K.S.R.M.
COLLEGE OF ENGINEERING

(UGC - Autonomous)
Accredited by NAAC with A+ Grade & B.Tech. (EEE, ECE, CSE, CE and ME) Programs by NBA
An ISO 9001:2015, 14001: 2015 & 50001: 2018 Certified Institution

ACADEMIC REGULATIONS (R25PG)
COURSE STRUCTURE AND SYLLABI

(Effective for the students admitted into I year
from the academic year 2025 -2026 onwards)

MASTER OF TECHNOLOGY (M.Tech.)
POWER SYSTEMS
(REGULAR, FULL-TIME)

K.S.R.M. COLLEGE OF ENGINEERING

VISION:

To evolve as a centre of repute for providing quality academic programs amalgamated with creative learning and research excellence to produce graduates with leadership qualities, ethical and human values to serve the nation.

MISSION:

M1. Provide high quality education with enriched curriculum blended with impactful Teaching-Learning practices.

M2. Promote Research, Entrepreneurship and Innovation through industry collaborations.

M3. Produce highly competent professional leaders for contributing to socio-economic development of the region and the nation.

DEPARTMENT
OF
ELECTRICAL AND ELECTRONICS ENGINEERING

VISION:

To emerge as a department of excellence in the domain of Electrical and Electronics Engineering producing globally competent engineers with research acumen having moral and social values.

MISSION:

M1. To offer education with skill-based curriculum through innovative pedagogy, enabling the students to engage in lifelong learning.

M2. To establish industry interactions for creating research-oriented culture to invoke the desire among the students for pursuing successful career.

M3. To maintain sustainable environment of learning in which students acquire knowledge and imbibed with social and ethical values.

M.Tech Power Systems

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

PEO1. To equip graduates with advanced knowledge and analytical skills in power systems for solving complex engineering problems and conducting quality research.

PEO2. To enable postgraduates to contribute effectively in power utilities, research organizations, academia, and industries by applying appropriate tools and technologies.

PEO3. To foster innovation and promote lifelong learning in emerging areas of power system engineering, smart grids, and renewable energy integration.

PEO4. To develop professional ethics, communication skills, and leadership qualities to work effectively in multidisciplinary teams and contribute to sustainable development.

PROGRAM OUTCOMES (POs):

After successful completion of the program, graduates will be able to

PO1. Apply advanced concepts of power systems to analyze and solve complex engineering problems using modern tools and techniques.

PO2. Conduct research and investigations to address challenges in power generation, transmission, distribution, and integration of renewable energy systems.

PO3. Design efficient and sustainable power system components and processes that meet performance, safety, and environmental requirements.

PO4. Use advanced software, simulation tools, and project management skills for analyzing and executing power system projects.

PO5. Communicate technical information effectively and uphold ethical standards in professional practice and decision-making.

PO6. Pursue lifelong learning and understand the social, environmental, and global impact of power engineering solutions.

K.S.R.M. COLLEGE OF ENGINEERING

(AUTONOMOUS)

Academic Regulations of M.Tech. (Full Time/Regular) Programme

(Effective for the students admitted into I year from the Academic Year 2025-26 and onwards)

K.S.R.M. College of Engineering (KSRMCE) offers **Two** Years (**Four** Semesters) full-time Master of Technology (M.Tech.) Degree programme, under Choice Based Credit System (CBCS) in different branches of Engineering and Technology with different specializations.

The affiliating university Jawaharlal Nehru Technological University Anantapur shall confer M.Tech. degree on candidates who are admitted to the programme and fulfill all the requirements for the award of the degree.

1. Award of the M.Tech. Degree

A student will be declared eligible for the award of the M.Tech. degree if he/she fulfils the following:

1.1 Pursues a course of study for not less than two academic years and not more than four academic years.

1.2 Registers for 75 credits and secures all 75 credits.

2. Students, who fail to fulfil all the academic requirements for the award of the degree within four academic years from the year of their admission, shall forfeit their seat in M.Tech. course and their admission stands cancelled.

3. Programme of Study:

The following M.Tech. Specializations are offered at present in different branches of Engineering and Technology and are as follows:

Discipline	**Name of the Specialization**	**Code**
Civil Engineering	Geo Technical Engineering	12
Electrical and Electronics Engineering	Power Systems	52
Mechanical Engineering	Renewable Energy	99
Computer Science and Engineering	Artificial Intelligence and Data Science	98
Electronics & Communication Engineering	Embedded Systems & VLSI	84

4. Eligibility for Admissions:

4.1 Admission to the M. Tech Program shall be made subject to the eligibility, qualification and specialization prescribed by the A.P. State Government/University from time to time.

4.2 Admissions shall be made either on the basis of either the merit rank or Percentile obtained by the qualified student in the relevant qualifying GATE Examination/ the merit rank obtained by the qualified student in an entrance test conducted by A.P. State Government (APPGECET) for M.Tech. programmes an entrance test conducted by University/on the basis of any other exams approved by the University, subject to reservations as laid down by the Govt. from time to time.

5. Programme related terms:

5.1 ***Credit:*** A unit by which the course work is measured. It determines the number of hours of instructions required per week. One credit is equivalent to one hour of teaching (Lecture/Tutorial) or two hours of practical work/field work per week.

Credit definition:

1 Hr. Lecture (L) per week	1 credit
1 Hr. Tutorial (T) per week	1 credit
1 Hr. Practical (P) per week	0.5 credit

5.2 ***Academic Year:*** Two consecutive (one odd + one even) semesters constitute one academic year.

5.3 ***Choice Based Credit System (CBCS):*** The CBCS provides choice for students to select from the prescribed courses.

6. Programme Pattern:

6.1 Total duration of the of M.Tech. programme is two academic years

6.2 Each academic year of study is divided into two semesters.

6.3 Each Semester shall be of 22 weeks duration (inclusive of Examinations), with a minimum of 90 instructional days per semester.

6.4 The student shall not take more than four academic years to fulfill all the academic requirements for the award of M.Tech. degree from the date of commencement of first year first semester, failing which the student shall forfeit the seat in M.Tech. programme.

6.5 The medium of instruction of the programme (including examinations and project reports) will be in English only.

6.6 All subjects/courses offered for the M.Tech. degree programme are broadly classified as follows:

S. No.	Broad Course Classification	Course Category	Description
1.	Core Courses	Foundational & Professional Core Courses (PC)	Includes subjects related to the parent discipline / department / branch of Engineering/specialization.
2.	Elective Courses	Program Elective Courses (PE)	Includes elective courses related to the parent discipline / department / branch of Engineering
		Open Elective Courses (OE)	Elective courses which include inter-disciplinary courses or courses in an area outside the parent discipline which are of importance in the context of special skill development
3.	Mandatory Courses	Quantum Technology and Application	To understand importance of latest technologies, research and process of creation of patents through research
		Research methodology & IPR	
4.	Integrated Experiential Learning Courses	Skill Enhancement courses (SE)	Interdisciplinary / job-oriented / domain courses which are relevant to the industry
		Comprehensive Viva	To test the overall domain knowledge
		Short Term Industry Internship	To provide real time exposure
		Dissertation	To provide application of domain knowledge to solve real problems

S. No.	Broad Course Classification	Course Category	Description
5.	Audit Courses	Mandatory non-credit courses	Covering courses of developing desired attitude among the learners.

6.7 The college shall take measures to implement Virtual Labs (https://www.vlab.co.in) which provide remote access to labs in various disciplines of Engineering and will help student in learning basic and advanced concept through remote experimentation. Student shall be made to work on virtual lab experiments during the regular labs.

6.8 A faculty advisor/mentor shall be assigned to each specialization to advise students on the programme, its Course Structure and Curriculum, Choice of Courses, based on his competence, progress, pre-requisites and interest.

6.9 Preferably 25% course work for the theory courses in every semester shall be conducted in the blended mode of learning.

7. Attendance Requirements:

7.1 A student shall be eligible to appear for the Semester-End examinations if he/she acquires i) a minimum of 50% attendance in each course and ii) 75% of attendance in aggregate of all the courses.

7.2 Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester may be granted by the College Academic Committee.

7.3 Condonation of shortage of attendance shall be granted only on genuine and valid reasons on representation by the candidate with supporting evidence

7.4 Students whose shortage of attendance is not condoned in any semester are not eligible to take their semester-end examination of that class.

7.5 A stipulated fee shall be payable towards condonation of shortage of attendance.

7.6 A student will not be promoted to the next semester unless he satisfies the attendance requirements of the present semester. They may seek re-admission into that semester when offered next.

7.7 If any candidate fulfils the attendance requirement in the present semester, he shall not be eligible for readmission into the same class.

7.8 If the learning is carried out in blended mode (both offline & online), then the total attendance of the student shall be calculated considering the offline and online attendance of the student.

8. Evaluation – Distribution and Weightage of Marks:

The performance of a student in each semester shall be evaluated course - wise (irrespective of credits assigned), for a maximum of 100 marks for theory and 100 marks for practical, based on Internal Evaluation and Semester-End Examination.

8.1 There shall be five units in each of the theory courses. For the theory courses 60 marks will be for the Semester-End Examination and 40 marks will be for Internal Evaluation.

8.2 Two Internal Examinations shall be conducted for 30 marks each, one in the middle of the Semester and the other immediately after the completion of instruction period. The other 10 marks is awarded for continuous assessment in the form of assignments, quizzes, open book examination, presentation, etc. First mid examination shall be conducted for I & II units of the syllabus and second mid examination for III, IV & V units. Each mid

exam shall be conducted for a total duration of 120 minutes with 3 questions (without choice) and each question carries 10 marks. Final Internal marks for a total of 40 marks shall be arrived at by considering the marks secured by the student in both the internal examinations with 80% weightage to the better internal exam and 20% to the other.

8.3 The following pattern shall be followed in the End Examination:

i. Five questions shall be set from each of the five units with either/or type for 12 marks each.
ii. All the questions have to be answered compulsorily.
iii. Each question may consist of one, two or more sub-questions.

8.4 For practical courses, 60 marks shall be for the Semester-End Examinations and 40 marks will be for internal evaluation based on the day-to-day performance.

The internal evaluation based on the day-to-day work-10 marks, record- 10 marks and the remaining 20 marks to be awarded by conducting an internal laboratory test. The semester-end examination shall be conducted by the examiners, with a breakup mark of Procedure-10, Experimentation-25, Results-10, Viva-Voce-15.

8.5 There shall be Mandatory **Audit courses** in I & II semesters for zero credits. There is no external examination for audit courses. However, attendance shall be considered while calculating aggregate attendance and student shall be declared to have passed the mandatory course only when he/she secures 50% or more in the internal examinations. In case, the student fails, a re-examination shall be conducted for failed candidates for 40 marks for every six months/semester satisfying the conditions mentioned in item 1 & 2 of the regulations.

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

8.7 In case the candidate does not secure the minimum academic requirement in any of the courses he/she has to reappear for the Semester-End Examination either supplementary or regular in that course or repeat the course when next offered or do any other specified course as may be required.

8.8 The laboratory records and mid semester test papers shall be preserved for a minimum of 3 years in the respective institutions as per the University norms and shall be produced to the Committees of the University as and when the same are asked for.

9. Credit Transfer Policy

As per University Grants Commission (Credit Framework for Online Learning Courses through SWAYAM) Regulation, 2016, students are allowed to do up to a maximum of 40% of the Professional and Open Electives in a semester through SWAYAM/SWAYAM Plus.

9.1 The college offers credit mobility for MOOCs and give the equivalent credit weightage to the students for the credits earned through online learning courses through SWAYAM platform.

9.2 The online learning courses available on the SWAYAM platform will be considered for credit transfer. SWAYAM course credits are as specified in the platform

9.3 Student registration for the MOOCs shall be only through the college, it is mandatory for the student to share necessary information with the college

9.4 The institution will list out the courses to be permitted for credit transfer through

SWAYAM. However, while selecting courses in the online platform institution would essentially avoid the courses offered through the curriculum in the offline mode.

9.5 The institution will notify at the beginning of semester the list of the online learning courses eligible for credit transfer in the forthcoming Semester.

9.6 Students may register for an 8-week (2 credits) or 12-week (3 credits) SWAYAM / SWAYAM plus course with the approval of the Head of the Department (HoD).

9.7 Examination fees, if applicable, shall be borne by the student. Pass marks and grading will be as per the JNTUA academic regulations.

9.8 A student must get minimum 40% marks for assignments and quizzes on the SWAYAM/ SWAYAM plus platform to be eligible for the semester-end examination. The students who are unable to get minimum internal marks in SWAYAM/ SWAYAM plus platform, they have to re-register for the course in subsequent semester through SWAYAM/ SWAYAM plus platform.

9.9 The semester-end exam may be conducted by the National Testing Agency (NTA), the National Programme on Technology Enhanced Learning (NPTEL) or the College during the regular term-end exams. Evaluation shall comprise 60% weightage for the semester-end examination and 40% for assignments and quizzes conducted by the SWAYAM/ SWAYAM plus course coordinator. The student has to get 50% marks for internal and external with minimum of 40% marks in the external examination to declare them as pass.

9.10 The institution also ensures that the student completes the course and produces the course completion certificate as per the academic schedule given for the regular courses in that semester. However, the credits will be transferred to the students who got minimum 50% marks with 40% marks in the external examination

9.11 The institution will designate a faculty member as a Mentor for each course to guide the students from registration till completion of the credit course.

9.12 The college will ensure no overlap of SWAYAM MOOC exams with that of the semester-end examination schedule. In case of delay in SWAYAM results, the college will re-issue the marks sheet for such students.

9.13 Student pursuing courses under MOOCs shall acquire the required credits only after successful completion of the course and submitting a certificate issued by the competent authority along with the minimum 50% of marks and grades.

9.14 The institution maintains the following in the examination section and submits as and when demanded by the university:

a) List of students who have passed MOOC courses in the current semester along with the certificates of completion.
b) Undertaking form filled by the students for credit transfer.

9.15 The college will resolve any issues that may arise in the implementation of this policy from time to time and shall review its credit transfer policy in the light of periodic changes brought by UGC, SWAYAM, NPTEL and state government.

Note: Students are also be permitted to register for MOOCs offered through online platforms other than SWAYAM NPTEL. In such cases, credit transfer shall be permitted only after seeking approval of the Principal with the recommendations of the concerned HoD and Dean, Academics at least three months prior to the commencement of the semester.

10. Re-registration for Improvement of Internal Evaluation Marks:

A candidate shall be given one chance to re-register for each course provided the internal marks secured by a candidate are less than 50% and has failed in the end examination

10.1 The candidate should have completed the course work and obtained examinations results for **I, II and III** semesters.

10.2 The candidate should have passed all the courses for which the Internal Evaluation marks secured are more than 50%.

10.3 Out of the courses the candidate has failed in the examination due to Internal Evaluation marks secured being less than 50%, the candidate shall be given one chance for each Theory course and for a maximum of **three** Theory courses for Improvement of Internal evaluation marks.

10.4 The candidate has to re-register for the chosen courses and fulfill the academic requirements.

10.5 For re-registration, the candidates have to apply to the Principal through the respective HoD by paying the requisite fees and get approval from the Principal before the start of the semester in which re-registration is required

10.6 In the event of availing the Improvement of Internal evaluation marks, the internal evaluation marks as well as the Semester-End Examinations marks secured in the previous attempt(s) for the reregistered courses stand cancelled.

11. Evaluation of Project/Dissertation Work:

The Project work shall be initiated at the beginning of the III-Semester and the duration of the Project is of two semesters. Evaluation of Project work is for 300 marks with 200 marks for internal evaluation and 100 marks for external evaluation. Progress of the project work is monitored through three reviews:

- Project review – I at the beginning of the III semester for zero marks
- Project review – II at the end of the third semester for 100 marks
- Project review – III before submission of the thesis i.e., end of the IV semesters for 100 marks

External evaluation of final Project work viva voce in IV semester shall be for 100 marks.

A Project Review Committee (PRC) shall be constituted with the Head of the Department as Chairperson, Project Supervisor and one faculty member of the department offering the M.Tech. programme.

11.1 A candidate is permitted to register for the Project Work in III Semester after satisfying the attendance requirements in all the courses, both theory and laboratory (in I & II semesters).

11.2 A candidate is permitted to submit Project dissertation with the approval of PRC. The candidate has to pass all the theory, practical and other courses before submission of the Thesis.

11.3 Project work shall be carried out under the supervision of teacher in the parent department concerned.

11.4 A candidate shall be permitted to work on the project in an industry/research organization on the recommendation of the Head of the Department. In such cases, one

of the teachers from the department concerned would be the internal guide and an expert from the industry/research organization concerned shall act as co-supervisor/external guide. It is mandatory for the candidate to make full disclosure of all data/results on which they wish to base their dissertation. They cannot claim confidentiality simply because it would come into conflict with the Industry's or R&D laboratory's own interests. A certificate from the external supervisor is to be included in the dissertation.

11.5 Continuous assessment of Project Work - I and Project Work – II in III & IV semesters respectively will be monitored by the PRC.

11.6 The candidate shall submit status report by giving seminars in three different phases (two in III semester and one in IV semester) during the project work period. These seminar reports must be approved by the PRC before submission of the Project Thesis.

11.7 After registration, a candidate must present in Project Review - I, in consultation with his Project Supervisor, the title, objective and plan of action of his Project work to the PRC for approval within four weeks from the commencement of III Semester. Student shall initiate the project work, only after obtaining the approval of the PRC.

11.8 The Project Review - II in III semester carries internal marks of 100. Evaluation should be done by the PRC for 50 marks and the Supervisor will evaluate the work for the other 50 marks. The Supervisor and PRC will examine the Problem Definition, Objectives, Scope of Work, Literature Survey in the same domain and progress of the Project Work.

11.9 A candidate has to secure a minimum of 50% of marks to be declared successful in Project Review - II. Only after successful completion of Project Review – II, candidate shall be permitted for Project Work Review – III in IV Semester. The unsuccessful students in Project Review - II shall reappear after three months.

11.10 The Project Review - III in IV semester carries 100 internal marks. Evaluation should be done by the PRC for 50 marks and the Supervisor will evaluate it for the other 50 marks. The PRC will examine the overall progress of the Project Work and decide whether or not eligible for final submission. A candidate has to secure a minimum of 50% of marks to be declared successful in Project Review - III. If student fails to obtain the required minimum marks, he/she has to reappear for Project Review - III after a month.

11.11 For the approval of PRC, the candidate shall submit the draft copy of dissertation to the Head of the Department and make an oral presentation before the PRC.

11.12 After approval from the PRC, the student is permitted to submit a report. The dissertation report will be accepted only when the plagiarism is within 30% checked through Turnitin software (repository mode). The plagiarism report shall be submitted along with the dissertation report.

11.13 Research paper related to the Project Work shall be published in an SCI / SCIE / ESCI / Scopus or in conference proceedings with ISBN number organized by professional societies such as IEEE, IEI, etc.

11.14 After successful plagiarism check and publication of research paper, three copies of the dissertation certified by the supervisor and HOD shall be submitted to the College.

11.15 The dissertation shall be adjudicated by an external examiner selected by the College. For this, a panel of three examiners shall be submitted by the supervisor concerned and department head for each student. However, the dissertation will be adjudicated by one examiner nominated by the Principal.

11.16 If the report of the examiner is not satisfactory, the candidate shall revise and resubmit the dissertation, in the time frame as decided by the PRC. If report of the examiner is unfavorable again, the thesis shall be summarily rejected. The candidate has to reregister for the project and complete the project within the stipulated time after taking the approval from the Principal.

11.17 If the report of the examiner is satisfactory, the Head of the Department shall coordinate and make arrangements for the conduct of Project Viva voce exam.

11.18 The Project Viva voce examinations shall be conducted by a board consisting of the Supervisor, Head of the Department and the external examiner who has adjudicated the dissertation. For Dissertation Evaluation (Viva voce) in IV Sem. there are external marks of 100 and it is evaluated by external examiner. The candidate has to secure a minimum of 50% marks in Viva voce exam.

11.19 If he fails to fulfill the requirements as specified, he will reappear for the Project Viva voce examination only after three months. In the reappeared examination also, if he fails to fulfill the requirements, he will not be eligible for the award of the degree.

12 Industry Internships:

Industry internship either onsite or virtual with a minimum of 06-08 weeks duration, done at the end of 1st year second semester. It shall be completed in collaboration with local industries, Govt. Organizations, construction agencies, Power projects, software MNCs or any industries in the areas of concerned specialization of the PG program. The student shall register for the internship as per course structure after commencement of academic year.

Evaluation of the summer internships shall be through the departmental committee. A student will be required to submit a summer internship report to the concerned department and appear for an oral presentation before the departmental committee comprising of Head of the Department, Mentor/Supervisor of the internship and a senior faculty member of the department. A certificate of successful completion from industry shall be included in the report. Internship will be evaluated for 100 marks with 50 marks for the report evaluated by the mentor and 50 marks for oral presentation. A student should secure minimum 50% of marks for successful completion. In case, if a student fails, he/she shall reappear as and when semester supplementary examinations are conducted by the College.

13 Comprehensive Viva

A Comprehensive Viva shall be conducted after the II Semester examinations for 100 marks by a committee consisting of the Head of the Department, one senior faculty member of the same specialization, and an external subject expert appointed by the Principal. The student must secure a minimum of 50% marks to be declared as passed

14 Credits for Co-curricular Activities

A Student should earn 01 credits under the head of co-curricular activities, viz., attending Conference, Scientific Presentations and Other Scholarly Activities. The guidelines for awarding Credits for Co-curricular Activities are detailed in the following Table.

Name of the Activity	Maximum Credits / Activity
Participation in National Level Seminar / Conference / Workshop / Training programs (related to the specialization of the student)	0.5
Participation in International Level Seminar / Conference / Workshop / Training programs held outside India (related to the specialization of the student)	1
Academic Award/Research Award from State Level / National Agencies	0.5
Academic Award / Research Award from International Agencies	1
Research / Review Publication in National Journals (Indexed in Scopus / Web of Science)	0.5
Research / Review Publication in International Journals with Editorial board outside India (Indexed in Scopus / Web of Science)	1

Note:

i) Credit shall be awarded only for the first author. Certificate of attendance and participation in a Conference/Seminar is to be submitted for awarding credit. A minimum participation of five days is required to earn the necessary credits. Alternatively, the student may attend five different one day programs to meet this requirement.

ii) Certificate of attendance and participation in workshops and training programs (Internal or External) is to be submitted for awarding credit. The total duration should be at least one week.

iii) Participation in any activity shall be permitted only once for acquiring required credits under cocurricular activities

15 Grading:

As a measure of the student's performance, a 10-point Absolute Grading System using the following Letter Grades and corresponding percentage of marks shall be followed:

After each course is evaluated for 100 marks, the marks obtained in each course will be converted to a corresponding letter grade as given below, depending on the range in which the marks obtained by the student fall.

Structure of Grading of Academic Performance

Range in which the marks in the course fall	Grade	Grade points Assigned
≥ 90	S (Superior)	10
≥ 80 < 90	A (Excellent)	9
≥ 70 < 80	B (Very Good)	8
≥ 60 < 70	C (Good)	7
≥ 50 < 60	D (Pass)	6
< 50	F (Fail)	0
Absent	Ab (Absent)	0

i) A student obtaining Grade "F" or Grade "Ab" in a course shall be considered failed and will be required to reappear for that course when it is offered the next supplementary examination.

ii) For noncredit audit courses, "Satisfactory" or "Unsatisfactory" shall be indicated instead of the letter grade and this will not be counted for the computation of SGPA / CGPA / Percentage.

Computation of Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

The Semester Grade Point Average (SGPA) is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e.,

$SGPA = \Sigma (C_i \times G_i)/\Sigma C_i$

where, C_i is the number of credits of the i^{th} course and G_i is the grade point scored by the student in the i^{th} course.

i) The Cumulative Grade Point Average (CGPA) will be computed in the same manner considering all the courses undergone by a student over all the semesters of a program, i.e.,
   $CGPA = \Sigma (C_j \times S_i)/ \Sigma C_j$
   where "S_i" is the SGPA of the i^{th} semester and C_j is the total number of credits up to that semester.
ii) Both SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.
iii) While computing the SGPA the courses in which the student is awarded Zero grade points will also be included.

Grade Point: It is a numerical weight allotted to each letter grade on a 10-point scale. Letter Grade: It is an index of the performance of students in a said course. Grades are denoted by letters S, A, B, C, D and F.

16 Award of Class:

After a student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of M. Tech. Degree, he shall be placed in one of the following three classes:

Class Awarded	CGPA to be secured
First Class with Distinction	≥7.5%
First Class	< 7.5≥ 6.5
Pass Class	< 6.5

17 Exit Policy:

The student shall be permitted to exit with a PG Diploma based on his/her request to the university through the respective institution at the end of first year subject to passing all the courses in first year.

The Academic Council shall resolve any issues that may arise in the implementation of this policy from time to time and shall review the policy in the light of periodic changes brought by UGC, AICTE and State government.

