Classification – Auto correlation – Cross correlation – Stationary random process – Markov process – Markov chain – Poisson process – Gaussian process.

MODULE III LINEAR AND NON-LINEAR PROGRAMMING PROBLEMS 9+3

Formulation – Graphical method – Simplex method – Transportation and Assignment Models – Duality in linear programming – Sequencing Models – Formulation of general non-linear programming problem – Steepest descent (Cauchy) method – Conjugates gradient method – Newton's Method – Sequential quadratic programming – Penalty function method – Augmented lagrange multiplier method.

MODULE IV DYNAMIC PROGRAMMING 9+3

Multistage decision processes – Concept of sub-optimization and principle of optimality – Linear programming as a case of dynamic programming – Integer linear programming – Gomory's cutting plane method – Integer nonlinear programming – Branch and bound algorithms.

MODULE V CALCULUS OF VARIATIONS 9+3

Variation and its properties – Euler-Lagrange's equation – Functional dependent on first and higher order derivatives – Functional dependent on functions of several independent variables – Variational problems with fixed boundaries – Variational problems with moving boundaries – Isoperimetric problems.

L – 45; T – 15; TOTAL HOURS – 60

TEXT BOOKS:

1. Bronson R, "Matrix Operation", Schaum's outline series, McGraw Hill, New York (1989).
2. Oliver C. Ibe, "Fundamentals of Applied Probability and Random Processes", 3rd Edition, Academic Press (Elsevier), 2014.
3. Taha H. A., "Operations Research: An Introduction",11th Edition, Pearson Education, Asia, New Delhi 2022.
4. S.S. Rao, "Engineering Optimization: Theory and Practice", 4th Edition, Wiley, 2009.
5. A.S. Gupta, "Calculus of Variations with Applications", PHI Learning, 2nd Edition, 2014.

REFERENCES:

1. Andrews L.C and Phillips R.L., "Mathematical Techniques for Engineering and Scientists", Prentice Hall of India, 2006.
2. O'Neil P.V, "Advanced Engineering Mathematics", 7th Edition, Cengage

Learning India Private Limited, 2011.

3. B.S. Grewal, “Higher Engineering Mathematics”, 44th Edition, Khanna Publications, 2018.
4. Erwin Kreyszig, “Advanced Engineering Mathematics”, 10th Edition, Wiley India student Edition, 2015.

COURSE OUTCOMES: At the end of the course students will be able to

CO1: apply vector space theory and matrix decompositions to solve engineering problems.

CO2: solve one-dimensional random variable and random processes problems.

CO3: formulate optimization problems as linear and non-linear programming models, and solve them.

CO4: identify and classify problems that can be efficiently solved using dynamic programming

CO5:.formulate and solve variational problems using Euler-Lagrange equations for functionals with fixed and moving boundaries.

Board Of Studies (BOS) :
17th BOS of Department of Mathematics and Actuarial Science held on 23.06.2025.

Academic Council:
24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	-	-	-	-	-	-	-	-
CO2	1	1	-	-	-	-	-	-	-	-
CO3	3H	2	-	-	-	-	-	-	-	-
CO4	3	1	-	-	-	-	-	-	-	-
CO5	2	2	-	-	-	-	-	-	-	-

*** Legend: L – Low (1), M – Medium (2), H – High (3).**

SDG 4 – Quality Education: Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

Statement: Learning of essential mathematical and optimization tools will lead to knowledge of applications in electrical and electronics engineering.

EEF 6101	SYSTEM THEORY	L	T	P	C
SDG: 8,12		3	0	0	3

COURSE OBJECTIVES:

COB1: To acquire knowledge on state-space approach, state feedback controllers and observers for different processes.

COB2: To study the properties of linear systems such as Controllability and Observability.

COB3: To gain knowledge on stability analysis of multivariable processes.

COB4: To understand nonlinear systems and its linearization methods.

COB5: To learn the stability of Linear and Non-Linear Systems.

MODULE I STATE SPACE APPROACH L:9

Introduction to State Space Approach - System representation in state variable form – State transition matrix and its properties – Methods of computing the state transition matrix – System modes – Role of Eigen values and Eigen vectors.

MODULE II STATE FEEDBACK CONTROL AND STATE ESTIMATOR L:9

Introduction – Controllable and Observable Companion Forms – SISO and MIMO Systems – The Effect of State Feedback on Controllability and Observability – Pole Placement by State Feedback for both SISO and MIMO Systems – Full Order and Reduced Order Observers.

MODULE III STABILITY FOR LINEAR SYSTEMS L:9

Introduction – Equilibrium points – Stability in the sense of Lyapunov - BIBO Stability – Stability of LTI systems – The direct method of Lyapunov and the Linear continuous time autonomous systems – Popov Stability Criterion.

MODULE IV NON-LINEAR SYSTEMS L:9

Types of Non-Linearity – Typical Examples – Phase plane analysis (analytical and graphical methods) – Limit cycles – Equivalent Linearization.

Describing Function Analysis for Non-Linear Systems, Describing Functions for different non-linear elements- backlash, dead zone, saturation and hysteresis.

MODULE V STABILITY FOR NON-LINEAR SYSTEMS L:9

Equilibrium stability of nonlinear continuous time autonomous systems – Finding Lyapunov functions for nonlinear continuous time autonomous systems – Krasovskii and variable gradient method.

L – 45; T – 0; P – 0; Total Hours:45

TEXT BOOKS:

1. M.Gopal, "Modern Control System Theory", New Age International, 2010.
2. K.Ogata, "Modern Control Engineering", Prentice Hall of India, 2010.

REFERENCES:

1. John .S.Bay, "Fundamentals of Linear State Space Systems", Tata McGraw– Hill, 1999.
2. Z.Bubnicki, "Modern Control Theory", Springer, 2005.

COURSE OUTCOMES: At the end of the course, the students will be able to:

CO1: implement state space approach for the given process.

CO2: design state feedback controller and observers.

CO3: perform stability analyses of the system using conventional mathematical approach.

CO4: analyze complex systems using mathematical models.

CO5: analyze the stability of Linear Systems using Lyapnov, Popov Stability Criterions and the stability of Non-Linear Systems using novel techniques.

Board of Studies (BoS):	**Academic Council:**
21st meeting of BoS of EEE held on 23.06.2025	24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	-–	–	–	–	–	2	3	3	2
CO2	3	3	3	2	3	–	–	–	–	–	2	3	3	2
CO3	3	3	2	2	2	–	–	–	–	–	2	3	2	2
CO4	3	3	2	2	2	–	–	–	–	–	2	3	2	3
CO5	3	3	2	3	2	–	–	–	–	–	3	3	2	3

*** Legend: L – Low (1), M – Medium (2), H – High (3).**

SDG 8: Decent work and economic growth

Statement: The learners of this course can get decent work and earn financial benefits and they can work in interdisciplinary areas.

SDG 12: Responsible consumption and production.

Statement: Application of knowledge obtained from this course will lead to reasonable consumption and production.

		L	T	P	C
EEF 6102	**ADVANCED POWER SYSTEM ANALYSIS**	**L**	**T**	**P**	**C**
SDG: 8,12		**3**	**0**	**2**	**4**

COURSE OBJECTIVES:

COB1: To introduce efficient numerical techniques applied to sparse matrix for planning and operation of power system.

COB2: To gain in-depth knowledge in power flow analysis for single and multi-area system.

COB3: To assess optimal power flow solutions and evaluate security in power systems.

COB4: To analyze the faults in the power system networks and to design the circuit breaker and protection system.

COB5: To study the ttransient stability of power system.

MODULE I SPARSE MATRICES IN POWER SYSTEMS P:6 L:9

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.

Practical Exercise: Developing a program for storing matrices using sparse matrix techniques and for implementing optimal ordering schemes.

MODULE II POWER FLOW ANALYSIS P:6 L:9

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; DC Power Flow; Net Interchange power control in Multi-area power flow analysis.

Practical Exercises: Development of load flow analysis program by Newton-Raphson and FDPF methods including adjustment of PV buses.

MODULE III OPTIMAL POWER FLOW P:6 L:9

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 for generator and line outages using linear sensitivity factors - Security constrained Optimal Power Flow; Interior point algorithm; Bus Incremental costs. DC Optimal Power Flow (DCOPF).

Practical Exercise: Development of DC optimal power flow program.

MODULE IV SHORT CIRCUIT ANALYSIS P:6
L:9

Fault Studies -Bus impedance matrix (ZBUS) construction using Building Algorithm for lines with mutual coupling; - Simple numerical problems. - Fault analysis using ZBUS and sequence components - Derivation of equations for bus voltages, fault current and line currents, both in sequence and phase domain using Thevenin's equivalent and ZBUS matrix for different faults.

Practical Exercise: Development of a program for Z bus building.

MODULE V TRANSIENT STABILITY ANALYSIS P:6
L:9

Power angle curve – Review of numerical integration methods: Euler and Fourth Order RungeKutta methods, Numerical stability and implicit methods, Equal area criterion to test the transient stability of simple power systems – Calculation of critical clearing angle and clearing time – Further applications of the equal area criterion and its limitations.

Practical Exercise: Transient stability analysis of multi-machine power system using appropriate software.

L- 45 ; T – 0; P - 30; TOTAL HOURS: 75

TEXT BOOKS:

1. W Stagg, A.H El. Abiad, “Computer Methods in Power System Analysis”, McGraw Hill, 1968.
2. Grainger, J.J. and Stevenson, W.D. ‘Power System Analysis’ Tata McGraw hill, New Delhi, 2003.
3. HadiSaadat, ‘Power System Analysis’, Tata McGraw hill, New Delhi, 2002.

4. Arrillaga, J and Arnold, C.P., ‘Computer analysis of power systems’ John Wiley and Sons, New York, 1997.
5. Pai, M.A., ‘Computer Techniques in Power System Analysis’, Tata McGraw Hill, New Delhi, 2006.

REFERENCES:

1. P.Kundur, “Power System Stability and Control”, McGraw Hill, 1994.
2. A.J.Wood and B.F.Wollenberg, “Power Generation Operation and Control”, John Wiley and sons, New York, 1996.
3. W.F.Tinney and W.S.Meyer, “Solution of Large Sparse System by Ordered Triangular Factorization”, IEEE Trans. on Automatic Control, Vol:18, pp:333-346, Aug 1973.
4. K.Zollenkopf, “Bi-Factorization: Basic Computational Algorithm and Programming Techniques; pp: 75-96; Book on “Large Sparse Set of Linear Systems” Editor: J.K.Rerd, Academic Press, 1971.
5. Mariesa L. Crow, “Computational Methods for Electric Power Systems’, Second Edition CRC Press, 2009.
6. L.P. Singh, “Advanced Power System: Analysis and Dynamics”, Sixth Revised Edition, New Age International Pvt. Ltd., 2014.

COURSE OUTCOMES: At the end of the course, the students will be able to:

CO1: apply relevant solution techniques for sparse matrices in power system analysis.

CO2: perform load flow study and interpret the result effectively for power system operational problems.

CO3: simulate optimal settings for power system operation by performing optimal power flow analysis.

CO4: perform short circuit analyze and interpret the result for designing the circuit breaker and protection system in long term planning problem.

CO5: assess the transient stability of power system.

Board of Studies (BoS):	**Academic Council:**
21st meeting of BoS of EEE held on 23.06.2025	24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	1	2	1	-	-	-	-	-	-	2	2	1
CO2	3	3	2	2	3	-	-	-	-	-	-	3	3	3
CO3	3	3	2	3	2	-	-	-	-	-	-	3	3	3
CO4	3	3	2	3	2	-	-	-	-	-	-	3	3	2
CO5	3	2	3	3	3	-	-	-	-	-	-	3	3	3

*** Legend: L – Low (1), M – Medium (2), H – High (3).**

SDG 8: Decent work and economic growth

Statement: The learners of this course can get decent work and earn financial benefits and they can work in interdisciplinary areas.

SDG 12: Responsible consumption and production.

Statement: Application of knowledge obtained from this course will lead to reasonable consumption and production.

EEF 6103	**ADVANCED POWER SYSTEM PROTECTION**	**L**	**T**	**P**	**C**
SDG: 3,7,9,11		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To understand generator protection by analyzing its electrical circuit, fault types, and implementing stator and rotor protection schemes.

COB2: Acquire a deep understanding of transformer failure mechanisms and the application of protection strategies.

COB3: Understand bus bar fault scenarios and protection techniques

COB4: To develop the ability to apply over current and distance protection techniques using various relays

COB5: To enable students to understand, analyze, and apply numerical relay concepts for implementing modern, efficient protection schemes in power systems.

MODULE I GENERATOR PROTECTION L:9

Introduction to Equipment Protection - Protection of Generators -Electrical circuit of the generator -Various faults and abnormal operating conditions - Stator Protection- Rotor Protection- Loss of Excitation Protection- Other Generator Protection Systems: Over speed Protection -Generator Motoring Protection - Vibration Protection- Bearing Failure Protection- Coolant Failure Protection- Fire Protection- Generator Voltage transformer Fuse Blowing- Numerical examples for typical generator protection schemes.

MODULE II TRANSFORMER PROTECTION L:9

Equivalent circuit of transformer - Types of faults in transformers Types of Faults Encountered in Transformers- Percentage Differential Protection- Overheating Protection- Protection against Magnetising Inrush Current- Buchholz Relay- Oil Pressure Relief Devices- Rate of Rise of Pressure Relay- Overfluxing Protection- Protection of Earthing Transformer- Protection of Three-Winding Transformer- Numerical examples for transformer protection schemes.

MODULE III BUSBAR PROTECTION L:9

Introduction – Busbar protection requirements- Differential protection of busbars - External and internal fault - Actual behaviors of a protective CT - Circuit model of a saturated CT - External fault with one CT saturated-need for high impedance Busbar protection–Bus Differential Protection with Linear Couplers -Bus protection by backup line relays -Supervisory relay - Protection of three Phase busbars - Numerical problems on bus bar protection scheme.

MODULE IV OVER CURRENT AND DISTANCE PROTECTION L:9

Time - Current characteristics - Current setting - Time setting - Over current protective schemes - Reverse power or directional relay - Combined Earth fault and phase fault protection scheme - Instantaneous Over current Relay- Definite Time Over current Relay- Inverse-time Over current Relay

Distance protection–Impedance relay – Reactance relay – Mho relay Static-Distance Relay Using an Amplitude Comparator and Phase Comparator-- Input quantities for various types of distance relays- Wire pilot protection- Circulating Current Scheme- Balanced Voltage (or Opposed Voltage) Scheme- Transley Scheme (AEI).

MODULE V NUMERICAL PROTECTION L:9

Introduction – Block diagram of numerical relay - Advantages and Disadvantages of Numerical Relays- Data Acquisition System (DAS)- - Numerical over Current protection – Numerical transformer differential protection Carrier Aided Distance Protection- Numerical distance protection of transmission line - Numerical Differential Protection.

L – 45; T – 0; P – 0; Total Hours:45

TEXT BOOKS:

1. Y.G. Paithankar and S.R Bhide, “Fundamentals of Power System Protection”, Prentice-Hall of India, 2010

2. Badri Ram and D.N. Vishwakarma, “Power System Protection and Switchgear”, Tata McGraw- Hill Publishing Company, Second edition,2011.

REFERENCES:

1. BhaveshBhalja, R. P. Maheswari and NileshGhothani, “Protection and Switchgear,” Oxford University press, 2011
2. J. Lewis Blackburn and Thomas J. Domin “Protection Relaying: Principles and Applications”, CRC press, 2014
3. Anderson, Paul M., Charles F. Henville, RasheekRifaat, Brian Johnson, and SakisMeliopoulos. Power system protection. John Wiley & Sons, 2021.
4. Ravindranath, B., and M. Chander. Power system protection and switchgear. New age international, 1977.
5. Bansal, Ramesh. Power system protection in smart grid environment. CRC Press, 2019.

COURSE OUTCOMES: At the end of the course, the students will be able to:

CO1: Identify stator/rotor faults, and compute relay settings for appropriate protection schemes.

CO2: Ability to model a transformer, identify its faults, and calculate relay settings for differential, inrush, Buchholz, and overfluxing protection.

CO3: Ability to analyze CT behaviour under faults, design appropriate busbar protection schemes

CO4: Able to select suitable overcurrent and distance relays and design protection schemes to safely handle faults in transmission lines.

CO5: Ability to identify the functions of numerical relay and develop basic digital protection schemes.

Board of Studies (BoS):	**Academic Council:**
21st meeting of BoS of EEE held on 23.06.2025	24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	-	-	2	-	-	-	-	-	-	3	2	L
CO2	3	3	-	-	2	-	-	-	-	-	-	3	2	L
CO3	3	3	2	2	3	-	-	-	-	-	-	3	2	-
CO4	3	3	3	3	3	1	-	-	-	-	-	3	2	-
CO5	3	2	-	-	3	-	-	2	-	-	-	2	3	2

*** Legend: L – Low (1), M – Medium (2), H – High (3).**

SDG 3: Good Health and Well-being

Statement: Reliable power system protection helps prevent electrical accidents, fires, and hazards, safeguarding human health and safety in communities.

SDG 7: Affordable and Clean Energy

Statement: Enhances the reliability and efficiency of power systems, promoting continuous access to clean and affordable electricity.

SDG 9: Industry, Innovation, and Infrastructure

Statement: Supports resilient and modern infrastructure through advanced protection technologies, fostering innovation and sustainable industrial development.

SDG 11: Sustainable Cities and Communities

Statement: Contributes to safer and more resilient urban infrastructure by protecting critical power assets and ensuring uninterrupted electricity supply.

EEF 6104	FLEXIBLE AC TRANSMISSION SYSTEM	L	T	P	C
SDG: 3, 8		3	0	0	3

COURSE OBJECTIVES:

COB1: To understand the need of reactive power compensation in transmission system.

COB2: To study the role of SVC in transmission system.

COB3: To understand the basic concepts of TCSC, GCSC and its applications.

