G. Pullaiah College of Engineering and Technology

(Autonomous)

(Approved by AICTE | NAAC Accreditation with 'A' Grade | Accredited by NBA (CIV, ECE & EEE) | Affiliated to JNTUA)

Nandikotkur Road, Venkayapalli (V), Kurnool – 518452, Andhra Pradesh

MASTER OF TECHNOLOGY
Electrical Power Systems

ACADEMIC REGULATIONS GPCET – R25

M.Tech Regular Two Year Degree Programme

(for the batches admitted from the academic year 2025-26)

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

(Effective for the students admitted into I year from the Academic Year 2024-25 and onwards)

G.Pullaiah College of Engineering and Technology, Kurnool 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 G.Pullaiah College of Engineering and Technology, Kurnool 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 fulfills 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 fulfill 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.

S.No.	Discipline	Name of the Specialization	Code
01	Electrical and Electronics Engineering	Electrical Power Systems	07
02	Electronics and Communication Engineering	Digital Electronics & Communication Systems	38
03	Computer Science and Engineering	Computer Science & Engineering	58

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 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 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
2.	Elective Courses	Professional Elective Courses (PE)	Includes elective subjects related to the parent discipline/department/ branch of Engineering
		Open Elective Courses (OE)	Elective subjects which include inter-disciplinary subjects or subjects in an area outside the parent discipline which are of importance in the context of special skill development
3.	Mandatory Course	Quantum Technology and Application	To understand importance of latest technologies, research and process of creation of patents through research
		Research methodology & IPR	
4.	Research	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
5.	Audit Courses	Mandatory noncredit courses	Covering subjects 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 University external 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 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 subject - wise (irrespective of credits assigned), for a maximum of 100 marks for theory and 100 marks for practical, based on Internal Evaluation and End Semester Examination.

8.1 There shall be five units in each of the theory subjects. For the theory subjects 60 marks will be for the 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 bits.

8.4 For practical subjects, 60 marks shall be for the End Semester 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 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 subject if he secures a minimum of 40% of marks in the End Examination and a minimum aggregate of 50% of the total marks in the End Semester Examination and Internal Evaluation taken together.

8.7 In case the candidate does not secure the minimum academic requirement in any of the subjects he/she has to reappear for the Semester Examination either supplementary or regular in that subject or repeat the course when next offered or do any other specified subject 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, the University shall allow up to a maximum of 40% of the Professional and Open Electives in a semester through SWAYAM/SWAYAM Plus.

9.1 The University shall offer 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 institution, it is mandatory for the student to share necessary information with the institution

9.4 The institution shall select 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 shall 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 GPCET 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 end-semester 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 end-semester exam may be conducted by the National Testing Agency (NTA), the National Programme on Technology Enhanced Learning (NPTEL) or the University during the regular end-term exams. Evaluation shall comprise 60% weightage for the end-semester 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 shall also ensure that the student has to complete the course and produce 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 shall 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 university shall ensure no overlap of SWAYAM MOOC exams with that of the university examination schedule. In case of delay in SWAYAM results, the university 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 shall submit the following to the examination section of 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 university shall 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 shall 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 University 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 subject 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 subjects for which the Internal Evaluation marks secured are more than 50%.

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

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

10.5 For reregistration the candidates have to apply to the University through the college by paying the requisite fees and get approval from the University 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 End Examinations marks secured in the previous attempt(s) for the reregistered subjects 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 requirement in all the subjects, 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. Only after obtaining the approval of the PRC can the student initiate the project work.

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/ESCI/Scopus/UGC Care listed journal, 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 University. For this, the Principal of the College shall submit a panel of three examiners as submitted by the supervisor concerned and department head for each student. However, the dissertation will be adjudicated by one examiner nominated by the University.

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 University

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 Ist 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 University.

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 University. The student must secure a minimum of 50% marks to be declared as passed

14 Credits for Co-curricular Activities

The credits assigned for co-curricular activities shall be given by the principals of the colleges and the same shall be submitted to the University. A Student should earn 01 credits under the head of co-curricular activities, viz., attending Conference, Scientific Presentations and Other Scholarly Activities.