18 Withholding of Results:

If the candidate has any case of in-discipline pending against him/her, the result of the candidate shall be withheld, and he/she will not be allowed/promoted into the next higher semester. The issue of degree is liable to be withheld in such cases.

19 Transitory Regulations

Discontinued, detained, or failed candidates are eligible for readmission as and when the semester is offered after fulfilment of academic regulations. Candidates who have been detained for want of attendance or not fulfilled academic requirements or who have failed after having undergone the course in earlier regulations or have discontinued and wish to continue the course are eligible for admission into the unfinished semester from the date of commencement of class work with the same or equivalent courses as and when courses are offered, subject to Section 2 and they will follow the academic regulations into which they are readmitted.

20 General:

20.1 The academic regulations should be read as a whole for purpose of any interpretation.

20.2 Disciplinary action for Malpractice / improper conduct in examinations is appended.

20.3 There shall be no places transfer within the constituent colleges and affiliated colleges of Jawaharlal Nehru Technological University Anantapur.

20.4 Where the words “he”, “him”, “his”, occur in the regulations, they include “she”, “her”, “hers”.

20.5 In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Vice-Chancellor is final.

20.6 The College may change or amend the academic regulations or syllabi at any time and the changes or amendments shall be made applicable to all the students on rolls with effect from the dates notified by the College.

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RULES FOR

DISCIPLINARY ACTION FOR MALPRACTICES / IMPROPER CONDUCT IN EXAMINATIONS

S.No.	Nature of Malpractices / Improper conduct	Punishment
	If the candidate:	
1.(a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the course of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the course of the examination).	Expulsion from the examination hall and cancellation of the performance in that course only.
1.(b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that course only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the course of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the courses of that semester/year. The Hall Ticket of the candidate is to be cancelled and sent to the University.
3	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred for four consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. The performance of the original candidate who has been impersonated, shall be cancelled in all the courses of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining courses of that semester/year. The candidate is also debarred for four consecutive semesters from class work and all University examinations if his

S.No.	Nature of Malpractices / Improper conduct	Punishment
	If the candidate:	
		involvement is established. Otherwise, the candidate is debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.
4.	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that course and all the other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that course only.
6.	Refuses to obey the orders of the Chief Superintendent /Assistant - Superintendent /any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that course and all other courses the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the courses of that semester / year. If the candidate physically assaults the invigilator / officer-in-charge of the Examinations, then the candidate is also debarred and forfeits his/her seat. In case of outsiders, they will be handed over to the police and a police case is registered against them.

S.No.	Nature of Malpractices / Improper conduct	Punishment
	If the candidate:	
	of the examination.	
7	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that course and all the other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester/year. The candidate is also debarred and forfeits the seat.
9.	If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Student of the colleges expulsion from the examination hall and cancellation of the performance in that course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester / year. The candidate is also debarred and forfeits the seat. Person (s) who do not belong to the College will be handed over to police and, a police case will be registered against them.
10.	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester / year.
11.	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that course only or in that course and all other courses the candidate has appeared including practical examinations and project work of that semester / year

S.No.	Nature of Malpractices / Improper conduct	Punishment
	If the candidate:	
		examinations, depending on the recommendation of the committee.
12.	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the University for further action to award suitable punishment.	

1. Malpractices identified by squad or special invigilators
2. Punishments to the candidates as per the above guidelines.
3. Punishment for institutions: (if the squad reports that the college is also involved in encouraging malpractices)
4. A show cause notice shall be issued to the college.
5. Impose a suitable fine on the college.
6. Shifting the examination center from the college to another college for a specific period of not less than one year.

Note:

Whenever the performance of a student is cancelled in any course/courses due to Malpractice, he has to register for End Examinations in that course/courses consequently and has to fulfil all the norms required for the award of Degree.

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COURSE STRUCTURE
M.Tech. POWER SYSTEMS

I-SEMESTER

S.No.	Course Code	Course Title	Category	Hours per week			Credits
				L	T	P	
1.	2552101	Advanced Power System Protection	PC	3	0	0	3
2.	2552102	Power System Security and State Estimation	PC	3	0	0	3
3.	**Program Elective-I**		PE	3	0	0	3
	2552103	Energy Auditing and Management					
	2552104	Modelling and Analysis of HVDC Systems					
	2552105	Power System Optimization					
4.	**Program Elective-II**		PE	3	0	0	3
	2552106	Solar and Wind Energy Conversion Systems					
	2552107	Smart Grid Technologies					
	2552108	E-Mobility					
5.	2552151	Power System Analysis and Protection Lab	PC	0	0	4	2
6.	2552152	Power Systems Simulation Lab	PC	0	0	4	2
7.	2552153	AI Techniques in Electrical Engineering	SE	0	1	2	2
8.	2599171	Research Methodology and Intellectual Property Rights	MC	2	0	0	2
9.	**Audit Course–I**		AC	2	0	0	0
	2599181	English for Research Paper Writing					
	2512181	Disaster Management					
	2598181	Essence of Indian Traditional Knowledge					
			TOTAL	**16**	**1**	**10**	**20**

II-SEMESTER

S.No.	Course Code	Course Title	Category	Hours per week			Credits
				L	T	P	
1.	2552201	Power System Stability and Control	PC	3	0	0	3
2.	2552202	FACTS Controllers	PC	3	0	0	3
3.	**Program Elective-III**		PE	3	0	0	3
	2552203	Reactive power Compensation and Management					
	2552204	Modern Control Theory					
	2552205	Evolutionary Algorithms Applications in Power Engineering					
4.	**Program Elective-IV**		PE	3	0	0	3
	2552206	Power Quality					
	2552207	EV Charging Infrastructure and Technology					
	2552208	EHVAC Transmission systems					
5.	2552251	Renewable Energy Sources Lab	PC	0	0	4	2
6.	2552252	FACTS Devices Simulation Lab	PC	0	0	4	2
7.	2552253	Comprehensive Viva Voce	PC	0	0	0	2
8.	2598281	Quantum Technologies and Applications	MC	2	0	0	2
9.	**Audit Course–II**		AC	2	0	0	0
	25HS201	Pedagogy Studies					
	25HS202	Personality Development through Life Enlightenment Skills					
	25HS203	Yoga for Stress Management					
			TOTAL	**16**	**0**	**8**	**20**

* Students have to undergo an Industry Internship during Summer break in II-Semester for 06 to 08 weeks duration.

III-SEMESTER

S.No.	Course Code	Course Title	Category	Hours per week			Credits
				L	T	P	
1.	**Program Elective-V**		PE	3	0	0	3
	2552301	Restructured Power Systems					
	2552302	Machine Learning Applications in Power Engineering					
	2552303	Distributed Generation and Microgrid Control					
2.	2552351	Dissertation Phase–I	PR	0	0	20	10
3.	2552352	Industry Internship	PC	0	0	0	2
4.	2552353	Co-Curricular Activities	MC	0	0	0	1
5.		Open Elective	OE	3	0	0	3
			TOTAL	**6**	**0**	**20**	**19**

OPEN ELECTIVE

S.No.	Course Code	Course Name	Offered by Dept.
1	2512381	Green Buildings	Civil
2	2512382	Road Safety Engineering	
3	2598381	Advanced Data Structures and Algorithms	CSE
4	2598382	Cloud Computing	
5	2598383	AI Tools	
6	2584381	IoT and its Applications	ECE
7	2552381	Photovoltaic Systems	EEE
8	2599381	Integrated Product Design and Development	ME
9	25HS381	Advanced Numerical Methods and Computational Mathematics	Mathematics
10	25HS382	Mathematics for Machine Learning and Data Science	
11	25HS383	Statistical Learning Theory and Mathematical Foundations of AI	
12	25HS384	Chemistry of Nanomaterials and Applications in Engineering	Chemistry
13	25HS385	Photonics For Engineers	Physics

IV-SEMESTER

S. No.	Course Code	Course Title	Category	Hours per week			Credits
				L	T	P	
1.	2552451	Dissertation Phase-II	PR	0	0	32	16
			TOTAL	**0**	**0**	**32**	**16**

2552101	M.Tech., I-SEMESTER ADVANCED POWER SYSTEM PROTECTION (POWER SYSTEMS)	L	T	P	C
		3	0	0	3

Pre-Requisites: NIL

Course Outcomes:

On successful completion of the course, student will be able to

CO1. analyze static relay structures and comparator characteristics.

CO2. evaluate static overcurrent and differential relay performance.

CO3. assess distance relay operation and impacts of power swings.

CO4. implement microprocessor-based relay algorithms for protection.

CO5. apply AI techniques for intelligent protection and fault classification.

SYLLABUS:

UNIT–I: STATIC RELAYS & COMPARATORS (09 Periods)

Introduction to Static relays – Basic construction of Static relays – Level detectors – Replica Impedance– Mixing circuits– General equation for two input Phase and Amplitude Comparators – Duality between Amplitude and Phase Comparator.

Comparators: Types of Amplitude Comparators and Phase Comparators, Multi –Input Comparators: Conic section characteristics Three input amplitude comparator – Hybrid comparator – Switched distance schemes – Polyphase distance schemes– Phase fault scheme – Three phase scheme – Combined and ground fault scheme.

UNIT-II: STATIC OVER CURRENT AND DIFFERENTIAL RELAYS (09 Periods)

Introduction– Instantaneous over current relay – Time over current relays – Definite time and Inverse definite time over current relays– Directional over current relays – Static Differential Relays– Analysis of static differential relays– Static relay schemes– Dual bias transformer differential protection – Harmonic restraint relay.

UNIT-III: STATIC DISTANCE RELAYS AND POWER SWINGS (09 Periods)

Static Distance Relays: Static Impedance – Reactance – MHO and Angle Impedance relay Sampling comparator – Realization of reactance and MHO relay using a sampling comparator.

Power Swings: Effect of power swings on the performance of Distance relays– Power swing analysis – Principle of out of step tripping and blocking relays – Effect of line length and source impedance on distance relays.

UNIT-IV: MICROPROCESSOR BASED PROTECTIVE RELAYS (09 Periods)

Over current relays – Impedance relays – Directional relay – Reactance relay (Block diagram and flow chart approach only). Generalized mathematical expression for Distance relays– Measurement of R and X – MHO and offset MHO relays – Realization of MHO characteristics – Realization of Offset MHO characteristics (Block diagram and flow chart approach only) – Quadrilateral Relay –Basic principle of Digital computer relaying.

UNIT-V: ARTIFICIAL INTELLIGENCE BASED NUMERICAL PROTECTION

(09 Periods)

Application of Artificial Intelligence to Power System Protection – Application of ANN to Overcurrent Protection – Application of ANN to Transmission Line Protection – Neural Network Based Directional Relay – ANN Modular Approach for Fault Detection, Classification and Location – Wavelet Fuzzy Combined Approach for Fault Classification – Application of ANN to Power Transformer – Power Transformer Protection Based on Neural Network and Fuzzy Logic – Power Transformer Protection Based Upon Combined Wavelet Transform and Neural Network – Application of ANN to Generator Protection.

Total Periods: 45

Textbooks:

T1. Power System Protection Static Relays, T. S. Madhava Rao, Tata McGraw Hill Publishing Company Limited, 2004, 2nd Edition

T2. Power System Protection and Switchgear, Badri Ram and D. N. Vishwakarma, Tata McGraw Hill Publishing Company Limited, 2013, 2nd Edition

Reference Books:

R1. Protection and Switchgear, Bhavesh Bhalja, R. P. Maheshwari and N. G. Chothani, Oxford University Press, 2018, 2nd Edition.

R2. Power System Protection and Switchgear, B. A. Oza, N. C. Nair and R. P. Mehta, Tata McGraw Hill, 2011, 1st Edition

Online Learning Resources:

1. https://nptel.ac.in/courses/108105167
2. http://www.digimat.in/nptel/courses/video/108107167/L03.html

2552102	M.Tech., I-SEMESTER POWER SYSTEM SECURITY AND STATE ESTIMATION (POWER SYSTEMS)	L	T	P	C
		3	0	0	3

Pre-Requisites: NIL

Course Outcomes:

On successful completion of the course, student will be able to

CO1. formulate and compute bus matrices using systematic algorithms.
CO2. assess power system security using DC load-flow methods.
CO3. analyze contingencies using sensitivity-based techniques.
CO4. implement state estimation using least-squares and orthogonal methods.
CO5. evaluate ATC, congestion and wheeling transactions in deregulated systems.

SYLLABUS:

UNIT-I: POWER SYSTEM NETWORK MATRICES (09 Periods)

Formation of bus admittance matrices by direct inspection method and singular transformation method – Algorithm for formation of Bus impedance matrix: addition of a branch and addition of a link, removal element in Bus impedance matrix– Sparsity programming and Optimal Ordering – Numerical problems – ∏-representation of off-nominal tap transformers.

UNIT–II: POWER SYSTEM SECURITY-I (09 Periods)

Review of power flow methods (qualitative treatment only)– DC power flow method- Introduction to power system security – Factors influencing power system security.

UNIT-III: POWER SYSTEM SECURITY-II (09 Periods)

Introduction to contingency analysis – Contingency analysis: Detection of Network problems, linear sensitivity factors –AC power flow methods– Contingency selection.

UNIT-IV: STATE ESTIMATION IN POWER SYSTEM (09 Periods)

Power system state estimation – SCADA –EMS center, Methods of state estimation – Method of least squares, Orthogonal matrix–Properties– Givens rotation–Orthogonal decomposition–Bad data detection, Pseudo measurements and applications of power system state estimation – Simple problems.

UNIT-V: SECURITY IN DEREGULATED ENVIRONMENT (09 Periods)

Need and conditions for deregulation–Electricity sector structure model – Power wheeling transactions –Congestion management methods– Available Transfer Capability (ATC) – System security in deregulation.

Total Periods: 45

Textbooks:

T1. Power Generation Operation and Control, Allen J. Wood and B. F. Wollenberg, John Wiley and Sons, 2013, 3rd Edition.

T2. Electrical Power Systems Analysis Security and Deregulation, P. Venkatesh, B. V. Manikandan, S. Charles Raja and A. Srinivasan, PHI Learning Private Limited, Delhi, 2014, 1st Edition.

Reference Books:

R1. Modern Power System Analysis, I. J. Nagrath and D. P. Kothari, Tata McGraw Hill, New Delhi, 2004, 3rd Edition

R2. Power System Analysis, John J. Grainger and William D. Stevenson, Tata McGraw Hill, 2003, 1st Edition.

Online Learning Resources:

1. https://nptel.ac.in/content/storage2/courses/108106022/LECTURE%205.pdf
2. https://nptel.ac.in/content/storage2/courses/108101040/download/Lec-26.pdf

2552103	M.Tech., I-SEMESTER ENERGY AUDITING AND MANAGEMENT (POWER SYSTEMS) (PROGRAM ELECTIVE-I)	L	T	P	C
		3	0	0	3

Pre-Requisites: NIL

Course Outcomes:

On successful completion of the course, student will be able to

CO1. assess DSM options and audit requirements in utility systems.
CO2. conduct industrial energy audits and identify conservation opportunities.
CO3. interpret measurements from audit instrumentation for system evaluation.
CO4. analyze conservation strategies for HVAC, lighting, and thermal systems.
CO5. evaluate economic benefits of conservation measures in electrical systems.

SYLLABUS:

UNIT-I: ENERGY AUDIT AND DEMAND SIDE MANAGEMENT (DSM) IN POWER UTILITIES (09 Periods)

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

UNIT-II: ENERGY AUDIT (09 Periods)

Energy audit concepts - Basic elements and measurements - Mass and energy balances - Scope of energy auditing in industries - Evaluation of energy conserving opportunities and environmental management - Preparation and presentation of energy audit reports - case studies and potential energy savings.

UNIT-III: INSTRUMENTATION (09 Periods)

General Audit Instrumentation –Measuring building losses – Applications of IR thermography – Measurement of electrical system performance – Measurement of heating, ventilation, air conditioning system performance – Measurement of combustion systems.

UNIT-IV: ENERGY CONSERVATION (09 Periods)

Energy conservation in HVAC systems and thermal power plants, Solar systems, Fan and Lighting Systems - Different light sources and luminous efficiency

UNIT-V: ECONOMIC EVALUATION OF ENERGY CONSERVATION (09 Periods)

Energy conservation in electrical devices and systems - Economic evaluation of energy conservation measures - Electric motors and transformers - Inverters and UPS - Voltage stabilizers.

Total Periods: 45

Textbooks:

T1. Energy Management and Conservation Handbook, Frank Kreith and D. Yogi Goswamy, New York, 2008.

T2. Energy Management Handbook, W. C. Turner, Fairmont Press Inc., 2007, 7th Edition
T3. Handbook on Energy Audit and Environment Management, Y. P. Abbi and Shashank Jain, TERI Press, 2006,

Reference Books:

R1. Handbook of Energy Audits, Albert Thumann and William J. Younger, Marcel Dekker Inc., New York, 2003, 6th Edition.
R2. Industrial Energy Conservation, D. A. Reay, Pergamon Press, 1980.
R3. Instrument Engineers Handbook, B. G. Liptak (Ed.), Chilton Book Company, 2004.
R4. Analysis and Design of Energy Systems, B. K. Hodge, Prentice Hall, 2002.
R5. Industrial Energy Management and Utilization, Larry C. Witte, Schmidt and Brown, Hemisphere Publishing Company, New York, 1988.

Online Learning Resources:

1. https://onlinecourses.swayam2.ac.in/nou23_es05/preview
2. https://onlinecourses.nptel.ac.in/noc25_ar10/preview

2552104	M.Tech., I-SEMESTER MODELLING AND ANALYSIS OF HVDC SYSTEMS (POWER SYSTEMS) (PROGRAM ELECTIVE-I)	L	T	P	C
		3	0	0	3

Pre-Requisites: NIL

Course Outcomes:

On successful completion of the course, student will be able to

CO1. analyze converter characteristics and DC link control strategies.

CO2. develop AC/DC power-flow models and solve hybrid load-flow problems.

CO3. assess transient and dynamic stability of HVDC-linked systems.

CO4. analyze harmonic and torsional interactions in HVDC environments.

CO5. develop digital simulation models for converters and DC networks.

SYLLABUS:

UNIT–I: HVDC CONVERTERS AND SYSTEM CONTROL (09 Periods)

Analysis of HVDC Converters: Pulse number – choice of converter configuration – simplified analysis of Graetz circuit – converter bridge characteristics. Converter and HVDC system control: Principles of DC link control – converter control characteristics – system control hierarchy – firing angle control – current and extinction angle control – starting and stopping of DC link power control.

UNIT–II: MODELING FOR POWER FLOW ANALYSIS OF AC/DC SYSTEMS (09 Periods)

Modeling of HVDC Components: HVDC Converter model - Converter control - Modeling of DC network - Modeling of AC Network.

Power flow analysis in AC/DC systems: Modeling of DC links –Multi terminal DC links- Solution of DC load flow –per unit system for DC qualities – Solution of AC/DC power flow.

UNIT-III: TRANSIENT AND DYNAMIC STABILITY ANALYSIS (09 Periods)

Transient stability Analysis – Converter model – Converter control models – DC network models – solution methodology – Direct methods for stability Evaluation.

Dynamic Stability and power modulation - Power modulation for damping low frequency oscillations – Basic principles – practical consideration in the application of power modulation controllers – Gamma or reactive power modulation – power modulation in MTDC system – voltage stability in AC/DC system.

UNIT–IV: HARMONIC AND TORSIONAL INTERACTIONS (09 Periods)

Harmonic and Torsional Interactions: Harmonic Interactions - Torsion Interactions – Torsional interactions with in HVDC systems – counter measures to torsion interactions with DC systems.

Simulation of HVDC systems: System simulation – philosophy & Tools – HVDC system simulation – modeling of HVDC systems Digital dynamic simulation.

UNIT–V: MODELING OF HVDC SYSTEMS (09 Periods)

Digital dynamic simulation of converters and DC systems: Valve model, Gate pulse generation – generation of control voltage – transformer model – converter model – transient simulation of DC and AC systems. HVDC Breakers, Monopolar Operation.

Total Periods: 45

Textbooks:

T1. HVDC Power Transmission Systems Technology and System Interactions, K. R. Padiyar, New Age International Publishers, 2017, 3rd Edition.
T2. HVDC Transmission, S. Kamakshaiah and V. Kamaraju, Tata McGraw Hill, New Delhi, 2021, 2nd Edition.

Reference Books:

R1. Direct Current Transmission, E. W. Kimbark, Wiley Inter Science, New York, 1971, 1st Edition.
R2. HVDC Transmission, J. Arrillaga, Peter Peregrinus Ltd., London, 1998, 2nd Edition
R3. Power Transmission by Direct Current, E. Uhlmann, Springer Verlag, Berlin Helberg, 1985, 1st Edition

Online Learning Resources:

1. https://www.youtube.com/watch?v=yP7OACmLP48

2552105	M.Tech., I-SEMESTER POWER SYSTEM OPTIMIZATION (POWER SYSTEMS) (PROGRAM ELECTIVE-I)	L	T	P	C
		3	0	0	3

Pre-Requisites: NIL

Course Outcomes:

On successful completion of the course, student will be able to

CO1. apply classical optimization tools including KKT and interior-point methods.
CO2. implement PSO variants for power system optimization tasks.
CO3. analyze ant-colony search behaviour for solving optimization problems.
CO4. apply Tabu-search strategies for constrained and unconstrained problems.
CO5. evaluate optimization techniques for real-time power system applications.

SYLLABUS:

UNIT–I: CONVENTIONAL OPTIMIZATION TECHNIQUES (09 Periods)

Concepts & Terms related to Optimization -Quadratic optimization problem - Karush - Kuhn - Tucker (KKT) necessary and sufficient conditions for quadratic programming problem- Interior point method for convex optimization - linear programming.

UNIT–II: FUNDAMENTALS OF PARTICLE SWARM OPTIMIZATION (PSO) TECHNIQUE (09 Periods)

Background of PSO – Original PSO – Variation of PSO – Discrete PSO – PSO for MINLPs – Constriction Factor Approach (CFA) – Hybrid PSO (HPSO) – L best Model – Adaptive PSO (APSO) Evolutionary PSO (EPSO) – Applications. Problem formulation of VVC, VVC using PSO

UNIT-III: FUNDAMENTALS OF ANT COLONY SEARCH ALGORITHMS (09 Periods)

Ant Colony Search Algorithm – Behavior of Real Ants – Ant Colony Algorithms – The Ant System – The Ant Colony System – The Max-Min Ant System – Major Characteristics of Ant Colony Search Algorithm – Distributed Computation: Avoid Premature Convergence – Positive Feedback: Rapid Discovery of Good Solution – Use of Greedy Search and Constructive Heuristic Information: Find Acceptable Solutions in the Early Stage of the Process.

UNIT–IV: FUNDAMENTALS OF TABU SEARCH (09 Periods)

Overview of the Tabu Search Approach – Problem Formulation – Coding and Representation – Neighbourhood Structure – Characterization of the Neighbourhood – Functions and Strategies in Tabu Search – Recency- Based Tabu Search – Basic Tabu Search Algorithm – Candidate List Strategies – Tabu tenure – Aspiration Criteria – The Use of Long Term Memory in Tabu Search – Frequency- Based Memory – Intensification – Diversification – Other TS Strategies – Path Relinking – Strategic Oscillation – Applications of Tabu Search.

UNIT–V: APPLICATION TO POWER SYSTEMS (09 Periods)

Introduction to power system applications – Model identifications – Dynamic load modeling – Short term load forecasting – Distribution system applications – Network reconfiguration for loss reduction – Optimal protection and switching devices placements – Examples.

Total Periods: 45

Textbooks:

T1. Engineering Optimization Methods and Applications, A. Ravindran, K. M. Ragsdell and G. V. Reklaitis, Wiley India Edition.
T2. Modern Heuristic Optimization Techniques Theory and Applications to Power Systems, Kwang Y. Lee and Mohamed A. El Sharkawi, John Wiley and Sons Inc. Publication, 2020, 1st Edition.
T3. Power System Optimization, D. P. Kothari and J. S. Dhillon, PHI Learning Private Limited, 2011, 2nd Edition

Reference Books:

R1. Optimization of Power System Operation, Jizhong Zhu, IEEE Press and John Wiley and Sons Inc. Publication, 2015, 2nd Edition.
R2. Convex Optimization of Power Systems, Joshua Adam Taylor, Cambridge University Press, 2015, 1st Edition.

Online Learning Resources:

1. https://nptel.ac.in/courses/112/106/112106064/

		L	T	P	C
2552106	**M.Tech., I-SEMESTER** **SOLAR AND WIND ENERGY CONVERSION SYSTEMS** (POWER SYSTEMS) **(PROGRAM ELECTIVE-II)**	**3**	**0**	**0**	**3**

Pre-Requisites: NIL

Course Outcomes:

On successful completion of the course, student will be able to

CO1. analyze solar radiation models and aerodynamic behaviour of wind turbines.
CO2. evaluate PV module performance under mismatch and environmental effects.
CO3. design standalone and grid-connected PV systems using sizing methodology.
CO4. analyze wind turbine control approaches and site-specific performance.
CO5. assess variable-speed wind technologies and hybrid energy integrations.