COB4: To learn the characteristics, applications and modeling of series and shunt FACTS controllers

COB5: To analyze the interaction of different FACTS controller and study control coordination.

MODULE I INTRODUCTION L:9

Introduction to FACTS- Types of FACTS controllers- FACTS vs. HVDC- Benefits of FACTS- Performance Equations and Parameters of Transmission Lines- Transfer of Active and Reactive Power over a Transmission Line, Uncompensated Transmission lines- Need for Compensation- Functions of compensation – Mid point compensation

MODULE II STATIC VAR COMPENSATOR (SVC) L:9

Types of SVC - Voltage control by SVC - Modeling of SVC for load flow analysis and stability studies - Design of SVC to regulate the midpoint voltage of a SMIB system - Applications: transient stability enhancement and power oscillation damping of SMIB system with SVC connected at the mid-point of the line.

MODULE III THYRISTOR AND GTO THYRISTOR CONTROLLED SERIES CAPACITORS L:9

Principle of Controlled Series Compensation – Operation of TCSC and GCSC – Analysis of TCSC - Modeling of TCSC for Load Flow and Stability studies – Applications of TCSC – Applications of TCSC and GCSC.

MODULE IV VOLTAGE SOURCE CONVERTER BASED FACTS CONTROLLERS L:9

Static synchronous compensator(STATCOM)- Static synchronous series compensator(SSSC) - Operation of STATCOM and SSSC - Power flow control with STATCOM and SSSC- Modeling of STATCOM and SSSC for power flow and transient stability studies – operation of Unified and Interline power flow controllers (UPFC and IPFC)- Modeling of UPFC for load flow and transient stability studies - Applications.

MODULE V CONTROLLERS AND THEIR CO-ORDINATION L:9

FACTS Controller interactions – SVC–SVC interaction - co-ordination of multiple controllers using linear control techniques – Quantitative treatment of control coordination - control coordination using genetic algorithms.

L – 45; T – 0; P – 0; Total Hours:45

TEXT BOOKS:

1. R. Mohan Mathur, Rajiv K.Varma, “Thyristor - Based FACTS Controllers for Electrical Transmission Systems”, IEEE press and John Wiley & Sons, Inc., 2002.
2. Narain G. Hingorani, “Understanding FACTS -Concepts and Technology of Flexible AC Transmission Systems”, Standard Publishers Distributors, Delhi, 2001.

REFERENCES:

1. K. R. Padiyar, “FACTS Controllers in Power Transmission and Distribution”, New Age International (P) Limited, Publishers, New Delhi, 2021.
2. A. T. John, “Flexible A.C. Transmission Systems”, Institution of Electrical and Electronic Engineers (IEEE)”, Wiley IEEE Press,1999.
3. V. K. Sood, “HVDC and FACTS controllers - Applications of Static Converters in Power System”, Kluwer Academic Publishers, 2004.

COURSE OUTCOMES: At the end of the course, the student will be able to:

COB1: identify the need for compensation in transmission system and utility using conventional and FACTS devices.

COB2: apply SVC for voltage regulation and to implement SVC for transient stability enhancement and to damp power oscillations.

COB3: model and implement TCSC and GCSC for increasing the power transfer capability.

COB4: model and implement converter-based series and shunt FACTS controllers for the enhancement of power system performance.

COB5: analyze the interactions amongst various FACTS controllers.

Board of Studies (BoS):
21st meeting of BoS of EEE held on 23.06.2025

Academic Council:
24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	–	2	3	–	–	–	–	2	3	2	2
CO2	3	3	3	2	3	2	–	–	–	–	2	3	3	2
CO3	3	3	3	2	3	2	–	–	–	–	2	3	3	2
CO4	3	3	3	2	3	2	–	–	–	–	3	3	3	2
CO5	3	3	M	2	3	2	–	–	–	–	3	3	3	2

*

Legend: L – Low (1), M – Medium (2), H – High (3).

SDG 3: Good health and well-being.

Statement: Understanding of the fundamentals transmission system and FACTS devices can help in designing systems to promote good health and well-being.

SDG 8: Decent work and economic growth

Statement: The learners of this course can get decent work and earn financial benefits and they can work in electrical engineering filed

SEMESTER II

GEF 6201 SDG: 4, 8, 9	RESEARCH METHODOLOGY AND IPR FOR ENGINEERS	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES:

COB1: To apply a perspective on research

COB2: To select the appropriate statistical techniques for hypothesis construction and methods of data analysis and interpretation

COB3: To analyze the research design by using optimization techniques.

COB4: To describe the research findings as research reports, publications, copyrights Patenting and Intellectual Property Rights.

MODULE I RESEARCH PROBLEM FORMULATION AND RESEARCH DESIGN 8

Research - objectives – types - Research process, solving engineering problems -Identification of research topic - Formulation of the research problem, literature survey and review. Research design - meaning and need - basic concepts - Different research designs, Experimental design - principle, Design of experimental setup, Mathematical modeling - Simulation, validation, and experimentation.

MODULE II DATA COLLECTION, ANALYSIS AND INTERPRETATION OF DATA 8

Sources of Data, Use of the Internet in Research, Types of Data - Research Data Processing and analysis - Interpretation of results- Correlation with scientific facts - repeatability and reproducibility of results - Accuracy and precision –limitations, Application of Computer in Research- Importance of statistics in research - Sample design. Hypothesis testing, ANOVA, Design of experiments - Factorial designs - Orthogonal arrays.

MODULE III OPTIMIZATION TECHNIQUES **6**

Use of optimization techniques - Traditional methods – Evolutionary Optimization Techniques. Multivariate analysis Techniques, Classifications, Characteristics, Applications - correlation and regression, Curve fitting.

MODULE IV INTELLECTUAL PROPERTY RIGHTS **8**

The Research Report - Purpose of the written report - Synopsis writing - preparing papers for International Journals, Software for paper formatting like LaTeX/MS Office, Reference Management Software, Software for detection of Plagiarism – Thesis writing, - Organization of contents - style of writing- graphs, charts, and Presentation tool - Referencing, Oral presentation, and defense - Ethics in research - Patenting, Intellectual Property Rights - Patents, Industrial Designs, Copyrights, Trade Marks, Geographical Indications-Validity of IPR, Method of Patenting, procedures, Patent Search

L – 30; Total Hours: 30

TEXT BOOKS:

1. Ganesan R., “Research Methodology for Engineers”, MJP Publishers, Chennai, 2011.
2. George E. Dieter., “Engineering Design”, McGraw Hill – International edition, 2020.
3. Kothari C.R., “Research Methodology” – Methods and Techniques, New Age International (P) Ltd, New Delhi, 2020.
4. Kalyanmoy Deb., “Genetic Algorithms for optimization”, Kangal report, No.2001002.
5. Rajkumar S. Adukia, “Handbook on Intellectual Property Rights in India”, TMH Publishers, 2020.

REFERENCES:

1. Holeman, J.P., ”Experimental methods for Engineers, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 2017.

2.Govt. of India, ”Intellectual Property Laws; Acts, Rules & Regulations”, Universal Law Publishing Co. Pvt. Ltd., New Delhi 2020.

3. R Radha Krishnan & S Balasubramanian, “Intellectual Property Rights”. 1st Edition, Excel Books, 2012.

4.Derek Bosworth and Elizabeth Webster. “The Management of Intellectual Property”, Edward Elgar Publishing Ltd., 2013

COURSE OUTCOMES:

At the end of the course, the student should be able to:

COB1: Formulate the research problem

COB2: Design and Analyse the research methodology

COB3: Analyse and interpret the data to construct and optimize the research hypothesis

Board of Studies (BoS) :
20th BoS of Civil held on 08.07.2025

Academic Council:
24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4
CO1	3	**l**	**2**	**1**
CO2	2	3	**3**	**2**
CO3	3	2	2	3
CO4	**1**	3	2	**2**

Legend: L – Low (1), M – Medium (2), H – High (3).

SDG 4: Analysis and design of core field design promotes engineering skills and quality education.

Statement: This course enables the student to analyze the existing technology for further solution and its qualitative measures in terms of societal requirements.

SDG 8: Development of new technologies with core field design provides sustainable economic growth and productive employment.

Statement: To apply the hybrid techniques and concepts for different applications provides sustainable economic growth and productive employment.

SDG 9: Creative and curiosity of core field design fosters innovation and sustainable industrialization.

Statement: This course plays major roles through innovative ideas in industry towards modern infrastructures and sustainability.

EEF 6201	**ADVANCED POWER SYSTEM OPERATION AND CONTROL**	**L**	**T**	**P**	**C**
SDG: 8, 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To gain knowledge on the methods to estimate load forecasting.

COB 2: To learn unit commitment problem.

COB 3: To acquire knowledge on economic load dispatch.

COB 4: To understand the concepts of hydrothermal scheduling.

COB 5: To study the basics of AGC and the security of power systems.

MODULE I LOAD FORECASTING L:9

Introduction – Estimation of Average and trend terms – Estimation of periodic components – Estimation of Stochastic components: Time series approach – Auto-Regressive Model, Auto-Regressive Moving – Average Models – Kalman Filtering Approach – On-line techniques for non stationary load prediction.

MODULE II UNIT COMMITMENT L:10

Constraints in unit commitment – Spinning reserve – Thermal unit constraints – Other constraints – Solution using Priority List method, Forward Dynamic programming method - Lagrangian relaxation method.

MODULE III GENERATION SCHEDULING L:9

The Economic dispatch problem – Thermal system dispatching with network losses considered – The Lambda iteration method – Economic dispatch with Piecewise Linear cost functions – Transmission system effects – A two generator system – coordination equations – Incremental losses and penalty factors – Gradient method of economic dispatch -Base point and participation factors.

MODULE IV HYDROTHERMAL CO-ORDINATION L:10

Introduction- Hydro electric plant models-Scheduling Problems-Short term hydro thermal scheduling problem-Gradient approach-Hydro units in series (Hydraulically coupled)-Pumped storage hydro scheduling using lambda iteration method – Pumped storage hydro scheduling by a gradient method-Dynamic programming solution to hydro thermal scheduling problem.

MODULE V CONTROL OF POWER SYSTEMS L:7

Review of AGC and reactive power control -System operating states by security control functions – Monitoring, evaluation of system state by contingency analysis – Corrective controls (Preventive, emergency and restorative) - Energy control center – SCADA system – Functions – monitoring, Data acquisition and controls – Energy Management System.

L – 45; T – 0; P – 0; Total Hours:45

TEXTBOOK:

1. Allen J.Wood and Bruce.F.Wollenberg, "Power Generation Operation and Control', John Wiley & Sons, New York, 2014.

REFERENCES:

1. O.I.Elgerd, "Electric Energy System Theory - an Introduction", - Tata McGraw Hill, New Delhi, 2017.
2. P.Kundur; "Power System Stability and Control", EPRI Publications, California, 2006.
3. A.K. Mahalanabis, D.P.Kothari. andS.I.Ahson., "Computer Aided Power System Analysis and Control", Tata McGraw Hill publishing Ltd, 1988.

COURSE OUTCOME: At the end of the course, the student will be able to:

CO1: carry out load forecasting using different techniques.

CO2: perform real time unit commitment problem.

CO3: determine optimal generation scheduling with and without transmission loss.

CO4: carry out Hydro thermal co-ordination.

CO5: perform Automatic Generation Control and security of power systems.

Board of Studies (BoS):	**Academic Council:**
21st meeting of BoS of EEE held on 23.06.2025	24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	2	–	–	–	–	2	3	3	2
CO2	3	3	3	2	3	2	–	–	–	2	2	3	3	2
CO3	3	3	3	2	3	2	–	–	–	2	2	3	3	2
CO4	3	2	3	2	3	3	–	–	–	2	2	3	2	2
CO5	3	3	3	3	3	3	–	–	–	2	3	3	3	3

*** Legend: L – Low (1), M – Medium (2), H – High (3).**

SDG 8: Decent work and economic

Statement: The learners of this course can get decent work and earn financial benefits.

SDG 9: Industry, innovation and infrastructure

Statement: The knowledge on this course would result in new innovative systems for industry and establishing advanced infrastructure. Engineering stay in the area and support the economic growth and viability of local companies.

EEF 6202	**POWER SYSTEM DYNAMICS**	**L**	**T**	**P**	**C**
SDG: 7,9		**3**	**0**	**2**	**4**

COURSE OBJECTIVES:

COB1: To study the basic concepts of power system stability

COB2: To gain knowledge on dynamic modeling of a synchronous machine in detail

COB3: To learn and analyze the excitation and speed governing system under dynamic conditions.

COB4: To gain knowledge on fundamental concepts of small disturbance stability of dynamic systems.

COB5: To study and analyse the concepts of voltage stability.

MODULE I INTRODUCTION TO POWER SYSTEM STABILITY L:6

Power system stability: Basic Concepts and Definitions - Classification of Power system Stability – Rotor angle stability-Voltage stability and Voltage collapse - mid-term and long- term stability-stability phenomena - Historical review of stability problem - case studies.

MODULE II SYNCHRONOUS MACHINE MODELLING P:6 L:10

Schematic Diagram, Physical Description, Mathematical Description of a Synchronous Machine-Basic equations of a synchronous machine- stator circuit equations, dq0 Transformation, flux linkage and voltage equations for stator and rotor in dq0 coordinates- physical interpretation of dq0 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.

Practical Exercise: Development of program for steady-state analysis of a synchronous machine using appropriate software.

MODULE III MODELLING OF EXCITATION AND SPEED GOVERNING SYSTEMS P:12 L:10

Excitation System Requirements- Elements of an Excitation System-Types of Excitation System-Control and protective functions.

Turbine and Governing System Modeling- 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.

Practical Exercise: Simulation of response of different excitation and speed governing (thermal and hydro) for a step input using appropriate software.

MODULE IV SMALL-SIGNAL STABILITY ANALYSIS P:6 L:10

Rotor angle stability-State-space representation- 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- block diagram representation with K-constants- effect of field flux variation on system stability: analysis with numerical example - Enhancement Of Small Signal Stability and its countermeasures.

Practical Exercise: Development of small signal stability program for multi machine power system using appropriate software.

MODULE V VOLTAGE STABILITY ANALYSIS P:6 L:9

Voltage-reactive power characteristics of synchronous generators - Capability curves - Voltage dependence on loads - Load restoration dynamics-Integration of renewable energy sources and their impact on voltage stability-Voltage Stability Enhancement Methods: SVCs, STATCOMs, and capacitor banks-On-load tap changers (OLTC) and their role in voltage control.

Practical Exercise: Analyzing effect of various load models on voltage stability using appropriate software.

L – 45; T – 0; P – 30; Total Hours: 75

TEXT BOOKS:

1. P. Kundur, “Power System Stability and Control”, McGraw-Hill, 2006.

REFERENCES:

1. P.M Anderson and A.A Fouad, “Power System Control and Stability”, Iowa State University Press, Ames, Iowa, 2003.
2. IEEE Committee Report, “Dynamic Models for Steam and Hydro Turbines in Power System Studies”, IEEE Trans., Vol.PAS-92, pp:1904-1915, November/ December, 1973. on Turbine- Governor Model.
3. R. Ramanujam, “Power system dynamics, Analysis and Simulation”, Prentice Hall India Learning Pvt. Ltd., New Delhi, 2009.

COURSE OUTCOMES: At the end of the course, the students will be able to:

CO1: to understand the basic concepts of power system stability.

CO2: model the synchronous machine for stability analysis.

CO3: analyse the small signal stability of power systems.

CO4: model excitation and speed governing system for stability analysis.

CO5: investigate voltage stability of power system.

Board of Studies (BoS):

21st meeting of BoS of EEE held on 23.06.2025

Academic Council:

24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	3	-	-	-	-	3	3	2	3
CO2	3	3	3	3	2	3	-	-	-	-	3	3	2	3
CO3	3	3	3	3	3	3	-	-	-	-	3	3	3	2
CO4	3	3	3	3	3	3	-	-	-	-	3	3	2	3
CO5	3	3	2	3	3	3	-	-	-	-	3	3	2	3

*** Legend: L – Low (1), M – Medium (2), H – High (3).**

SDG 7: Ensure access to affordable, reliable, sustainable, and modern energy for all.

Statement: Enhances grid stability and reliability, facilitating the integration of renewable energy sources.

SDG 9: Build resilient Infrastructure, to support economic development and human well-being with a focus on affordable and equitable access for all.

Statement: The detailed knowledge of stability limits and effects leads to secured operation for sustainable industrialization.

EEF 6203	**SMART GRID**	**L**	**T**	**P**	**C**
SDG: 4,7,11,13		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To understand the fundamental concepts of Smart Grid.

COB2: To study the various Smart Grid technologies.

COB3: To acquire knowledge ondifferent smart meters and advanced metering infrastructure.

COB4: To understand the power quality management issues in Smart Grid.

COB5: To study the importance of security algorithms in Smart Grid.

MODULE I SMART GRID FUNDAMENTALS L:9

Evolution of Electric Grid -Smart grid concepts - Need for Smart Grid - Architecture of smart grid system - Difference between conventional & Smart Grid - components and control elements - Standards for smart grid system – Recent development & International policies in Smart Grid - Distributed Generation Resources and Energy Storage, Plug-in-Hybrid Electric Vehicles (PHEV) – Microgrid - Smart Grid Initiative for Power Distribution Utility in India – Case Study.

MODULE II SMART GRID TECHNOLOGIES L:9

Smart grid components – Smart Integration of energy resources - Intelligent Electronic Devices (IED) - Smart substation- Substation Automation - Feeder Automation –Distribution Automation - Virtual power plants–Outage management– Pricing regulations - Wide area monitoring system - Plug in Hybrid Electric Vehicles (PHEV) – Grid to Vehicle and Vehicle to Grid charging concepts.

MODULE III SMART METERS AND ADVANCED METERING INFRASTRUCTURE L:9

Introduction to Smart Meters – Advanced Metering Infrastructure (AMI) – AMI protocols, standards and initiatives - AMI needs in the smart grid- Load Forecasting - Phasor Measurement Unit(PMU) – Applications of PMU in monitoring & protection - Demand side management and demand response programs, Demand pricing and Time of Use, Real Time Pricing, Peak Time Pricing.