Following are the guidelines for awarding Credits for Co-curricular Activities

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

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

i) A student obtaining Grade 'F' or Grade 'Ab' in a subject shall be considered failed and will be required to reappear for that subject 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} subject 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.,

$$CGPA = \Sigma (C_i \times S_i)/ \Sigma C_i$$

where "S_i" is the SGPA of the i^{th} semester and C_i 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 subjects in which the student is awarded Zero grade points will also be included.

Grade Point: It is a numerical weight allotted to each letter grade on a 10-point scale. Letter Grade: It is an index of the performance of students in a said course. Grades are denoted by letters 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	Percentage of Marks to be secured
First Class with Distinction	>=8
First Class	>= 7 and < 8
Pass Class	>=5 and < 7

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 University 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 subjects as and when subjects 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 Where the words "he", "him", "his", occur in the regulations, they include "she", "her", "hers".

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

20.5 The University 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 University.

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RULES FOR

DISCIPLINARY ACTION FOR MALPRACTICES / IMPROPER CONDUCT IN EXAMINATIONS

	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 subject 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 subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.
(b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject 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 subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects 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 subjects of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The candidate is also debarred for four consecutive semesters from class work and all University examinations if his 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 subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects 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 subject 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 of the examination.	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects 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.
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 subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects 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 subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects 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 subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects 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 subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects 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 subject only or in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester / year 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 subject/subjects due to Malpractice, he has to register for End Examinations in that subject/subjects consequently and has to fulfil all the norms required for the award of Degree.

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G. Pullaiah College of Engineering and Technology

(Autonomous)

(Approved by AICTE | NAAC Accreditation with 'A' Grade | Accredited by NBA (CIV, ECE & EEE) | Affiliated to JNTUA)

Nandikotkur Road, Venkayapalli (V), Kurnool – 518452, Andhra Pradesh

M.TECH IN ELECTRICAL POWER SYSTEMS

COURSE STRUCTURE & SYLLABI

SEMESTER – I

S.No.	Course codes	Course Name	Category	Hours per week			Credits	Scheme of Examination Maximum Marks		
				L	T	P	C	Internal	External	Total
1	C40701	Advanced Power System Protection	PC	3	0	0	3	40	60	100
2	C40702	Power System Security and State	PC	3	0	0	3	40	60	100
3	C40703a C40703b C40703c	**Program Elective – I** Energy Auditing and Management Modelling and Analysis of HVDC Systems Power System Optimization	PE	3	0	0	3	40	60	100
4	C40704a C40704b C40704c	**Program Elective – II** Solar & Wind Energy Conversion Systems Smart Grid Technologies E-Mobility	PE	3	0	0	3	40	60	100
5	C40705	Power System Analysis and Protection Lab	PC	0	0	4	2	40	60	100
6	C40706	Power Systems Simulation Lab	PC	0	0	4	2	40	60	100
7	C40707	Research Methodology and IPR	MC	2	0	0	2	40	60	100
8	C40708	**Skill Enhancement Course** AI Techniques in Electrical Engineering	SE	0	1	2	2	40	60	100
9.	C40709a C40709b C40709c	**Audit Course – I** English for Research Paper Writing Disaster Management Essence of Indian Traditional Knowledge	AC	2	0	0	0	40*	-	40*
Total							20	320	480	800

* - There is no external examination for audit course. Student shall be declared to have passed the mandatory course only when he/she secures 50% or more in the internal examinations.