SYLLABUS:

UNIT- I: SOLAR AND WIND FUNDAMENTALS (09 Periods)

Need for sustainable energy sources – solar radiation – the sun and earth movement – angle of sunrays on solar collectors – sun tracking – estimating solar radiation – measurement of solar radiation. Types of wind energy conversion devices – definition - solidity, tip speed ratio, power coefficient, wind turbine ratings and specifications - aerodynamics of wind rotors - design of the wind turbine rotor – Issues due to integration of solar and wind energy systems.

UNIT- II: SOLAR PHOTOVOLTAIC MODULES (09 Periods)

Solar PV Modules from solar cells – model of a solar cell, effect of series and shunt resistance on efficiency, effect of solar radiation on efficiency - series and parallel connection of cells – mismatch in module – mismatch in series connection – hot spots in the module, bypass diode – mismatching in parallel diode – design and structure of PV modules – number of solar cells in a module, wattage of modules, fabrication of PV module – PV module power output.

UNIT- III: PV SYSTEM DESIGN AND APPLICATIONS (09 Periods)

Introduction to solar PV systems – standalone PV system configuration – design methodology of PV systems – design of PV powered DC fan without battery, standalone system with DC load using MPPT, design of PV powered DC pump, design of standalone system with battery and AC/DC load – wire sizing in PV system – precise sizing of PV systems – Hybrid PV systems – grid connected PV systems.

UNIT- IV: WIND TURBINE CONTROL SYSTEMS & SITE ANALYSIS (09 Periods)

Wind Turbine - Torque speed characteristics – Modelling of wind turbines, Pitch angle control – stall control – power electronic control – Yaw control – Control strategy – Wind speed measurements – Wind speed statistics – Site and turbine selection. Constant voltage & constant frequency- single output system –double output system with current converter & voltage source inverter – equivalent circuits – reactive power and harmonics - reactive power compensation – variable voltage, variable frequency – the self-excitation process – circuit model for the self-excited

induction generator – analysis of steady state operation – the excitation requirement – effect of a wind generator on the network.

UNIT- V: GENERATION WITH VARIABLE SPEED TURBINES AND APPLICATIONS (09 Periods)

Classification of schemes – operating area – induction generators – doubly fed induction generator – wound field synchronous generator – the permanent magnet generator – Merits and limitations of wind energy conversion systems – application in hybrid energy systems – diesel generator and photovoltaic systems – wind and photovoltaic systems.

Total Periods: 45

Textbooks:

T1. Solar Photovoltaics Fundamentals, Technologies and Applications, Chetan Singh Solanki, PHI publications, 2015, 3rd edition.

T2. Wind Electrical Systems, S.N. Bhadra, D. Kastha, S. Banerjee, Oxford University Press, 2013, 1st edition.

T3. Engineering of Wind Energy, Banshi D. Shukla, Jain Brothers, 2018, 1st edition.

Reference Books:

R1. Solar Energy Fundamentals and applications, H.P. Garg, J. Prakash, Tata McGraw- Hill publishers, 2000, 1st edition.

R2. Energy Technology, S. Rao & B.B. Parulekar, Khanna publishers, 2005, 4th edition.

R3. Renewable Energy sources & Conversion Technology, N.K. Bansal, M. Kleemann, Michael Meliss, Tata McGraw Hill Publishers & Co., 1990, 1st edition.

Web Resources:

1. https://www.youtube.com/watch?v=yKgKW4K9ILU
2. http://www.digimat.in/nptel/courses/video/103103206/L37.html

2552107	M.Tech., I-SEMESTER SMART GRID TECHNOLOGIES (POWER SYSTEMS) (PROGRAM ELECTIVE-II)	L	T	P	C
		3	0	0	3

Pre-Requisites: NIL

Course Outcomes:

On successful completion of the course, student will be able to

CO1. analyze technological enhancements enabled by smart grid architectures.
CO2. apply modeling and analytical tools for T&D system management.
CO3. evaluate smart metering systems and demand-side integration mechanisms.
CO4. compare communication technologies used in modern smart grids.
CO5. assess security mechanisms including encryption, signatures, and authentication.

SYLLABUS:

UNIT–I: SMART GRIDS (09 Periods)

Smart grid overview- ageing assets and lack of circuit capacity- thermal constraints, operational constraints, security of supply- national initiatives- early smart grid initiatives- active distribution networks- virtual power plant- other initiatives and demonstrations- overview of the technologies required for the smart grid.

UNIT–II: TRANSMISSION AND DISTRIBUTION MANAGEMENT (09 Periods)

Data Sources- Energy Management System-Wide Area Applications, Visualization Techniques-Data Sources and Associated External Systems- SCADA- Customer Information System- Modeling and Analysis Tools, Distribution System Modeling- Topology Analysis- Load Forecasting- Power Flow Analysis- Fault Calculations- State Estimation- Applications-System Monitoring- Operation-Management- Outage Management System-Overview of energy storage technologies.

UNIT-III: SMART METERING AND DEMAND SIDE INTEGRATION (09 Periods)

Overview- Smart metering – Evolution of electricity metering- key components of smart metering-smart meters: an overview of the hardware used – signal acquisition- signal conditioning-analogue to digital conversion- computation-input/output and communication. Communication infrastructure and protocols for smart metering - Home area network, Neighbourhood Area Network- Data Concentrator- meter data management system- Protocols for communication. Demand Side Integration- Services Provided by DSI-Implementation of DSI- Hardware Support- Flexibility Delivered by consumers from the Demand Side- System Support from DSI.

UNIT–IV: COMMUNICATION TECHNOLOGIES FOR THE SMART GRID (09 Periods)

Data Communications: Dedicated and Shared Communication Channels, Switching Techniques, Circuit Switching, Message Switching, Packet Switching- Communication Channels, Introduction to TCP/IP.

Communication Technologies: IEEE 802 Series- Mobile Communications- Multi-Protocol Label Switching-Power line Communication.

UNIT–V: INFORMATION SECURITY FOR THE SMART GRID (09 Periods)

Overview- Encryption and Decryption, Symmetric Key Encryption- Public Key Encryption- Authentication- Authentication Based on Shared Secret Key- Authentication Based on Key Distribution Center- Digital Signatures- Secret Key Signature-Public Key Signature- Message Digest.

Total Periods: 45

Textbooks:

T1. Smart Grid Technology and Applications, Janaka Ekanayake, Kithsiri Liyanage et al., Wiley Publications, 2012, 1st Edition.

T2. Smart Grid Fundamentals of Design and Analysis, James Momoh, Wiley IEEE Press, 2012, 1st Edition.

T3. Fundamentals of Smart Grid Technology, Bharat Modi, Anuprakash and Yogesh Kumar, S. K. Kataria and Sons, 2019, 1st Edition.

Reference Books:

R1. Applied Cyber Security and the Smart Grid Implementing Security Controls into the Modern Power Infrastructure, Eric D. Knapp and Raj Samani, Syngress Publishers, 2013, 1st Edition.

R2. Smart Grids, Nouredine Hadjsaid and Jean Claude Sabonnadiere, Wiley Blackwell Publications, 2012, 1st Edition.

R3. Smart Power Climate Changes the Smart Grid and the Future of Electric Utilities, Peter Fox Penner, Island Press, 2010, 1st Edition.

Online Learning Resources:

1. www.indiasmartgrid.org

2552108	M.Tech., I-SEMESTER E-MOBILITY (POWER SYSTEMS) (PROGRAM ELECTIVE-II)	L	T	P	C
		3	0	0	3

Pre-Requisites: NIL

Course Outcomes:

On successful completion of the course, student will be able to

CO1. analyze EV configurations and quantify system-level performance parameters.

CO2. evaluate propulsion options and model vehicle dynamics.

CO3. assess fuel-cell characteristics and hybrid EV architectures.

CO4. implement battery-charging and control schemes for EV systems.

CO5. analyze energy-storage technologies and their integration into EV/grid systems.

SYLLABUS:

UNIT–I: INTRODUCTION TO EV SYSTEMS AND ENERGY SOURCES (09 Periods)

Past, Present and Future of EV - EV Concept- EV Technology- State-of-the Art of EVs- EV configuration- EV system- Fixed and Variable gearing- Single and multiple motor drive- In-wheel drives- EV parameters: Weight, size, force and energy, performance parameters.

Electro mobility and the environment- History of Electric power trains- Carbon emissions from fuels- Green houses and pollutants- Comparison of conventional, battery, hybrid and fuel cell electric systems.

UNIT–II: EV PROPULSION AND DYNAMICS (09 Periods)

Choice of electric propulsion system- Block diagram- Concept of EV Motors- Single and multi-motor configurations- Fixed and variable geared transmission- In-wheel motor configuration- Classification- Electric motors used in current vehicle applications- Recent EV Motors- Linear Induction Motors Vehicle load factors- Vehicle acceleration.

UNIT-III: FUEL CELLS (09 Periods)

Introduction of fuel cells- Basic operation- Model - Voltage, power and efficiency- Power plant system – Characteristics- Sizing - Example of fuel cell electric vehicle.

Introduction to HEV- Brake specific fuel consumption - Comparison of Series-Parallel hybrid systems- Examples.

UNIT–IV: BATTERY CHARGING AND CONTROL (09 Periods)

Battery charging: Basic requirements- Charger architecture- Charger functions- Wireless charging- Power factor correction.

Control: Introduction- Modeling of electro mechanical system- Feedback controller design approach- PI controllers designing- Torque-loop, Speed control loop compensation- Acceleration of battery electric vehicle.

UNIT–V: ENERGY STORAGE TECHNOLOGIES (09 Periods)

Role of Energy Storage Systems- Thermal- Mechanical-Chemical- Electrochemical- Electrical - Efficiency of energy storage systems- Super Capacitors-Superconducting Magnetic Energy Storage

(SMES)- SoC- SoH -fuel cells - G2V- V2G- Energy storage in Micro-grid and Smart grid- Energy Management with storage systems- Hybrid energy storage systems -Battery SCADA.

Total Periods: 45

Textbooks:

T1. Modern Electric Vehicle Technology, C. C. Chan and K. T. Chau, Oxford University Press Inc., New York, 2001, 1st Edition.

T2. Energy Storage in Power Systems, Francisco Diaz Gonzalez, Andreas Sumper and Oriol Gomis Bellmunt, Wiley Publication, 2016, 1st Edition

Reference Books:

R1. Electric and Hybrid Vehicles Design Fundamentals, Iqbal Husain, CRC Press, 2021, 3rd Edition.

R2. Advanced Electric Drive Vehicles, Ali Emadi, CRC Press, 2015, 1st Edition.

R3. Energy Storage for Power Systems, A. G. Ter Gazarian, Institution of Engineering and Technology Publication, UK, 2011, 2nd Edition.

R4. Modern Electric Hybrid Electric and Fuel Cell Vehicles Fundamentals Theory and Design, Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay and Ali Emadi, CRC Press, 2004, 1st Edition.

R5. Electric Vehicle Technology Explained, James Larminie and John Lowry, Wiley, 2003, 2nd Edition.

Online Learning Resources:

1. https://nptel.ac.in/courses/108/102/108102121/
2. https://nptel.ac.in/syllabus/108103009

2552151	M.Tech., I-SEMESTER POWER SYSTEM ANALYSIS AND PROTECTION LAB (POWER SYSTEMS)	L	T	P	C
		0	0	4	2

Course Outcomes:

On successful completion of the course, student will be able to

CO1. analyze power system parameters through experimental procedures involving machine Characteristics, relay testing, and fault analysis

CO2. interpret experimental and computed results to assess relay performance and system Behaviour under various fault and operating conditions.

CO3. develop protection strategies and relay configurations based on laboratory investigations and simulation results.

CO4. able to apply appropriate Tools and Techniques to understand and analyze the problems Following professional ethics with focus on societal and environmental aspects.

CO5. work as a team and communicate results in an effective way.

CO6. make decisions as an individual or as team member to manage tasks and also engage in Independent and life-long learning with ability to adapt to new and technological changes.

SYLLABUS:

List of Experiments:

1. Determination of Subtransient Reactance and Time Constant of a Salient Pole Machine
2. Determination of Sequence Impedances of a Cylindrical Rotor Synchronous Machine
3. Fault Analysis
    i) LG Fault
    ii) LL Fault
    iii) LLG Fault
    iv) LLLG Fault
4. Equivalent Circuit of a Three Winding Transformer
5. Separation of No-Load losses of a Three Phase Squirrel Cage Induction Motor
6. Power Angle Characteristics of a Salient Pole Synchronous Machine
7. Characteristics of Static/Numeric Over Current Relay
8. Characteristics of Static Negative Sequence Relay
9. Characteristics of Static/Numeric Over Voltage Relay
10. Characteristics of Static/Numeric Percentage Biased Differential Relay
11. Testing of Buchholz Relay
12. Testing of Frequency Relay
13. Testing of Reverse Power Relay
14. Testing of Earth fault Relay
15. Microprocessor Based Relay

Web Sources:

1. https://www.vlab.co.in

2552152	M.Tech., I-SEMESTER POWER SYSTEMS SIMULATION LAB (POWER SYSTEMS)	L	T	P	C
		0	0	4	2

Course Outcomes:

On successful completion of the course, student will be able to

CO1. develop simulation models for load flow, stability, contingency, and harmonic studies using appropriate computational tools

CO2. analyze system performance under varying operating and disturbance scenarios through simulation outputs

CO3. apply simulation-based insights to design improved solutions for power-flow, protection, and power-quality issues

CO4. able to apply appropriate Tools and Techniques to understand and analyze the problems following professional ethics with focus on societal and environmental aspects.

CO5. work as a team and communicate results in an effective way.

CO6. make decisions as an individual or as team member to manage tasks and also engage in independent and life-long learning with ability to adapt to new and technological changes.

SYLLABUS:

List of Experiments:

1. Y - Bus Formation
2. Z- Bus Formation
3. Gauss – Seidel Load Flow Analysis
4. Newton-Raphson Method for Load Flow Analysis
5. Fast Decoupled Load Flow Analysis
6. Fast Decoupled Load Flow Analysis for Distribution Systems
7. Point by Point Method
8. Computation of Available Transfer Capabilities
9. Contingency analysis
10. State estimation using Weighted Least Square, linear and non-linear methods
11. Simulation of power quality problems (Sag/Swell, interruption, transients, harmonics, flickers etc.)
12. Harmonic analysis and Single tuned filter design to mitigate harmonics
13. Harmonic analysis and Double tuned filter design to mitigate harmonics

Web Sources:

1. https://www.vlab.co.in

2552153	M.Tech., I-SEMESTER AI TECHNIQUES IN ELECTRICAL ENGINEERING (POWER SYSTEMS)	L	T	P	C
		0	1	2	2

Pre-Requisites: NIL

Course Outcomes:

On successful completion of the course, student will be able to

CO1. analyze neural network architectures and apply learning mechanisms for engineering problem formulation.

CO2. develop fuzzy inference systems and genetic algorithm models for optimization and control tasks.

CO3. apply ANN, fuzzy logic, and GA techniques to solve power system applications such as forecasting, dispatch, and control.

CO4. able to apply appropriate Tools and Techniques to understand and analyze the problems following professional ethics with focus on societal and environmental aspects.

CO5. work as a team and communicate results in an effective way.

CO6. make decisions as an individual or as team member to manage tasks and also engage in independent and life-long learning with ability to adapt to new and technological changes.

SYLLABUS

UNIT-I: ARTIFICIAL NEURAL NETWORKS (09 Periods)

Introduction-Models of Neural Network - Architectures – Knowledge representation – Artificial Intelligence and Neural networks – Learning process – Error correction learning – Hebbian learning – Competitive learning – Boltzmann learning – Supervised learning –Unsupervised learning – Reinforcement learning -learning tasks.

UNIT-II: ANN PARADIGMS (09 Periods)

Multi – layer perceptron using Back propagation Algorithm-Self – organizing Map –Radial Basis Function Network–Functional link network– Hopfield Network.

UNIT-III: FUZZYLOGIC (09 Periods)

Introduction – Fuzzy versus crisp – Fuzzy sets - Membership function – Basic Fuzzy set operations –Properties of Fuzzy sets – Fuzzy Cartesian Product – Operations on Fuzzy relations – Fuzzy logic – Fuzzy Quantifiers-Fuzzy Inference- Fuzzy Rule based system– Defuzzification methods.

UNIT-IV: GENETIC ALGORITHMS (09 Periods)

Introduction-Encoding– Fitness Function-Reproduction operators–Genetic Modeling –Genetic operators- Crossover- Single–site crossover –Two-point crossover–Multi point crossover-Uniform crossover–Matrix crossover-Crossover Rate-Inversion & Deletion–Mutation operator–Mutation– Mutation Rate-Bit-wise operators-Generational cycle-convergence of Genetic Algorithm.

UNIT-V: APPLICATIONS OF AI TECHNIQUES (09 Periods)

Load forecasting – Load flow studies – Economic load dispatch –Load frequency control – Single area system and two area system – Small Signal Stability (Dynamic stability)- Reactive power control – speed control of DC and AC Motors.

Total Periods: 45

Textbooks:

T1. Neural Networks Fuzzy Logic and Genetic Algorithms, S. Rajasekaran and G. A. V. Pai, PHI, New Delhi, 2017, 2nd Edition.
T2. Introduction to Neural Networks Fuzzy Logic and Genetic Algorithms, Sudarshan K. Valluru and T. Nageswara Rao, Jaico Publishing House, 2010, 1st Edition.

Reference Books:

R1. Neural Computing Theory and Practice, P. D. Wasserman, Van Nostrand Reinhold, New York, 1989, 1st Edition.
R2. Neural Network and Fuzzy System, Bart Kosko, Prentice Hall, 1992.
R3. Fuzzy Sets Uncertainty and Information, G. J. Klir and T. A. Folger, Pearson, 2015, 1st Edition.
R4. Genetic Algorithms, D. E. Goldberg, Pearson Education India, 2008, 1st Edition.

Online Learning Resources:

1. https://onlinecourses.swayam2.ac.in/ntr24_ed08/preview
2. https://onlinecourses.nptel.ac.in/noc23_ge36/preview
3. https://onlinecourses.nptel.ac.in/noc22_hs59/preview

		L	T	P	C
2599171	**M.Tech., I-SEMESTER** **RESEARCH METHODOLOGY AND INTELLECTUAL PROPERTY RIGHTS** (Common to AIDS, PS, Geo-Tech, RE, ES&VLSI) **(MANDATORY COURSE)**	**2**	**0**	**0**	**2**

Pre-Requisites: NIL

Course Outcomes:

On successful completion of the course, student will be able to

CO1. demonstrate the research process, types and methods, use data correctly, follow ethical rules, and use proper citation styles.

CO2. apply appropriate data collection methods, identify data types and sources, ensure quality, and follow ethical practices using suitable tools.

CO3. apply multivariate analysis and experimental design to study cause-effect relationships, ensure measurement validity, and write structured research papers and proposals.

CO4. demonstrate the concept, evolution, and types of Intellectual Property Rights (IPR), recognize global IPR practices and institutions like WIPO, WTO, and UNESCO, and identify key agreements, trade secrets, and biodiversity-related rights.

CO5. demonstrate the concept, features, and benefits of patents; identify types of patent applications and the filing process; and explain the roles of patent agents, licensing, and patent regulations.

SYLLABUS:

UNIT–I: FUNDAMENTALS OF RESEARCH METHODOLOGY (05 Periods)

Overview of research process and design - Types of Research - Approaches to Research (Qualitative vs Quantitative) - Observation studies, Experiments and Surveys - Use of Secondary and exploratory data to answer the research question - Importance of Reasoning in Research and Research ethics - Documentation Styles (APA/IEEE etc.) - Plagiarism and its consequences.

UNIT-II: DATA COLLECTION AND SOURCES (05 Periods)

Importance of Data Collection - Types of Data - Data Collection Methods - Data Sources - primary, secondary and Big Data sources - Data Quality & Ethics - Tools and Technology for Data Collection.

UNIT-III: DATA ANALYSIS AND REPORTING (06 Periods)

Overview of Multivariate analysis - Experimental research, cause-effect relationship, and development of hypotheses- Measurement systems analysis, error propagation, and validity of experiments - Guidelines for writing abstracts, introductions, methodologies, results, and discussions - Writing Research Papers & proposals.

UNIT- IV: UNDERSTANDING INTELLECTUAL PROPERTY RIGHTS (07 Periods)

Intellectual Property – The concept of IPR, Evolution and development of concept of IPR, IPR development process, Trade secrets, utility Models, IPR & Bio diversity, Role of WIPO and WTO in IPR establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance.

UNIT–V: PATENTS **(07 Periods)**

Patents – objectives and benefits of patent, Concept, features of patent, Inventive step, Specification - Types of patent application, process E-filling, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licenses, Licensing of related patents, patent agents, Registration of patent agents

Total Periods: 30

Textbooks:

T1. Research Methodology: An introduction for Science & Engineering students, Stuart Melville and Wayne Goddard, Juta and Company Ltd, 2004

T2. Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets, Catherine J. Holland, Entrepreneur Press, 2007.

References Books:

R1. Business Research Methods, Cooper Donald R, Schindler Pamela S and Sharma JK, Tata McGraw Hill Education, 2012, Eleventh Edition,

R2. Research Methodology: A Step-by-Step Guide for Beginners, David Hunt, Long Nguyen, Matthew Rodgers, Wiley, 2007.

R3. Intellectual Property: The Law of Trademarks, Copyrights, Patents, and Trade Secrets, Deborah E. Bouchoux, Cengage, 2024, Sixth Edition,

R4. The Craft of Research, Wayne C. Booth, Gregory G. Colomb, Joseph M. Williams, University of Chicago Press, 2024, Fifth Edition.

R5. Professional Programme Intellectual Property Rights, Law and practice, The Institute of Company Secretaries of India, Statutory body under an Act of parliament, September, 2013.

Web Resources:

1. Research Methodology and Data Analysis courses, Coursera / edX
2. Latest journals on research design and statistics, Springer Link & ScienceDirect
3. Free access to research papers Google Scholar
4. Open-access research methodology resources, NCBI Bookshelf
5. For fundamentals of hypothesis testing, regression, and ANOVA. Khan Academy (Statistics & Probability)

2599181	M.Tech., I-SEMESTER ENGLISH FOR RESEARCH PAPER WRITING (Common to AIDS, PS, Geo-Tech, RE, ES&VLSI) (AUDIT COURSE-I)	L	T	P	C
		2	0	0	0

Pre-Requisites: NIL

Course Outcomes:

On successful completion of the course, student will be able to

CO1. Demonstrate proficiency in academic English by applying MAP principles, using clear, precise, and objective language, structuring coherent paragraphs, integrating references, and employing paraphrasing and appropriate tone in writing.

CO2. Exhibit critical reading skills to analyze academic texts, differentiate between article types, identify arguments and methodologies, evaluate findings, and make effective notes.

CO3. Apply advanced grammar and punctuation to construct clear, accurate, and complex sentences with proper voice, tense consistency, subject-verb agreement, and unambiguous references.

CO4. Revise and refine written work by editing for clarity, coherence, and grammar; proofread for accuracy; and apply effective strategies for professional correspondence and creative writing.

CO5. Demonstrate digital literacy by critically evaluating online content, using AI tools ethically in research writing, generating accurate citations, and practicing plagiarism-free writing with awareness of fair practices.

SYLLABUS:

UNIT-I: FUNDAMENTALS OF ACADEMIC ENGLISH (05 Periods)

Academic English - MAP (Message-Audience-Purpose) - Language Proficiency for Writing - Key Language Aspects - Clarity and Precision - Objectivity - Formal Tone - Integrating References - Word order - Sentences and Paragraphs - Link Words for Cohesion - Avoiding Redundancy / Repetition - Breaking up long sentences - Structuring Paragraphs - Paraphrasing Skills – Framing Title and Sub-headings

UNIT-II: READING SKILLS FOR RESEARCHERS (06 Periods)

Reading Academic Texts - Critical Reading Strategies - Skimming and Scanning - Primary Research Article vs. Review Article - Reading an Abstract - Analyzing Research Articles - Identifying Arguments - Classifying Methodologies - Evaluating Findings - Making Notes

UNIT-III: GRAMMAR REFINEMENT FOR RESEARCH WRITING (06 Periods)

Advanced Punctuation Usage - Grammar for Clarity - Complex Sentence Structures - Active-Passive Voice - Subject-Verb Agreement - Proper Use of Modifiers - Avoiding Ambiguous Pronoun References - Verb Tense Consistency - Conditional Sentences.

UNIT-IV: MASTERY IN REFINING WRITTEN CONTENT/EDITING SKILLS (07 Periods)

Effective Revisions - Restructuring Paragraph - Editing vs Proofreading, Editing for Clarity and Coherence - Rectifying Sentence Structure Issues - Proofreading for Grammatical Precision – Spellings - Tips for Correspondence with Editors - Critical and Creative Phases of Writing.