MODULE IV POWER QUALITY MANAGEMENT IN SMART GRID L:9

Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit- Coordination between cloud computing and Smart power grids- Monitoring GIS and Google Mapping Tools, Multi agent Systems (MAS) Technology

MODULE V SECURITY AND DATA PRIVACY IN SMART GRID L:9

Security Challenges in Smart Grid Implementation - Smart Grid Security andPrivacy of Customer Side Networks - Types of physical attack on smart griddevices - Smart Grid Security Protection against False Data Injection (FDI) Attacks - End-to-End security with devices/equipment, sensors, controllers, actuators, communication and systems- Cyber security solutions for control and monitoring system- Standards with Cyber security Controls for Smart Grid - IEC 62443.

L – 45; T – 0; P – 0; Total Hours: 45

TEXT BOOKS:

1. J. A. Momoh, “Smart Grid: Fundamentals of Design and Analysis” WileyIndia, 1st Edition, 2015.

REFERENCES:

1. Al-Shaer, Ehab, Rahman and Mohammad Ashiqur, “Security and ResiliencyAnalytics for Smart Grids’, Springer Intr., 1st Edition, 2016.
2. Stuart Borlase, “Smart Grid: Infrastructure, Technology and Solutions”, CRC Press 2012.
3. Ali Keyhani:” Design of Smart Power Grid Renewable Energy System “,First Edition, John Wiley Inc., 2011
4. Mini S. Thomas, John D McDonald, “Power System SCADA and Smart Grids”, CRC Press,2015
5. Kenneth C. Budka, Jayant G. Deshpande, Marina Thottan, “Communication Networks for SmartGrids”, Springer, 2014.

COURSE OUTCOMES: At the end of the course, the student will be able to:

CO1: apply the concepts of Smart Grid and its recent developments.

CO2: analyze different Smart Grid technologies.

CO3: use different smart meters and advanced metering infrastructure.

CO4: implement the concept of power quality management in Smart Grid.

CO5: develop cyber secure algorithm for secure communication between meters and control centre.

Board of Studies (BoS):

21st meeting of BoS of EEE held on 23.06.2025

Academic Council:

24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	-	-	-	-	-	1	2	2	3
CO2	3	2	2	-	-	-	-	-	-	-	1	2	2	3
CO3	3	2	2	-	-	-	-	-	-	-	1	2	2	3
CO4	3	2	2	-	-	-	-	-	-	-	1	2	2	3
CO5	3	2	2	-	-	-	-	-	-	-	1	2	2	3

*** Legend: L – Low (1), M – Medium (2), H – High (3).**

SDG 4: Quality Education

This course contributes to high-quality engineering education, integrating theoretical knowledge with real-world applications of smart and sustainable energy systems.

SDG 7: Affordable and Clean Energy

By promoting energy sustainability and smart energy management, the course directly supports the achievement of universal access to clean, reliable, and modern energy.

SDG 11: Sustainable Cities and Communities

The course empowers students to design and manage energy systems that contribute to smart and sustainable cities.

SDG 13: Climate Action

Smart Grids reduce carbon footprints by facilitating the use of renewable energy and improving energy efficiency. Through load optimization and better demand-supply balancing, they help mitigate greenhouse gas emissions and enable climate-resilient energy systems.

ENF 6281	PROFESSIONAL COMMUNICATION	L	T	P	C
SDG: 4 & 8		0	0	2	1

COURSE OBJECTIVES:

COB1: To introduce the fundamentals of professional communication in workplace contexts.

COB2: To develop structured presentation and public speaking skills.

COB3: To develop students' proficiency in written correspondence, including emails, and reports.

COB4: To enhance awareness and use of body language in professional settings

COB5: To instil appropriate workplace etiquette and digital professionalism.

MODULE I COMMUNICATION AT THE WORKPLACE P: 6

Language and communication fundamentals, Types of workplace communication, Formal and informal Communication, Direction and flow of communication-Organizational communication and interpersonal dynamics, 7 Cs of Communication - Ethical use of AI assisted communication tools

MODULE II PRESENTATION & PUBLIC SPEAKING SKILLS P: 6

Importance of presentation skills, Managing public speaking anxiety, Structured planning and delivery of presentations, Use of visual aids and technology - Interactive tools

MODULE III CORRESPONDENCE AT WORK P: 9

Digital correspondence - Email Writing and Etiquette, Report Writing: Incident Reports, Feasibility Reports, and Executive Summaries

MODULE IV BODY LANGUAGE P: 5

Fundamentals of body language in professional communication, Types of non-verbal cues, posture -Interpreting and responding to non-verbal signals in interpersonal and group contexts, Cultural variations in body language and their implications in global communication

MODULE V WORKPLACE ETIQUETTE P: 4

Workplace etiquette, Cultural sensitivity in globalized work environments, Gender sensitivity and inclusivity, DEI, Netiquette and digital professionalism - video conferencing, Professional networking (Social media, LinkedIn, etc.), Virtual team dynamics

P – 30; Total Hours:30

TEXT BOOKS:

1. Course material by the Department of English

REFERENCES:

1. Bovee, C. L., & Thill, J. V. *Business Communication Today* (14th ed.). Pearson, 2021.
2. Cardon, P. W., & Marshall, B. The hype and reality of social media use for work collaboration and team communication. *International Journal of Business Communication*, 52(3), 2015, 273–293.
3. Guffey, M. E., & Loewy, D. *Essentials of Business Communication* (11th ed.). Cengage Learning, 2020.
4. Jones, D. A., & Pittman, M. The digital professionalism paradox: Workplace norms and expectations in the era of online communication. *Journal of Applied Communication Research*, 49(3), 2021, 283–301.
5. Keyton, J., & Smith, F. L. M. Communication practices of work teams: Task, social, and identity functions. *Journal of Business Communication*, 46(4), 2009, 402–426.
6. Krizan, A. C., Merrier, P., Logan, J., & Williams, K. *Business Communication* (9th ed.). Cengage Learning, 2016.
7. Lesikar, R. V., Flatley, M. E., Rentz, K., & Lentz, P. *Lesikar's Business Communication: Connecting in a Digital World* (13th ed.). McGraw-Hill Education, 2019.
8. Madlock, P. E. The link between leadership style, communicator competence, and employee satisfaction. *Journal of Business Communication*, 45(1), 2008, 61–78.
9. Raman, M., & Sharma, S. Technical communication: Principles and practice (3rd ed.). Oxford University Press, 2015.
10. Robles, M. M. Executive perceptions of the top 10 soft skills needed in today's workplace. *Business Communication Quarterly*, 75(4), 2012, 453–465. https://doi.org/10.1177/1080569912460400

COURSE OUTCOMES:

On completion of the course, students will be able to

CO1: Demonstrate clarity in professional communication by selecting appropriate modes and formats for workplace interactions.

CO2: Deliver structured presentations with confidence, using relevant verbal and visual communication techniques.

CO3: Produce clear and effective written correspondence, including emails, and formal reports.

CO4: Interpret and apply non-verbal communication cues appropriately in professional contexts.

CO5: Exhibit workplace etiquette, digital conduct, and cultural sensitivity in professional environments.

Board of Studies (BoS):

18th BoS of the Department of English held on 04.06.2025

Academic Council:

24th AC held on 26.08.2025

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1														
CO2														
CO3														
CO4														
CO5														

*** Legend: L – Low (1), M – Medium (2), H – High (3).**

SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

Statement: This course ensures that the students acquire quality education and are also made eligible to obtain productive and decent employment.

SDG 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

Statement: This course equips students with the competencies required for employment in a dynamic global workforce.

EEF 6204	**MINI PROJECT**	**L**	**T**	**P**	**C**
SDG: 4,8,9,12		**0**	**0**	**6**	**3**

COURSE OBJECTIVES:

COB1: To enhance students' ability to identify, analyze, and solve complex engineering problems in their specialization.

COB2: To provide practical experience in designing and developing solutions through a systematic project-based approach.

COB3: To improve technical writing, documentation, and presentation skills.

COB4: To promote, time management, and independent learning.

COURSE DESCRIPTION

Mini 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 mini 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 mini project work shall be jointly supervised by a faculty of the Department and the faculty of the other department of the University or an Engineer / Scientist from the organization. The student shall meet the faculty periodically and attend the periodic reviews for evaluating the progress.

There will be three reviews for continuous 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:

At the end of the mini project, the student will be able to

CO1: formulate and define a relevant technical problem based on literature or industrial need.

CO2: apply appropriate tools, techniques, and knowledge to design or simulate a viable solution.

CO3: analyze results and validate the developed solution or model using theoretical and/or empirical methods.

CO4: demonstrate effective communication, documentation, and presentation of technical work.

CO5: exhibit project planning, and adherence to ethical and professional responsibilities.

Board of Studies (BoS):
21st meeting of BoS of EEE held on 23.06.2025

Academic Council:
24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	1	-	-	-	1	2	3	3	3
CO2	2	3	3	3	3	1	-	-	-	1	2	3	3	3
CO3	2	3	3	3	3	1	-	-	-	M	2	3	3	3
CO4	1	1	1	1	1	1	-	-	3	L	2	3	3	3
CO5	1	1	1	1	1	2	3	2	-	2	2	3	3	3

*** Legend: L – Low (1), M – Medium (2), H – High (3).**

SDG 4: Quality Education

Statement: It promotes advanced engineering learning through problem formulation, design, analysis, documentation, and presentation, thereby strengthening quality education in technical fields.

SDG 8: Decent Work & Economic Growth

Statement: Emphasizes innovation, technical skills, and professional conduct, supporting the development of a skilled workforce for sustainable economic growth.

SDG 9: Industry, Innovation & Infrastructure

Statement: Encourages the creation and validation of engineering solutions contributing to technological advancement and resilient industrial infrastructure.

SDG 12 Responsible Consumption & Production

Statement: Integrates sustainable engineering practices, ensuring efficient resource utilization and adherence to ethical and responsible design and development processes.

SEMESTER III

		L	T	P	C
EEF 7101	**RENEWABLE ENERGY SYSTEMS**	**L**	**T**	**P**	**C**
SDG: 7		**3**	**0**	**2**	**4**

COURSE OBJECTIVES:

COB1: To study the fundamental principles and applications of various renewable energy sources, including solar, biomass, and wind energy.

COB2: To explore the technical aspects of solar energy conversion, including both non-concentrating and concentrating collector systems.

COB3: To examine the processes and technologies involved in biomass conversion for energy production.

COB4: To understand the principles of wind turbine operation and power generation.

COB5: To study the role of energy storage in optimizing renewable energy systems.

MODULE I BASICS OF SOLAR ENERGY L:9

Basic concepts of Energy - Types of Energy-Renewable and Non renewable Energies- Energy alternatives and current energy scenario – Sun – Earth Relationship- Formation of the Atmosphere- Solar Radiation at Earth's surface – Air Mass- Instruments for the measurement of Solar radiation and Sunshine.

MODULE II SOLAR AND GEOTHERMAL COLLECTORS L:9

Solar thermal collectors- Flat plate collectors - theory of flat plate collectors- Thermal Analysis- Absorber coatings- Solar Air heaters and Evacuated tube collectors- Solar cooker - Solar stills- Solar cooling and Refrigeration- Concentrating collectors-Thermal and Performance Analysis – Geothermal collectors.

MODULE III STORAGE SYSTEMS L:9

Thermal Energy storage- Thermo chemical storage- Mechanical storage – Solar pond- types of solar ponds- Advantages- Applications.

MODULE IV WIND ENERGY CONVERSION SYSTEMS L:9

History and Basics of wind energy – Important terms - Turbine types – Betz limit – characteristics and power generation from wind energy – Generators and Power electronics for wind systems.

MODULE V BIOMASS L:9

Types and characterization – classification of energy sources – analysis of composition – characteristics and properties of bio mass- structural components of biomass- Biomass residues and energy conversion process- classification of bio gas plants.

L – 45; T – 0; P – 30; Total Hours: 75

List of Experiments

1. Modeling and Simulation of Solar Photovoltaic (PV) System under Variable Irradiance and Temperature Conditions.
2. Simulation of Wind Energy Conversion System (WECS) with MPPT Control.
3. Design and Simulation of Hybrid Renewable Energy System (PV-Wind-Battery).
4. Simulation of Grid-Connected PV System with Inverter Control.
5. Simulation of Standalone PV System with various DC-DC Converter (Buck / Boost / Buck-Boost) and Load.
6. Simulation of Biomass Power Generation with Gasification Model.
7. Simulation of Fuel Cell Stack with Load Variation.
8. Implementation of MPPT Algorithm using embedded controller for PV Systems.
9. Experimental Study of a Small-Scale Wind Energy Conversion System.
10. Performance Analysis of a Solar Box-Type Cooker.
11. Experimental Study of Battery Charging and Discharging Characteristics.
12. Basic Fuel Cell Performance Evaluation.

TEXT BOOKS:

1. S.P. Sukhatme, Energy- Principles of thermal collection and storage, Tata McGraw-Hill, New Delhi, 2006.
2. S. N. Bhadra, D. Kastha, S. Banerjee, Wind Electrical Systems ‖, Oxford University Press, 2005.

3. Khan B. H., Non-Conventional Energy Resources, 2nd Edition, Tata McGraw-Hill Education Pvt. Ltd. 2009.

COURSE OUTCOMES: At the end of the course, the student is expected to

CO1: demonstrate a comprehensive understanding of the fundamental principles behind solar, biomass, and wind energy.

CO2: apply scientific knowledge to analyze the performance and design considerations of non-concentrating and concentrating solar collectors.

CO3: design and implement energy storage solutions to optimize the performance.

CO4: analyze factors affecting wind energy generation.

CO5: evaluate the various biomass conversion processes and their suitability for sustainable energy production.

Board of Studies (BoS):

21st meeting of BoS of EEE held on 23.06.2025

Academic Council:

24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	2	-	-	-	-	-	-	-	1	2	2	2
CO2	3	3	3	-	-	-	-	-	-	-	2	3	3	3
CO3	3	3	3	2	-	-	-	-	-	-	2	3	3	3
CO4	3	3	3	1	-	-	-	-	-	-	2	3	3	3
CO5	2	2	3	1	-	-	-	-	-	-	L	2	2	2

*** Legend: L – Low (1), M – Medium (2), H – High (3).**

SDG 7: Affordable and Clean Energy.

Ensure access to affordable, reliable, sustainable and modern energy for all.

Statement: Understanding the technical details of these renewable energy sources empowers students to contribute to their development, implementation, and optimization. This aligns with the overall goal of SDG 7 to promote the use of clean energy technologies. The course includes a section on energy storage, a crucial element in integrating renewable energy sources with the existing grid infrastructure. This aligns with SDG 7's emphasis on reliable and modern energy services.

EEF 7102	INDUSTRY INTERNSHIP	L	T	P	C
SDG: 3,4,8,9		0	0	2	2

COURSE OBJECTIVE:

COB1: To expose the students to an industrial environment and make them industry ready.

COURSE DESCRIPTION:

1. To earn credits for this course, industrial training for a period of 15 days, in a single slot, is mandatory. The course has to be undertaken during the first year summer vacation and the credits will be awarded in the third semester.
2. If the student is not able to complete the internship during the first year summer vacation, he/she can complete the course in a single slot between 2th and 4th semester vacation.
3. For effective implementation of the course Industry Internship, a teaching faculty is appointed as the coordinator by the Head of the department.
4. The students will be allowed to undergo training only in reputed companies/research labs/design centres. The co-ordinator identifies the companies related to core engineering for internship during second semester. He/she assists the students in every process of getting into the companies as an intern.
5. To enable the students to focus on the internship, no two students are allowed to be in the same site.
6. Interacting with the respective industries, where the students do their internship, the Coordinator continuously monitors the performance of the students during the internship.
7. After completion of the internship, the students are required to submit a detailed report and present what they had learned through the internship, in the

form of posters. The students should submit the industry certificate at the time of giving the presentation.

8. The performance of the student will be evaluated by the industry as well as the University. Both the evaluations will be considered and aggregated to award the final grade. 50% weightage is given to the evaluation by the industry and remaining 50% weightage to the evaluation by the committee appointed by the Head of the Department.

9. The 50 % weightage of evaluation done at the department comprises of (a) 20/50 for viva-voce, (b) 20/50 for the Intern report and (c) 10/50 for poster presentation.

COURSE OUTCOMES: At the end of the internship, the student will be able to:

CO1: Solve problems typically encountered by engineers in industry.

CO2: Identify and address social, economic, and safety issues in an engineering problem and develop a solution that addresses this.

CO3: Learn new concepts and apply them to the solution of engineering problems.

CO4: Function effectively on a multidisciplinary team and interface effectively with other areas of the organization.

CO5: Clearly communicate their ideas orally and in writing.

CO6: Prepare for a lifelong productive career as an engineer.

Board of Studies (BoS):
21st meeting of BoS of EEE held on 23.06.2025

Academic Council:
24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	2	2	3	2	2	2	2	-	3	2	2	2
CO2	2	2	2	2	2	2	2	2	2	-	2	2	2	2
CO3	2	2	2	2	2	2	2	2	2	-	2	2	2	2
CO4	2	2	2	2	2	2	2	2	2	-	3	2	3	3
CO5	2	2	2	2	3	3	3	3	3	-	3	2	3	3

*** Legend: L – Low (1), M – Medium (2), H – High (3).**

SDG 3: Good Health & Well-Being.

Statement: learn workplace safety practices and risk mitigation, contributing to improved health and well-being in industrial environments.

SDG 4: Quality Education

Statement: Internship provides experiential learning, skill enhancement, and professional communication development, ensuring high-quality engineering education.

SDG 8: Decent Work & Economic Growth

Statement: By developing problem-solving and employability skills, students become industry-ready and capable of contributing to sustainable economic growth.

SDG 9: Industry, Innovation & Infrastructure

Statement: engage with industry technologies and innovative practices, enabling them to contribute to sustainable industrial development and resilient infrastructure.