SEMESTER – II

S.No.	Course codes	Course Name	Category	Hours per week			Credits	Scheme of Examination		
				L	T	P		Internal	External	Total
1.	C40710	Power System Stability and Control	PC	3	0	0	3	40	60	100
2.	C40711	FACTS Controllers	PC	3	0	0	3	40	60	100
3.	C40712a C40712b C40712c	**Program Elective – III** Reactive power Compensation & Management Modern Control Theory Evolutionary Algorithms Applications in Power Engineering	PE	3	0	0	3	40	60	100
4.	C40713a C40713b C40713c	**Program Elective – IV** Power Quality EV Charging Infrastructure & Technology EHVAC Transmission systems	PE	3	0	0	3	40	60	100
5.	C40714	Renewable Energy Sources Lab	PC	0	0	4	2	40	60	100
6.	C40715	FACTS Devices Simulation Lab	PC	0	0	4	2	40	60	100
7.	C40716	Quantum Technologies and Applications	MC	2	0	0	2	40	60	100
8.	C40717	Comprehensive Viva Voce	PC	0	0	0	2	100	-	100
9.	C40718	**Audit Course – II**	AC	2	0	0	0	40*	-	-
Total							20	380	420	800

* - There is no external examination for audit course. Student shall be declared to have passed the mandatory course only when he/she secures 50% or more in the internal examinations.

SEMESTER – III

S.No.	Course codes	Course Name	Category	Hours per week			Credits	Scheme of Examination Maximum Marks		
				L	T	P		Internal	External	Total
1.	C40719a C40719b C40719c	**Program Elective – V** Restructured Power Systems Machine Learning Applications in Power Engineering Distributed Generation and Micro grid Control	PE	3	0	0	3	40	60	100
2.	C40720	**Open Elective -I** Photovoltaic Systems	OE	3	0	0	3	40	60	100
3	C40721	Dissertation Phase – I	PR	0	0	20	10	100	-	100
	C40722	Industry Internship		0	0	0	2	100	-	100
4	C40723	Co-curricular Activities		0	0	0	1	Grad		
Total							**19**	**280**	**120**	**400**

SEMESTER - IV

S.No.	Course codes	Course Name	Category	Hours per week			Credits	Scheme of Examination		
				L	T	P		Internal	External	Total
1.	C40724	Dissertation Phase – II	PR	0	0	32	16	100	100	200
Total							**16**	**100**	**100**	**200**

Course Code	ADVANCED POWER SYSTEM PROTECTION	L	T	P	C
C40701		3	0	0	3
	Semester	**I**			

Course Objectives:

- To know construction of static relays, the operation of microprocessor based protective relays and Artificial Intelligence based numerical protection.
- To understand the operation of amplitude and phase comparators.
- To comprehend the concepts of Static over current, static differential and static distance relays.
- To understand multi-input comparators and concept of power swings on the distance relays.

Course Outcomes (CO): Student will be able to

- Understand the construction of static relay and identify the advantages of static relay over electromagnetic relay and analyze the importance of reliability in various fields.
- Explore the operation of rectifier bridge comparators, instantaneous comparators, phase comparators, multi-input comparators, static differential and distance relays.
- Analyse over current relays, microprocessor-based relays and power swings on distance relays.
- Apply the concept of Artificial Intelligence in power system protection.

UNIT - I		Lecture Hrs:8

STATIC RELAYS & COMPARATORS: 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		Lecture Hrs:

STATIC OVER CURRENT AND DIFFERENTIAL RELAYS: 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		Lecture Hrs:

STATIC DISTANCE RELAYS AND POWER SWINGS: 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		Lecture Hrs:

MICROPROCESSOR BASED PROTECTIVE RELAYS: 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		Lecture Hrs:

ARTIFICIAL INTELLIGENCE BASED NUMERICAL PROTECTION : 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.
Textbooks:
1.T.S. Madhava Rao, Power system Protection static relay, Tata McGrawHill Publishing Company limited, 2nd Edition, 2004. 2.Badri Ram and D.N. Vishwakarma, Power system Protection and Switchgear, Tata McGraw Hill Publication Company limited, 2nd Edition, 2013.
Reference Books:
1.Bhavesh Bhalja, R. P. Maheshwari, N. G. Chothani, Protection and Switchgear, Oxford University Press, 2nd Edition, New Delhi, India, 2018. 2. Oza, B. A., N. C. Nair, R. P. Mehta, et al., Power System Protection & Switchgear, Tata McGraw Hill, New Delhi, 1st Edition, 2011.