UNIT-V: TECHNOLOGY AND LANGUAGE FOR RESEARCH (06 Periods)

Digital Literacy and Critical Evaluation of Online Content - Technology and Role of AI in Research Writing – Assistance in Generating Citations and References - Plagiarism and Ethical Considerations – Tools and Awareness – Fair Practices

Total Periods: 30

Textbooks:

T1. Academic Writing: A Handbook for International Students. Routledge, Bailey. S. London and New York: 2015.

T2. English for Writing Research Papers, Adrian Wallwork, Springer New York Dordrecht Heidelberg London, 2011.

Reference books:

R1. Writing for Academic Success, Craswell, G., Sage Publications, 2004.

R2. Writing With Power, Peter Elbow, E-book, Oxford University Press, 2007

R3. Writing Academic English, Oshima, A. & Hogue, A., Addison-Wesley, New York, 2005

R4. Academic Writing for Graduate Students: Essential Skills and Tasks, Swales, J. & C. Feak, Michigan University Press, 2012.

R5. Writing for Science, Goldbort R., Yale University Press (available on Google Books), 2006

R6. How to Write and Publish a Scientific Paper, Day R., Cambridge University Press, 2006

Web Resources:

1. https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-ge04/
2. https://onlinecourses.swayam2.ac.in/ntr24_ed15/preview
3. "Writing in the Sciences" – Stanford University (MOOC on Coursera) https://www.coursera.org/learn/sciwrite
4. Academic Phrasebank – University of Manchester http://www.phrasebank.manchester.ac.uk
5. OWL (Online Writing Lab) – Purdue University, https://owl.purdue.edu *(Resources on APA/MLA formats, grammar, structure, paraphrasing)*
6. Zotero or Mendeley (Reference Management Tools) – Useful for managing citations and sources.

2512181	M.Tech., I-SEMESTER DISASTER MANAGEMENT (Common to AIDS, PS, Geo-Tech, RE, ES&VLSI) (AUDIT COURSE - I)	L	T	P	C
		2	0	0	0

Pre-Requisites: NIL

Course Out Comes:

On successful completion of the course, student will be able to

CO1. Identify and map disaster-prone areas and understand the epidemiological consequences of disasters.

CO2. Define and distinguish between hazards and disasters, and explain their types, nature, and impacts.

CO3. Assess the economic, social, and ecological repercussions of major natural and man-made disasters.

CO4. Apply risk assessment methods and propose disaster risk reduction strategies at local, national, and global levels.

CO5. Demonstrate knowledge of disaster preparedness tools such as remote sensing, meteorological data, risk evaluation, and community awareness.

SYLLABUS:

UNIT–I: INTRODUCTION **(06 Periods)**

Disaster Prone Areas in India - Study of Seismic Zones - Areas Prone to Floods and Droughts, Landslides and Avalanches - Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami - Post-Disaster Diseases and Epidemics.

UNIT-II: REPERCUSSIONS OF DISASTERS AND HAZARDS **(06 Periods)**

Economic Damage - Loss of Human and Animal Life - Destruction of Ecosystem - Natural Disasters - Earthquakes, Volcanism, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster - Nuclear Reactor Meltdown - Industrial Accidents - Oil Slick sand Spills - Outbreaks of Disease and Epidemics War and Conflicts

UNIT-III: DISASTER PREPAREDNESS AND MANAGEMENT **(06 Periods)**

Preparedness - Monitoring of Phenomena - Triggering a Disaster or Hazard - Evaluation of Risk-Application of Remote Sensing - Data from Meteorological and Other Agencies -Media Reports-Governmental and Community Preparedness

UNIT-IV: RISK ASSESSMENT **(06 Periods)**

Disaster Risk -Concept and Elements, Disaster Risk Reduction - Global and National Disaster Risk Situation -Techniques of Risk Assessment – Global Co-Operation in Risk Assessment and Warning - People's participation Risk Assessment – Strategies for Survival

UNIT-V: DISASTER MITIGATION **(06 Periods)**

Meaning, Concept and Strategies of Disaster Mitigation – Emerging Trendsin Mitigation - Structural Mitigation and Non- Structural Mitigation - Programs of Disaster Mitigation in India

Total Periods: 30

Textbooks:

T1. Disaster Management, Gupta, H. K, Universities Press, 2003
T2. Natural Hazards and Disaster Management, Singh, R. B., Rawat Publications, 2006.

Reference Books:

R1. Introduction to International Disaster Management, Coppola, D. P., Elsevier, 4th ed., 2020.
R2. Science and Technology in Disaster Risk Reduction in Asia, Shaw, R., & Izumi, T., Springer, 2022.
R3. Handbook of Hazards and Disaster Risk Reduction and Management, Wisner, B., Gaillard, J. C., & Kelman, I., Routledge, 2nd ed., 2021.
R4. Disaster Management in India: Policy, Issues and Perspectives, Saini, V. K., Sage India, 2021.
R5. Disaster by Choice: How Our Actions Turn Natural Hazards into Catastrophes, Kelman, I., Oxford University Press, 2022
R6. Disaster Mitigation: Experiences and Reflections, Sahni, P. & Dhameja, A., Prentice Hall of India, 2004.

Web Resources:

1. https://ndma.gov.in – official guidelines, reports, and policy frameworks.
2. https://www.undrr.org – Sendai Framework, global risk reduction strategies.
3. https://www.gdacs.org – real-time disaster alerts
4. https://www.undrr.org – Sendai Framework, global risk reduction strategies.

2598181	**M.Tech., I-SEMESTER** **ESSENCE OF** **INDIAN TRADITIONAL KNOWLEDGE** (Common to AIDS, PS, Geo-Tech, RE, ES&VLSI) **(AUDIT COURSE - I)**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**0**

Pre-Requisites: NIL

Course Out Comes:

On successful completion of the course, student will be able to

CO1. Illustrate traditional knowledge, its nature, characteristics, and scope

CO2. Demonstrate the need for protecting traditional knowledge and its significance in the global economy

CO3. Explain the legal framework and policies related to traditional knowledge protection

CO4. Apply traditional knowledge in different sectors, such as engineering, medicine, agriculture, and biotechnology

CO5. Analyze the importance of traditional knowledge in various contexts, including its historical impact and social change, relationship between traditional knowledge and intellectual property rights, including patents and non-IPR mechanisms

SYLLABUS:

UNIT-I: INTRODUCTION TO TRADITIONAL KNOWLEDGE (06 Periods)

Definition, Nature and characteristics, scope and importance - Kinds of traditional knowledge - Physical and social contexts in which traditional knowledge develop - Historical impact of social change on traditional knowledge systems - Indigenous Knowledge (IK) – Characteristics - traditional knowledge vis-à-vis indigenous knowledge -Traditional knowledge Vs western knowledge, traditional knowledge vis-à-vis formal knowledge

UNIT-II: PROTECTION OF TRADITIONAL KNOWLEDGE (06 Periods)

Need for protecting traditional knowledge - Significance of TK Protection - Value of TK in global economy - Role of Government to harness TK.

UNIT-III: **LEGAL FRAME WORK AND TRADITIONAL KNOWLEDGE (06 Periods)**

The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 - Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act).

The Biological Diversity Act 2002 and Rules 2004 - the protection of traditional knowledge bill, 2016 Geographical Indicators Act 2003.

UNIT-IV: TRADITIONAL KNOWLEDGE AND INTELLECTUAL PROPERTY

(06 Periods)

Systems of traditional knowledge protection - Legal concepts for the protection of traditional knowledge - Certain non-IPR mechanisms of traditional knowledge protection - Patents and traditional knowledge - Strategies to increase protection of traditional knowledge -Global legal FORA for increasing protection of Indian Traditional Knowledge.

UNIT-V: TRADITIONAL KNOWLEDGE IN DIFFERENT SECTORS (06 Periods)

Traditional knowledge and Engineering - Traditional medicine system - TK and Biotechnology - TK in Agriculture - Traditional societies depend on it for their food and healthcare needs - Importance of conservation and sustainable development of environment - Management of biodiversity, Food security of the country and protection of TK

Total Periods: 30

Textbooks:

T1. Introduction to Indian Knowledge System: Concepts and Applications, Mahadevan, B., Bhat Vinayak Rajat, and Nagendra Pavana R.N., PHI Learning Pvt. Ltd., Delhi, 2022 (1st Edition).

T2. Traditional Knowledge System and Technology in India, Basanta Kumar Mohanta and Vipin Kumar Singh, Pratibha Prakashan, 2012 (1st Edition).

Reference Books

R1. Pride of India: A Glimpse into India's Scientific Heritage, Samskrita Bharati, New Delhi 2006.

R2. On Astronomy in Ancient India, Kak, S.C. Indian Journal of History of Science, 22(3), 1987

R3. Indian Astronomy: A Source Book, Subbarayappa, B.V. and Sarma, K.V. Nehru Centre, Mumbai, 1985.

R4. History of Technology in India, Vol. I, Bag, A.K., Indian National Science Academy, New Delhi, 1997.

R5. Indian Architecture, Acarya, P.K. Munshiram Manoharlal Publishers, New Delhi, 1996.

R6. Public Administration in Ancient India, Banerjea, P. Macmillan, London, 1961.

R7. Indian Knowledge Systems Vol – I & II, Kapoor Kapil, Singh Avadhesh, Indian Institute of Advanced Study, Shimla, H.P., 2022

Web Resources:

1. https://www.youtube.com/watch?v=LZP1StpYEPM
2. http://nptel.ac.in/courses/12110600

2552201	M.Tech., II-SEMESTER POWER SYSTEM STABILITY AND CONTROL (POWER SYSTEMS)	L	T	P	C
		3	0	0	3

Pre-Requisites: Power System Security and State Estimation

Course Outcomes:

On successful completion of the course, student will be able to

CO1. demonstrate the concepts of single and multi-machine systems connected to infinite bus bar

CO2. analyze system responses to small disturbances and concept of dynamic stability and power system stabilizers

CO3. apply the various stability methods to evaluate the stability of the system

CO4. design the state space model equations for excitation systems and methods for finding voltage and angle instability

CO5. evaluate voltage stability and analyze factors leading to voltage instability and collapse in power systems.

SYLLABUS:

UNIT-I: THE ELEMENTARY MATHEMATICAL MODEL (9 Periods)

Introduction to equal area criteria – Power Angle curve of a Synchronous Machine – Model of single machine connected to an infinite bus – Model of multimachine system – Problems – Classical Stability Study of multimachine system – Effect of the excitation system on Transient stability

UNIT-II: SYSTEM RESPONSE TO SMALL DISTURBANCES AND DYNAMIC STABILITY (9 Periods)

The unregulated synchronous Machine – Modes of oscillation of an unregulated multimachine system – Regulated synchronous machine – Voltage regulator with one time lag – Governor with one time lag – Problems - Concept of Dynamic stability – State-space model of single machine system connected to infinite bus – Effect of excitation on Dynamic stability – Examination of dynamic stability by Routh-Hurwitz criterion.

UNIT-III: POWER SYSTEM STABILIZERS (9 Periods)

Introduction to supplementary stabilizing signals – Block diagram of the linear system – Approximate model of the complete exciter – Generator system – Lead compensation – Stability analysis using eigen value approach.

UNIT-IV: EXCITATION SYSTEMS (9 Periods)

Introduction to excitation systems – non-continuously, continuously regulated systems – Excitation system compensation – State-space description of the excitation system – Simplified linear model – Effect of excitation on generator power limits. Type- 2, Type-3 and Type-4 excitation systems and their state-space modelling equations.

UNIT-V: STABILITY ANALYSIS (9 Periods)

Review of Lyapunov's stability of non-liner systems using energy concept – Method based on first

concept – Method based on first integrals –Lyapunov function for single machine connected to infinite bus – Voltage stability – Factors affecting voltage instability and collapse – Comparison of Angle and Voltage stability – Analysis of voltage instability and collapse – Control of voltage instability.

Total Periods: 45

Text Books:

T1. Power System Control and Stability, Vijay Vittal, James D. McCalley and Paul M. Anderson, John Wiley & Sons, 2019, Third Edition.

T2. Power System Stability and Control, Prabha Kundur, McGraw Hill Education (India), 2008, First Edition.

Reference Books:

R1. Power System Dynamics: Stability and Control, Jan Machowski, Janusz W. Bialek and Jim Bumby, John Wiley & Sons, 2011, Second Edition.

R2. Power System Stability – Analysis by the Direct Method of Lyapunov, M. A. Pai, North Holland Publishing Company, New York, 1981, First Edition.

Web Resources:

1.. https://nptel.ac.in/courses/108/105/108105133/

2552202	M.Tech. II-SEMESTER FACTS CONTROLLERS (POWER SYSTEMS)	L	T	P	C
		3	0	0	3

Pre-Requisites: Power System Security and State Estimation

Course Outcomes:

On successful completion of the course, student will be able to

CO1. interpret FACTS concepts and converter topologies used for power flow control in AC transmission systems.

CO2. differentiate shunt compensation techniques and assess the performance of SVC and STATCOM.

CO3. examine the operating principles and control schemes of series compensation devices.

CO4. interpret the operating principles and control structure of UPFC and IPFC.

CO5. assess the functionality of special FACTS devices used for power flow and power quality improvement.

SYLLABUS:

UNIT- I: FACTS CONCEPTS, VSI AND CSI (10 Periods)

Transmission interconnections power flow in an AC system, loading capability limits, Dynamic stability considerations, importance of controllable parameters basic types of FACTS controllers, benefits from FACTS controllers. Single phase three phase full wave bridge converters transformer connections for 12 pulse 24 and 48 pulse operation. Three level voltage source converter, pulse width modulation converter, basic concept of current source Converters, and comparison of current source converters with voltage source converters.

UNIT- II: SHUNT COMPENSATION (08 Periods)

Objectives of shunt compensation - Methods of controllable var generation - Variable impedance type static var generators - switching converter type var generators - hybrid var generators – Comparison of SVC and STATCOM.

UNIT- III: SERIES COMPENSATION (08 Periods)

Objectives of series compensation – GTO Thyristor Controlled Series Capacitor (GCSC) - Thyristor Switched Series Capacitor (TSSC) - Thyristor Controlled Series Capacitor (TCSC) - Control schemes for TCSC, TSSC and TCSC.

UNIT- IV: UNIFIED POWER FLOW CONTROLLER (UPFC) & INTERLINE POWER FLOW CONTROLLER (IPFC) (10 Periods)

Introduction - The Unified Power Flow Controller - Basic Operating Principles - Conventional Transmission Control Capabilities - Independent Real and Reactive Power Flow Control - Control Structure - Basic Control System for P and Q Control - Hybrid Arrangements: UPFC With a Phase Shifting Transformer.

UNIT- V: SPECIAL FACTS DEVICES **(09 Periods)**

TCPAR: Thyristor controlled phase angle regulator, NGH sub-synchronous reactance damper, TCBR: thyristor controlled breaking resistor, D-STATCOM: Distribution STATCOM, UPQC: Unified power quality controller.

Total Periods: 45

Text Books:

T1. Understanding FACTS – Concepts and Technology of Flexible AC Transmission Systems, Narain G. Hingorani and Laszlo Gyugyi, IEEE Press, Wiley, 2000, First Edition, Reprint 2015.

T2. FACTS Controllers in Power Transmission and Distribution, K. R. Padiyar, New Age International Publishers, 2007, First Edition.

Reference Books:

R1. Flexible AC Transmission Systems: Modelling and Control, Xiao-Ping Zhang, Christian Rehtanz and Bikash Pal, Springer, 2012, First Indian Reprint, 2015.

R2. FACTS – Modelling and Simulation in Power Networks, Enrique Acha, Claudio R. Fuerte-Esquivel, Hugo Ambriz-Perez and Cesar Angeles-Camacho, Wiley, 2004, First Edition.

Web Resources:

1. https://nptel.ac.in/courses/108107114
2. http://www.digimat.in/nptel/courses/video/108107114/L02.html

		L	T	P	C
2552203	**M.Tech. II-SEMESTER** **REACTIVE POWER COMPENSATION AND MANAGEMENT** (POWER SYSTEMS) **(PROGRAM ELECTIVE-III)**	**3**	**0**	**0**	**3**

Course Outcomes: Power System Security and State Estimation

On successful completion of the course, student will be able to

CO1. apply load compensation techniques to improve voltage regulation, phase balancing, and power factor of electrical loads.

CO2. analyze transmission system performance and evaluate various steady-state and dynamic reactive power compensation methods.

CO3. assess power quality issues and implement reactive power coordination and demand-side management strategies for efficient power utilization.

CO4. design reactive power management solutions for distribution systems through optimal capacitor selection and placement to minimize losses.

CO5. evaluate reactive power requirements and propose compensation techniques for electric traction systems and arc furnace applications.

SYLLABUS:

UNIT- I: LOAD COMPENSATION **(09 Periods)**

Objectives – specifications of a load compensator – Reactive power characteristics – Reactive power bias – Load compensator as a voltage regulator – Phase balancing and power factor correction of unsymmetrical loads.

UNIT- II: STEADY STATE & TRANSIENT STATE REACTIVE POWER COORDINATION & COMPENSATION IN TRANSMISSION SYSTEM **(08 Periods)**

Uncompensated line - Electrical parameters, fundamental transmission line equation, surge impedance and natural loading, basic concepts no-load and under load conditions – Types of compensation – Passive shunt and series and dynamic shunt compensation – Characteristic time periods – Passive shunt compensation – Static compensation - Series capacitor compensation – Compensation using synchronous condensers.

UNIT- III: REACTIVE POWER COORDINATION & DEMAND SIDE MANAGEMENT **(10 Periods)**

Objective - Basic concepts of quality of power supply – Disturbances - Steady – state variations – Effects of under voltages – Frequency – Harmonics, radio frequency and electromagnetic interferences. Load patterns – Basic methods - load shaping – Power tariffs - KVAR based tariffs - penalties for voltage flickers and Harmonic voltage levels.

UNIT- IV: DISTRIBUTION & USER SIDE REACTIVE POWER MANAGEMENT **(10 Periods)**

System losses – Loss reduction methods – Examples – Reactive power planning – Objectives –

Economics - Planning capacitor placement – Retrofitting of capacitor banks - KVAR requirements for domestic appliances – Purpose of using capacitors – Selection of capacitors – Deciding factors – Types of capacitors, characteristics and Limitations.

UNIT- V: REACTIVE POWER MANAGEMENT IN ELECTRIC TRACTION SYSTEMS AND ARC FURNACES (08 Periods)

Typical layout of traction systems – Reactive power control requirements – Distribution transformers – Electric arc furnaces – Furnaces transformer – Filter requirements – Remedial measures – Power factor of an arc furnace.

Total Periods: 45

Text Books:

T1. Reactive Power Control in Electric Systems, T.J.E.Miller, John Wiley and Sons, 2017, 5th edition.
T2. Reactive power Management, D.M.Tagare, Tata Mc Graw Hill, 2004, 1st Edition.

Reference Books:

R1. Reactive Power Compensation, Dr. Hidaia Mohmood Alassouli, 2018, Kindle Edition.
R2. Reactive Power Compensation: A Practical Guide, Wolfgang Hofmann, Jurgen Schlabbach, Wolfgang Just, Wiley publication, 2012, 4th Edition.

Web Resources:

1. https://www.storytel.com/tv/books/reactive-power-compensation-932259?srsltid=AfmBOootzxjp_Cu36sDmauUe8zZ0uY1nb0T9IPXjxyhpjgsTzZevCFxU

2552204	M.Tech. II-SEMESTER MODERN CONTROL THEORY (POWER SYSTEMS) (PROGRAM ELECTIVE-III)	L	T	P	C
		3	0	0	3

Pre-Requisites: NIL

Course Outcomes:

On successful completion of the course, student will be able to

CO1. apply state-space modeling techniques to represent dynamic systems and compute system responses using state equations and state transition matrices.

CO2. analyze controllability and perform system transformations and pole placement using state feedback methods for linear control system design.

CO3. design optimal controllers using Linear Quadratic Regulator (LQR) techniques by solving algebraic Riccati equations and implementing output feedback control.

CO4. design full-order and reduced-order state observers based on observability concepts for state estimation and observer-based control implementation.

CO5. evaluate system stability using Lyapunov methods and analyze sensitivity, disturbance rejection, and decoupling in state-space control systems.

SYLLABUS:

UNIT- I: STATE VARIABLE DESCRIPTION **(10 Periods)**

Introductory matrix algebra and linear Vector Space, State space representation of systems- Linearization of a non-linear System- Solution of state equations- Evaluation of State Transition Matrix (STM).

UNIT- II: TRANSFORMATION, POLEPLACEMENT AND CONTROLLABILITY **(10 Periods)**

Similarity transformation and invariance of system properties due to similarity transformations. Minimal realization of SISO, SIMO and MISO transfer functions. Discretization of a continuous time state space model- Conversion of state space model to transfer function model using Fadeeva algorithm- Fundamental theorem of feedback control - Controllability and Controllable canonical form - Pole assignment by state feedback using Ackermann's formula– Eigen structure assignment problem.

UNIT- III: OPTIMAL CONTROL **(09 Periods)**

Linear Quadratic Regulator (LQR) problem and solution of algebraic Riccati equation using Eigen value and Eigen vector methods- iterative method- Controller design using output feedback.

UNIT- IV: OBSERVERS **(08 Periods)**

Observability and observable canonical form-Design of full order observer using Ackermann's formula -Bass Gura algorithm- Duality between controllability and observability- Full order Observer based controller design- Reduced order observer design.

UNIT- V: STABILITY ANALYSIS AND SENSITIVITY **(08 Periods)**

Internal stability of a system- Stability in the sense of Lyapunov- Asymptotic stability of linear time invariant continuous and discrete time systems- Solution of Lyapunov type equation- Model decomposition and decoupling by state feedback- Disturbance rejection- sensitivity and complementary sensitivity functions.

Total Periods: 45

Text Books:

T1. Modern Control Engineering, K. Ogata, Prentice Hall, India, 2010, 5th Edition.

T2. Linear Systems, T. Kailath, Prentice Hall, India, 2016.

T3. Control Systems, N.K. Sinha, New Age International, 2013, 4th Edition.

Reference Books:

R1. Linear Systems, Panos J Antsaklis, and Anthony N.Michel, New Age International, 2009.

R2. Linear Control System Analysis and Design conventional and Modern, John JD Azzoand C. H. Houpis, Mc Graw- Hill Book Company, 1988, 3rd Edition.

R3. Numerical Methods for linear Control Systems, B.N.Dutta, Elsevier Publication, 2007.

R4. Linear System Theory and Design, C.T. Chen, PHI, India, 1984.

R5. Modern Control Systems, Richard C. Dorf and Robert H. Bishop, Pearson Edu., India, 2009, 11th Edition.

Web Resources:

1. http://www.digimat.in/nptel/courses/video/108103007/L01.html

		L	T	P	C
2552205	**M.Tech. II-SEMESTER** **EVOLUTIONARY ALGORITHMS APPLICATIONS IN POWER ENGINEERING** (POWER SYSTEMS) **(PROGRAM ELECTIVE-III)**	**3**	**0**	**0**	**3**

Pre-Requisites: NIL

Course Outcomes:

On successful completion of the course, student will be able to

CO1. explain the fundamentals of soft computing, optimization problem classification, and meta-heuristic techniques, including swarm intelligence concepts.

CO2. apply Genetic Algorithm (GA) and Particle Swarm Optimization (PSO) techniques to solve constrained and unconstrained optimization problems such as Economic Load Dispatch.

CO3. analyze Artificial Bee Colony (ABC), Ant Colony Optimization (ACO), and Differential Evolution (DE) algorithms for power system optimization problems.

CO4. evaluate the performance of Bat Algorithm (BA) and Shuffled Frog Leaping Algorithm (SFLA) for ELD and optimal placement and sizing of Distributed Generation.

CO5. design and implement multi-objective optimization solutions using Pareto optimality and NSGA-II for engineering applications such as power converter control.

SYLLABUS:

UNIT-I: FUNDAMENTALS OF SOFT COMPUTING TECHNIQUES (10 Periods)

Definition-Classification of optimization problems- Unconstrained and Constrained optimization Optimality conditions- Introduction to intelligent systems- Soft computing techniques- Conventional Computing versus Swarm Computing - Classification of meta-heuristic techniques - Single solution based and population based algorithms – Exploitation and exploration in population based algorithms - Properties of Swarm intelligent Systems - Application domain - Discrete and continuous problems - Single objective and multi-objective problems.

UNIT-II: GENETIC ALGORITHM AND PARTICLE SWARM OPTIMIZATION (08 Periods)

Genetic Algorithm versus Conventional Optimization Techniques - Genetic representations and selection mechanisms; Genetic operators- different types of crossover and mutation operators -Bird flocking and Fish Schooling – anatomy of a particle- equations based on velocity and positions -PSO topologies – control parameters – GA and PSO algorithms for solving ELD problem.