EEF 7103	**Project Work– Phase I**	**L**	**T**	**P**	**C**
	(III Sem)	**0**	**0**	**14**	**7***
EEF 7103	**Project Work– Phase II**	**L**	**T**	**P**	**C**
SDG: 4,7,9,11,13	**(IV Sem)**	**0**	**0**	**35**	**18**

COURSE OBJECTIVES:

COB1: To enable students to undertake independent research or development work relevant to their specialization.

COB2: To apply advanced knowledge, techniques, and tools in solving real-world or research problems.

COB3: To enhance project planning, execution, and management skills.

COB4: To develop skills in technical documentation and effective communication.

COB5: To cultivate innovation, ethical practice, and lifelong learning in professional work.

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 the faculty of the other department of the University or an Engineer / Scientist from the organization. The student shall meet the faculty periodically and attend the periodic reviews for evaluating the progress.

There will be three reviews for continuous 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. The research findings have to be published in conference/Journal.

COURSE OUTCOMES:

At the end of the project work, the student will be able to:

CO1:Identify and define a research or application-oriented problem relevant to Power System Engineering, and apply appropriate methodologies, tools, and technologies to analyze and solve it.

CO2:Design, implement, and evaluate power system models, components, or solutions that meet specified performance and functional objectives.

CO3:Exhibit critical thinking, creativity, and independence in addressing complex engineering challenges.

CO14:Prepare comprehensive technical documentation and effectively communicate the project outcomes through written reports, presentations, and academic publications.

CO5:Demonstrate ethical conduct, project management skills, and contribute to professional knowledge by presenting findings at conferences or publishing in journals.

Board of Studies (BoS):

21st meeting of BoS of EEE held on 23.06.2025

Academic Council:

24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	1	-	-	-	1	2	3	3	3
CO2	2	3	3	3	3	1	-	-	-	1	2	3	3	3
CO3	2	3	3	3	3	1	-	-	-	2	2	3	3	3
CO4	1	1	1	1	1	1	-	-	3	1	2	3	3	3
CO5	1	1	1	1	1	2	3	2		2	2	3	3	3

*** Legend: L – Low (1), M – Medium (2), H – High (3).**

SDG 4: Quality Education

Statement: Promotes advanced engineering learning through research, innovation, and dissemination of technical knowledge via documentation and publications.

SDG 7: Affordable & Clean Energy

Statement: Facilitates development of clean, efficient, and reliable power system solutions, supporting sustainable energy access.

SDG 9: Industry, Innovation & Infrastructure

Statement: Strengthens innovation and technological development in power systems to support modern and resilient infrastructure.

SDG 11 Sustainable Cities & Communities

Statement: Encourages design of smart, safe, and sustainable power infrastructure that supports urban development.

SDG 13 Climate Action

Statement: Enables research on low-carbon energy systems, renewable energy integration, and climate-resilient power networks.

PROFESSIONAL ELECTIVE COURSES

EEFY 001	RESTRUCTURED POWER SYSTEMS	L	T	P	C
SDG: 8, 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To gain knowledge on restructuring of power system.

COB2: To study the new trends in operation and control in deregulated power systems.

COB3: To understand the functioning of different electric utility markets in united states.

COB4: To study the OASIS and ATC in deregulated power system.

COB5: To explore the electricity trading in restructured environment.

MODULE I OVERVIEW OF POWER SYSTEM RESTRUCTURING L:9

Restructuring Models: PoolCo Model, Bilateral Contracts Model, Hybrid Model - Independent System Operator (ISO): The Role of ISO - Power Exchange(PX): Market Clearing Price (MCP) - Market operations: Day-ahead and Hour-Ahead Markets, Elastic and Inelastic Markets - Market Power - Stranded costs – Impact of losses- scheduling of operating reserves.

MODULE II KEY ISSUES IN RESTRUCTURING L:9

Transmission Pricing: Contract Path Method, The MW-Mile Method - Congestion Pricing: Congestion Pricing Methods, Transmission Rights - Management of Inter-Zonal/Intra Zonal Congestion: Solution procedure, Formulation of Inter-Zonal Congestion Sub problem, Formulation of Intra- Zonal Congestion Sub problem.

MODULE III ELECTRIC UTILITY MARKETS IN THE UNITED STATES L:8

California Markets: ISO, Generation, Power Exchange, Scheduling Coordinator, UDCs, Retailers and Customers, Day-ahead and Hour-Ahead Markets, Block forwards Market, Transmission Congestion Contracts(TCCs) - New York Market: Market operations - PJM interconnection - Ercot ISO - New England ISO.

MODULE IV OPEN ACCESS SAMETIME INFORMATION SYSTEM & AVAILABLE TRANSFER CAPABILITY (ATC) L:12

FERC order 889 - Structure of OASIS: Functionality and Architecture of OASIS - Definition of Available Transfer Capability (ATC)- Calculation of ATC using network response method -Formulation of D.C. Optimal Power Flow (DCOPF) model for assessment of Available Transfer Capability (ATC), assessment of Simultaneous ATC (SATC) and Congestion Management -Numerical examples for the above problems.

MODULE V ELECTRIC ENERGY TRADING L:7

Essence of Electric Energy Trading - Energy Trading Framework: The Qualifying factors - Derivative Instruments of Energy Trading: Forward Contracts, Futures Contracts, Options, Swaps, Application of Derivatives in Electric Energy Trading –Brokers in electricity trading – Green power trading.

L – 45; T – 0; P – 0; Total Hours: 45

TEXTBOOK:

1. Mohammad Shahidehpour and MuwaffaqvAlmoush, “Restructured Electrical Power systems: Operation, Trading and Volatility”, Marcel Dekkar, Inc., 2001.

REFERENCES:

1. G.Zaccour, “Deregulation of Electric Utilities”, Kluwer Academic Publishers, 1998.
2. M.Ilic, F. Galiana and L.Fink, "Power Systems Restructuring: Engineering and Economics", Kluwer Academic Publishers, 2000.
3. Editor: Loi Lei Lai, "Power System Restructuring and Deregulation: Trading, Performance and Information Technology", John Wiley and sons Ltd, 2001.
4. K.Bhattacharya, M.H.J.Bollen and J.E.Daader, "Operation of Restructured Power Systems", Kluwer Academic Publishers, 2001.
5. J.H.Chow,F.F.Wu and J.A.Momoh, "Applied Mathematics for restructured electric power systems: Optimization, Control and Computation Intelligence", Springer 2004.
6. F.C.Schweppe, M.C.Caramanis, R.D.Tabors and R.E.Bohn, "Spot Pricing of Electricity", Kluwer Academic Publishers, 2002.
7. Rajesh Joseph Abraham, Automatic Generation Control : Traditional and Deregulated Environments”, LAP Lambert Academic Publishing, September 2010.

COURSE OUTCOMES: At the end of the course, the student will be able to:

CO1: explain the process of restructuring and perform the market clearing and settlement.

CO2: compute transmission pricing and perform inter zonal and intra zonal congestion management.

CO3: explain the operation of different electricity markets in United States.

CO4: interpret the real time information available in an OASIS and compute the ATC and perform congestion management in restructured power systems.

CO5: carry out competitive energy trading in restructured power systems.

Board of Studies (BoS):

21st meeting of BoS of EEE held on 23.06.2025

Academic Council:

24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	-	-	-	-	3	2	3	3	3
CO2	3	3	3	3	3	-	-	-	-	3	2	3	3	3
CO3	3	3	3	2	3	-	-	-	-	3	2	1	1	1
CO4	3	3	3	3	3	-	-	-	-	3	2	3	3	3
CO5	3	2	3	2	3	3	-	-	-	3	2	3	3	3

*** Legend: L – Low (1), M – Medium (2), H – High (3).**

SDG 8: Decent work and economic growth.

Statement: The learners of this course can get decent work and earn financial benefits.

SDG 9: Industry, innovation and infrastructure.

Statement: The knowledge on this course would result in new innovative systems for industry and establishing advanced infrastructure.

EEFY 002	EHV POWER TRANSMISSION	L	T	P	C
SDG: 8,9,12		3	0	0	3

COURSE OBJECTIVES:

COB1: To understand the need for long EHV & UHV transmission lines.

COB2: To study the calculation procedures to obtain line parameters, conductor voltage gradients and electric field produced in the vicinity of the line.

COB3: To study about the audible noise and radio interference caused by corona and methods to regulate them.

COB4: To acquire knowledge on corona and its impact.

COB5: To gain knowledge on electric field produced by EHV lines.

MODULE I INTRODUCTION L:9

Indian Power Scenario - Power Scenario in Tamil Nadu - Conventional and non-conventional methods of power generation details in India - Choice of economic voltage - standard transmission voltages - Necessity of EHV AC transmission - Advantages-problems with long EHVAC lines - need for compensation - FACTS devices - HVDC transmission-Clearances (Insulation Distance) for AC and HVDC.-Over voltage in EHV system due to switching operations-Transmission Planning and its co-relation with Generation Planning.

MODULE II LINE PARAMETERS L:9

Types of Line supports, Line Insulators and Overhead/ Underground Conductors (ACSR/ Insulated Power Cables) with their function- bundled conductors - various line configurations of EHVAC lines – High Temperature Low Sag (HTLS) Conductor in transmission lines- line resistance - Temperature rise of line conductors and current carrying capacity of lines- Maxwell’s potential coefficient matrix - Inductance and capacitance matrices of multi conductor untransposed / transposed lines - sequence inductances and capacitances - line parameters for modes of propagation in case of travelling wave propagation.

MODULE III LINE LOADINGS AND VOLTAGE GRADIENT OF CONDUCTORS L:9

Surge impedance loading - Power handling capacity of long lines - EHVAC and HVDC alternatives - Line loss - mechanical vibrations / oscillations of line conductors and their reduction – Charge - potential relations for multi conductor lines - surface voltage gradients of bundled conductors - gradients factors and their use - distribution of voltage gradient on sub conductors of bundle - voltage gradients on conductors in the presence of ground wires on towers - Design of cylindrical cages.

MODULE IV EFFECTS OF CORONA L:9

Corona Power loss and its comparison with leakage loss and I^2R Loss -charge voltage diagram- Audible noise generation and its characteristics - Limits for audible noise -Day-Night equivalent noise level - Radio Interference (RI) due to corona pulse generation and its properties - Limits for RI fields-Corona Phenomenon with HVDC-CIGRE formula.

MODULE V EFFECT OF ELECTRIC FIELD FROM EHV LINES L:9

Effects of EHV lines on heavy vehicles - Calculation of electric field of EHVAC lines - Effect of high fields on humans, animals and plants - Measurement of electric fields - Induced voltages in unenergized circuit of a double circuit line - induced voltages in insulated ground wires - electromagnetic interference-IEEE Standards-Design of EHV lines.

L – 45; T – 0; P – 0; Total Hours:45

TEXT BOOKS:

1. Rakosh Das Begamudre, “Extra High Voltage AC Transmission engineering”, New Academic Science Limited, 2013.
2. S Kamakshaiah& V Kamaraju, “HVDC Transmission”, Tata McgrawHilll Publishers, 2011.

REFERENCES:

1. C.L. Wadhwa,“ Electrical Power Systems”, New Academic Science, 2017.
2. K.R. Padiyar, “ HVDC Power Transmission Systems”, New Age International Publishers, 2015.
3. Sunil S.Rao, “EHV-AC, HVDC Transmission & Distribution”,Khanna Publishers, 2009.

4. Sanjay Kumar Sharma, "EHV-AC HVDC Transmission and Distribution Engineering", Publishers S.K. Kataria & Sons, 2013.

COURSE OUTCOMES: At the end of the course, the student will be able to:

CO1: analyze power scenario of India and major countries of the world, history of growth of electrical industry and its latest development.

CO2: obtain line parameters for analysis with symmetrical and unsymmetrical power frequency operation and modes of operation with travelling wave propagation.

CO3: work out voltage gradients on EHVAC and HVDC lines with bundled conductors analytically and by using pre-calculated charts.

CO4: identify the occurrence of corona and regulate its effects in the form of audible and radio noises.

CO5: analyze electrostatic field effects associated with EHV lines and design appropriate EHV AC transmission systems.

Board of Studies (BoS):
21st meeting of BoS of EEE held on 23.06.2025

Academic Council:
24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	1	1	1	-	-	-	-	-	-	-	1	1	
CO2	2	3	1	2	-	-	-	-	-	-	-	2	2	2
CO3	2	3	2	2	-	-	-	-	-	-	-	2	2	2
CO4	3	3	3	3	-	-	-	-	-	-	-	3	2	1
CO5	3	3	3	3	-	-	-	-	-	-	-	3	2	1

*** Legend: L – Low (1), M – Medium (2), H – High (3).**

SDG 8: Decent work and economic growth

Statement: The learners of this course can get decent work and earn financial benefits and they can work in interdisciplinary areas.

Statement:

This course equips learners with specialized skills in Extra High Voltage (EHV) Power Transmission, enabling them to access opens pathways for employment across engineering, safety, environmental, and policy domains, contributing to sustainable economic growth.

SDG 9: Industry, innovation, and infrastructure

Statement: The knowledge on this course would result in new innovative systems for industry and establishing advanced infrastructure.

Statement:

The EHV transmission advancements strengthen industrial capabilities and support the creation of resilient and modern energy infrastructure, essential for sustainable industrialization and societal progress.

SDG 12: Responsible consumption and production.

Statement: Application of knowledge obtained from this course will lead to reasonable consumption and production.

Statement:

The application of EHV power transmission principles promotes energy efficiency, minimizes transmission losses, and supports optimal resource use.

EEFY 003	POWER QUALITY	L	T	P	C
SDG: 3 ,8		3	0	0	3

COURSE OBJECTIVES:

COB1: To study the various terms associated with Power Quality problems.

COB2: To study the Harmonic sources and its evaluation.

COB3: To acquire knowledge on the Harmonic distortions and its control.

COB4: To acquaint with power quality issues in distributed generation.

COB5: To study about Power Quality monitoring and measurements.

MODULE I INTRODUCTION L:9

Power Quality – Significance of power quality, Terms and Definitions (IEC Standards) – Transients, Voltage Imbalance, Waveform distortion, Power frequency variations, DC offset, Electric Noise, Voltage Fluctuation and Flicker- Impact on Sensitive Loads (Data Centers, Medical Equipment, etc.)- PQ Challenges in Distributed Energy Resources (DERs) Integration- Impact of EV Charging Infrastructure-Sources of Sags and Interruptions - Estimating Voltage Sag Performance - Solutions at the End-User Level.

MODULE II DISCRETE FREQUENCY DOMAIN ANALYSIS L:9

Harmonics versus Transients - Harmonic Indices -Harmonic Sources from Commercial Loads - Harmonic Sources from Industrial Loads - Time domain methods and Frequency domain methods: Laplace, Fourier and Hartley transform – The Walsh Transform – Wavelet Transform- Harmonic Distortion -Voltage versus Current Distortion - Locating Harmonic Sources - System Response Characteristics - Effects of Harmonics

MODULE III FUNDAMENTALS OF HARMONICS L:9

Harmonic Distortion Evaluations – End users, utility -Principles for Controlling Harmonics- Where to Control Harmonics - Harmonic Studies – Computer tools for harmonic analysis - Harmonic analyzer - Devices for Controlling Harmonic Distortion - Harmonic Filter Design (both active and passive filters).

MODULE IV DISTRIBUTED GENERATION AND POWER QUALITY L:9

Resurgence of DG-DG Technologies – Interfacing DG to the Utility System -Power Quality Issues -Harmonics Generated by Distributed Generators- Operating Conflicts -DG on Distribution Networks - Sitting DG Distributed Generation - Interconnection Standards (IEC).

MODULE V POWER QUALITY MONITORING AND ANALYSIS L:9

Monitoring considerations: Power line disturbance analyzer, power quality measurement equipment, harmonic / spectrum analyzer, flicker meters, disturbance analyzer. Analysis of power outages, Analysis of unbalance: Symmetrical components of phasor quantities, Instantaneous symmetrical components, Instantaneous real and reactive powers, Analysis of distortion: On–line extraction of fundamental sequence components from measured samples.

L – 45; T – 0; P – 0; Total Hours:45

TEXT BOOKS:

1. Roger C.Durgan, Mark F .Mc Granhagan, Suryasantoso, “Electrical Power System Quality” ,Mc Graw Hill, Tata Mcgraw-hill, New Delhi, 3rd edition,2012.
2. Arindam Ghosh, “Power Quality Enhancement Using Custom Power Devices”, Kluwer Academic Publishers, 2002

REFERENCES:

1. Heydt, G.T., ‘Electric Power Quality’, Stars in a Circle Publications, Indiana, 2nd edition 1996.
2. Bollen, M.H.J., ‘Understanding Power Quality Problems: Voltage sags and interruptions’, IEEE Press, New York, 2000
3. Arrillaga, J, Watson, N.R., Chen, S., ‘Power System Quality Assessment’, Wiley, New York, 2000.
4. Surajit Chattopadhyay, Madhuchhanda Mitra, Samarjit Sengupta, Surajit Chattopadhyay, Madhuchhanda Mitra, Samarjit Sengupta, “Electric Power Quality”, Springer, 2010.

COURSE OUTCOMES: At the end of the course, the student is expected to possess knowledge and achieve skills on the following:

COB1: Identify the power quality issues and its importance.

COB2: evaluate the characteristics of power quality disturbances.

COB3: identify the harmonic distortions and implement mitigation techniques.

COB4: locate the Power Quality disturbances in distributed generations and to nullify it.

COB5: implement Power Quality monitoring and measurements techniques on various power quality issues.

Board of Studies (BoS):
21st meeting of BoS of EEE held on 23.06.2025

Academic Council:
24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO1	3	2			1	2	2				2	3	1	2
CO2	3	3		2	2						2	3	2	2
CO3	3	3	2	2	3		2				2	3	2	2
CO4	3	2	2	2	3	1	3				2	3	2	3
CO5	3	3		3	3	1		2		2	3	2	3	2

*** Legend: L – Low (1), M – Medium (2), H – High (3).**

SDG 3: Good health and well being

Statement: Understanding of the fundamentals power quality issues can help in designing systems to promote good health and well being.