Course Code	POWER SYSTEM SECURITY AND STATE ESTIMATION	L	T	P	C
C40702		3	0	0	3
	Semester	I			

Course Objectives:

- Understand the basic concepts of network matrices, power flow methods, state estimation, and applications of power system state estimation and structure of deregulated power system.
- Analyze about admittance/impedance matrices, factors influencing power system security, network problems and power wheeling transactions.
- Implement the methods for determining the bus matrices, optimal ordering, DC power flow, AC power flow, estimating a value and Available Transfer Capability (ATC).
- Develop the algorithm for orthogonal matrix, method to identify network problems and congestion management methods and electricity sector structure

Course Outcomes (CO):

- Understand the concepts of network matrices, power flow methods, contingency analysis, state estimation, and need and conditions for deregulation. L2
- Analyze the bus admittance/impedance matrices methods, power system security, sensitivity factors, state estimation and electricity structure model. L4
- Apply the methods for evaluating the bus matrices, sparsity, DC power flow, AC power flow, estimating a value and Available Transfer Capability (ATC). L3
- Develop the methods for state estimation, method to identify network problems and methods for congestion management. L5

UNIT - I		Lecture Hrs:

POWER SYSTEM NETWORK MATRICES: 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		Lecture Hrs:

POWER SYSTEM SECURITY-I: Review of power flow methods (qualitative treatment only), DC power flow method, Introduction to power system security, Factors influencing power system security**.**

UNIT - III		Lecture Hrs:

POWER SYSTEM SECURITY-II: Introduction to contingency analysis, Contingency analysis: Detection of Network problems, linear sensitivity factors, AC power flow methods, Contingency selection.

UNIT - IV		Lecture Hrs:

STATE ESTIMATION IN POWER SYSTEM: 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		Lecture Hrs:

SECURITY IN DEREGULATED ENVIRONMENT: Need and conditions for deregulation, Electricity sector structure model, Power wheeling transactions, Congestion management methods, Available Transfer Capability (ATC), System security in deregulation.

Textbooks:

1. Allen J. Wood and Wollenberg B.F, Power Generation Operation and control, John Wiley & Sons, 3rd edition, 2013.
2. P. Venkatesh, B.V. Manikandan, S. Charles Raja and A. Srinivasan, Electrical power systems analysis, security, and deregulation, PHI learning private limited, Delhi, 1st edition 2014.

Reference Books:

1.Nagrath I.J. and Kothari D.P., Modern Power System Analysis, TMH, New Delhi, 3rd Edition, 2004.
2.John J. Grainger and William D. Stevenson, Power System Analysis, Tata McGraw-Hill, 1st edition.

Course Code	ENERGY AUDITING AND MANAGEMENT	L	T	P	C
C40703a	(PE-I)	3	0	0	3
	Semester	I			

Course Objectives:

- To understand the current energy scenario and importance of energy conservation.
- To acquire knowledge about different energy efficient devices.
- To measure thermal efficiency and other renewable resources.
- To design suitable energy monitoring system to analyze and optimize the energy consumption in an electrical system.

Course Outcomes (CO): Student will be able to

- Understand the current energy scenario and importance of energy conservation. L2
- Acquire knowledge about different energy efficient devices. L2
- Measure efficiency in renewable energy resources. L3
- Identify the equipment and areas of a system where energy conservation and Audit is necessary. L3

UNIT - I	Lecture Hrs:

ENERGY AUDIT AND DEMAND SIDE MANAGEMENT (DSM) IN POWER UTILITIES: 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	Lecture Hrs:

ENERGY AUDIT: 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	Lecture Hrs:

INSTRUMENTATION: 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	Lecture Hrs:

ENERGY CONSERVATION: Energy conservation in HVAC systems and thermal power plants, Solar systems, Fan and Lighting Systems, Different light sources and luminous efficiency.

UNIT - V	Lecture Hrs:

ECONOMIC EVALUATION OF ENERGY CONSERVATION: Energy conservation in electrical devices and systems, Economic evaluation of energy conservation measures, Electric motors and transformers, Inverters and UPS, Voltage stabilizers.