UNIT-III: ARTIFICIAL BEE COLONY ALGORITHM AND DIFFERENTIAL EVOLUTION (10 Periods)

Artificial bee colony (ABC) algorithms-binary ABC algorithms – ACO and ABC algorithms for solving Economic Dispatch of thermal units. The Motivation for Differential Evolution (DE), Introduction to Parameter Optimization, Single-Point, Derivative-Based Optimization, Local Versus Global Optimization, Differential Mutation, Recombination, Selection, Benchmarking Differential Evolution, DE Versus Other Optimizers, DE on Parallel Processors.

UNIT-IV: SHUFFLED FROG-LEAPING ALGORITHM AND BAT OPTIMIZATION ALGORITHM (09 Periods)

Bat Algorithm- Echolocation of bats- Behaviour of microbats- Acoustics of Echolocation- Movement of Virtual Bats- Loudness and Pulse Emission- Shuffled frog algorithm-virtual population of frogs - comparison of memes and genes -memeplex formation- memeplex updation- BA and SFLA algorithms for solving ELD and optimal placement and sizing of the DG problem.

UNIT-V: MULTI OBJECTIVE OPTIMIZATION (08 Periods)

Multi-Objective optimization Introduction- Concept of Pareto optimality – non-dominant sorting technique- Pareto fronts-best compromise solution- min-max method-NSGA-II algorithm and applications – Control of Power Converters.

Total Periods: 45

Text Books:

T1. Recent Advances in Swarm Intelligence and Evolutionary Computation, Xin-She Yang, Springer International Publishing, 2015.

T2. Multi-Objective Optimization Using Evolutionary Algorithms, Kalyanmoy Deb, John Wiley & Sons, 2001.

Reference Books:

R1. Evolutionary Optimization Algorithms, Altaf Q. H. Badar, CRC Press, 2022.

R2. Artificial Intelligence and Intelligent Systems, N. P. Padhy, Oxford University Press, 2005.

R3. Swarm Intelligence, James Kennedy and Russell C. Eberhart, Morgan Kaufmann Publishers, 2001.

Web Resources:

1. https://www.youtube.com/playlist?list=PLwNx-fzXuQ9ZKLp0Vvj5OYt5xXZA4aALj
2. https://nptel.ac.in/courses/108/106/108106165
3. https://www.scholarpedia.org/article/Particle_swarm_optimization
4. https://www.mathworks.com/help/gads/artificial-bee-colony.html
5. https://www.sciencedirect.com/topics/computer-science/bat-algorithm
6. https://www.mathworks.com/help/gads/multiobjective-optimization.html

		L	T	P	C
2552206	**M.Tech. II-SEMESTER** **POWER QUALITY** (POWER SYSTEMS) **(PROGRAM ELECTIVE-IV)**	**3**	**0**	**0**	**3**

Pre-Requisites: Power System Security and State Estimation

Course Outcomes:

On successful completion of the course, student will be able to

CO1. understand the fundamentals and terminology of power quality and identify common power quality issues such as voltage sag, swell, and flicker.

CO2. apply the concept of power frequency disturbances, types of transients, and transient waveforms in power systems.

CO3. analyze harmonic methodology, harmonic distortion effects, and electromagnetic interference (EMI) concepts in power systems.

CO4. remember the necessity of grounding, bonding, and various methods of grounding used in electrical systems.

CO5. understand different techniques of measuring and solving power quality problems using appropriate instruments and mitigation devices.

SYLLABUS:

UNIT-I: INTRODUCTION TO POWER QUALITY **(09 Periods)**

Definition of Power Quality - Power Quality Progression - Power Quality Terminology - Power Quality Issues– Voltage swells, sags, flicker, Responsibilities of Power Suppliers and Users-Power Quality Standards.

UNIT-II: POWER FREQUENCY DISTURBANCE & TRANSIENTS **(08 Periods)**

Introduction to Power Frequency Disturbance - Common Power Frequency Disturbances – Characteristics of Low Frequency Disturbances - Voltage Tolerance Criteria- ITIC Graph - Introduction to Transients -Transient System Model - Examples of Transient Models and their Response - Power System Transient Modeling – Types and Causes of Transients -Examples of Transient Waveforms.

UNIT-III: HARMONICS & ELECTROMAGNETIC INTERFERENCE (EMI)

(10 Periods)

Definition of Harmonics - Harmonic Number (h) - Odd and Even Order Harmonics - Harmonic Phase Rotation and Phase Angle - Voltage and Current Harmonics - Individual and Total Harmonic Distortion -Harmonic Signatures - Effect of Harmonics On Power System Devices - Guidelines For Harmonic Voltage and Current Limitation - Harmonic Current Mitigation - Introduction to EMI - Frequency Classification –Electrical Fields- Magnetic Fields-EMI Terminology-Power Frequency Fields-High Frequency Interference-EMI Susceptibility- EMI Mitigation-Cable Shielding-Health Concerns of EMI.

UNIT-IV: GROUNDING AND BONDING (10 Periods)

Introduction to Grounding and Bonding-Shock and Fire Hazards-NEC Grounding Requirements-Essentials of a Grounded System-Ground Electrodes-Earth Resistance Tests-Earth Ground Grid Systems-Power Ground System-Signal Reference Ground (SRG)-SRG Methods-Single and Multipoint Grounding –Ground Loops – Electro Chemical Reaction -Examples of Grounding Anomalies.

UNIT-V: MEASURING AND SOLVING POWER QUALITY PROBLEMS (8 Periods)

Introduction to Power Quality Measurements-Power Quality Measurement Devices-Power Quality Measurements Test Locations-Test Duration-Instrument Setup- Instrument Guidelines – Power quality mitigating concepts and devices.

Total Periods: 45

Text Books:

T1. Power Quality, C. Sankaran, CRC Press, 2001, First Edition.
T2. Electrical Power Systems Quality, Roger C. Dugan, Mark F. McGranaghan, Surya Santoso and H. Wayne Beaty, McGraw Hill Education, 1996, Second Edition.

Reference Books:

R1. Power Quality Enhancement Using Custom Power Devices, Arindam Ghosh and Gerard Ledwich, Springer, 2002, First Edition.
R2. Electric Power Distribution System Engineering, Turan Gonen, CRC Press, 2008, Second Edition.

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc26_ee26/preview
2. https://onlinecourses.nptel.ac.in/noc20_ee10/course

	M.Tech. II-SEMESTER EV CHARGING INFRASTRUCTURE AND TECHNOLOGY (POWER SYSTEMS) (PROGRAM ELECTIVE-IV)	L	T	P	C
2552207		3	0	0	3

Pre-Requisites: NIL

Course Outcomes:

On successful completion of the course, student will be able to

CO1. differentiate AC and DC EV charging systems and explain their technical standards, power ratings and EV supply equipment.

CO2. apply location planning methodologies to identify suitable sites for EV charging infrastructure considering demand patterns and urban planning principles.

CO3. analyze electricity supply arrangements, regulatory aspects and the role of DISCOMs in connecting EV charging infrastructure to the power grid.

CO4. analyze the impact of EV charging loads on the electricity grid and propose smart charging strategies for effective EV-grid integration.

CO5. compare different EV charging infrastructure implementation models in India and recommend suitable approaches for practical deployment.

SYLLABUS:

UNIT- I: AN OVERVIEW OF EV CHARGING INFRASTRUCTURE (09 Periods)

Orientation to EV charging infrastructure, brief introduction to technical concepts of electric vehicle supply equipment, AC and DC charging, power ratings, and charging standards.

UNIT- II: LOCATION PLANNING AND LAND ALLOCATION (09 Periods)

The location and site planning aspects for EV charging, framing the principles of location planning and demonstrating a methodology for spatial allocation of charging demand, identifying enabling processes and policies to integrate public charging in urban planning.

UNIT- III: CONNECTING EVs TO THE ELECTRICITY GRID (09 Periods)

Supply of electricity for charging infrastructure, familiarizing with the regulations that govern electricity supply for EV charging, the role of DISCOMs in provision of EV charging connections and the three methods of arranging for power supply for charging infrastructure.

UNIT- IV: ACHIEVING EFFECTIVE EV-GRID INTEGRATION (09 Periods)

Site-level considerations for supply of electricity to assess grid-level impacts, highlighting the need for smart charging to minimize adverse impacts of EV charging loads on the grid.

UNIT- V: MODELS OF EV CHARGING IMPLEMENTATION (09 Periods)

Typical roles within an implementation model for EV charging infrastructure and identifying three models in India – the government-driven model, the consumer-driven model and the charge point operator-driven model –for charging infrastructure implementation.

Total Periods: 45

Text Books:

T1. Smart Charging Solutions for Hybrid and Electric Vehicles, Sulabh Sachan, P. Sanjeevikumar and Sanchari Deb, Wiley Publications, 2022.
T2. Handbook of Electric Vehicle Charging Infrastructure Implementation, NITI Aayog and Rocky Mountain Institute, Version-1, 2019.

Reference Books:

R1. Electric Vehicle Integration via Smart Charging, Vahid Vahidinasab and Behnam Mohammadi-Ivatloo, Springer, 2022.
R2. Developing Charging Infrastructure and Technologies for Electric Vehicles, Mohammad Saad Alam, Reji Kumar Pillai and N. Murugesan, IGI Global Publisher, 2021.

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc25_ee134/preview

2552208	M.Tech. II-SEMESTER EHVAC TRANSMISSION SYSTEMS (POWER SYSTEMS) (PROGRAM ELECTIVE-IV)	L	T	P	C
		3	0	0	3

Pre-Requisites: Advanced Power System Protection

Course Outcomes:

On successful completion of the course, student will be able to

CO1. understand the basic concepts, need, advantages, and problems of EHVAC transmission systems.

CO2. apply the principles of line inductance, capacitance, and electrostatic field calculations in EHV transmission systems & identifying the factors affecting AC-DC transmission.

CO3. analyze corona effects including corona loss, audible noise, and radio interference in EHV transmission lines.

CO4. analyze travelling waves, reflection and refraction coefficients, and surge impedance in transmission lines.

CO5. evaluate various voltage control methods such as shunt compensation, series compensation, synchronous condensers, and Static VAR compensators.

SYLLABUS:

UNIT-I: PRELIMINARIES (08 Periods)

Necessity of EHVAC transmission – Advantages and problems – Power handling capacity and line losses – Mechanical considerations – Resistance of conductors – Properties of bundled conductors – Bundle spacing and bundle radius – Examples.

UNIT-II: LINE AND GROUND REACTIVE PARAMETERS (10 Periods)

Line inductance and capacitances – Sequence inductances and capacitances – Modes of propagation – Ground return – Examples. Electrostatics – Field of sphere gap – Field of line changes and properties – Charge – potential relations for multi-conductors–Surface voltage gradient on conductors–Distribution of voltage gradient on sub-conductors of bundle–Examples.

UNIT-III: CORONA EFFECTS (10 Periods)

Power loss and audible noise(AN) –corona loss formulae –Charge voltage diagram–Generation, characteristics -Limits and measurements of AN–Relation between1-phase and 3 -phase AN levels– Radio interference (RI)- Corona pulses generation, properties, limits – Frequency spectrum– Modes of propagation–Excitation function– Measurement of RI, RIV and excitation functions **-** Examples.

UNIT-IV: ELECTROSTATIC FIELD & TRAVELING WAVE THEORY (10 Periods)

Electrostatic field: calculation of electrostatic field of EHV/AC lines – Effect on humans, animals and plants – Electrostatic induction in un-energised circuit of double - circuit line – Electromagnetic interference - Examples. Traveling wave expression and solution - Source of excitation - Terminal conditions - Open circuited and short circuited end-Reflection and refraction coefficients-Lumped parameters of distributed lines-Generalized constants-No-load voltage conditions and charging current.

UNIT-V: VOLTAGE CONTROL **(07 Periods)**

Power circle diagram and its use – Voltage control using synchronous condensers – Cascade connection of shunt and series compensation – Sub-synchronous resonance in series capacitor – Compensated lines – Static VAR compensating system.

Total Periods: 45

Text Books:

T1. EHV-AC, HVDC Transmission and Distribution Engineering, Sanjay Kumar Sharma, S. K. Kataria & Sons, 2016, Second Edition.

T2. EHVAC Transmission Engineering, R. D. Begamudre, New Age International (P) Ltd., 2012, Second Revised Edition.

T3. EHV Transmission, M. G. Dwek, Elsevier Science, 1992, Third Edition.

Reference Books:

R1. HVDC Transmission Systems, K. R. Padiyar, Wiley Eastern Ltd., New Delhi, 1992, Second Revised Edition.

R2. High Voltage Direct Current Transmission, J. Arrillaga, Peter Peregrinus Ltd., London, U.K., 1998, Second Edition.

R3. Direct Current Transmission, Vol. 1, E. W. Kimbark, Wiley-Interscience, New York, 1971, First Edition.

Web Resources:

1. https://nptel.ac.in/courses/108104013
2. https://nptel.ac.in/courses/108108099
3. https://nptel.ac.in/courses/108108116
4. http://www.digimat.in/nptel/courses/video/108108099/L01.html
5. https://www.youtube.com/watch?v=yP7OACmLP48
6. https://en.wikipedia.org/wiki/Electric_power_transmission
7. https://www.electrical4u.com/corona-effect-in-power-system/
8. https://www.electricaleasy.com/2016/07/corona-discharge.html
9. https://www.youtube.com/watch?v=Z1HLlKcPxaE&t=1s

2552251	M.Tech. II-SEMESTER RENEWABLE ENERGY SOURCES LAB (POWER SYSTEMS)	L	T	P	C
		0	0	2	1

Course Outcomes:

On successful completion of the course, student will be able to

CO1. observe the I-V and P-V curves and Series and Parallel connection of Solar systems.

CO2. analyze the sun tracking and MPPT Charge Controllers of Solar PVsystems, Power, Voltage and Frequency Measurement of Wind Generator.

CO3. understand the effect of temperature variation and irradiation on Photovoltaic Array

CO4. able to apply appropriate Tools and Techniques to understand and analyze the problems following professional ethics with focus on societal and environmental aspects.

CO5. work as a team and communicate results in an effective way.

CO6. make decisions as an individual or as team member to manage tasks and also engage in independent and life-long learning with ability to adapt to new and technological changes.

List of Experiments:

1. Draw the I-V and P-V curves of Solar Panel using PV Panel
2. Study of Series and Parallel connection of Solar Panels
3. Study of Sun tracking system
4. Maximum Power Point Tracking Charge Controllers
5. Inverter control for Solar PV based systems
6. Power, Voltage & Frequency Measurement of output of Wind Generator
7. Impact of load and wind speed on power output and its quality
8. Performance of frequency drop characteristics of induction generator at different loading condition
9. Charging and Discharging characteristics of Battery

Simulation Experiments:

1. Modelling of PV Cell
2. Effect of temperature variation on Photovoltaic Array
3. Effect of Irradiation on a Photovoltaic Array
4. Design of solar PV boost converter using P&O MPPT techniques/ List of Experiments:

Web Resources:

https://www.vlab.co.in

2552252	M.Tech. II-SEMESTER FACTS DEVICES SIMULATION LAB (POWER SYSTEMS)	L	T	P	C
		0	0	4	2

Course Outcomes:

On successful completion of the course, student will be able to

CO1. understand and apply load balancing using Compensators.

CO2. analyze load flow incorporating SVC & STATCOM.

CO3. develop a Simulation model for STATCOM & UPFC

CO4. able to apply appropriate tools and techniques to understand and analyze the problems following professional ethics with focus on societal and environmental aspects.

CO5. work as a team and communicate results in an effective way.

CO6. make decisions as an individual or as team member to manage tasks and also engage in independent and lifelong learning with ability to adapt to new and technological changes.

List of Exercises/ List of Experiments:

Minimum Ten experiments are to be conducted.

1. Voltage regulation using shunt and series compensation
2. Load balancing in power system network using compensators
3. Simulation of TCSC
4. Voltage profile improvement using SVC
5. Voltage profile improvement using STATCOM
6. Transient Stability enhancement using STATCOM.
7. Simulation of UPFC with mathematical models
8. Load flow incorporating SVC
9. Load flow incorporating STATCOM
10. Simulation of DVR
11. Transmission Line Characteristics (P vs δ, Q vs δ, P vs Distance, Q vs Distance and V vs Distance) with and without Compensation
12. Sizing- simulation and operation of TCR and FC-TCR for a transmission line fed by an ac supply and feeding
    (a) Resistive/inductive/capacitive load one at a time
    (b) A load which can have leading as well as lagging behaviour
13. Sizing- simulation and operation of TCSC for a transmission line fed by an ac supply and feeding
    (a) Resistive/inductive/capacitive load one at a time
    (b) A load which can have leading as well as lagging behaviour
14. Sizing- simulation and operation of STATCOM for a transmission line fed by an ac supply and feeding
    (a) Resistive/inductive/capacitive load one at a time
    (b) A load which can have leading as well as lagging behaviour
15. Sizing- simulation and operation of SSSC for a transmission line fed by an ac supply and feeding
    (a) Resistive/inductive/capacitive load one at a time
    (b) A load which can have leading as well as lagging behaviour

Web Resources:

https://www.vlab.co.in

2552253	M.Tech., II-SEMESTER COMPREHENSIVE VIVA VOCE (POWER SYSTEMS)	L	T	P	C
		0	0	0	2

Pre-Requisites: All Courses

Course Outcomes:

On successful completion of the course, student will be able to

CO1. Demonstrate comprehensive understanding of core concepts learned throughout the program.

CO2. Apply theoretical knowledge to analyze and solve discipline-specific problems.

CO3. Communicate technical ideas, concepts, and project outcomes clearly and effectively during oral examination.

CO4. Integrate knowledge from various subjects to justify solutions and decisions.

CO5. Exhibit critical thinking, professional ethics, and confidence while responding to technical and situational questions.

		L	T	P	C
2598281	**M.Tech., II-SEMESTER** **QUANTUM TECHNOLOGIES AND APPLICATIONS** (Common to AIDS, PS, Geo-Tech, RE, ES&VLSI) **(MANDATORY COURSE-II)**	**2**	**0**	**0**	**2**

Pre-Requisites: NIL

Course Outcomes:

On successful completion of the course, student will be able to

CO1. Demonstrate the basic principles and technological importance of quantum physics.

CO2. Explain the basic concepts of qubits, quantum states, entanglement, and differences between classical and quantum information systems..

CO3. Analyze the key challenges and requirements in developing stable and scalable quantum hardware systems.

CO4. Explain the basic concepts of quantum communication and computing, including QKD, quantum parallelism, and related challenges.

CO5. Demonstrate the major applications, industry developments, and future opportunities of quantum technologies along with their societal and practical challenges.

SYLLABUS:

UNIT-I: FOUNDATIONS OF QUANTUM THEORY AND TECHNOLOGIES (05 Periods)

Transition from classical to quantum physics. Key conceptual principles: Superposition, Entanglement, Uncertainty, Wave-particle duality. Quantum states and measurement; the role of the observer. Representative quantum systems: electrons, photons, atoms. Concept of quantization and discrete energy levels. Strategic relevance of quantum technologies.

Overview of major domains: Computing, Communication, Sensing. Global quantum initiatives: India's National Quantum Mission, EU Quantum Flagship, USA, China.

UNIT-II: CONCEPTUAL STRUCTURE OF QUANTUM INFORMATION (07 Periods)

Qubits: qualitative understanding using spin and polarization. Classical bits vs quantum bits: distinctions and implications. Quantum systems (non-engineering perspective): trapped ions, superconducting qubits, photonics. Coherence and decoherence mechanisms. Abstract notions: quantum states, measurement operators, Hilbert space—interpretation without mathematics. Entanglement and non-locality as foundational resources. Quantum vs classical information principles; philosophical considerations.

UNIT-III: BUILDING A QUANTUM COMPUTER – CHALLENGES AND REQUIREMENTS (06 Periods)

Conceptual prerequisites for functional quantum hardware. Fragility of quantum states: decoherence, noise, stability issues. Requirements: isolation, error resilience, scalability, control. Why maintaining entanglement is difficult; theoretical necessity of quantum error correction. Comparative overview of hardware platforms (superconducting circuits, trapped ions, photonics).Current progress vs scientific constraints; conceptual view of quantum software's role.

UNIT-IV: QUANTUM COMMUNICATION AND COMPUTING (06 Periods)

Quantum vs classical communication paradigms. Essentials of Quantum Key Distribution (QKD) and its security rationale. Entanglement- enabled communication protocols. Concept of the Quantum Internet and secure global networking. Introduction to quantum computing and quantum

parallelism.
Conceptual comparison of classical and quantum gate operations. Challenges: decoherence, noise, and the necessity of error correction frameworks.

UNIT-V: APPLICATIONS, INDUSTRY, AND FUTURE DIRECTIONS (06 Periods)

Application domains: Healthcare and drug discovery, Material science and chemistry, Optimization and logistics, Quantum sensing and precision timing. Case studies: IBM, Google, Microsoft, PsiQuantum. Ethical, societal, and policy considerations. Barriers to adoption: cost, skilled workforce, standards. Emerging research and career landscapes; India's strategic opportunity in the global quantum ecosystem.

Total Periods: 30

Textbooks:

T1. Quantum Computation and Quantum Information, Nielsen & Chuang, Cambridge University Press, 2010.
T2. Quantum Computing: A Gentle Introduction, Rieffel & Polak, MIT Press, 2011.
T3. Quantum Computing for Everyone, Chris Bernhardt, MIT Press, 2019.

Reference Books:

R1. Quantum Computing Explained, David McMahon, Wiley, 2008.
R2. An Introduction to Quantum Computing, Kaye, Laflamme, Mosca, OUP, 2007.
R3. Quantum Computing Since Democritus, Scott Aaronson, CUP, 2013.
R4. Quantum Mechanics: The Theoretical Minimum, Susskind & Friedman, Basic Books, 2014.
R5. Quantum Enigma, Rosenblum & Kuttner, OUP, 2011.
R6. Principles of Quantum Computation and Information, Benenti et al., World Scientific, 2004.
R7. DST India and MeitY: Official Quantum Mission Reports, 2020 onwards.
R8. Quantum Flagship EU: Roadmaps and Strategy Documents.

Online Learning Resources

1. IBM Quantum Experience & Qiskit Textbook Coursera – Quantum Mechanics and Quantum Computation (UC Berkeley) edX – Quantum Internet & Quantum Computers
2. YouTube – Quantum Computing for the Determined (Michael Nielsen)

25HS201	M.Tech., II-SEMESTER PEDAGOGY STUDIES (Common to AIDS, PS, Geo-Tech, RE, ES&VLSI) (AUDIT COURSE-II)	L	T	P	C
		2	0	0	0

Pre-Requisites: NIL

Course Outcomes:

On successful completion of the course, student will be able to

CO1. Apply pedagogy, learning theories, and technology to design learner-centered education.

CO2. Design and implement effective lesson plans and curriculum using appropriate teaching strategies and technology tools to enhance the teaching–learning process.

CO3. Analyze and apply instructional design models, emerging e-learning trends, and ICT tools to design and implement effective technology-integrated teaching–learning systems.

CO4. Apply pedagogical analysis and appropriate assessment methods, including technology-based tools and reflective practices, to improve teaching–learning effectiveness.

CO5. Apply pedagogical analysis and appropriate assessment methods, including technology-based tools and reflective practices, to improve teaching–learning effectiveness.