SDG 8: Decent work and economic growth

Statement: The learners of this course can get decent work and earn financial benefits and they can work in electrical engineering filed.

EEFY 004	**POWER SYSTEM PLANNING AND RELIABILITY**	**L**	**T**	**P**	**C**
SDG: 8,9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To learn load forecasting in power systems.

COB2: To study basic probability theory and concepts of reliability analysis.

COB3: To familiarize factors influencing the reliability of generation systems, transmission systems and distribution systems.

COB4: To understand the factors influencing the reliability of transmission systems and expansion planning.

COB5: To explore distribution planning in power system.

MODULE I INTRODUCTION TO POWER SYSTEMS AND LOADFORECASTING L:9

A perspective: brief introduction to structure of power systems, growth of power system in India, present Indian power industry, GRID formation, concept of National GRID. 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.

MODULE II INTRODUCTION TO RELIABILITY ANALYSIS L:9

Review of probability distribution, binomial distribution and exponential distribution – Network modeling and evaluation of simple and complex systems – System reliability evaluation using probability distributions – Frequency and duration techniques. Reliability concepts: Meantime to failure – Series and parallel systems – MARKOV process – Recursive technique.

MODULE III GENERATION SYSTEM RELIABILITY ANALYSIS L:9

Probabilistic generation and load models - Determination of reliability of isolated and interconnected generation systems – Energy transfer and off peak loading.

MODULE IV TRANSMISSION SYSTEM RELIABILITY ANALYSIS AND EXPANSION PLANNING L: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- Basic concepts on expansion planning - Procedure followed to integrate transmission system planning, current practice in India.

MODULE V DISTRIBUTION SYSTEM PLANNING AND RELIABILITY L: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.

L – 45; T – 0; P – 0; Total Hours: 45

TEXT BOOKS:

1. R.L.Sullivan, "Power System Planning", Heber Hill, 1987.

REFERENCES:

1. Roy Billington, “Power System Reliability Evaluation”, Gordan& Breach Scain Publishers, 1990.
2. A.S.Pabla, “Electric Power Distribution”, Tata Mc Graw-Hill Publishing Company, 5th edition, 2003.
3. TurenGonen, “Electric Power Distribution System Engineering”, McGraw Hill, 1986.
4. TurenGonen, “Electric Power Transmission System Engineering Analysis and Design”, McGraw Hill, 2nd Edition, 2010.
5. Eodrenyi, J., “Reliability Modelling in Electric Power System”, John Wiley, 1980.
6. B.R. Gupta, “Power System Analysis and Design”, S.C hand, New Delhi, 2003.

COURSE OUTCOMES: At the end of the course, the student will be able to:

CO1: carry out contingency analysis in transmission systems.

CO2: apply the probabilistic methods for evaluating the reliability of generation and transmission system.

CO3: design different model of system components in reliability studies.

CO4: design the expansion planning of power system.

CO5: forecast the load using different regression models.

Board of Studies (BoS):

21st meeting of BoS of EEE held on 23.06.2025

Academic Council:

24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	3	1	-	-	-	-	-	-	1	3	2	3
CO2	3	3	3	3	-	-	-	-	-	-	2	3	3	3
CO3	1	3	3	2	-	-	-	-	-	-	2	3	3	3
CO4	3	2	3	3	-	-	-	-	-	-	2	3	3	3
CO5	3	2	3	3	-	-	-	-	-	-	2	3	3	3

*** Legend: L – Low (1), M – Medium (2), H – High (3).**

SDG 8: Decent work and economic growth.

Statement: The learners of this course can get decent work and earn financial benefits and they can work in interdisciplinary areas.

SDG 9: Build resilient Infrastructure, to support economic development and human well-being with a focus on affordable and equitable access for all.

Statement: The complete understanding of this course lead to sustainable industrialization and promote economic development.

EEFY 005	ADVANCED DIGITAL SIGNAL PROCESSING	L	T	P	C
SDG: 9, 12		3	0	0	3

COURSE OBJECTIVES:

COB1: To study the mathematical foundations of digital signal processing including sampling, filtering, and spectral analysis.

COB2: To study various methods for power spectrum estimation using both parametric and non-parametric techniques.

COB3: To study adaptive filters for real-world applications like noise cancellation and channel equalization.

COB4: To understand multirate signal processing techniques and the design of efficient digital systems for different sampling rates.

COB5: To learn DSP techniques to speech signal processing and understand the fundamentals of speech modeling and analysis.

MODULE I DIGITAL SIGNAL PROCESSING L:9

Sampling of analog signals - Selection of sampling frequency - Frequency response – Transfer functions - Filter structures - Fast Fourier Transform (FFT) Algorithms - Image coding – DCT Continuous Wavelet Transform – Wavelet Transform Ideal Case.

MODULE II POWER SPECTRUM ESTIMATION L:9

Parametric Methods: Relationship between the auto correlation and the model parameters – The Yule – Walker method for the AR Model Parameters – The Burg Method for the AR Model parameters - Bayesian Methods - Markov Chain Monte Carlo (MCMC) and variational inference - Non-Parametric Methods: Estimation of spectra from finite duration observation of signals,: Bartlett Method.

MODULE III ADAPTIVE SIGNAL PROCESSING L:9

FIR adaptive filters – Implementation of Digital Filters - Filter and 1st Order All Pass Filter, Frequency sampling structures of FIR, Lattice structures - Forward and Backward prediction error filters, – Application: noise cancellation – channel equalization – adaptive recursive filters – recursive least squares.

MODULE IV MULTIRATE SIGNAL PROCESSING AND DSP INTEGRATED CIRCUITS L:9

Decimation by a factor D – Interpolation by a factor I – Sampling rate conversion by a rational factor I/D, Design of Phase Shifters, Interfacing of Digital Systems with Different Sampling Rates.

MODULE V SPEECH SIGNAL PROCESSING L:9

Digital models for speech signal : Mechanism of speech production – model for vocal tract, radiation and excitation – complete model – time domain processing of speech signal:- Pitch period estimation – using autocorrelation function – Linear predictive Coding: Basic Principles – autocorrelation method – Durbin recursive solution.

L – 45; T – 0; P – 0; Total Hours: 45

TEXT BOOKS:

1. Sanjit K. Mitra, "Digital Signal Processing: A Computer-Based Approach", McGraw-Hill Education, 4th Edition,2013.
2. Richard. G. Lyons, "Understanding Digital Signal Processing", Prentice Hall, 3rd edition, 2010.
3. Richard. G. Lyons and D. LEE Fugal, "The Essential Guide to Digital Signal Processing", Pearson, 1st edition, 2014.

REFERENCES:

1. J.G.Proakis& D. K.Manolakis, "Digital Signal Processing: Principles, Algorithms &Applications" -, 4th Ed., Pearson Education, 2014.
2. Alan V Oppenheim & Ronald W Schafer "Discrete Time signal processing", Pearson Education, 3rd edition, 2014.
3. Steven. M .Kay, "Modern Spectral Estimation: Theory & Application –PHI", 2009.
4. P.P.Vaidyanathan, "Multi Rate Systems and Filter Banks" , Pearson Education, 1993.
5. Emmanuel C. Ifeachor, Barrie W. Jervis, "Digital Signal Processing – A practical approach", Second Edition, Harlow, Prentice Hall, 2011.

COURSE OUTCOMES: At the end of the course the students will be able to:

CO1: apply the mathematical foundations of digital signal processing including sampling, filtering, and spectral analysis.

CO2: analyze and implement various methods for power spectrum estimation using both parametric and non-parametric techniques.

CO3: design and evaluate adaptive filters for real-world applications like noise cancellation and channel equalization.

CO4: implement multirate signal processing techniques and the design of efficient digital systems for different sampling rates.

CO5: apply DSP techniques to speech signal processing.

Board of Studies (BoS):

21st meeting of BoS of EEE held on 23.06.2025

Academic Council:

24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2		3	-	-	-	-	-	-	2	1	1
CO2	3	3	2	2	3	-	-	-	-	-	-	3	2	1
CO3	3	3	3	2	3	-	-	-	-	-	-	3	3	2
CO4	3	2	3	3	3	-	-	-	-	-	-	2	3	2
CO5	3	3	2	2	2	-	-	-	-	-	-	1	1	1

*** Legend: L – Low (1), M – Medium (2), H – High (3).**

SDG 9 : Build resilient Infrastructure, to support economic development and human well being with a focus on affordable and equitable access for all.

Statement : Understanding digital signal processing and its application to communication and power systems supports sustainable industrialization, innovation, and infrastructure development.

SDG 12: Responsible consumption and production.

Statement: Use of efficient digital signal processing algorithms and hardware promotes sustainable design of instrumentation systems, supporting responsible energy consumption and production.

		L	T	P	C
EEFY 006	**INDUSTRIAL POWER SYSTEM ANALYSIS AND DESIGN**	**3**	**0**	**0**	**3**
SDG: 8,9					

COURSE OBJECTIVES:

COB1: To impart knowledge on Motor Starting Studies.

COB2: To understand the need for power factor correction and to study the various methods that are used in the power factor correction studies.

COB3: To learn about the sources of harmonics, evaluate the harmonics present in the power system and mitigate them by filters.

COB4: To analyse the sources that can cause the voltage flicker and find solutions to minimize the flicker.

COB5: To impart knowledge on the ground grid analysis.

MODULE I MOTOR STARTING STUDIES L:9

Introduction – Need for starters- Starting Methods – Classification of motors as per NEMA standards - System Data - Voltage Drop Calculations - Calculation of Acceleration Time - Motor Starting with limited capacity generators – Types of motor enclosures- Motors for classified areas- Computer aided Analysis - IEEE/ IEC Standards.

MODULE II POWER FACTOR CORRECTION STUDIES L:9

Introduction – Need for power factor study- selection of capacitors for improving power factor - System description and modeling - Acceptance criteria - Frequency Scan Analysis - Voltage Magnification Analysis - Sustained Over voltages - Switching Surge Analysis - Back to Back Switching.

MODULE III HARMONIC ANALYSIS L:9

Harmonic Sources – Harmonic Analysis- Techniques-Necessary steps for the study - System Response to Harmonics - System Model for Computer Aided Analysis - Acceptance Criteria – Series and parallel resonance-Harmonic Filters - harmonic Evaluation - IEEE/ IEC Standards.

MODULE IV FLICKER ANALYSIS **L:9**

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

MODULE V GROUND GRID ANALYSIS **L:9**

Introduction – Step voltage-Touch voltage-Transferred potential - Ground Grid Calculations - Computer-Aided Analysis - Improving the Performance of the Grounding Grids.

L – 45; T – 0; P – 0; Total Hours:45

TEXT BOOKS:

1. Ramasamy Natarajan, "Computer Aided Power System Analysis", Marcel Dekker Inc.,2005.
2. Shoaib Khan, "Industrial Power Systems", CRC Press, 2018.

REFERENCES:

1. Duncan Glover J., MulukutlaSarma S., Thomas Overbye, “Power System Analysis and Design", 6th Edition 2022.
2. TuranGonen, "Electrical Power Transmission System Engineering: Analysis and Design", Mcgraw Hill publishers, 2009.
3. Sen, S.K., “Principles of electrical machine design with computer programmes”, Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi, Third Edition 2014.

COURSE OUTCOMES: At the end of the course, the student is expected to:

COB1: select appropriate starting methods of induction motor and to perform calculations on voltage drop and acceleration time.

COB2: perform power factor correction studies.

COB3: identify and to analyze harmonics.

COB4: identify the flicker and minimize it.

COB5: perform ground grid analysis.

Board of Studies (BoS):

21st meeting of BoS of EEE held on 23.06.2025

Academic Council:

24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	3	2	1	1	1	2	3	3	3
CO2	3	3	3	1	3	1	2	1	1	1	2	3	2	3
CO3	3	3	3	1	3	1	2	1	1	1	2	3	2	3
CO4	3	3	3	3	3	1	2	1	1	1	2	3	2	3
CO5	3	3	3	3	3	1	2	1	1	1	2	3	2	3

*** Legend: L – Low (1), M – Medium (2), H – High (3).**

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Statement:

The various industrial standards of technical drawing and the application of orthographic projections to draw simple solids helps to innovate a new design for sustainable industrialization

EEFY 007	HIGH VOLTAGE DIRECT CURRENT TRANSMISSION	L	T	P	C
SDG: 8,9		3	0	0	3

COURSE OBJECTIVES:

COB1: To study EHVAC and HVDC systems.

COB2: To learn about HVDC controller circuit with various pulses.

COB3: To acquire knowledge on HVDC converters, system control and development of MTDC systems.

COB4: To gain knowledge on Harmonics and design of filters.

COB5: To study about power flow analysis in an integrated EHVAC - HVDC system.

MODULE I COMPARISON OF EHVAC AND HVDC SYSTEMS L:9

Technical and economic problems in bulk power transmission over long distances using EHV / UHV AC lines - HVDC alternatives for transmission - Description of HVDC systems - its application - comparison of EHVAC and HVDC systems.

MODULE II ANALYSIS OF HVDC CONVERTERS L:9

Planning of HVDC transmission - modern trends in HVDC transmission - DC breakers - U/G cable transmission - VSC based HVDC - pulse number - choice of converter configuration - simplified analysis of Graetz circuit - 6 pulse converter bridge characteristics - generation of harmonics and filtering.

MODULE III ANALYSIS AND CONTROL OF HVDC SYSTEMS L:9

Twelve pulse converter characteristics - its advantages - detailed analysis of Converters - Principles of DC link control - converter / inverter control characteristics - system control hierarchy - firing angle control - current and extinction angle control - power control - higher level controllers– HVDC systems simulation: modeling of HVDC systems for digital simulation.

MODULE IV MULTI TERMINAL HVDC SYSTEMS L:9

Introduction to MTDC systems – potential applications of MTDC systems – Types of MTDC systems – Control and protection of MTDC systems – Detailed study about developments of MTDC systems.

MODULE V POWER FLOW ANALYSIS L:9

Per unit system for DC quantities – modeling of DC links – solution of DC power flow – solution of AC – DC power flow – case studies- Application in Wind Power generation.

L – 45; T – 0; P – 0; Total Hours: 45

TEXT BOOKS:

1. J. Arrillaga, "High Voltage Direct Current Transmission", Peter Pregrinus, London, 2012.
2. P. Kundur, "Power System stability and Control", Tata McGraw Hill, 2022.

REFERENCES:

1. K.R. Padiyar, "HVDC Power Transmission Systems", New Age International Pvt Ltd., New Delhi, 2002.
2. 2. V.K. Sood, "HVDC and FACTS Controllers - Applications of Static Converters in power system", Kluwer Academic Publishers, 2004.

COURSE OUTCOMES: At the end of the course, the students will be able to:

CO1: identify the situations where HVDC transmission is a better alternative to EHVAC transmission

CO2: implement converter/Inverter for power control.

CO3: develop MTDC systems.

CO4: perform power flow analysis used for Integrated EHVAC-HVDC system.

CO5: simulate and analyze the steady-state performance of the EHVAC-HVDC system.

Board of Studies (BoS):

21st meeting of BoS of EEE held on 23.06.2025

Academic Council:

24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	2	–	–	–	–	2	3	2	3
CO2	3	3	3	2	3	–	–	–	–	–	2	3	3	3
CO3	3	3	3	2	3	–	–	–	–	–	2	3	3	3
CO4	3	3	2	3	3	–	–	–	–	–	3	3	3	3
CO5	3	2	2	3	3	–	–	–	–	–	3	3	3	3

*** Legend: L – Low (1), M – Medium (2), H – High (3).**

SDG 8: Decent work and economic growth

Statement: The learners of this course can get decent work and earn financial benefits and they can work in interdisciplinary areas.

SDG 12: Responsible consumption and production.

Statement: Application of knowledge obtained from this course will lead to reasonable consumption and production.

EEFY 008 SDG: 7, 8	WIND ENERGY CONVERSION SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

COB1: To understand the fundamentals of wind power generation.

COB2: To study the design aspects of wind turbine and its associated control strategy.

COB3: To impart knowledge on fixed speed wind turbine and its generation schemes.

COB4: To impart knowledge on variable speed wind turbine and its generation schemes.

COB5: To acquire knowledge on power electronic components used in WECS and grid connected system.

MODULE I INTRODUCTION L:9

Introduction – Efficiency limit for wind energy conversion – Efficiency limit for a thrust-operated converter – Types of wind energy conversion devices – Rayleigh distribution – Aerodynamics of wind rotor – aerodynamic efficiency - Analysis using blade element theory – components of wind energy conversion system-Wind speed measurement - Design of wind turbine rotor – Power-speed characteristics – Torque-speed characteristics.

MODULE II POWER ELECTRONICS FOR WIND ENERGYSYSTEMS L:9

Principle of operation: line commutated converters (inversion-mode) – Boost and buck-boost converters - Inverters for high power applications: Multi-level Inverters, Analysis of their performance, Selection of inverter, Battery sizing, Array sizing, harmonics, Interaction with power grid.

MODULE III FIXED SPEED SYSTEMS L:9

Fixed speed wind turbine - Generation schemes with fixed speed turbines – Constant voltage, constant frequency generation Choice of Generators - Deciding factors - Synchronous Generator - Squirrel Cage Induction Generator - Model of Wind Speed - Model wind turbine rotor - Drive Train model - Generator model for Steady state and Transient stability analysis.

MODULE IV VARIABLE SPEED SYSTEMS L:9

Need of variable speed systems - Variable speed constant frequency systems synchronous generator – DFIG - PMSG - Variable speed generators modeling - Variable speed variable frequency schemes– Wind turbine control mechanism – Control strategy for five different ranges of wind speed..

MODULE V GRID CONNECTED SYSTEMS L:9

Induction generator-Controlled firing angle scheme with AC and DC side Capacitor-Scalar method-flux vector scheme-Control scheme for Synchronous generator with variable speed drive-Variable speed synchronous generator control with boost converter- Stand alone and Grid Connected WECS system-Grid connection Issues-Impacts of wind power on Power System Stability- Storage technologies.