SYLLABUS:

UNIT-I: FOUNDATIONS OF PEDAGOGY (05 Periods)

Introduction to pedagogy and its importance in education - Historical and philosophical foundations of pedagogy - Theories of learning and teaching (behaviorist, cognitive, constructivist) - Role of pedagogy in shaping educational practices - Role of technology in modern pedagogy (ICT, e-learning, blended learning)

UNIT-II: TEACHING-LEARNING PROCESSES (06 Periods)

Understanding the teaching-learning process - Lesson planning and curriculum design - Strategies for effective teaching and learning (expository, collaborative, experiential) - Use of technology to enhance teaching-learning processes (multimedia, simulations, gamification)

UNIT-III: TECHNOLOGY INTEGRATION IN EDUCATION (07 Periods)

Educational technology and system design - Instructional design models (ADDIE, ASSURE, Dick and Carey Model) - Emerging trends in e-learning (social learning, MOOCs, mobile learning) - ICT tools for teaching and learning (Learning Management Systems, online resources)

UNIT-IV: PEDAGOGY AND ASSESSMENT (06 Periods)

Pedagogy, pedagogical analysis, and assessment - Types of assessment (placement, formative, diagnostic, summative) - Technology-based assessment tools (online quizzes, polls, discussions) - Rubrics for self and peer evaluation- Reflective Practices

UNIT-V: CONTEMPORARY ISSUES AND TRENDS (06 Periods)

Inclusive education and technology (assistive technology, accessibility) - Change management and innovation in education - Quality assurance and evaluation in education (TQM, Six Sigma) - Future trends in pedagogy and technology (AI, AR, VR in education) - Personalized learning and adaptive teaching

Total Periods: 30

Text Books:

T1. Essays on Pedagogy, Alexander, R. J., Routledge, 2008.
T2. The Wisdom of Practice: Essays on Teaching, Learning, and Learning to Teach, Shulman, L. S., Jossey-Bass, 2004

Reference Books:

R1. Teaching for the Future: Effective Teacher Education and Pedagogical Practices. OECD Publishing., 2021
R2. System Change in Education: Sustainability and Impact, Fullan, M., & Edwards, M, Routledge, 2022.
R3. Great Teaching Toolkit: Evidence Review, Coe, R., Rauch, C., Kime, S., & Singleton, D., Evidence Based Education., 2020
R4. The Struggle for the Soul of Teacher Education, Zeichner, K. M., Routledge, 2024
R5. UNESCO. Global Education Monitoring Report: Pedagogy, Teachers and Learning. UNESCO Publishing, 2024
R6. Visible Learning: A Synthesis of Over 800 Meta-Analyses Relating to Achievement, Hattie, J., Routledge., 2009
R7. Teacher Education Around the World: What Can We Learn from International Practice?, Darling-Hammond, L. , Routledge, 2007

Online Resources:

1. UNESCO Education Resources – https://www.unesco.org/education
2. OECD Education and Skills – https://www.oecd.org/education
3. ERIC (Education Resources Information Center) – https://eric.ed.gov (peer-reviewed papers, reports).
4. World Bank Education – https://www.worldbank.org/en/topic/education (research reports on teacher development in developing countries).
5. NPTEL/SWAYAM MOOCs – Teacher education and pedagogy-focused courses.
6. Google Scholar Alerts – set alerts for "pedagogical practices", "teacher education", "curriculum research" for the latest academic papers.

		L	T	P	C
25HS202	**M.Tech., II-SEMESTER** **PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS** (Common to AIDS, PS, Geo-Tech, RE, ES&VLSI) **(AUDIT COURSE-II)**	**2**	**0**	**0**	**0**

Pre-Requisites: NIL

Course Outcomes:

On successful completion of the course, student will be able to

CO1. Practice self-awareness and personal effectiveness by analyzing strengths, weaknesses, opportunities, and challenges (SWOC), setting SMART goals, and practicing reflection, journaling, and self-care strategies.

CO2. Evince emotional intelligence by developing self-awareness, self-regulation, motivation, communication, interpersonal, and conflict-resolution skills for personal and professional effectiveness.

CO3. Exhibit a positive mindset, resilience, and emotional well-being by cultivating growth-oriented thinking, gratitude, mindfulness, and strategies to overcome negative thoughts and behaviors.

CO4. Enhance personal and professional effectiveness by developing verbal, non-verbal, and presentation skills, while building confidence and competence in public speaking.

CO5. Demonstrate leadership capabilities by understanding styles and qualities, enhancing teamwork, collaboration, and problem-solving skills for effective team management.

SYLLABUS:

UNIT-I: SELF-AWARENESS AND PERSONAL GROWTH (06 Periods)

Understanding personality and its development- Identifying strengths, weaknesses, opportunities, and challenges (SWOC analysis)- Setting personal and professional goals- Practicing Self-Reflection and Journaling

(Activities: Personality assessments, self reflection exercises, group discussions, SWOC analysis worksheet, Action Plan, SMART goal activities, Reflective journaling, Self-care Planning)

UNIT-II: EMOTIONAL INTELLIGENCE AND INTERPERSONAL SKILLS (06 Periods)

Understanding emotional intelligence and its importance - Developing self-awareness, self-regulation, and motivation - Building effective communication and interpersonal skills - Conflict resolution and negotiation strategies.

(Activities: Emotional Intelligence Quiz, Self-Reflection exercises, feedback sessions, mindfulness exercises, Positive self-talk, Active Listening exercises, conflict-resolution Role-play, Case studies & Group activities)

UNIT-III: POSITIVE THINKING AND ATTITUDE (06 Periods)

Understanding the power of positive thinking- Developing a growth mindset and resilience - Practicing gratitude and mindfulness- Overcoming negative thoughts and behaviors

(Activities on positive thinking, growth mindset, mindfulness and self-care plan for overcoming negative thoughts)

UNIT-IV: EFFECTIVE COMMUNICATION AND PRESENTATION SKILLS (06 Periods)

Understanding the importance of effective communication- Developing verbal and non-verbal communication skills- Preparing and delivering effective presentations- Building confidence and public speaking skills

(Activities: Group discussions, Case studies, Role-Play, Non-verbal communication exercises, Practice presentations, Peer feedback, Public speaking exercises, Storytelling, Debates)

UNIT-V: LEADERSHIP AND TEAMWORK (06 Periods)

Understanding leadership styles and qualities - Developing leadership skills and qualities- Building effective teams and teamwork strategies- Practicing collaboration and problem-solving

(Activities: Case studies, Group discussions, Debates, Leadership role-playing, team building activities, Group projects, Collaborative problem-solving exercies, feedback sessions)

Total Periods: 30

Text Books:

T1. Daniel Goleman, Emotional Intelligence: Why It Can Matter More Than IQ, Bantam Books, 2017.

T2. Stephen R. Covey, The 7 Habits of Highly Effective People, Simon & Schuster, 2020

Reference Books:

R1. Dale Carnegie, How to Win Friends and Influence People, Simon & Schuster, 2020.

R2. Brian Tracy, Goals!: How to Get Everything You Want Faster Than You Ever Thought Possible, Berrett-Koehler Publishers, 2021.

R3. Robin Sharma, The 5 AM Club: Own Your Morning, Elevate Your Life, HarperCollins, 2020.

R4. Carol S. Dweck, Mindset: The New Psychology of Success, Random House, 2016.

R5. Daniel H. Pink,Drive: The Surprising Truth About What Motivates Us, Riverhead Books, 2018.

R6. John C. Maxwell, Leadershift: 11 Essential Changes Every Leader Must Embrace, Harper Collins, 2019.

Online Resources:

1. Coursera – *Personal Development Specialization* (https://www.coursera.org)
2. edX – *Leadership and Emotional Intelligence Courses* (https://www.edx.org)
3. FutureLearn – *Mindfulness and Resilience Training* (https://www.futurelearn.com)
4. MindTools – Practical resources on leadership, communication, and emotional intelligence (https://www.mindtools.com)
5. Positive Psychology – Articles and tools on resilience, gratitude, and well-being (https://positivepsychology.com)
6. TED Talks – Inspirational talks on leadership, communication, and self-growth (https://www.ted.com)
7. Harvard Business Review (HBR) – Leadership, negotiation, and workplace communication (https://hbr.org)

25HS203	M.Tech., II-SEMESTER **YOGA AND MEDITATION** (Common to AIDS, PS, Geo-Tech, RE, ES&VLSI) **(AUDIT COURSE-II)**	L	T	P	C
		2	0	0	0

Pre-Requisites: NIL

Course Outcomes:

On successful completion of the course, student will be able to

CO1. Explain the eight limbs of Ashtanga Yoga and their significance in achieving physical, mental, and spiritual well-being.

CO2. Explain the principles of Yama and Niyama and their role in ethical and personal discipline in yoga practice.

CO3. Practice the principles of Yama and Niyama as ethical guidelines for disciplined and harmonious living.

CO4. Explain the role of Asana and Pranayama in promoting physical fitness and mental well-being.

CO5. Practice yoga poses and pranayama techniques and their benefits for mind and body.

SYLLABUS:

UNIT-I: ASHTANGA YOGA (05 Periods)

Definitions of Eight parts of yoga - Yama (Restraints / Moral Disciplines), Niyama (Observances / Personal Disciplines), Asana (Postures / Physical Exercises), Pranayama (Breath Control / Life Force Regulation), Pratyahara (Withdrawal of Senses / Sense Control), Dharana (Concentration / Focus), Dhyana (Meditation / Contemplation), Samadhi (Absorption / Liberation)

UNIT-II: YAMA AND NIYAMA IN ASHTANGA YOGA (07 Periods)

Yama (Moral Restraints) - Ahimsa (Non-violence), Satya (Truthfulness), Asteya (Non-stealing), Brahmacharya (Moderation / Celibacy), Aparigraha (Non-possessiveness / Non-greed).

Niyama (Personal Disciplines / Observances) - Shaucha (Cleanliness / Purity), Santosha (Contentment), Tapas (Discipline / Austerity), Swadhyaya (Self-study / Study of Scriptures), Ishwar Pranidhana (Surrender to God / Devotion).

UNIT-III: DO'S AND DON'TS IN LIFE – YAMA AND NIYAMA (06 Periods)

Do‘s and Don‘ts in life.

UNIT-IV: ASANA AND PRANAYAM (06 Periods)

Asana - Body development and steadiness; Pranayam - Breath control and energy regulation

UNIT-V: YOGA POSES AND PRANAYAMA – BENEFITS AND TYPES (06 Periods)

Various yoga poses and their benefits for mind and body

Regularization of breathing techniques and its effects-Types of pranayama

Total Periods: 30

Text Books:

T1. Swami Prabhavananda and Christopher Isherwood (translation & commentary), Patanjali Yoga Sutras,Sri Ramakrishna Math, 1953.

T2. B.K.S. Iyengar, Light on Yoga, Thorsons, 2003.

Reference Books:

R1. T.K.V. Desikachar, The Heart of Yoga: Developing a Personal Practice, Inner Traditions 2nd Edition, 1999.

R2. Acharya Yatendra, Yoga & Stress Management, Fingerprint Publishers, 2019

R3. Yamini Muthanna, The Power of Yoga, Om Books International, 2015.

R4. Nayaswami Devarshi, Kriya Yoga: Spiritual Awakening for the New Age, Ananda Sangha Publications, 2023.

Online Resources:

1. NPTEL / SWAYAM Online Courses – Yoga and Physical Education modules.
2. AYUSH Ministry Website: https://yoga.ayush.gov.in – official yoga resources, protocols, and research.
3. Yoga Journal: https://www.yogajournal.com – practical guides, research updates, asana tutorials.
4. Art of Living Foundation: https://www.artofliving.org – pranayama, meditation, and wellness practices.
5. YouTube Channels (scholarly & practice-based):
    a. Sivananda Yoga Vedanta Centre
    b. Yoga with Adriene (for practical asana guidance)

2552301	M.Tech. III-SEMESTER RESTRUCTURED POWER SYSTEMS (POWER SYSTEMS) (PROGRAM ELECTVE-V)	L	T	P	C
		3	0	0	3

Pre-Requisites: Power System Stability and Control

Course Outcomes:

On successful completion of the course, student will be able to

CO1. evaluate restructuring models, ISO functions, power exchange mechanisms, transmission pricing, and congestion management in restructured power systems.

CO2. analyze power system operational planning activities of ISO and GENCOs in pool and bilateral market structures.

CO3. evaluate Available Transfer Capability (ATC) and electricity pricing mechanisms including volatility, forecasting, and forward price curves.

CO4. examine the structure and functioning of OASIS and assess different types of market power and their mitigation techniques.

CO5. compare transmission cost allocation methods and explain ancillary service management in competitive electricity markets.

SYLLABUS:

UNIT-I: KEY ISSUES IN ELECTRIC UTILITIES **(10 Periods)**

Introduction – Restructuring models – Independent System Operator (ISO) – Power Exchange – Market operations – Market Power – Standard cost – Transmission Pricing – Congestion Pricing – Management of Inter zonal/Intra zonal Congestion.

UNIT-II: POWER SYSTEM OPERATION IN COMPETITIVE ENVIRONMENT **(08 Periods)**

Introduction – Operational Planning Activities of ISO – The ISO in Pool Markets – The ISO in Bilateral Markets – Operational Planning Activities of a GENCO.

UNIT-III: AVAILABLE TRANSFER CAPABILITY (ATC) & ELECTRICITY PRICING **(10 Periods)**

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

UNIT-IV: OPEN ACCESS SAME-TIME INFORMATION SYSTEM & MARKET POWER **(07 Periods)**

Structure of OASIS – Posting of Information – Transfer capability on OASIS – Market Power: Introduction – Different types of market Power – Mitigation of Market Power – Examples.

UNIT-V: TRANSMISSION COST ALLOCATION METHODS & ANCILLARY SERVICES MANAGEMENT **(10 Periods)**

Transmission Cost Allocation Methods: Postage Stamp Rate Method – Contract Path Method – MW-

Mile Method – Unused Transmission Capacity Method – MVA-Mile method– Comparison of cost allocation methods – Ancillary Services Management: Introduction – Reactive Power as an Ancillary Service, a Review – Synchronous Generators as Ancillary Service Providers.

Total Periods: 45

Text Books:

T1. Operation of Restructured Power Systems, Kankar Bhattacharya, Math H.J. Boller and Jaap E. Daalder, Kluwer Academic Publishers, 2001, First Edition.

T2. Restructured Electrical Power Systems, Mohammad Shahidehpour and Muwaffaq Alomoush, Marcel Dekker Inc., 2001, First Edition.

Reference Books:

R1. Power System Restructuring and Deregulation, Loi Lei Lai, John Wiley & Sons Ltd., 2001, First Edition.

R2. Power Generation, Operation and Control, Allen J. Wood, Bruce F. Wollenberg and Gerald B. Sheble, John Wiley & Sons, 2013, Third Edition.

R3. Power System Economics, Steven Stoft, IEEE Press & Wiley-Interscience, 2002, First Edition.

R4. Fundamentals of Power System Economics, H. G. Stoll, IEEE Press, 1989, First Edition.

R5. Electric Power Systems, B. M. Weedy, B. J. Cory, N. Jenkins, J. B. Ekanayake and G. Strbac, John Wiley & Sons, 2012, Fifth Edition.

Web Resources:

1. https://nptel.ac.in/courses/108/101/108101005/
2. https://nptel.ac.in/courses/108/101/108101039/
3. https://www.caiso.com/market/Pages/default.aspx
4. https://resourcecenter.ieee-pes.org/

		L	T	P	C
2552302	**M.Tech. III-SEMESTER** **MACHINE LEARNING APPLICATIONS IN POWER ENGINEERING** (POWER SYSTEMS) **(PROGRAM ELECTVE-V)**	**3**	**0**	**0**	**3**

Pre-Requisites: Power System Stability and Control

Course Outcomes:

On successful completion of the course, student will be able to

CO1. understand the fundamental concepts and theoretical foundations of machine learning techniques used in engineering applications.

CO2. distinguish between supervised, unsupervised, and reinforcement learning paradigms.

CO3. apply supervised learning algorithms such as regression, classification, SVM, and tree ensembles to engineering problems.

CO4. analyze unsupervised and reinforcement learning techniques including clustering, dimensionality reduction, and Markov Decision Processes.

CO5. apply machine learning tools and algorithms to electrical power engineering problems such as load forecasting, renewable energy prediction, and fault detection.

SYLLABUS:

UNIT-I: LEARNING THEORY **(09 Periods)**

Introduction to Machine Learning: What is Learning – Learning Objectives – Data needed – Bayesian inference and Learning – Bayes theorem – inference – naïve Bayes – Regularization – Bias-Variance Decomposition and Trade-off – Concentration Inequalities – Generalization and Uniform Convergence – VC –dimension- Types of Learning- Supervised Learning – Unsupervised Learning and Reinforcement Learning.

UNIT-II: SUPERVISED LEARNING **(08 Periods)**

Introduction to Power Frequency Disturbance - Common Power Frequency Disturbances – Characteristics of Low Frequency Disturbances - Voltage Tolerance Criteria- ITIC Graph - Introduction to Transients -Transient System Model - Examples of Transient Models and their Response - Power System Transient Modeling – Types and Causes of Transients -Examples of Transient Waveforms.

UNIT-III: UNSUPERVISED LEARNING **(10 Periods)**

Unsupervised learning (clustering)- K –means Clustering Algorithm – Gaussian Mixture Model (GMM) – Expectation Maximization (EM) – Variational Auto Encoder (VAE) – Factor Analysis – Principle Components Analysis (PCA) – Independent Component Analysis (ICA).

UNIT-IV: REINFORCEMENT LEARNING **(10 Periods)**

Reinforcement learning- Markov Decision Processes (MDP) – Bellman's Equations- Value Iteration and Policy Iteration - Value Function Approximation – Q – Learning.

UNIT-V: APPLICATIONS OF ML **(8 Periods)**

Load Forecasting – Energy Market forecasting – Renewable energy forecasting, Fault identification and localization – Renewable Uncertainty estimation. ML for solar power MPPT, False data injection attack detection-Control of Power Converters.

Total Periods: 45

Text Books:

T1. Pattern Recognition and Machine Learning, Christopher M. Bishop, Springer, 2011.
T2. Machine Learning, Ethem Alpaydin, MIT Press, 2010.
T3. Machine Learning, Anuradha Srinivasaraghavan and Vincy Joseph, Wiley Publications, 2019.

Reference Books:

R1. Application of Machine Learning and Deep Learning Methods to Power System Problems, Morteza Nazari-Heris, Somayeh Asadi and Behnam Mohammadi-Ivatloo, Springer, 2021, First Edition.
R2. Deep Learning for Power System Applications: Case Studies Linking Artificial Intelligence and Power Systems, Fangxing Li and Yan Du, Springer, 2024, First Edition.

Web Resources:

1. https://nptel.ac.in
2. https://www.tensorflow.org

		L	T	P	C
2552303	**M.Tech. III-SEMESTER** **DISTRIBUTED GENERATION AND MICROGRID CONTROL** (POWER SYSTEMS) **(PROGRAM ELECTVE-V)**	**3**	**0**	**0**	**3**

Pre-Requisites: Power System Stability and Control and FACTS Controllers

Course Outcomes:

On successful completion of the course, student will be able to

CO1. examine the concept of distributed generation, distribution network and Microgrid configuration along with advantages and limitations.

CO2. evaluate the concepts of combined heat and power systems, wind energy conversion systems, solar photovoltaic systems and other renewable energy sources.

CO3. analyze the impact of Microgrid and active distribution network management system on technical, environmental and market aspects.

CO4. assess SCADA systems, communication architecture and control mechanisms in active distribution networks and Microgrids.

CO5. analyze the impact of distributed generation integration on power quality disturbances, reliability and premium power issues.

SYLLABUS:

UNIT- I: INTRODUCTION TO DISTRIBUTED GENERATION AND MICRO GRID **(09 Periods)**

Introduction to distributed generation - Active distribution network - Concept of Microgrid - Microgrid configuration - Interconnection of Microgrids - Technical and economical advantages of Microgrid - Challenges and limitations of Microgrid development - Management and operational issues of a Microgrid – Dynamic interactions of Microgrid with main grid – low voltage DC grid.

UNIT- II: DISTRIBUTED ENERGY RESOURCES **(09 Periods)**

Introduction - Combined heat and power (CHP) systems: Micro-CHP systems - Wind energy conversion systems (WECS): Wind turbine operating systems - Solar photovoltaic (PV) systems: Classification of PV cell - Small- scale hydroelectric power generation - Other renewable energy sources - Storage devices.

UNIT- III: MICRO GRID AND ACTIVE DISTRIBUTION NETWORK MANAGEMENT SYSTEM **(09 Periods)**

Introduction - Impact on heat utilization - Impact on process optimisation - Impact on market - Impact on environment - Impact on distribution system - Impact on communication standards and protocols – Network management needs of Microgrid – Micro source controller - Central controller.

UNIT- IV: SCADA AND ACTIVE DISTRIBUTION NETWORKS **(09 Periods)**

Introduction - Existing DNO SCADA systems - Control of DNO SCADA systems - SCADA in Microgrids - Human–machine interface (HMI) - Hardware components - Communication trends in

SCADA - Distributed control system (DCS) - Sub-station communication standardization - SCADA communication and control architectures - Communication devices.

UNIT- V: IMPACT OF DG INTEGRATION ON POWER QUALITY AND RELIABILITY **(09 Periods)**

Introduction - Power quality disturbances - Power quality sensitive customers - Power quality improvement technologies - Impact of DG integration - Issues of premium power in DG integration.

Total Periods: 45

Text Books:

T1. Microgrids and Active Distribution Networks, S. Chowdhury, S.P. Chowdhury and P. Crossley, The Institution of Engineering and Technology, 2009.
T2. Distributed Energy Resources in Microgrids: Integration, Challenges and Optimization, Rajeev Kumar Chauhan and Kalpana Chauhan, Academic Press, 2019, First Edition.

Reference Books:

R1. Microgrid: Advanced Control Methods and Renewable Energy System Integration, Magdi S. Mahmoud, Joc Hayton, 2016, First Edition.

Web Resources:

1. https://nptel.ac.in/courses/108107143
2. https://www.youtube.com/watch?v=4PdkdUNU4n8&list=PLLy_2iUCG87CVEavUXzRbiBihLRkjKcSY

		L	T	P	C
2552351	**M.Tech., III-SEMESTER** **DISSERTATION PHASE–I** (POWER SYSTEMS)	**0**	**0**	**20**	**10**

Pre-Requisites: NIL

Course Outcomes:

On successful completion of the course, student will be able to

CO1. identify and formulate a research problem in the chosen area of specialization through comprehensive literature review.

CO2. analyze existing methods and technologies related to the problem and identify research gaps.

CO3. design a suitable methodology, framework, or experimental setup to address the identified research problem.

CO4. apply appropriate tools and techniques to understand and analyze the problems following professional ethics with focus on societal and environmental aspects.

CO5. prepare and present a detailed project proposal and preliminary results effectively through technical reports and seminars.

CO6. make decisions to manage tasks and also engage in independent and life-long learning with ability to adapt to new and technological changes.

2552352	M.Tech., III-SEMESTER INDUSTRY INTERNSHIP (POWER SYSTEMS)	L	T	P	C
		0	0	0	2

Pre-Requisites: All Courses

Course Outcomes:

On successful completion of the course, student will be able to

CO1. demonstrate the organizational structure, workflow, and professional practices followed in industry.

CO2. apply engineering knowledge and technical skills to solve real-world industrial problems.

CO3. develop professional competencies such as teamwork, communication, time management, and work ethics in an industrial environment.

CO4. prepare and present a comprehensive report reflecting practical learning, observations, and outcomes.

2552353	M.Tech., III-SEMESTER CO-CURRICULAR ACTIVITIES (POWER SYSTEMS)	L	T	P	C
		0	0	0	1

Pre-Requisites: NIL

Course Outcomes:

On successful completion of the course, student will be able to

CO1. demonstrate participation and engagement in technical and professional co-curricular activities such as seminars, workshops, competitions, and technical events.

CO2. develop problem-solving, analytical, and innovation skills through active involvement in technical activities.

CO3. enhance communication, leadership, teamwork, and organizational skills through collaborative participation in co-curricular programs.

CO4. apply acquired knowledge and skills to improve overall professional competence and lifelong learning abilities.

2512381	M.Tech., III-SEMESTER GREEN BUILDINGS (Common to AIDS, PS, RE, ES&VLSI) (OPEN ELECTIVE)	L	T	P	C
		3	0	0	3

Pre-Requisites: NIL

Course Outcomes:

On successful completion of the course, student will be able to

CO1. Apply principles of green building design to plan and evaluate sustainable buildings by integrating energy efficiency, water conservation, eco-friendly materials, and sustainable construction practices.

CO2. Explain green building concepts, rating systems, and sustainable practices for energy, water, and materials efficiency.

CO3. Apply green building design principles to reduce energy demand and integrate renewable and onsite energy systems efficiently.

CO4. Apply energy-efficient HVAC design principles for sustainable air conditioning and green building performance.

CO5. Apply material conservation strategies and indoor environmental quality principles to promote sustainable and healthy buildings.

SYLLABUS:

UNIT-I: INTRODUCTION TO GREEN BUILDING AND SUSTAINABLE FEATURES

(08 Periods)

Introduction to Green Building – Necessity of Green Buildings, Benefits of Green Buildings, Green Building Materials and Equipment in India, Key Requisites for Constructing a Green Building, Important Sustainable Features for Green Buildings.

UNIT-II: GREEN BUILDING CONCEPTS AND SUSTAINABLE PRACTICES

(09 Periods)

Green Building Concepts and Practices – Indian Green Building Council, Green Building Movement in India, Benefits Experienced in Green Buildings, Launch of Green Building Rating Systems, Residential Sector, Market Transformation; Green Building Opportunities and Benefits: Opportunities of Green Buildings, Green Building Features, Material and Resources, Water Efficiency, Optimum Energy Efficiency, Typical Energy-Saving Approaches in Buildings, LEED India Rating System, and Energy Efficiency.

UNIT-III: GREEN BUILDING DESIGN AND ENERGY OPTIMIZATION

(09 Periods)

Green Building Design – Introduction, Reduction in Energy Demand, Onsite Sources and Sinks, Maximizing System Efficiency, Steps to Reduce Energy Demand and Use Onsite Sources and Sinks, Use of Renewable Energy Sources, Eco-friendly Captive Power Generation for Factories, Building Requirements.

UNIT-IV: AIR CONDITIONING AND ENERGY-EFFICIENT BUILDING SYSTEMS

(09 Periods)

Air Conditioning – Introduction, CII Godrej Green Business Centre, Design Philosophy, Design Interventions, Energy Modeling, HVAC System Design, Chiller Selection, Pump Selection, Selection of Cooling Towers, Selection of Air Handling Units, Pre-cooling of Fresh Air, Interior

Lighting Systems, Key Features of the Building, Eco-friendly Captive Power Generation for Factories, Building Requirements.

UNIT-V: MATERIAL CONSERVATION AND INDOOR ENVIRONMENTAL QUALITY (09 Periods)

Material Conservation – Handling of Non-Process Waste, Waste Reduction During Construction, Materials with Recycled Content, Local Materials, Material Reuse, Certified Wood, Rapidly Renewable Building Materials and Furniture. Indoor Environment Quality and Occupational Health – Air Conditioning, Indoor Air Quality, Sick Building Syndrome, Tobacco Smoke.

Total Periods: 45

Text Books:

T1. Handbook on Green Practices published by Indian Society of Heating Refrigerating and Air conditioning Engineers, 2009.

T2. Green Building Hand Book , Tomwoolley and Samkimings, 2009.

References:

R1. Complete Guide to Green Buildings, Trish riley

R2. Standard for the design for High Performance Green Buildings, Kent Peterson, 2009

R3. Energy Conservation Building Code –ECBC-2020, BEE.

2512382	M.Tech., III-SEMESTER ROAD SAFETY ENGINEERING (Common to AIDS, PS, RE, ES&VLSI) (OPEN ELECTIVE)	L	T	P	C
		3	0	0	3

Pre-Requisites: NIL

Course Outcomes:

On successful completion of the course, student will be able to

CO1. Analyze accident data to identify causes and recommend safety improvements.

CO2. Apply statistical methods to analyze traffic data and improve accident prevention measures.

CO3. Analyze vehicle, human, and geometric design factors to recommend safe road design and traffic control measures.

CO4. Classify traffic signs and road markings and evaluate their design and role in enhancing road safety.

CO5. Evaluate traffic management systems, road safety audit processes, and ITS applications to improve road safety performance.

SYLLABUS:

UNIT-I: ACCIDENT INVESTIGATION AND ROAD SAFETY RISK MANAGEMENT

(08 Periods)

Accident Investigations and Risk Management, Collection of Accident Data, Assessment of Road Safety, Methods to Identify and Prioritize Hazardous Locations and Elements, Determine Possible Causes of Crashes, Crash Reduction Capabilities and Countermeasures, Effectiveness of Safety Design Features, Accident Reconstruction, Condition and Collision Diagram.

UNIT-II: TRAFFIC ENGINEERING AND STATISTICAL ANALYSIS IN ROAD SAFETY

(09 Periods)

Traffic Engineering Studies; Statistical Methods In Traffic Safety Analysis – Regression Methods, Poisson Distribution, Chi- Squared Distribution, Statistical Comparisons- Traffic Management Measures And Their Influence On Accident Prevention.

UNIT-III: ROAD SAFETY IN TRANSPORT PLANNING AND GEOMETRIC DESIGN

(09 Periods)

Road Safety in ` Transport Planning and Geometric Design: Vehicle and Human Characteristics, Road Design and Safety Elements, Redesigning Junctions, Cross Section Improvements, Traffic Control, Traffic Calming Measures, Road Safety Furniture

UNIT-IV: ROLE OF SIGNS AND MARKINGS IN SAFETY

(08 Periods)

Types of Signs – Design Specifications – Guidelines for Installation – Role of Signs in Safety; Types of Road Markings – Design Specifications – Role of Road Markings in Safety.

UNIT-V: TRAFFIC MANAGEMENT SYSTEMS AND ROAD SAFETY AUDIT

(10 Periods)

Traffic Management Systems for Safety, Road Safety Audits and Tools for Safety Management Systems, Road Safety Audit Process, Road Safety Improvement Strategies, ITS and Safety.

Total Periods: 45

Text Books:

T1. Traffic Engineering and Transportation Planning, L.R. Kadiyali, Khanna Publishers

T2. Fundamentals of Transportation Engineering, C.S.Papacostas, Prentice Hall India.

T3. Road Safety by NCHRP

References:

R1. Transportation Engineering - An Introduction, C.Jotin Khisty, B. Kent Lall

R2. Fundamentals of Traffic Engineering, Richardo G Sigua

R3. Handbook of Road Safety Measures, Second Edition, Rune Elvik, Alena Hoye, TrulsVaa, Michael Sorenson

		L	T	P	C
2598381	**M.Tech., III-SEMESTER** **ADVANCED DATA STRUCTURES AND ALGORITHMS** (Common to PS, Geo-Tech, RE, ES&VLSI) **(OPEN ELECTIVE)**	**3**	**0**	**0**	**3**

Pre-Requisites: NIL

Course Outcomes:

On successful completion of the course, student will be able to

CO1. Implement and manipulate linear data structures like singly/doubly linked lists, circular lists, stacks, and queues using dynamic memory allocation.

CO2. Apply and analyze searching and sorting algorithms including linear, binary search, bubble, selection, insertion, quick, and merge sort.

CO3. Design and implement dictionaries and hashing techniques to efficiently store and retrieve data.

CO4. Construct and operate on trees and priority queues, performing insertion, deletion, and traversal operations.

CO5. Compare and implement balanced search trees (AVL, Red-Black, Splay, B-Trees) for optimized data access and storage.

SYLLABUS:

UNIT-I: INTRODUCTION **(09 Periods)**

Introduction to Data Structures, Singly Linked Lists, Doubly Linked Lists, Circular Lists-Algorithms. Stacks and Queues: Algorithm Implementation using Linked Lists.

UNIT-II: SEARCHING AND SORTING **(09 Periods)**

Linear and Binary Search Methods, Sorting: -Basic sorting techniques, Radix Sort, Bucket Sort, Shell Sort Trees- Binary trees, Properties, Representation and Traversals, Expression Trees (Infix, prefix, postfix). Graphs-Basic Concepts, Storage structures and Traversals.

UNIT-III: DICTIONARIES AND HASHING **(09 Periods)**

Dictionaries: Definition, Dictionary Abstract Data Type, Implementation of Dictionaries.

Hashing: Review of Hashing, Hash Function, Collision Resolution Techniques in Hashing, Separate Chaining, Open Addressing, Linear Probing, Quadratic Probing, Double Hashing, Rehashing, Extendible Hashing

UNIT-IV: PRIORITY QUEUES **(09 Periods)**

Definition, ADT, Realizing a Priority Queue Using Heaps, Definition, Insertion, Deletion .Search Trees- Binary Search Trees, Definition, ADT, Implementation, Operations-Searching, Insertion, Deletion.

UNIT-V: SEARCH TREES **(09 Periods)**

AVL Trees, Definition, Height of AVL Tree, Operations-, Insertion, Deletion and Searching, Introduction to Red-Black and Splay Trees, B-Trees, Height of B-Tree, Insertion, Deletion and Searching, Comparison of Search Trees.

Total Periods: 45

Text Books:

T1. Data Structures: A Pseudo Code Approach, Richard F.Gilberg, Behrouz A. Forouzon and Cengage, 2/e.

T2. Data Structures, Algorithms and Applications in java, SartajSahni, University Press, 2/e.

Reference Books:

R1. Data Structures and Algorithm Analysis, Mark Allen Weiss, Pearson, 2/e.

R2. Data Structures and Algorithms, Adam Drozdek, Cengage, 3/e,

R3. C and Data Structures: A Snap Shot Oriented Treatise using Live Engineering Examples, N.B.Venkateswarulu, E.V.Prasad and S Chand & Co.

	M.Tech., III-SEMESTER	L	T	P	C
2598382	**CLOUD COMPUTING** (Common to PS, Geo-Tech, RE, ES&VLSI) **(OPEN ELECTIVE)**	**3**	**0**	**0**	**3**

Pre-Requisites: NIL

Course Outcomes:

On successful completion of the course, student will be able to

CO1. Explain cloud computing fundamentals including characteristics, deployment and service models, multitenancy, cloud economics, networking role, and platforms such as Amazon EC2, Google App Engine, and Microsoft Azure.

CO2. Demonstrate virtualization concepts including server, storage, network and service virtualization, virtual machines, virtualization management, performance measurement, and hypervisors such as KVM, Xen, and VMware ESXi.

CO3. Explain relational databases, cloud file systems such as Google File System and Hadoop Distributed File System, data models including Bigtable, Apache HBase, Amazon Dynamo, and the MapReduce model with its parallel computing efficiency.

CO4. Explain cloud security fundamentals, including security architecture, vulnerability assessment, privacy, trusted computing, secure execution environments, identity and access management, and autonomic security.

CO5. Analyze issues in cloud computing including real-time application deployment, inter-cloud challenges, QoS and monitoring, dependability, data migration, streaming, and the role of cloud middleware.

SYLLABUS:

UNIT-I: CLOUD COMPUTING FUNDAMENTALS (09 Periods)

Definition, characteristics, components, Cloud service provider, the role of networks in Cloud computing, Cloud deployment models- private, public & hybrid, Cloud service models, multitenancy, Cloud economics and benefits, Cloud computing platforms - IaaS: Amazon EC2, PaaS: Google App Engine, Microsoft Azure, SaaS.

UNIT-II: VIRTUALIZATION TECHNOLOGIES (09 Periods)

Virtualization concepts, Server virtualization, Storage virtualization, Storage services, Network virtualization, Service virtualization, Virtualization management, Virtualization technologies and architectures, virtual machine, Measurement and profiling of virtualized applications. Hypervisors: KVM, Xen, VMware hypervisors and their features.

UNIT-III: DISTRIBUTED DATA MANAGEMENT AND PROCESSING (09 Periods)

Relational databases, Cloud file systems: GFS and HDFS, Bigtable, HBase and Dynamo. MapReduce and extensions: Parallel computing, the map -Reduce model, Parallel efficiency of Map Reduce.

UNIT-IV: CLOUD SECURITY (09 Periods)

Cloud security fundamentals, Vulnerability assessment tool for cloud, Privacy and Security in cloud. Cloud computing security architecture: General Issues, Trusted Cloud computing, Secure Execution Environments and Communications, Micro - architectures; Identity Management and Access control, Autonomic security.

UNIT-V: ADVANCED CLOUD COMPUTING ISSUES (09 Periods)

Issues in cloud computing Implementing real time application over cloud platform, Issues in Inter - cloud environments, QOS Issues in Cloud, Dependability, data migration, streaming in Cloud. Quality of Service (QoS) monitoring in a Cloud computing environment. Cloud Middleware.

Total Periods: 45

Text Books:

T1. Enterprise Cloud Computing, Gautam Shroff, Cambridge publication.

T2. Enterprise Cloud Computing Technology Architecture Applications, Gautam Shroff, Cambridge University Press; 1 edition, [ISBN: 978-0521137355], 2010.

Reference Books:

R1. Cloud Security, Ronald Krutz and Russell Dean Vines, Wiley -India.

R2. Cloud Computing, Dr. Kumar Saurabh, Wiley Publication.

R3. Cloud Computing Strategies, Dimitris N. Chorafas, CRC Press; 1 edition [ISBN: 1439834539],2010

R4. Cloud Computing, A Practical Approach, Toby Velte, Anthony Velte, Robert Elsenpeter, McGraw Hill Osborne Media; 1 edition [ISBN: 0071626948], 2009.

R5. Cloud Computing: Principles and Paradigms, Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Wiley Publication, 2011.

R6. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, Tim Mather, Subra Kumaraswamy, Shahed Latif, O'Reilly Media Inc, 2009.

2598383	M.Tech., III-SEMESTER AI TOOLS (Common to PS, Geo-Tech, RE, ES&VLSI) (OPEN ELECTIVE)	L	T	P	C
		3	0	0	3

Pre-Requisites: NIL

Course Outcomes:

On successful completion of the course, student will be able to

CO1. Explain the fundamentals and evolution of AI tools.
CO2. Use AI tools for text, language, and communication tasks.
CO3. Apply AI tools for image, audio, and video generation.
CO4. Utilize AI tools for coding, research, and productivity enhancement.
CO5. Analyze ethical, security, and application-oriented aspects of AI tools.

SYLLABUS:

UNIT-I: INTRODUCTION TO AI TOOLS (09 Periods)

Definition of Artificial Intelligence, Evolution of AI and Intelligent Systems, Categories of AI Tools (Generative, Analytical, Assistive), Rule-based vs Learning-based AI Tools, Overview of Machine Learning & Deep Learning Tools, AI Tool Ecosystem (OpenAI, Google, Meta, Microsoft), Cloud-based AI Tools, Future Trends in AI Tool Development.

UNIT-II: TEXT & LANGUAGE AI TOOLS (09 Periods)

Natural Language Processing (NLP) Basics, ChatGPT – Architecture and Capabilities, Prompt Engineering Concepts, AI Tools for Content Writing, AI Tools for Email, Resume & Report Generation, AI-based Translation and Summarization Tools, AI Chatbots and Virtual Assistants, Limitations and Bias in Language AI Tools.

UNIT-III: IMAGE, AUDIO & VIDEO AI TOOLS (09 Periods)

Image Generation Tools (DALL·E, Midjourney, Stable Diffusion), Image Editing and Enhancement using AI, AI Tools for Graphic Design & Posters, Text-to-Speech AI Tools (ElevenLabs, Google TTS), Speech-to-Text AI Tools, AI-based Video Creation Tools, Avatar and Animation AI Tools, Applications in Media, Education & Healthcare.

UNIT-IV: AI TOOLS FOR CODING, RESEARCH & PRODUCTIVITY (09 Periods)

AI Tools for Programming Assistance, Code Generation and Debugging using AI, AI Tools for Data Analysis, AI Tools for Research Paper Writing, AI Tools for Literature Survey and Citations, AI in Project Management, AI Tools for Presentation Creation, AI Tools for Automation and Workflow Optimization.

UNIT-V: ETHICAL, SECURITY & APPLIED AI TOOLS (09 Periods)

Ethical Issues in AI Tool Usage, Data Privacy and Security Concerns, AI Tool Regulations and Policies, AI Tools in Education, AI Tools in Healthcare, AI Tools in Finance and Business, AI Tools in Smart Cities and Governance, Responsible and Sustainable AI Practices.

Total Periods: 45

Text Books:

T1. Artificial Intelligence: A Modern Approach, Stuart Russell and Peter Norvig, Pearson Education, 4th Edition, 2021.
T2. AI for Everyone, Michael Miller, Pearson, 2020.
T3. Artificial Intelligence for Business, Liam Ottley, Wiley, 2022.

Reference Books:

R1. AI Superpowers: China, Silicon Valley, and the New World Order, Kai-Fu Lee, Houghton Mifflin Harcourt, 2018.

R2. Artificial Intelligence in Practice, Bernard Marr, Wiley, 2020.

R3. Ethical Guidelines for Trustworthy AI, European Commission, 2019.

2584381	M.Tech., III-SEMESTER IOT AND ITS APPLICATIONS (Common to AIDS, PS, Geo-Tech, RE) (OPEN ELECTIVE)	L	T	P	C
		3	0	0	3

Pre-Requisites: NIL

Course Outcomes:

On successful completion of the course, student will be able to

CO1. Apply the Knowledge in IOT Technologies and Data management.

CO2. Determine the values chains Perspective of M2M to IOT.

CO3. Implement the state of the Architecture of an IOT.

CO4. Compare IOT Applications in Industrial & real world.

CO5. Demonstrate knowledge and understand the security and ethical issues of an IOT.

SYLLABUS:

UNIT-I: FUNDAMENTALS OF IOT (09 Periods)

Evolution of Internet of Things, Enabling Technologies, IoT Architectures, oneM2M, IoT World Forum (IoTWF) and Alternative IoT models, Simplified IoT Architecture and Core IoT Functional Stack, Fog, Edge and Cloud in IoT, Functional blocks of an IoT ecosystem, Sensors, Actuators, Smart Objects and Connecting Smart Objects.

IoT Platform overview: Overview of IoT supported Hardware platforms such as: Raspberry pi, ARM Cortex Processors, Arduino and Intel Galileo boards.

UNIT-II: IOT PROTOCOLS (09 Periods)

IT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and Lora WAN, Network Layer: IP versions, Constrained Nodes and Constrained Networks, Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks, Application Transport Methods: Supervisory Control and Data Acquisition, Application Layer Protocols: CoAP and MQTT.

UNIT-III: DESIGN AND DEVELOPMENT (09 Periods)

Design Methodology, Embedded computing logic, Microcontroller, System on Chips, IoT system building blocks, Arduino, Board details, IDE programming, Raspberry Pi, Interfaces and Raspberry Pi with Python Programming.

UNIT-IV: DATA ANALYTICS AND SUPPORTING SERVICES (09 Periods)

Structured Vs Unstructured Data and Data in Motion Vs Data in Rest, Role of Machine Learning – No SQL Databases, Hadoop Ecosystem, Apache Kafka, Apache Spark, Edge Streaming Analytics and Network Analytics, Xively Cloud for IoT, Python Web Application Framework, Django, AWS for IoT, System Management with NETCONF-YANG.

UNIT-V: CASE STUDIES/INDUSTRIAL APPLICATIONS (09 Periods)

IoT applications in home, infrastructures, buildings, security, Industries, Home appliances, other IoT electronic equipments. Use of Big Data and Visualization in IoT, Industry 4.0 concepts. Sensors and sensor Node and interfacing using any Embedded target boards (Raspberry Pi / Intel Galileo/ARM Cortex/ Arduino).

Total Periods: 45

Text Books:

T1. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, Cisco Press, 2017.

T2. Internet of Things – A hands-on approach, Arshdeep Bahga, Vijay Madisetti, Universities Press, 2015.

Reference Books:

R1. The Internet of Things – Key applications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi and Wiley, 2012 (for Unit 2).

R2. From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence‖, Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle and Elsevier, 2014.

R3. Architecting the Internet of Things, Dieter Uckelmann, Mark Harrison, Michahelles and Florian (Eds), Springer, 2011.

	M.Tech., III-SEMESTER	L	T	P	C
2552381	PHOTOVOLTAIC SYSTEMS (Common to AIDS, Geo-Tech, RE, ES&VLSI) (OPEN ELECTIVE)	3	0	0	3

Pre-Requisites: NIL

Course Outcomes:

On successful completion of the course, student will be able to

CO1. Understand solar radiation principles, measurement techniques, and solar cell characteristics and performance.

CO2. Explain solar cell manufacturing technologies, PV module design, encapsulation, power rating, hotspot effect, and design qualification standards.

CO3. Explain flat plate arrays, mounting structures, module interconnection, lightning protection, and performance evaluation including temperature coefficients, series resistance, and curve correction factors.

CO4. Explain photovoltaic system types, design considerations, system, battery and inverter sizing, and balance of system components.

CO5. Explain maximum power point tracking techniques, instrument design, and grid-interactive photovoltaic systems.

SYLLABUS:

UNIT-I: SOLAR ENERGY (09 Periods)

Sun and Earth, Solar Spectrum, Solar Geometry, Solar radiation on horizontal and inclined planes, Instruments for measurement of solar radiation, Solar cell, Equivalent circuit, V-I characteristics, Performance improvement.

UNIT-II: SOLAR CELLS (09 Periods)

Manufacture of Solar Cells-Technologies, Design of Solar cells, Photovoltaic modules, Design requirements, Encapsulation systems, Manufacture, Power rating, Hotspot effect, Design qualifications.

UNIT-III: PROTECTION AND MEASUREMENTS (09 Periods)

Flat plate arrays, Support structures, Module interconnection and cabling, Lightning protection, Performance measurement using natural sun light and simulator, Determination of temperature coefficients, Internal series resistance, Curve correction factor.

UNIT-IV: PHOTOVOLTAIC SYSTEMS (09 Periods)

Photovoltaic systems, Types, General design considerations, System sizing, Battery sizing, Inverter sizing, Design examples, Balance of PV systems.

UNIT-V: MAXIMUM POWER POINT TRACKERS (09 Periods)

Maximum power point trackers, Perturb and observe, Incremental conductance method, Hill climbing method, Hybrid and complex methods, Data based and other approximate methods, Instrument design, Other MPP techniques, Grid interactive PV system.

Total Periods: 45

Text Books:

T1. Generating electricity from Sun, F.C.Treble, Pergamon Press.

T2. Photovoltaic systems: Analysis and design, A.K.Mukherjee, Nivedita Thakur, PHI, 2011.

Reference Books:

R1. Solar Photovoltaics: Fundamentals, Technologies and applications, C.S.Solanki, PHI, 2009.

Online Learning Resources:

1. https://nptel.ac.in/courses/117108141

		L	T	P	C
2599381	**M.Tech., III-SEMESTER** **INTEGRATED PRODUCT DESIGN AND DEVELOMENT** (Common to AIDS, PS, Geo-Tech, ES&VLSI) **(OPEN ELECTIVE)**	**3**	**0**	**0**	**3**

Pre-Requisites: NIL

Course Outcomes:

On successful completion of the course, student will be able to

CO1. Explain design concepts, product development planning and customer requirements

CO2. Generate the concept using creative problem solving methods, concept generation and testing.

CO3. Realize Product Teardown, Specifications, Portfolios and Architecture, configurations and prototyping.

CO4. Demonstrate and classify The Design aspects for Risk, Reliability and Safety and environments.

CO5. Do industrial design, understand intellectual property, robust design and product development economics.

SYLLABUS:

UNIT-I: PRODUCT DEVELOPMENT CONCEPTS (09 Periods)

Design Concepts: Design process – Considerations of a good design – Description of good design process – Design codes and standards. Product Development and Planning Process: Characteristics and challenges of product development – Concept development – Generic product development – Product development process flows –Tyco product development – Product development organizations – Organizational structure and design – Product and process cycles – Technological innovation – Structure of opportunity – Opportunity identification – Product planning process – Types of product development projects. **Identifying Customer Needs**: Process of identifying customer needs – Customer requirements.

UNIT-II: CONCEPT SELECTION, GENERATION AND TESTING (09 Periods)

Concept Generation: Activity – Concept generation process – Creativity and problem solving – Creative thinking methods and design – Functional decomposition and synthesis – Morphological methods – Axiomatic design.

Concept Selection and Testing: Development process – Choosing a concept – Concept screening and scoring – Decision making and evaluation – Methods for testing product concepts.

UNIT-III: EMBODIMENT AND DETAIL DESIGN (09 Periods)

Product Teardown, Specifications, Portfolios and Architecture: Teardown process, methods and applications – Post teardown report – Benchmarking approach and support tools for benchmarking process – Product portfolios architecture – Architecture type – Platform architecture – Target Specifications – Setting the final specifications – Modularity – Implications of the architecture – Establishing the architecture – Delayed differentiation – Platform planning – Related system-level design.

Configuration and Detail Design: Generating, analyzing and evaluating configuration design – Best practices for configuration design – Design for X – Design and manufacturing information – Final design review – Activities beyond detail design.

Prototyping: Principles, types and technologies – Understanding prototypes and planning.

UNIT-IV: DESIGN FOR ENVIRONMENT, MANUFACTURING AND SAFETY

(09 Periods)

Design for Manufacture and Environment: Cross-functional team – Overview of DFM process – Life cycles – Environmental impacts – Design for environment process.

Design for Risk, Reliability and Safety: Classification of societal hazards – Standards – Risk assessment – Design for reliability – Causes of unreliability – Minimizing failure – FMEA – Fault tree analysis – Defects and failure modes – Potential dangers – Guidelines for design for safety – Warning labels.

UNIT-V: INDUSTRIAL DESIGN AND PRODUCT DEVELOPMENT ECONOMICS

(09 Periods)

Industrial Design: Need – Impact – Industrial design process – Management of the industrial design process –Assessing the quality of industrial design. **Robust Design:** Robust design process.

Intellectual Property: Disclosure – Process of pursuing a patent.

Product Development Economics: Elements of economic analysis and process.

Managing Projects: Understanding and representing tasks – Baseline project planning – Accelerating projects – Project execution – Postmortem project evaluation - Project Portfolio Management (PPM) - Earned Value Management (EVM) - Sustainability and ESG in Project Management.

Total Periods: 45

Text Books:

T1. Product Design and Development, Karl T Ulrich, Steven D Eppinger and Maria C. Yang, 7/e, 2020, McGraw-Hill Education Pvt.Ltd., Noida.

T2. Engineering Design, George E.Dieter and Linda C.Schmidt, 4/e, 2013, McGraw-Hill Education Pvt., Ltd., Noida.

Reference Books:

R1. Product Design, Kevin Otto and Kristin Wood, 1/e, 2003, Pearson Education, India.

R2. Product Development, Anil Mital, Anoop Desai, Anand Subramanian and Aashi Mital, 1/e, 2007, Butterworth-Heinemann, Elsevier.

R3. Integrated Product and Process Design and Development: the Product Realization Process (Special Indian Edition), Edward B. Magrab, Satyandra K. Gupta, F. Patrick McCluskey and Peter A. Sandborn, 2/e, 2010, CRC Press, Taylor & Francis Group, LLC.