L – 45; T – 0; P – 0; Total Hours: 45

TEXTBOOK:

1. S.N.Bhadra, D.Kasthra, S.Banerjee, “Wind Electrical Systems”, Oxford Higher Education, 2005.

REFERENCES:

1. Thomas Ackermann, ”Wind Power in Power System”, Wiley 2012.
2. L.L.Freris ,"Wind Energy conversion Systems", Prentice Hall, 1990.
3. Jian Zhang, Adam Dysko, John O'Reilly, William E. Leithead, "Modeling and performance of fixed-speed induction generators in power system oscillation stability studies", Electric Power System Research Vol. 78, pp: 1416-1424,2008.
4. Andre´s Feijoo, Jose Cidras, Camilo Carrillo, "A third order model for the doubly-fed induction machine", Electric Power Systems Research 56 (2000)121-127.
5. Eurostag 4.3 Theory Manual Part I.
6. Ion Boldea, "Variable speed generators", Taylor & Francis group, 2006.
7. E.W. Golding, "The generation of Electricity by wind power", Redwood burn Ltd., Trowbridge, 1976.

8. S.Heir, "Grid Integration of WECS", Wiley 1998.

COURSE OUTCOMES: At the end of the course, the student will be able to:

CO1: recognize the need of renewable energy technologies and their role in the world energy demand.

CO2: to gain knowledge on design and control strategy of wind turbine.

CO3: to gain knowledge on fixed speed system and its generation scheme.

CO4: Study about the need of Variable speed system and its modeling.

CO5: analyse the wind power integration issues and their mitigation techniques and the future energy storage technologies used in standalone and grid connected operation.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	3	1	–	–	3	2	–	–	–	2	3	1	3
CO2	3	3	3	2	3	2	–	–	–	–	2	2	2	3
CO3	3	2	2	–	3	2	–	–	–	–	2	3	2	2
CO4	3	3	3	2	3	2	–	–	–	–	3	3	3	2
CO5	3	3	2	2	3	3	–	–	–	2	3	3	3	3

*** Legend: L – Low (1), M – Medium (2), H – High (3).**

Board of Studies (BoS):
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Academic Council:
24th AC held on 26.08.2025

SDG 7: Affordable and Clean Energy.
Statement: Electrical Engineering contributes to clean sustainable energy, by generating, storage and transport electricity and help to produce climate neutral power to the world.

SDG 8: Decent Work and Economic Growth
Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

Statement: Decent Work and Economic Growth is supported via an increasing supply of competent engineers who will help solve the challenges of the future in all areas of everyday life. Most of the engineers graduated from Electrical Engineering stay in the area and support the economic growth and viability of local companies.

EEFY 009 **POWER DISTRIBUTION SYSTEMS** **L T P C**

SDG: 8, 9 **3 0 0 3**

COURSE OBJECTIVES:

COB1: To understand the basics of distribution systems.

COB2: To gain knowledge on distribution feeders and substation design.

COB3: To acquire knowledge on voltage drop and power loss analysis of distribution system.

COB4: To understand the protection devices and practices followed in distribution system.

COB5: To understand the concepts of reactive power compensation in distribution system.

MODULE I INTRODUCTION TO DISTRIBUTION SYSTEMS L:9

General, an overview of the role of computers in distribution system planning Load modeling and characteristics: definition of basic terms like demand factor, utilization factor, load factor, plant factor, diversity factor, coincidence factor, contribution factor and loss factor - coincident demand- non-concident demand -Relationship between the load factor and loss factor - Classification of loads (Residential, Commercial, Agricultural and Industrial) and their characteristics- Load growth and forecasting- load modeling.

MODULE II DISTRIBUTION FEEDERS AND SUBSTATIONS L:9

Design consideration of Distribution feeders: Radial and loop types of primary feeders- voltage levels- feeder loading. Design practice of the secondary distribution system-Location of Substations: Rating of a Distribution Substation service area with primary feeder - Substation application curves- benefits derived through optimal location of substations. Substation bus schemes.

MODULE III SYSTEM ANALYSIS L:9

Voltage drop and power loss calculations: Derivation for voltage drop and power loss in lines- manual methods of solution for radial networks - three-phase balanced primary lines- non-three-phase primary lines- voltage drop computation based on load density.

MODULE IV PROTECTIVE DEVICES AND COORDINATION L:9

Objectives of distribution system protection - types of common faults and procedure for fault calculation. Protective Devices: Principle of operation of fuses, circuit reclosers, line sectionalizer and circuit breakers-Coordination of protective devices: General coordination procedure.

MODULE V CAPACITIVE COMPENSATION FOR POWER FACTOR CONTROL L:9

Different types of power capacitors, shunt and series capacitors, effect of shunt capacitors (Fixed and switched) - power factor correction, capacitor location. Economic justification - Procedure to determine the best capacitor location.

L – 45; T – 0; P – 0; Total Hours: 45

TEXTBOOK:

1. TuranGonen, "Electric Power Distribution System Engineering", Mc.GrawHill Book Company, 2014.

REFERENCES:

1. A.S.Pabla, "Electric Power Distribution", Tata Mc Graw-Hill Publishing Company, 4th edition,2000.
2. V.Kamaraju, "Electrical Power Distribution Systems", Tata McGraw Hill publication, 2017.

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: apply the basics of power distribution system.

CO2: design distribution feeders and substations.

CO3: perform voltage drop and power loss calculations.

CO4: perform fault calculations and decide on the protective devices to be used.

CO5: carry out reactive power compensation in distribution system.

Board of Studies (BoS):
21st meeting of BoS of EEE held on 23.06.2025

Academic Council:
24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	-	-	-	-	-	2	1	1
CO2	3	3	3	2	3	-	-	-	-	3	3	3	3	3
CO3	3	3	3	2	3	-	-	-	-	3	3	3	3	3
CO4	3	3	3	2	3	-	-	-	2	3	3	3	3	3
CO5	3	3	3	2	3	-	-	-	2	3	3	3	3	3

*** Legend: L – Low (1), M – Medium (2), H – High (3).**

SDG 8: Decent work and economic growth.
Statement: The learners of this course can get decent work and earn financial benefits.

SDG 9: Industry, innovation and infrastructure.
Statement: The knowledge on this course would result in new innovative systems for industry and establishing advanced infrastructure.

		L	T	P	C
EEFY 010	**ELECTRICAL TRANSIENTS IN POWER SYSTEMS**	**L**	**T**	**P**	**C**
SDG: 8, 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To study transmission line modelling.

COB2: To understand the fault analysis in transmission line.

COB3: To study about the wave propagation and lattice diagram.

COB4: To study about the generation of switching and lightning transients, their propagation on the grid.

COB5: To gain knowledge on protection against over voltages and insulation coordination.

MODULE I LINE MODELLING L:9

Line parameters - Bundled Conductors - Maxwell potential coefficient matrices for various line configurations - L and C calculations for lines - resistance and inductance of ground return using Carson's formulae - Line modeling for Power frequency and surge over voltages.

MODULE II POWER FREQUENCY OVER VOLTAGES L:9

Symmetrical components for O/H lines and computation of sequence impedance – α, β, γ and Karrenbaur's transformations - over voltages caused by unsymmetrical line faults - over voltages due to Ferranti effect and load rejection.

MODULE III PROPAGATION OF TRAVELLING WAVES L:9

Wave equation and its solution - Relation between voltage and current waves-velocity of travelling waves-reflection and refraction - behavior at line terminations - multiple reflections - lattice diagram - attenuation and distortion.

MODULE IV MODAL ANALYSIS FOR MULTICONDUCTOR LINES AND LIGHTNING L:9

Wave equation for multi conductor lines - general solution using modal analysis-significance of modal analysis - simple example of modal analysis – modes of propagation for a three-conductor system-Lightning and switching over voltages - their influence on line transients.

MODULE V PROTECTION AND INSULATION CO-ORDINATION L:9

Protection against over voltages - shielding and non - shielding methods -back flashover - characteristics of surge arrestors - Location of surge arrestors –substation earthing - Basic Insulation levels - insulation co-ordination in 220kVand 400kV systems - Specific examples - insulation co-ordination in HVDC systems - IEEE/IEC standards.

L – 45; T – 0; P – 0; Total Hours: 45

TEXT BOOKS:

1. Allan Greenwood, “Electrical Transients in Power System”, Wiley & Sons Inc., New York, 1991.

REFERENCES:

1. Pritindra Chowdhari, “Electromagnetic transients in Power system”, PHI Learning. Age International (P) Ltd., Publishers New Delhi, 2008.
2. H.W. Dommel, “EMTP Theory Book”, Microtran Power System Analysis Corporation, Vancouver B.C.,1992.

COURSE OUTCOMES: At the end of the course, the student will be able to:

CO1: distinguish between power frequency and surge over-voltages and model the transmission lines accordingly.

CO2: analyse the propagation characteristics of voltage and current surges in O/H lines.

CO3: analyse the propagation of travelling waves.

CO4: analyse and control power frequency over voltages due to unsymmetrical faults, Ferranti effect and load rectification.

CO5: design insulation co-ordination schemes for 220kV and 400kV systems.

Board of Studies (BoS):

21st meeting of BoS of EEE held on 23.06.2025

Academic Council:

24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	PO11	PSO1	PSO2	PSO3
CO1	1	1	3	1	-	-	-	-	-	-	1	3	2	3
CO2	3	2	3	3	-	-	-	-	-	-	2	3	3	3
CO3	2	3	3	1	-	-	-	-	-	-	1	3	2	3
CO4	3	2	3	3	-	-	-	-	-	-	2	3	3	3
CO5	3	2	3	3	-	-	-	-	-	-	2	3	3	3

*** Legend: L – Low (1), M – Medium (2), H – High (3).**

SDG 8: Decent work and economic growth.

Statement: The learners of this course can get decent work and earn financial benefits and they can work in interdisciplinary areas.

SDG 9: Build resilient Infrastructure, to support economic development and human well-being with a focus on affordable and equitable access for all.

Statement: The complete understanding of this course lead to sustainable industrialization and promote economic development.

EEFY 011	**DISTRIBUTED GENERATION AND MICRO-GRID**	**L**	**T**	**P**	**C**
SDG: 8, 9, 11, 12		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To gain knowledge on renewable based generation system to meet the growing demands.

COB2: To study about the optimal location of distributed generation system in the distribution system network.

COB3: To understand the impact of grid integration.

COB4: To learn the grid integration system with conventional and non-conventional energy sources.

COB5: To understand different configurations of DC and AC microgrid.

MODULE I INTRODUCTION L:8

Microgrid basic concepts – architecture - operational conditions, Microgrid: merits and demerits - functionalities and variables in microgrid - issues in microgrid. Types of microgrid (LV microgrid, MV microgrid - DC microgrid, AC microgrid, Hybrid) - Microgrid as part of smarter grid Modes of operation: grid connected mode - islanded mode - transition between grid connected mode and islanded mode. Primary control strategy - secondary control strategy - Control of distribution generation - demand side management - Opportunities and risk of different market players.

MODULE II DISTRIBUTED ENERGY RESOURCES AND STORAGE DEVICES L:9

Distributed Energy Resources: solar – wind – CHP – MCHP – Micro turbine- Diesel generators –geo thermal –working, characteristics and mathematical modeling, Energy storage elements: Batteries, ultra-capacitors, fuel cells, flywheels Technical impacts of DGs.

MODULE III DISTRIBUTED SYSTEM EXPANSION AND CONTROLLERS L:10

Power flow, short circuit and loss calculations- with and without distributed generation- Distribution system reliability analysis –Distribution system expansion planning– optimal location of distributed generation – solution technique. Three phase converter - Three phase Voltage source Inverter (VSI) – Boost Converter – PWM Techniques - P-Q Control - Structure of the VSI PQ Controller - Power-Voltage (PV) Control Scheme - Frequency (V/f) Control Scheme.

MODULE IV PROTECTION ISSUES L:9

Requirements of protection - issues in protection (LOM, Blinding of protection, unwanted islanding, lack of selectivity, failure of co-ordination between fuse and recloser) - challenges in protection scheme – Solutions for microgrid protection - digital relays- Adaptive protection scheme: centralized, decentralized– Multiagent based protection scheme – protection scheme based on variables.

MODULE V MICROGRID COMPONENTS L:9

Introduction to micro-grids – Types of micro-grids – autonomous and non-autonomous grids – Sizing of micro-grids- modeling& analysis- Micro-grids with multiple DGs – Micro- grids with power electronic interfacing units. Microgridpilots : KERI – CERTS - Intelligent Electronic Device (IED) - Microgrid Management system (MMS) - Static Transfer switch (STS) - RTU/ gateway - Smart metering –Sensing Devices. .

L – 45; T – 0; P – 0; Total Hours: 45

TEXT BOOKS:

1. H. Lee Willis, Walter G. Scott ,'Distributed Power Generation – Planning and Evaluation', Marcel Decker Press, 2000.
2. JukkaIhamäki, "Integration of microgrids into electricity distribution networks" Master's Thesis in Lappeenranta University of Technology, 2012.
3. AmirhosseinHajimiragha, "Generation Control in Small Isolated Power Systems" Master of Science Thesis -Royal Institute of Technology, Department of Electrical Engineering Stockholm 2005.

4. Juan Carlos V´asquez Quintero, “Decentralized Control Techniques Applied to Electric Power Distributed Generation in Microgrids dissertation submitted for the degree of European Doctor of Philosophy, June 10, 2009.
5. Stanley H.Horowitz and Arun G. Phadke, “ Power System Relaying third edition, John Wiley & sons, 2008.

REFERENCES:

1. TahaSelimUstun, CagilOzansoy and AladinZayegh, “Fault current coefficient and time delay assignment for microgrid protection system with central protection unit” IEEE Transaction (Accepted for publication in future issue of the journal-DOI-10.1109/TPWRS.2012.2214489.
2. TahaSelimUstun, CagilOzansoy and AladinZayegh, “Modeling of a centralized Microgrid Protection system and Distributed Energy Resources according to IEC 61850-7-420” IEEE Transaction on power systems, vol 27, No.3, pp 1560-1567, 2012.
3. M. Amin Zamani, AmirnaserYazdani, and TarlochanS. , “A Communication-Assisted Protection Strategy for Inverter-Based Medium-Voltage Microgrids”, IEEE Transactions on Smart Grid, Vol. 3, No.4,pp.2088-2099, 2012.
4. Eric Sorotomme, S.S. Venkata, JoydeepMitra, “ Microgrid protection using communication assisted digital relays” IEEE transaction on power delivery, Vol.25, No.4, pp.2789-2796, 2010.
5. Renewable Microgrid controller RMC 600 – ABB Brochure.

COURSE OUTCOMES: At the end of the course, the students should be able to:

CO1: apply the basic concepts with respect to microgrid.

CO2: model the distributed generator for distribution network.

CO3: optimally locate the distributed generator in the distribution.

CO4: address the Issues involved in microgrid protection.

CO5: model controllers for distributed generator to interface it to the distribution system network.

Board of Studies (BoS):

21st meeting of BoS of EEE held on 23.06.2025

Academic Council:

24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	1	1	1	-	-	-	-	-	-	2	2	3
CO2	2	2	3	3	2	-	-	-	-	-	-	3	3	3
CO3	3	2	3	2	2	-	-	-	-	-	-	3	3	3
CO4	2	3	2	3	3	-	-	-	-	-	-	2	2	2
CO5	3	2	2	3	3	-	-	-	-	-	-	3	3	2

*** Legend: L – Low (1), M – Medium (2), H – High (3).**

SDG 8: Decent work and economic growth.

Statement: The learners of this course can get decent work and earn financial benefits and they can work in interdisciplinary areas.

SDG 9: Build resilient Infrastructure, to support economic development and human well-being with a focus on affordable and equitable access for all.

Statement: The complete understanding of this course lead to sustainable industrialization and promote economic development.

SDG 11: Sustainable cities and communities.

Statement: Understanding the renewable energy sources helps in building sustainable cities and communities.

SDG 12: Responsible consumption and production.

Statement: Use of microgrid results in reasonable consumption and production.

EEFY 012 **STATE ESTIMATION AND CONTINGENCY ANALYSIS IN SMARTGRID**

SDG: 7, 8

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

COB1: To understand the model, management and protection of smart grid systems.

COB2: To understand the information systems used in smart grid.

COB3: To study about the power system operating states.

COB4: To gain knowledge on the contingency analysis in transmission grid.

COB5: To acquire knowledge on the state estimation models.

MODULE I SMART GRID SYSTEMS L:9

Introduction to Smart Grid - Major systems in Smart Grid a technical perspective: Smart infrastructure system- Smart management system-Smart protection system- benefits and requirements of smart grid- Microgrid - Grid to vehicle and vehicle to grid.

MODULE II SMART INFORMATION SYSTEMS L:9

Smart Metering- Smart Monitoring and Measurement- Information Management-Smart Communication Subsystem: An Overview- Wireless Technologies -wired technologies.

MODULE III CONTINGENCY ANALYSIS FOR POWER SYSTEMS L:9

Contingency Analysis of Power System - Types of Violations - Low Voltage Violations - Line MVA Limits Violation - Instability Prediction.

MODULE IV CONTINGENCY STUDY OF NIGERIAN TRANSMISSION GRID L:9

Case Study of Nigeria’s 330kV Transmission Grid, Power System Security- Algorithm of a typical Contingency Analysis- Line Loadability- Simulation - Phasor and PMU Functions - Phasor Measurement Unit -Typical PMU Applications.

MODULE V STATIC STATE ESTIMATION MODELS L:9

Power System Static State Estimation- Exact Model- Nature of problem- Modeling- General Theory-State Estimation – Detection – Identification - Initial Tests- Approximate Model: State Estimation using P- Delta, Contingency Evaluation: P-Delta, Reactive Power and Voltage Magnitude.