R4. Product Design for Engineers, Devdas Shetty, 1/e, 2016, Cengage Learning, India.

R5. Introduction to Product Design and Development for Engineers, Ali Jamnia, 2018, CRC Press, Taylor & Francis Group, LLC.

Online Learning Resources:

1. https://onlinecourses.nptel.ac.in/noc25_me121/preview
2. https://onlinecourses.swayam2.ac.in/imb25_mg123/preview

		L	T	P	C
25HS381	**M.Tech., III-SEMESTER** **ADVANCED NUMERICAL METHODS AND COMPUTATIONAL MATHEMATICS** (Common to AIDS, PS, Geo-Tech, RE, ES&VLSI) **(OPEN ELECTIVE)**	**3**	**0**	**0**	**3**

Pre-Requisites: NIL

Course Outcomes:

On successful completion of the course, student will be able to

- **CO1.** Analyze conditioning, stability, and error behavior of numerical linear algebra routines for dense and sparse problems.
- **CO2.** Derive and apply finite difference for BVP for linear and nonlinear models.
- **CO3.** Derive and apply finite difference for PDE models; assess consistency and stability with Lax equivalence and CFL ideas.
- **CO4.** Optimize engineering models via unconstrained/constrained methods; justify algorithm selection and tuning using theory and diagnostics.
- **CO5.** Integrate GPU/MPI paradigms and the SciPy stack to build scalable, reproducible computational workflows; profile and validate results.

SYLLABUS:

UNIT-I: NUMERICAL LINEAR ALGEBRA (09 Periods)

Floating- point arithmetic, conditioning, stability, backward/forward error; Direct solvers: LU/Cholesky/QR; pivoting and orthogonality; SVD, low- rank approximations, pseudoinverses; Iterative solvers: Jacobi/Gauss–Seidel/CG/GMRES; basic preconditioning; Sparse matrix formats and operations for large- scale systems; Krylov subspace and Arnoldi/Lanczos overviews.

UNIT-II: DISCRETIZATION OF LINEAR AND NONLINEAR ODEs (09 Periods)

Numerical solutions of initial value problems: (single step and multi -step methods); Stability of the numerical methods for initial value problems; Boundary value problems; shooting method; Finite difference for BVP (second and higher order methods), for linear and nonlinear problems Consistency–stability–convergence.

UNIT-III: DISCRETIZATION OF LINEAR AND NONLINEAR PDEs (09 Periods)

Finite difference methods for parabolic problems explicit and implicit methods, Finite difference for hyperbolic explicit and implicit methods; Elliptic PDE; Consistency, Stability and convergence; Lax equivalence and CFL (Courant–Friedrichs–Lewy) ideas; Iterative solvers and multigrid overview for discretized systems.

UNIT-IV: NUMERICAL OPTIMIZATION AND INVERSE PROBLEMS (09 Periods)

Unconstrained methods: gradient, Newton, quasi- Newton, trust- region; Constrained methods: KKT conditions, interior- point, SQP principles; Nonlinear least squares: Gauss–Newton and Levenberg–Marquardt; Regularization (Tikhonov/L1) and model selection concepts; Scientific Python stack:scipy.optimize.minimize, scipy.optimize.linprog, and scipy.optimize.curve_fit; solver choice and diagnostics.

UNIT-V: HIGH- PERFORMANCE SCIENTIFIC COMPUTING (09 Periods)

Parallel paradigms: data/task parallelism; domain decomposition fundamentals; GPU programming model: threads/warps/memory hierarchy; CUDA libraries; MPI and PETSc for scalable sparse linear

algebra and time- steppers; Performance engineering: profiling, locality, and roofline- style thinking; Python at scale: NumPy/SciPy sparse and vectorization; brief Numba/CuPy ecosystem; end-to-end case sketches in CFD/structures/machine learning numerics.

Total Periods: 45

Text Books:

T1. Numerical Linear Algebra, Trefethen, L. N., and D. Bau III, Twenty- Fifth Anniversary Edition, SIAM, 2023.

T2. Finite Difference Methods for Ordinary and Partial Differential Equations: Steady- State and Time-Dependent Problems, LeVeque, R. J., SIAM, 2007.

T3. Numerical Optimization, Nocedal, J., and S. J. Wright, 2nd ed., Springer, 2006.

Reference Books:

R1. Programming Massively Parallel Processors: A Hands- on Approach, Hwu, W.- M. W., and D. B. Kirk, 4th ed., Elsevier, 2022.

R2. Numerical linera algebra and Application, B. N. dutta, Springer Publications.

R3. SciPy Project, Optimization (scipy.optimize), SciPy Manual and Optimization and Root Finding, SciPy 1.16.2 (stable) Reference.

R4. PETSc/TAO Users Manual, Balay, S., et al. Argonne National Laboratory, ANL-21/39 Rev 3.18release documentation.

R5. Automated Solution of Differential Equations by the Finite Element Method: The FEniCS Book. Logg, A., K.- A. Mardal, and G. N. Wells (eds.). Berlin: Springer, 2012.

R6. Numerical analysis Mathematics of scientific computing, David Kincaid Ward Chenery, AMS Book publishers.

R7. Computational Methods for Partial Differential Equations, M. K. Jain, S. R. K. Iyengar and R. K. Jain, New Age publications.

		L	T	P	C
25HS382	**M.Tech., III-SEMESTER** **MATHEMATICS FOR MACHINE LEARNING AND DATA SCIENCE** (Common to AIDS, PS, Geo-Tech, RE, ES&VLSI) **(OPEN ELECTIVE)**	**3**	**0**	**0**	**3**

Pre-Requisites: NIL

Course Outcomes:

On successful completion of the course, student will be able to

CO1. Analyze linear models and matrix factorizations for dimensionality reduction and feature representation.

CO2. Formulate and solve convex and constrained optimization problems; compare first- and second-order methods.

CO3. Apply probabilistic modeling, Bayesian inference, and information- theoretic measures to estimation and generalization.

CO4. Prove convergence properties or error bounds for selected learning algorithms such as SGD and regularized estimators.

CO5. Evaluate and integrate methods into applications such as PCA, SVMs, and neural networks with appropriate regularization.

SYLLABUS:

UNIT-I: LINEAR ALGEBRA FOUNDATIONS (09 Periods)

Vector spaces, norms, inner products, orthogonality, and projections; Eigenvalues/eigenvectors, spectral theorem, and invariant subspaces; Singular value decomposition, low- rank approximations, and Eckart–Young; Matrix calculus for ML; gradients/Jacobians/Hessians in matrix form; Numerical linear algebra: conditioning, stability, power/QR methods; Feature whitening and centering; PCA link to covariance eigen structure.

UNIT-II: OPTIMIZATION FOR LEARNING (08 Periods)

Unconstrained methods: gradient descent, line search, Newton/quasi- Newton; Constrained optimization: Lagrange multipliers, projected and barrier methods; Convex sets/functions, KKT conditions for nonlinear programing problems; Regularization: l_1/l_2penalties, bias–variance trade-offs in risk minimization; Convergence rates and step- size strategies in deterministic models.

UNIT-III: PROBABILITY AND STATISTICAL LEARNING (10 Periods)

Random variables, expectations, covariance; exponential family basics; Bayesian inference: conjugacy, MAP vs. MLE, posterior predictive analysis; Hypothesis testing and confidence intervals for model comparison; Information measures: entropy, KL divergence, mutual information in learning; Generalization, overfitting, and model selection criteria (e.g., AIC/BIC/VC-style capacity); Concentration and uncertainty quantification for predictions.

UNIT-IV: MODELS AND ALGORITHMS (09 Periods)

Linear and kernel methods: least squares, logistic regression, and SVMs; Dimensionality reduction: PCA, kernel PCA, and manifold intuition; Probabilistic models: Naive Bayes, Gaussian mixtures, EM overview; Neural network mathematics: backpropagation, initialization, normalization; Regularization schemes: weight decay, early stopping, dropout perspectives.

UNIT-V: INTEGRATIVE APPLICATIONS AND WORKED EXAMPLES (09 Periods)

End-to-end ML pipelines: preprocessing, scaling/whitening, and feature engineering; PCA- based exploration and anomaly detection in high- dimensional data; SVMs and convex models for fault diagnosis and predictive maintenance; Bayesian A/B testing and decision- making under uncertainty; Neural network design trade-offs: capacity, optimization, and generalization; Model evaluation: calibration, ROC/PR analysis, and uncertainty reporting.

Total Periods: 45

Text Books:

T1. Mathematics for Machine Learning. Deisenroth, M. P., Faisal, A. A., & Ong, C. S. Cambridge University Press, 2020

T2. Probabilistic Machine Learning: An Introduction, Murphy, K. P., MIT Press, 2022.

T3. Convex Optimization, Boyd, S., & Vandenberghe, L., Cambridge University Press, 2004.

Reference Books:

R1. Deep Learning, Goodfellow, I., Bengio, Y., & Courville, A., MIT Press, 2016

R2. Understanding Machine Learning: From Theory to Algorithms. Shalev- Shwartz, S., & Ben-David, S., Cambridge University Press, 2014

R3. Principal component analysis: a review and recent developments. Jolliffe, I. T., & Cadima, J., Phil. Trans. R. Soc. A, 2016

R4. Elements of Information Theory, Cover, T. M., & Thomas, J. A. 2nd ed. Wiley, 2006.

R5. Probabilistic Machine Learning: Advanced Topic, Murphy, K. P. MIT Press, 2023.

		L	T	P	C
25HS383	**M.Tech., III-SEMESTER** **STATISTICAL LEARNING THEORY AND MATHEMATICAL FOUNDATIONS OF AI** (Common to AIDS, PS, Geo-Tech, RE, ES&VLSI) **(OPEN ELECTIVE)**	**3**	**0**	**0**	**3**

Pre-Requisites: NIL

Course Outcomes:

On successful completion of the course, student will be able to

- **CO1.** Analyze probabilistic models, convergence theorems, and stochastic processes underlying learning algorithms.
- **CO2.** Formulate and prove generalization bounds using VC dimension, Rademacher complexity, and stability.
- **CO3.** Derive and optimize loss/regularization for linear, kernel, and deep models; justify selections by convexity and smoothness properties.
- **CO4.** Evaluate algorithms via bias–variance, PAC guarantees, and information- theoretic criteria such as KL and mutual information.
- **CO5.** Integrate theory to design robust AI solutions for multi- domain engineering applications and communicate findings effectively.

SYLLABUS:

UNIT-I: PROBABILITY AND MEASURE FOUNDATIONS (09 Periods)

Probability spaces, σ- algebras, random variables; expectation and conditional expectation; Inequalities and concentration: Markov, Chebyshev, Hoeffding; LLN and CLT; Modes of convergence and Borel–Cantelli; almost sure vs in- probability convergence; Random processes and martingale basics; optional stopping; Doob's inequality (overview); Markov chains: ergodicity, mixing, stationary distributions for modeling sequences.

UNIT-II: STATISTICAL LEARNING THEORY (09 Periods)

PAC learning model, realizable/agnostic cases; sample complexity and no- free- lunch; VC dimension, shattering, Sauer's lemma; uniform convergence guarantees; Empirical risk minimization and structural risk minimization; capacity control; Rademacher/Gaussian complexities and symmetrization for data- dependent bounds; Algorithmic stability and generalization; regularization and early stopping as capacity control; PAC- Bayes bounds and posterior- based generalization certificates.

UNIT-III: OPTIMIZATION FOR LEARNING (09 Periods)

Convex analysis: Lipschitzness, smoothness, strong convexity; implications for rates; Gradient, stochastic, and variance- reducedethods; step- size and convergence trade-offs; Proximal methods and projected gradients; sparsity via ℓ_1 (Lasso) and shrinkage via ℓ_2 (ridge); Duality and KKT conditions; constrained learning formulations; Nonconvex landscapes in deep networks—saddle points, over-parameterization, and implicit regularization; Generalization–optimization interplay: implicit bias of optimizers.

UNIT-IV: KERNEL AND PROBABILISTIC MODELS (09 Periods)

Reproducing kernel Hilbert spaces, kernel trick, representer theorem; Large- margin methods: SVMs, soft margins, hinge loss; primal–dual views; Gaussian processes: kernels as priors; posterior prediction and uncertainty quantification; Graphical models—Bayesian networks and

Markov/conditional random fields for structured prediction; exact inference (variable elimination, junction tree) and approximate methods (loopy belief propagation, variational); Hidden Markov models; EM for latent- variable learning; Variational inference and message passing for scalable probabilistic AI.

UNIT-V: DEEP LEARNING AND INFORMATION THEORY (09 Periods)

Backpropagation (chain rule), initialization, normalization, and activation design; Loss functions and calibration; cross- entropy, margin losses, and robust objectives; Generalization in deep nets: margins, flat minima, compression, and stability views; Information- theoretic tools: entropy, mutual information, KL divergence; Information bottleneck and representation learning, with links to PAC- Bayes; Worked examples: applying theory to vision, language, and control tasks in engineering.

Total Periods: 45

Text Books:

T1. Understanding Machine Learning: From Theory to Algorithms, Shalev- Shwartz, S., Ben-David, S., Cambridge University Press, first edition, 2014.

T2. Deep Learning, Goodfellow, I., Bengio, Y., Courville, A., MIT Press, 2016.

T3. Pattern Recognition and Machine Learning, Bishop, C. M., Springer, 2006.

Reference Books:

R1. The Nature of Statistical Learning Theory, Vapnik, V. N., Springer, 1995/1998.

R2. Elements of Information Theory, Cover, T. M., Thomas, J. A., 2nd ed., Wiley, 2006.

R3. Foundations of Machine Learning, Mohri, M., Rostamizadeh, A., Talwalkar, A., 2nd ed., MIT Press, 2018.

R4. Learning with Kernels: Support Vector Machines, Regularization, Optimization, and Beyond, Schölkopf, B., Smola, A. J., MIT Press, 2002.

R5. Gaussian Processes for Machine Learning, Rasmussen, C. E., Williams, C. K. I., MIT Press, 2006.

25HS384	M.Tech., III-SEMESTER CHEMISTRY OF NANOMATERIALS AND APPLICATIONS IN ENGINEERING (Common to AIDS, PS, Geo-Tech, RE, ES&VLSI) (OPEN ELECTIVE)	L	T	P	C
		3	0	0	3

Pre-Requisites: NIL

COURSE OUTCOMES:

On successful completion of the course, student will be able to

CO1. Explain the basic concepts, scope, natural occurrence, classification, and importance of nanoscience and nanomaterials**.**

CO2. Explain the top-down and bottom-up synthetic methods used for the preparation of nanomaterials**.**

CO3. Understand the principles and applications of various characterization techniques used for analyzing nanomaterials**.**

CO4. Explain the synthesis, properties, and applications of important nanomaterials**.**

CO5. Understand the applications of nanomaterials such as nanoparticles, nanorods, and nanowires in various engineering and technological fields**.**

SYLLABUS:

UNIT-I: BASICS OF NANOMATERIALS (08 Periods)

Introduction**,** Scope of nanoscience and nanotechnology, nanoscience in nature, classification of nanostructured materials, importance of nanomaterials.

UNIT-II: SYNTHESIS OF NANOMATERIALS (10 Periods)

Top-Down approach**,** Inert gas condensation, arc discharge method, aerosol synthesis, plasma arc technique, ion sputtering, laser ablation, laser pyrolysis, and chemical vapor deposition method, electrode position method, high-energy ball milling method.

Synthetic Methods**:** Bottom-Up approach**,** Sol-gel synthesis, microemulsions or reverse micelles, co- precipitation method, solvothermal synthesis, hydrothermal synthesis, microwave heating synthesis and sonochemical synthesis.

UNIT-III: TECHNIQUES FOR CHARACTERIZATION (09 Periods)

Diffraction techniques, spectroscopy techniques, electron microscopy techniques for the characterization of nanomaterials, BET method for surface area analysis, dynamic light scattering for particle size determination.

UNIT-IV: STUDIES OF NANO-STRUCTURED MATERIALS (09 Periods)

Synthesis, properties and applications of the following nanomaterials: fullerenes, carbon nanotubes, 2D-nanomaterial (Graphene), core-shell, magnetic nanoparticles, thermoelectric materials, non-linear optical materials.

UNIT-V: ADVANCED ENGINEERING APPLICATIONS OF NANOMATERIALS (09 Periods)

Applications of nanoparticles, nanorods, nano wires in Water treatment, sensors, electronic devices, medical domain, civil engineering, chemical engineering, metallurgy and mechanical engineering, food science, agriculture, pollutants degradation.

Total Periods: 45

Text Books:

T1. NANO: The Essentials, T Pradeep, MaGraw-Hill, 2007.

T2. Textbook of Nanoscience and nanotechnology, B S Murty, P Shankar, Baldev Rai,BB Rath and James Murday, Univ. Press, 2012.

Reference Books:

R1. Concepts of Nano chemistry; LudovicoCademrtiri and Geoffrey A. Ozin & Geoffrey A. Ozin, Wiley-VCH, 2011.

R2. Nanostructures & Nanomaterials; Synthesis, Properties & Applications, Guozhong Cao, Imperial College Press, 2007.

R3. Nanomaterials Chemistry, C. N. R. Rao, Achim Muller, K.Cheetham, Wiley-VCH, 2007.

25HS385	M.Tech., III-SEMESTER PHOTONICS FOR ENGINEERS (Common to AIDS, PS, Geo-Tech, RE, ES&VLSI) (OPEN ELECTIVE)	L	T	P	C
		3	0	0	3

Pre-Requisites: NIL

Course Outcomes:

On successful completion of the course, student will be able to

CO1. Describe how light behaves and propagates in optical media.

CO2. Explain light–matter interaction mechanisms and analyze the working, characteristics, and applications of LEDs, laser diodes, quantum well lasers and various photodetectors.

CO3. Explain key nonlinear effects and analyze the operation of optical modulators and switches such as the Mach–Zehnder Interferometer.

CO4. Analyse fiber parameters and explain the functioning of transmitters, receivers, WDM systems, couplers and resonator-based communication devices.

CO5. Describe the working of photonic sensors and emerging quantum and ultrafast photonic technologies used in sensing, computation and communication.

SYLLABUS:

UNIT-I: FUNDAMENTALS OF PHOTONICS (09 Periods)

Nature of light: wave-particle duality, polarization, coherence. Maxwell's equations and wave propagation in dielectric media. Reflection, refraction, (vector notation) interference, diffraction, dispersion and birefringence.

UNIT-II: PHOTONIC DEVICES AND COMPONENTS – I (09 Periods)

Absorption, spontaneous and stimulated emission. Einstein coefficients, population inversion, optical gain. Semiconductor light sources: LEDs, laser diodes, quantum well lasers. Photodetectors: PIN, avalanche photodiodes, photomultiplier tubes.

UNIT-III: PHOTONIC DEVICES AND COMPONENTS – II (09 Periods)

Nonlinear optical effects – second-harmonic generation, Kerr effect, four-wave mixing. Electro-optic Magneto optic and acousto-optic modulation principles. Optical modulators and switches (Mach Zehnder Interferometer).

UNIT-IV: OPTICAL WAVEGUIDES AND APPLICATIONS (09 Periods)

Optical fibers – numerical aperture, V-number, modes, attenuation, dispersion. Fiber-optic communication systems: transmitters, receivers, multiplexing (WDM), optical couplers, ring resonators.

UNIT-V: PHOTONIC SYSTEMS AND APPLICATIONS (09 Periods)

Photonic sensors – interferometric, fiber Bragg gratings, biosensing. Optical signal processing and computing.

Introduction to quantum photonics: single-photon sources, entanglement, and photonic qubits. Plasmonics and metamaterials, Ultrafast and terahertz photonics.

Total Periods: 45

Text Books:

T1. Fundamentals of Photonics, B.E.A. Saleh & M.C. Teich., Wiley.

T2. Semiconductor Optoelectronics: Physics and Technology, J. Singh, McGraw Hill Edition.

T3. Photonics: Optical Electronics in Modern Communications, A. Yariv & P. Yeh, Oxford Series.

T4. Optical Fiber Communications, G. Keiser, McGraw Hill Edition.

Reference Books:

R1. Optoelectronics: An Introduction, J. Wilson & J.F.B. Hawkes.
R2. Nonlinear Optics, R.W. Boyd.
R3. Electromagnetic waves and radiating systems E. Jordan.

2552451	M.Tech., IV-SEMESTER DISSERTATION PHASE–II (POWER SYSTEMS)	L	T	P	C
		0	0	32	16

Pre-Requisites: All Courses

Course Outcomes:

On successful completion of the course, student will be able to

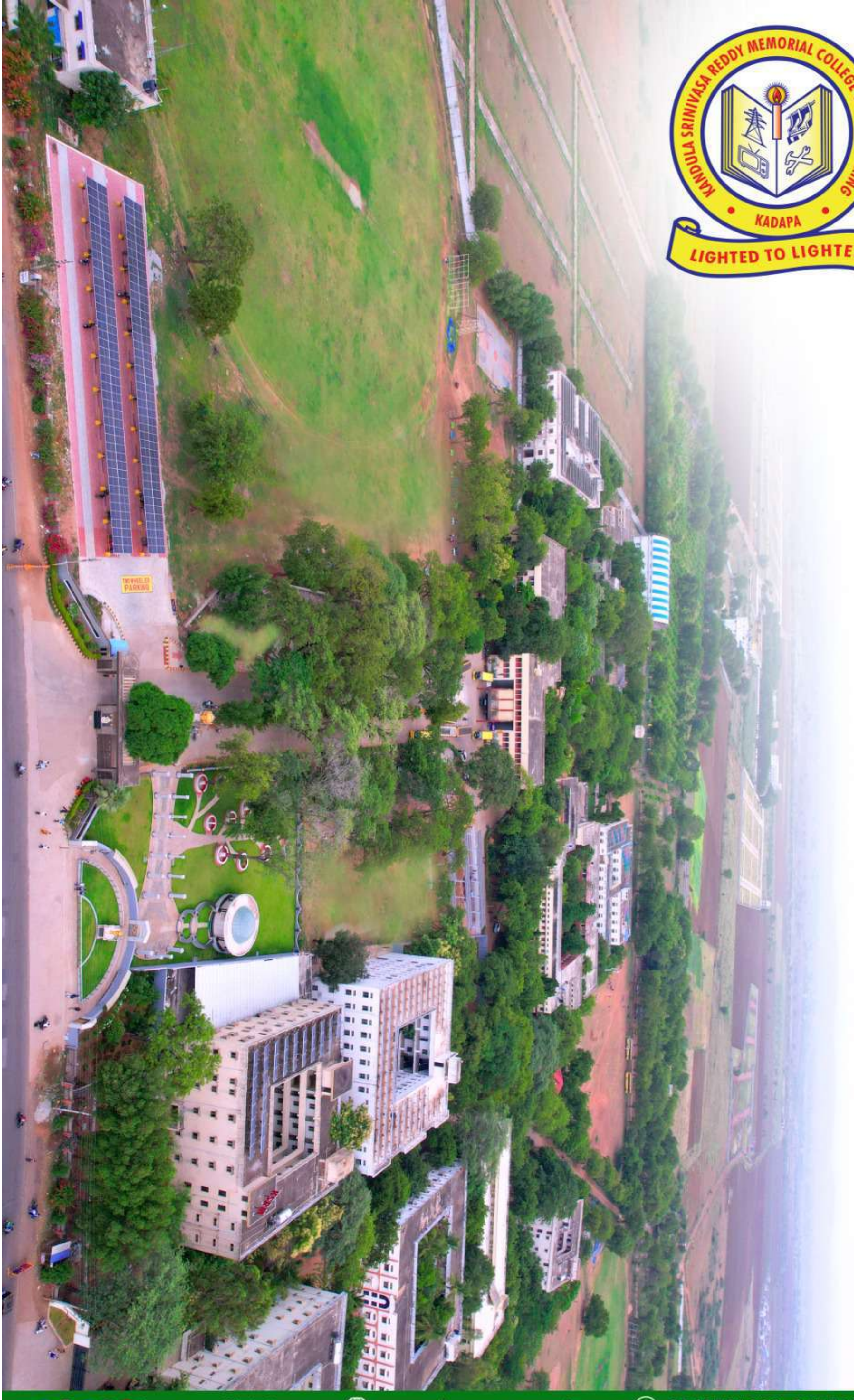
CO1. implement the proposed methodology or design to develop a functional solution or prototype for the identified research problem.

CO2. analyze and evaluate the results using appropriate tools, techniques, or experimental methods.

CO3. interpret results and draw meaningful conclusions with respect to the objectives of the research work.

CO4. prepare a comprehensive project report and effectively present the research findings through seminars and viva voce.

CO5. make decisions to manage tasks and also engage in independent and life-long learning with ability to adapt to new and technological changes.



KANDULA SRINIVASA REDDY MEMORIAL COLLEGE OF ENGINEERING

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