L – 45; T – 0; P – 0; Total Hours:45

TEXT BOOKS:

1. Mukhtar Ahmad, "Power System State Estimation", Lap Lambert Acad Publishers, 2013.

REFERENCES:

1. Nonyelu, Chibuzo Joseph, Prof. Theophilus C. Madueme, "Power System Contingency Analysis: A Study of Nigeria's 330kV Transmission Grid", Conference of Energy Source for Power Generation, University of Nigeri, Nsukka, Vol.: 4, February 2016.
2. Xinyu Tony Jiang, Joe H Chow, Bruce Fardanesh, Deepak Maragal, George Stefopoulos, Michael Raxanousky, " Power System State Estimation using Direct Non-Iterative method", Electrical Power and Energy Systems, Vol. 73, Pages 361-368, 2015.
3. Mrs. Veenavati Jagadish Prasad Mishra, Prof. Manisha D. Khardenvis, "Contingency Analysis of Power System", IEEE Students' Conference on Electrical, Electronics and Computer Science, 2012.
4. Feng Ding, C.D. Booth, "Protection and Stability Assessment in Future Distribution Networks Using PMUs", 11th International Conference on Developments in Power Systems Protection, 2012.
5. Xi Fand, Satyajayant Misre, Guoliang Xue, Dejun Yang, "Smart Grid - The New and Improved Power Grid: A Survey", Vol.14, Issue 4, Pages: 944 – 980, 2012.
6. Antonio Gomez Exp Bsito and Ali Abur, "Generalized Observability Analysis and Measurement Classification", IEEE Transactions on Power Systems, Vol. 13, No3, August 1998.

7. Jinyu Yu , Zhigang Li , Jiahui Zhang , Xiang Bai , Huaichang Ge , J.H. Zheng , Q.H. Wu,Efficient contingency analysis of power systems using linear power flow with generalized warm-start compensation, International Journal of Electrical Power & Energy Systems, Volume 156, February 2024.
8. Fred C. Scheweppe, and J.Wildes, "Power System Static-State Estimation, Exact Model", Transactions on Power Apparatus and Systems, Vol.PAS-8, No1, January 1970.

COURSE OUTCOMES: At the end of the course, the student will be able to:

COB1: model smart grid power systems.

COB2: analyse smart grid information systems.

COB3: perform contingency analysis in smart grids.

COB4: perform contingency analysis in a Nigerian transmission grid.

COB5: perform the state estimation.

Board of Studies (BoS):
21st meeting of BoS of EEE held on 23.06.2025

Academic Council:
24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	2	–	–	–	–	2	3	3	3
CO2	3	3	2	2	3	2	–	–	–	–	2	3	3	3
CO3	3	3	2	3	3	2	–	–	–	2	2	3	3	2
CO4	3	3	2	3	3	3	–	–	–	2	2	3	3	2
CO5	3	3	2	3	3	2	–	–	–	2	3	3	3	2

*** Legend: L – Low (1), M – Medium (2), H – High (3).**

SDG 7: Affordable and Clean Energy.

Ensure access to affordable, reliable, sustainable and modern energy for all.

Statement: Electrical Engineering contributes to clean sustainable energy, by generating, storage and transport electricity and help to produce climate neutral power to the world.

SDG 8: Decent Work and economic growth.

Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

Statement: Decent Work and economic growth is supported via an increasing supply of competent engineers who will help solve the challenges of the future in all areas of everyday life. Most of the engineers graduated from Electrical Engineering stay in the area and support the economic growth and viability of local companies.

EEFY 013	SPECIAL ELECTRICAL MACHINES AND CONTROLLERS	L	T	P	C
SDG:3,5,8		3	0	0	3

COURSE OBJECTIVES:

COB1: To understand the construction, principle of operation and performance of Stepping Motors.

COB2: To gain knowledge on construction, principle of operation and performance of switched reluctance motors.

COB3: To study about the construction, principle of operation and performance of permanent magnet brushless D.C. motors and PMSM.

COB4: To understand the construction, principle of operation and performance of various Special Machines

COB5: To learn the MAGNET software for performance analysis of motor.

MODULE I STEPPING MOTORS L:9

Constructional features, principle of operation, modes of excitation, torque equation, characteristics, Power circuit, Drive systems, Open loop and closed loop control of stepping motor, Applications.

MODULE II SWITCHED RELUCTANCE MOTOR L:9

Constructional features –Principle of operation- Torque prediction–Characteristics- Power controllers – Control of SRM drive- Speed control - current control - Microprocessor based control -inductance based estimation –applications.

MODULE III PERMANENT MAGNET BRUSHLESS D.C. MOTORS AND SYNCHRONOUS MOTOR L:9

Fundamentals of Permanent Magnets, Principle of operation, types, magnetic circuit analysis, EMF and Torque equations, Power Controllers, Motor characteristics and control of PMSM and BLDC motors, Applications.

MODULE IV MISCELLANEOUS MACHINES L:9

Constructional features, Principle of operation and Characteristics of Synchronous Reluctance Motor, Linear Induction motor, Repulsion motor, Applications.

MODULE V CASE STUDIES L:9

Modelling and simulation – Switched Reluctance Machines – Permanent magnet BLDC Motor – PMSM – MAGNET software.

L – 45; T – 0; P – 0; Total Hours:45

TEXT BOOKS:

1. T.Kenjo, ‘ Stepping motors and their microprocessor controls’, Oxford University press, New Delhi, 2000 Dekker 2009.
2. K.Venkataratnam, Special Electrical Machines, Universities Press (India) Private Limited, 2008.
3. Bilgin, Berker Emadi, Ali Jiang, James Weisheng - Switched reluctance motor drives: fundamentals to applications-CRC 2019.
4. R. Krishnan - Switched Reluctance Motor Drives Modeling, Simulation, Analysis, Design, and Applications -CRC Press 2017.
5. Ramu Krishnan - Permanent Magnet Synchronous and Brushless DC Motor Drives -CRC Press, Marcel Applications -CRC Press 2009.

REFERENCES:

1. E.G. Janardanan, Special electrical machines, PHI learning Private Limited, Delhi, 2014.
2. Jacek F. Gieras, Dr. Rong-Jie Wang, Professor Maarten J. Kamper - Axial Flux Permanent Magnet Brushless Machines-Springer Netherlands 2008.
3. T. Kenjo, S. Nagamori, “Permanent Magnet and Brushless DC Motors”, Clarendon Press, London, 1988.
4. T.J.E. Miller, ‘Brushless magnet and Reluctance motor drives’, Clarendon press, London, 1989.

COURSE OUTCOMES: At the end of the course, the students will be able to:

CO1: estimate the performance and applications of stepping motors.

CO2: design control circuit for switched reluctance motors.

CO3: choose the appropriate type of permanent magnet brushless DC motor and PMSM for industrial application.

CO4: model low power rating motor for real time applications.

CO5: design and simulate special electrical machines using MAGNET software

Board of Studies (BoS):
21st meeting of BoS of EEE held on 23.06.2025

Academic Council:
24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO 3
CO1	2	3	3	3	2	-	-	-	-	-	-	2	2	-
CO2	2	3	3	3	2	-	-	-	-	-	-	1	3	-
CO3	-	-	-	-	3	-	-	-	-	-	-	3	3	-
CO4	-	2	2	2	2	-	-	-	-	-	-	2	2	-
CO5	1	-	-	-	3	-	-	-	-	-	-	3	3	-

*** Legend: L – Low (1), M – Medium (2), H – High (3).**

SDG 3: Good health and well being.

Statement : Understanding of the fundamentals of electrical machines can help in designing systems to promote good health and well being.

SDG 5: Gender equality

Statement: Acquiring the knowledge to help and overcome the gender barriers in work place.

SDG 8: Decent work and economic

Statement: The learners of this course can get decent work and earn financial benefits.

		L	T	P	C
EEFY 014	**FUNDAMENTALS OF GRID CONNECTED PHOTO VOLTAIC POWER ELECTRONIC CONVERTER DESIGN**				
SDG: 7,8		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To gain knowledge on constructional details and characteristics of solar panels.

COB2: To study the concepts of power converters in PV systems.

COB3: To familiarize with the control of power converters for PV systems.

COB4: To study the concepts of power conditioning schemes.

COB5: To explore the design and optimization techniques in grid connected PV systems.

MODULE I INTRODUCTIONTOGRID CONNECTED PV SYSTEMS L:10

Characteristics of sunlight – semiconductors and P-N junctions – behavior of solar cells – cell properties – PV cell interconnections - Power Electronics for Photovoltaic Power Systems: Basics, Types, Stand-alone PV systems, Grid connected PV systems- Grid tied and grid interactive inverters- grid connection issues.

MODULE II POWER CONVERTERS FOR PHOTO VOLTAIC SYSTEMS L:8

Grid connection standards, Solar Cell Characteristics, Solar panel and converter configurations, Converter topologies, Grid filter topologies, Temporary storage.

MODULE III CONTROL OF PV CONVERTERS L:10

Maximum power utilization of photo voltaic power sources – DC-DC Converter control - DC- AC Converter control - Harmonic compensation - Grid synchronization - Anti Islanding - Digital Signal Processing – Optimization algorithms.

MODULE IV POWER CONDITIONING SCHEMES L:8

DC Power conditioning Converters - Maximum Power point tracking algorithms - AC Power conditioners Synchronized operation with grid supply - Harmonic problem – building integrated PV systems.

MODULE V SYSTEM DESIGN AND OPTIMIZATION L:9

Radiation and load data - Design of System Components for different PV Applications - Sizing and Reliability - DC-DC Converter- I-V Characteristic- Maximum Power Point

Tracker- DC-AC Converter- PLL- Current control- Voltage control- LCL filter - Simple Case Studies.

L – 45; T – 0; P – 0; Total Hours: 45

TEXT BOOKS:

1. Svein Erik Evju, Fundamentals of Grid Connected Photo-Voltaic Power Electronic Converter Design', Norwegian University of Science and Technology,2007.

REFERENCES:

1. H Garg& J Prakash, "Solar Energy : Fundamentals and Applications", McGraw Hill Education, 2017.
2. Solanki C.S, "Solar Photovoltaics - Fundamentals, Technologies and Applications", PHI, 2015
3. Frank S. Barnes & Jonah G. Levine, Large Energy storage Systems Handbook, CRC Press, 2011.
4. Solar & Wind energy Technologies – McNeils, Frenkel, Desai, Wiley Eastern, 1990.
5. Solar Energy , S.P. Sukhatme, Tata McGraw Hill,1987.

COURSE OUTCOMES: At the end of the course, the student will be able to:

CO1: choose components of PV systems, including solar modules, power control components, and the balance of system components

CO2: explain the principles that underlie the ability of various natural phenomena to deliver solar energy.

CO3: apply the technologies that are used to harness the power of solar energy.

CO4: carry out a credible design of a grid-connected PV system.

CO5: model and design MPPT and controllers of grid tied inverters.

Board of Studies (BoS):

21st meeting of BoS of EEE held on 23.06.2025

Academic Council:

24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	3	1	-	-	-	-	-	-	-	3	2	2
CO2	3	2	3	2	-	-	-	-	-	-	-	3	3	3
CO3	1	3	3	1	-	-	-	-	-	-	-	3	3	3
CO4	2	2	3	3	-	-	-	-	-	-	-	3	3	3
CO5	3	2	3	3	-	-	-	-	-	-	-	3	3	3

*** Legend: L – Low (1), M – Medium (2), H – High (3).**

SDG 7: Affordable and Clean Energy

Ensure access to affordable, reliable, sustainable and modern energy for all.

Statement: Understanding of solar energy technology contributes to clean sustainable energy, by generating, storage and transport electricity and help to produce climate neutral power to the world.

SDG 8 :Decent work and economic growth

Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

Statement: Decent Work and economic growth is supported via an increasing supply of competent engineers who will help solve the challenges of the future in all areas of everyday life. Most of the engineers graduated from Electrical Engineering stay in the area and support the economic growth and viability of local companies.

EEFY 015	**ADVANCED POWER SEMICONDUCTOR DEVICES**	**L**	**T**	**P**	**C**
SDG: 3, 5, 8		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To understand the concepts related with power switches and its requirements.

COB2: To know about the developments and characteristics of Silicon Carbide (SiC) and Galium Nitride (GaN) devices.

COB3: To understand the working, steady state and switching characteristics of current controlled and voltage controlled silicon devices.

COB4: To understand the control and firing circuit for different devices.

COB5: To acquire knowledge about the thermal protection of the devices.

MODULE I INTRODUCTION L:8

Power switching devices overview; Attributes of an ideal switch, application requirements, circuit symbols. Power handling capability, Device selection strategy, EMI due to switching, Power diodes, Types, characteristics and rating - Features and Brief History of Silicon Carbide -Physical Properties of Silicon Carbide devices - GaN Technology Overview.

MODULE II CURRENT CONTROLLED DEVICES L:10

BJT's – Construction, static characteristics, switching characteristics, Power Darlington circuit, – Thyristors – Physical and electrical principle underlying operating mode, Two transistor analogy, concept of latching; Gate and switching characteristics, converter grade and inverter grade, series and parallel operation, comparison of BJT and Thyristor, steady state and dynamic models of BJT &Thyristor - Basics of GTO, SiC based Bipolar devices and Applications- Building a GaN Transistor – GaN Transistor Electrical Characteristics.

MODULE III VOLTAGE CONTROLLED DEVICES AND DRIVER CIRCUITS L:9

Power MOSFETs and IGBTs, Principle of voltage-controlled devices, construction, types, static and switching characteristics, steady state and dynamic models of MOSFET and IGBTs, Basics of GTO, MCT, FCT, RCT and IGCT. Driver ICs: MOC series SCR, IR2XXX Series Full Bridge and Half Bridge MOSFET / IGBT Driver ICs - SiC based unipolar devices-applications.

MODULE IV DEVICE SELECTION, FIRING AND PROTECTING CIRCUITS L:9

Device selection strategy – On-state and switching losses – EMI due to switching - necessity of isolation, pulse transformer, optocoupler – Gate drives circuit: SCR, MOSFET, IGBTs and base driving circuit for power BJT. Over voltage, over current and gate protections, Design of snubbers.

MODULE V THERMAL PROTECTION L: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. .

L – 45; T – 0; P – 0; Total Hours: 45

TEXT BOOKS:

1. Rashid M.H., “ Power Electronics Circuits, Devices and Applications “, Pearson, 4th Edition, 10th Impression 2021.
2. Mohan, Undeland and Robins, “Power Electronics: Converters Applications and Design, MediaEnhanced 3rd Edition, Wiley, 2007
3. Tsunenobu Kimoto and James A. Cooper , Fundamentals of Silicon Carbide Technology:Growth, Characterization, Devices, and Applications, First Edition., 2014 John Wiley & Sons Singapore Pte Ltd

REFERENCES:

1. Vedam Subramanian, "Power Electronics", New Age International (P) Limited, New Delhi, 1997.
2. Ned Mohan, Undcland and Robins, “Power Electronics – Concepts, applications and Design, John Wiley and Sons, Singapore, 2000.
3. B.W. Williams, “Power Electronics – Devices, Drivers, Applications and Passive Components”, Macmillan, 1992.

4. Dr.Ing. Arendt Wintrich, Dr. Ing. Ulrich Nicolai, Dr. techn. Werner Tursky, Tobias Reimann, Application Manual Power Semiconductors, published by SEMIKRON International GmbH.

COURSE OUTCOMES: At the end of the course, the students will be able to:

CO1: determine the suitable device for the application.

CO2: Know the advantages of Silicon Carbide devices and Galium Nitride devices.

CO3: Understand the principles and characteristics of Silicon devices, Silicon Carbide devicesand Galium Nitride devices.

CO4: Design proper driving circuits and protection circuits.

CO5: Construct a proper thermal protective device for power semiconductor devices.

Board of Studies (BoS):

21st meeting of BoS of EEE held on 23.06.2025

Academic Council:

24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	1	3	3	2	-	-	-	-	-	2	3	2	2
CO2	1	1	3	3	1	-	-	-	-	-	2	3	2	2
CO3	1	1	3	3	1	-	-	-	-	-	2	3	2	2
CO4	1	1	3	3	2	-	-	-	-	-	2	3	2	2
CO5	1	1	3	3	1	-	-	-	-	-	2	3	2	2

*** Legend: L – Low (1), M – Medium (2), H – High (3).**

SDG3:Good health and well-being.

Statement : Understanding of the fundamentals of power semiconductor devices can help in designing systems to promote good health and well-being.

SDG 8: Decent work and economic growth

Statement: The learners of this course can get decent work and earn financial benefits.

SDG 9 : Build resilient Infrastructure, to support economic development and human well-being with a focus on affordable and equitable access for all.

Statement : The complete understanding of electron devices and components lead to sustainable industrialization and promote economic development.

EEFY 016	**ANALYSIS OF POWER CONVERTERS**	**L**	**T**	**P**	**C**
SDG: 3, 5, 8		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To gain knowledge on the phase-controlled power electronic converters.

COB2: To discuss in depth of the DC-DC converters.

COB3: To acquire knowledge on AC-AC converters.

COB4: To acquire knowledge on active front end control schemes in electrical systems.

COB5: To study DAB converter.

MODULE I PHASE CONTROLLED AC-DC CONVERTERS L:9

Power semiconductor devices – Single phase and three phase half controlled and fully controlled converters with R-L, R-L-E loads and free wheeling diodes - continuous and discontinuous modes of operation - Sequence control of converters – performance parameters: harmonics, ripple, distortion, power factor - effect of source impedance and overlap-reactive power and power balance in converter circuits – 12 pulse converter.

MODULE II DC-DC CONVERTERS L:9

Fundamental choppers: Buck, Boost, Buck-Boost and Cuk – Full bridge converter – Resonant and quasi – resonant converters – Voltage Lift Luo Converters – Super-Lift Luo Converters – Cascaded Boost Converters.

MODULE III ADVANCED AC-AC CONVERTERS L:9

Matrix Converter: Fundamentals – Working – Advantages and Applications – Soft switching techniques in AC-AC converters - Symmetrical - open delta - Ring connected cycloconverter circuits- Harmonic distortion in the output voltage – General Expression for Three pulse waveform for an arbitrary firing angle control method - Harmonic series of three and six pulse cycloconverters – cosine wave control method.

MODULE IV ACTIVE FRONT END POWER CONVERTERS L:9

Analysis of Single-phase and Three phase AC Voltage Controllers - Overview of Power Factor Correction Approaches - Unity power factor rectifiers – Resistor emulation principle – mathematical modeling – control schemes- Design of feedback compensators -front end rectifiers with real and reactive power control –Phase shifter.

MODULE V DUAL ACTIVE BRIDGE CONVERTER L:9

Dual active bridge converter – circuit configuration – steady state analysis – steady state model of DC-DC DAB Converters - Steady-State Model for AC-AC DAB Converters - soft switching analysis – DAB for Solid state transformer.

L – 45; T – 0; P – 0; Total Hours:45

TEXT BOOKS:

1. Luo, F.L. and Ye, H., Advanced DC/DC Converters, CRC Press, Boca Raton, FL, 2004.
2. Erickson, R.W. and Maksimovic, D., Fundamentals of Power Electronics, 2nd ed., Kluwer Academic Publishers, Norwell, MA, 1999.
3. Ned Mohan, Tore M. Undeland. "Power Electronics- Converters, Applications and Design", John Wiley & Sons (Asia) Private Ltd., 2003.

REFERENCES:

1. M. H. Rashid, "Power Electronics - Circuits, Devices and Applications", Pearson Education India, 2003
2. M.D. Singh, “Power Electronics” Tata McGraw-Hill Education, 07-Jul-2008.
3. Eric Monmasson, Power Electronic Converters PWM Strategies and Current Control Techniques, John Wiley & Sons, Inc, ISTE Ltd 2011.
4. D.M. Mitchell, DC-DC Switching Regulator Analysis, McGraw-Hill Ryerson,Limited, 1988.

COURSE OUTCOMES: At the end of the course, the student will be able to:

COB1: explain the operation of phase-controlled AC- DC Converters.

COB2: analyze performance parameters of advanced choppers.

COB3: explain the operation of matrix converter and cyclo-converters.

COB4: apply the active front end schemes in electrical systems.

COB5: analyze the various dual active bridge converters.

Board of Studies (BoS):

21st meeting of BoS of EEE held on 23.06.2025

Academic Council:

24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	3	1	-	-	-	-	-	-	1	2	-	-
CO2	3	2	3	2	-	-	-	-	-	-	2	2	-	-
CO3	1	3	3	1	-	-	-	-	-	-	1	2	-	-
CO4	2	2	3	3	-	-	-	-	-	-	2	2	-	-
CO5	2	2	3	3	-	-	-	-	-	-	2	2	-	-

*** Legend: L – Low (1), M – Medium (2), H – High (3).**

SDG 3: Good health and well-being.

Statement: Understanding of the fundamentals of power semiconductor devices can help in designing systems to promote good health and wellbeing.

SDG 5: Gender equality

Statement: Acquiring the knowledge to help and overcome the gender barriers in work place.

SDG 8: Decent work and economic growth

Statement: The learners of this course can get decent work and earn financial benefits.

EEFY 017 **ELECTRIC DRIVES**

SDG: 3, 5, 8

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

COB1: To understand the stable steady-state operation and transient dynamics of a motor-load system.

COB2: To study the operation of the converter / chopper fed dc drive and to solve simple problems.

COB3: To study the operation of both classical and modern induction motor drives.

COB4: To understand the differences between synchronous motor drive and induction motor drive and to learn the basics of synchronous motor drives with converter.

COB5: To understand microprocessor-based drive control and drive selection for industrial applications.

MODULE I FUNDAMENTAL OF DC AND AC DRIVE L:9

Components of electrical Drives-electric machines, power converter, controllers-dynamics of electric drive - torque equation - equivalent values of drive parameters-components of load torques types of loads - four quadrant operation of a motor– steady state stability– load equalization – classes of motor duty - determination of motor rating – Criteria for selection of motor for drives. Motor-drive system efficiency and thermal constraints.

MODULE II CONTROL OF DC DRIVE L:9

Hall Effect sensors and mechanical position sensors – Absolute and incremental encoders – Resolvers for accurate position detection – Modeling and transient analysis of DC drive systems – Control of separately excited and series DC motors using single-phase, three-phase, and dual converters – Chopper-fed DC motor drives – Converter ratings – Closed-loop control with transfer functions – Linear modeling of converters – Current and speed control loops – P, PI, and PID controllers – System response evaluation – Simulation of converter and chopper-fed DC drives.

MODULE III CONTROL OF INDUCTION MOTOR DRIVE L:9

Induction motor drives -Stator control – Stator voltage and frequency control – AC chopper fed induction motor drives – Voltage source inverter – current source inverter – Cyclo-converter fed induction motor drive – Rotor control – Static rotor resistance control and slip power - Advanced control of Induction Motor Drives.

MODULE IV CONTROL OF SYNCHRONOUS MOTOR DRIVE L:9

Synchronous motor drives – Speed control of three-phase synchronous motor – drives Voltage source inverter – current source inverter fed synchronous motor drive – Z - source inverter fed synchronous motor – Cyclo-converter fed synchronous motor - Control Strategies for Industrial and EV Drives.

MODULE V DIGITAL CONTROL OF DRIVES L:9

Microprocessor based control of drives, Phase Locked Loop, Digital technique in speed control, Selection of drives and control schemes for paper mills, Selection of drives for lifts and cranes- Digital Hardware Platforms for Drive Control.

L – 45; T – 0; P – 0; Total Hours:45

TEXT BOOKS:

1. R. Krishnan, Electrical Motor Drives, PHI 2003.
2. G.K.Dubey, Power semiconductor controlled drives, Prentice Hall- 2000.
3. G.K.Dubey, Fundamentals of Electrical Drives, Narosa-1999.

REFERENCES:

1. A. Nasar, Boldea , Electrical Drives, Second Edition, CRC Press, 2006.
2. M. A. El Sharkawi , Fundamentals of Electrical Drives , Thomson Learning 2000.
3. W. Leohnard, Control of Electric Drives, Springer, 2001.
4. Murphy and Turnbull, Power Electronic Control of AC motors, Pergamon Press, 1973.
5. Vedam Subrahmaniam, Electric Drives, Tata McGraw Hill, 2000.

COURSE OUTCOMES: At the end of this course, the student will be able to:

COB1: Analyze the system considering the steady state and dynamic characteristics.

COB2: Design a closed loop control of AC and DC drives.

COB3: Analyze and compare the performance of classical and modern induction motor drive systems.

COB4: Distinguish between synchronous and induction motor drives and understand the fundamentals of converter-fed synchronous motor drives.

COB5: Implement microprocessor-based control and select suitable drives for various industrial applications.

Board of Studies (BoS):
21st meeting of BoS of EEE held on 23.06.2025

Academic Council:
24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	-	-	-	-	-	-	2	3	3
CO2	3	3	3	3	3	-	-	-	-	-	-	2	3	3
CO3	3	3	3	3	3	-	-	-	-	-	-	2	3	3
CO4	3	3	3	3	3	-	-	-	-	-	-	2	2	2
CO5	3	3	3	3	3	-	-	-	-	-	-	2	3	3

*** Legend: L – Low (1), M – Medium (2), H – High (3).**

SDG 3: Good health and well-being.

Statement: Understanding of the fundamentals of power semiconductor devices can help in designing systems to promote good health and wellbeing.

SDG 5: Gender equality

Statement: Acquiring the knowledge to help and overcome the gender barriers in work place.

SDG 8: Decent work and economic growth

Statement: The learners of this course can get decent work and earn financial benefits.

EEFY 018	**ENERGY MANAGEMENT AND AUDITING**	**L**	**T**	**P**	**C**
SDG: 7,9,12,13		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To understand the significance of energy management in industrial and commercial sectors.

COB2: To understand various energy costs, performance assessments, and methods to optimize energy resources.

COB3: To learn a systematic approach for conducting energy audits.

COB4: To identify energy conservation opportunities in various systems.

COB5: To study the use of various instruments for accurate and safe energy audits.

MODULE I FUNDAMENTALS OF ENERGY MANAGEMENT AND AUDITING L:10

Need and importance of Energy Conservation and Management in industrial and commercial sectors – Definitions and Objectives of Energy Management – General Principles of Managing Energy Systems focusing on efficiency and optimization – Types and Scope of Energy Audits: Preliminary and Detailed – Roles and Responsibilities of Energy Managers and Auditors – Overview of the Energy Conservation (Amendment) Act 2022: Updated Legal and Regulatory Frameworks – Bureau of Energy Efficiency (BEE) and its Key Functions – Recent Policy Developments: National Energy Efficiency Mission, Energy Efficiency Obligations, and Strategic Directions in Energy Management.

MODULE II ENERGY COSTS, PERFORMANCE ASSESSMENT AND STRATEGIES L:8

Understanding different types of Energy Costs including Direct and Indirect – Energy Performance Assessments: Energy Intensity and Productivity Indicators – Benchmarking Methods – Matching Energy Usage to Requirements – Maximizing System Efficiency – Fuel Substitution Strategies – Life Cycle Costing – Techno-Economic Feasibility Assessments for Energy Optimization.

MODULE III ENERGY AUDIT METHODOLOGY AND ANALYSIS TECHNIQUES L:9

Systematic Approach to Energy Audits – Data Collection Methods – Survey Procedures – Use of Checklists and Loggers – Analytical Techniques: Mass and Energy Balance, Heat Transfer Calculations, Process Simulations – Analysis of Electrical Load Characteristics – Incremental Cost Analysis – Load Curve Techniques.

MODULE IV IDENTIFICATION AND EVALUATION OF ENERGY SAVING OPPORTUNITIES L:10

Identification of Energy Conservation Opportunities in Electrical, Thermal, and Auxiliary Systems – Compressed Air, Lighting, and HVAC Systems – Analysis of Economic and Non-Economic Factors Influencing Energy-Saving Decisions – Energy Economic Analysis: Payback Period, Net Present Value (NPV), Internal Rate of Return (IRR), Depreciation, and Tax Benefits – Preparation of Professional Audit Reports and Energy Balance Sheets.

MODULE V INSTRUMENTS AND TOOLS FOR ENERGY AUDITING L:8

Introduction to Monitoring Parameters: Temperature, Pressure, Flow, Illuminance, Power Factor – Instruments for Energy Audits: Power Analysers, Clamp Meters, Flow Meters, Infrared Thermography Tools, Lux Meters – Importance of Calibration, Accuracy, and Safety in Measurements – Advancements in IoT-Based Energy Monitoring Tools and Portable Energy Audit Kits.

L – 45; T – 0; P – 0; Total Hours: 45

TEXT BOOKS:

1. *B.L. Capehart, W.C. Turner, W.J. Kennedy,* Guide to Energy Management*, CRC Press, 9th Edition, 2020.*

REFERENCES:

1. *Bureau of Energy Efficiency (BEE),* Energy Manager Guide Books – Vol. I to IV*, BEE, Ministry of Power, Government of India.*

2. *Amit Kumar Tyagi,* Handbook on Energy Audits and Management*, TERI Press, 2017.*
3. *P.W. O'Callaghan,* Energy Management*, McGraw Hill, 2021.*
4. *Y.P. Abbi, Shashank Jain,* Handbook on Energy Audit and Environment Management*, TERI, 2006.*
5. *S. Doty, W. Turner,* Energy Management Handbook*, Fairmont Press, 8th Edition, 2013.*
6. *F. Kreith, D. Yogi Goswami,* Energy Management and Conservation Handbook*, CRC Press, 2008.*
7. *S.C. Tripathy,* Electric Energy Utilization and Conservation*, Tata McGraw Hill, 1991.*
8. *D.W. Brown,* Energy Audit of Building Systems*, CRC Press, 2001.*

COURSE OUTCOMES: At the end of this course, students will be able to:

CO1: implement energy management in industrial and commercial sectors.

CO2: compare various energy costs, performance assessments, and methods to optimize energy resources.

CO3: implement systematic approach for conducting energy audits.

CO4: identify energy conservation opportunities in various systems.

CO5: Measure energy parameters using appropriate instruments.

Board of Studies (BoS):
21st meeting of BoS of EEE held on 23.06.2025

Academic Council:
24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	3	2	-	-	3	-	-	-	-	1	-	3	3
CO2	2	3	3	-	-	2	-	-	-	3	2	-	3	2
CO3	3	3	-	3	3	-	-	-	-	-	-	3	3	2
CO4	2	3	-	2	2	-	-	-	3	3	2	2	3	-
CO5	3	-	-	3	3	-	-	-	-	-	2	3	3	-

*** Legend: L – Low (1), M – Medium (2), H – High (3).**

SDG 7: Ensure access to affordable, reliable, sustainable, and modern energy for all.

Statement: Effective energy management and auditing promote the efficient use of energy resources, advancing access to clean and sustainable energy while reducing waste.

SDG 9: Build resilient infrastructure, to support economic development and human well-being with a focus on affordable and equitable access for all.

Statement: The implementation of advanced energy auditing tools and management techniques supports sustainable industrialization and promotes economic growth through optimized energy use.

SDG 12: Ensure sustainable consumption and production patterns.

Statement: Energy conservation and efficiency assessments foster responsible consumption, minimizing environmental impact and encouraging sustainable production practices.

SDG 13: Take urgent action to combat climate change and its impacts.

Statement: Improving energy efficiency through systematic audits and regulatory compliance reduces greenhouse gas emissions, contributing to climate change mitigation.

EEFY 019	**ELECTRIC VEHICLES**	**L**	**T**	**P**	**C**
SDG: 7		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To introduce the fundamentals, need, and types of electric vehicles with a focus on environmental and market perspectives.

COB2: To impart knowledge on energy storage systems.

COB3: To explore various motors and drives used in electric vehicles and their control strategies.

COB4: To understand different EV charging technologies, power converter designs, and grid integration aspects.

COB5: To enable students to model and design hybrid electric drivetrain systems considering practical parameters.

MODULE I INTRODUCTION TO ELECTRIC VEHICLE L:7

Overview traditional vehicles -need for EVs - History and evolution of electric vehicles - EV architecture Vs conventional vehicles -Types of electric vehicles: BEV, HEV, PHEV, FCEV - Environmental impact and sustainability benefits - Global and local EV markets and policy frameworks.

MODULE II ENERGY STORAGE L:8

Energy storage requirements, Battery parameters, Types of Batteries, Modelling of Battery, Fuel Cell basic principle and operation, Types of Fuel Cells, PEMFC and its operation, Modelling of PEMFC, Supercapacitors – Battery management system.

MODULE III MOTORS AND DRIVES FOR EV L:10

Traction motor characteristics, Tractive effort and Transmission requirement-DC motor drives and speed control - Induction motor drives - Permanent Magnet Motor Drive - Switch Reluctance Motor Drive for Electric Vehicles - Configuration and control of Drives.

MODULE IV CHARGING TECHNOLOGIES L:10

Charging technologies: Level 1, 2, DC fast charging - Standards and protocols - Grid integration and smart charging - Converters for Charging -Z-converter, Isolated bidirectional DC-DC converter, Design of Z- converter for battery charging, High-frequency transformer based isolated charger topology, Transformer less topology.

MODULE V DESIGN OF HYBRID ELECTRIC DRIVE TRAIN L:10

Tractive Effort - Modeling Vehicle Acceleration - Modeling Electric Vehicle Range - Aerodynamic Considerations - Transmission Efficiency –Series Hybrid Electric Drive Train Design: Operating patterns - control strategies - sizing of major components - power rating of traction motor - power rating of engine/generator - design of PPS. Parallel Hybrid Electric Drive Train Design: Control strategies - design of engine power capacity - design of electric motor drive capacity - transmission design - energy storage design.

L – 45; T – 0; P – 0; Total Hours: 45

TEXT BOOKS:

1. James Larminie and John Lowry, “Electric Vehicle Technology Explained”, John Wiley & Sons Ltd, 2003.
2. Iqbal Husain, “Electric and Hybrid Vehicles”, Design Fundamentals, CRC Press,3rd Edition, 2021.
3. M. Ehsani, Y. Gao, S. Gay and A. Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles” , 3rd Edition, CRC Press, 2018.

REFERENCES:

1. James Larminie and John Lowry, *Electric Vehicle Technology Explained*, Wiley, 2nd Edition, 2012.
2. Sheldon S. Williamson, *Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles*, Springer, 2013.
3. RuiXiong, *Battery Management Systems and SOC Development*, Springer, 2020.

COURSE OUTCOMES: At the end of the course, the students will be able to:

CO1: Understand the fundamental principles, types, and benefits of electric vehicles in modern transportation systems.

CO2: Analyze and model various energy storage systems including batteries and fuel cells for EV applications

CO3: Select appropriate motor drive technologies and configure control systems for efficient EV operation

CO4: Evaluate charging technologies, converter topologies, and their integration with the electric grid

CO5: Design hybrid electric drive train systems considering vehicle dynamics and energy efficiency.

Board of Studies (BoS):

21st meeting of BoS of EEE held on 23.06.2025

Academic Council:

24th AC held on 26.08.2025

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CO1	3	2	1	1	1	2	-	-	-	-	-	3	3	3
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CO3	3	2	3	2	3	1	-	-	-	-	-	3	3	3
CO4	3	3	2	2	3	2	-	-	-	-	-	3	3	3
CO5	3	3	3	3	3	1	-	-	-	-	-	3	3	3

*** Legend: L – Low (1), M – Medium (2), H – High (3).**

SDG: Goal 7 – Affordable and Clean Energy

The course "Electric Vehicles" supports SDG 7: Affordable and Clean Energy by promoting the adoption of electric mobility powered by renewable energy sources, reducing dependence on fossil fuels. It equips students with knowledge of energy-efficient storage systems, smart charging technologies, and grid integration to enhance energy sustainability. By fostering innovation and accessibility in clean transportation, the course contributes to a more affordable and reliable energy future.