Textbooks:

1.Frank kreith and D. Yogi goswamy/ Editors, “Energy Management and conservation handbook”. NewYork,2008.
2.WC Turner: Energy Management Handbook, Seventh Edition, (Fairmont Press Inc., 2007)
3.YP Abbi and Shashank Jain: Handbook on Energy Audit and Environment Management, (TERIPress, 2006)

Reference Books:

1.Albert Thumann, and William J. Younger, “Handbook of Energy Audits”, Marcel Dekker, Inc., Newyork, 6th edition, 2003.
2.D.A.Reay, Industrial Energy Conservation-Pergamon Press, 1980.
3.T.L.Boten, LiptakB.G.,(Ed)Instrument Engineers Handbook, Chinton Book Company, 2--2004.
4.Hodge B.K, Analysis and Design of Energy Systems, Prentice Hall, 2002.
5.Larry C.Witte, Schmidt & Brown, Industrial energy management and utilization. Hemisphere publishing, Co.NewYork,1988.

Course Code	MODELLING AND ANALYSIS OF HVDC SYSTEMS (PE-I)	L	T	P	C
C40703B		3	0	0	3
Semester		I			

Course Objectives:

- To understand the concept, planning of DC power transmission.
- To analyze HVDC converters, Transient and Dynamic Stability.
- To apply modeling of power flow analysis.
- To design digital dynamic simulation of converters and DC systems.

Course Outcomes (CO):

- To identify the electrical requirements for HVDC lines. L3
- Analyze the different modes of operation for six pulse & twelve pulse converter unit in the context of HVDC system. L4
- Apply the knowledge of HVDC transmission in Power networks. L3
- Determine the appropriate HVDC transmission line parameters under different physical conditions. L2

UNIT - I		Lecture Hrs:

HVDC CONVERTERS AND SYSTEM CONTROL: 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		Lecture Hrs:

MODELING FOR POWER FLOW ANALYSIS OF AC/DC SYSTEMS: 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		Lecture Hrs:

TRANSIENT AND DYNAMIC STABILITY ANALYSIS: 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		Lecture Hrs:

HARMONIC AND TORSIONAL INTERACTIONS: Harmonic and Torsional Interactions: Harmonic Interactions, Torsion Interactions, Torsional interactions with 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		Lecture Hrs:

MODELING OF HVDC SYSTEMS: 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.

Textbooks:

1.K.R. Padiyar, HVDC Power Transmission Systems – Technology & System Interactions, New Age International Publishers,3rd Edition, 2017
2.S Kamakshaiah and V Kamaraju, HVDC Transmission, Tata Mc Graw Hill, New Delhi, 2nd Edition, 2021

Reference Books:
1.E.W. Kimbark, Direct current transmission, Wiely Inter Science – New York, 1st Edition, 1971 2.J. Arillaga, HVDC Transmission, Peter Peregrinus Ltd., London UK 2nd Edition, 1998 3.E. Uhlman, Power transmission by direct current, Springer Verlag, Berlin Helberg, 1st Edition, 1985

Course Code	POWER SYSTEM OPTIMIZATION	L	T	P	C
C40703c	(PE-I)	3	0	0	3
	Semester	I			

Course Objectives:

- Understand the fundamental concepts of Optimization Techniques.
- Analyze the importance of optimizations in real life scenarios.
- Apply the concepts of various classical and modern methods for constrained and unconstrained problems in both single and multivariable.
- Design the algorithms for different optimizations techniques

Course Outcomes (CO): Student will be able to

- Understand the concept of optimality criteria for various type of optimization problems.
- Analyze the concept of different optimization techniques in real world applications.
- Solve various constrained and unconstrained problems in single variable as well as multivariable.
- Design the methods of optimization for real life situations.

UNIT - I		Lecture Hrs:

CONVENTIONAL OPTIMIZATION TECHNIQUES: 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		Lecture Hrs:

FUNDAMENTALS OF PARTICLE SWARM OPTIMIZATION (PSO) TECHNIQUE: 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		Lecture Hrs:

FUNDAMENTALS OF ANT COLONY SEARCH ALGORITHMS : 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		Lecture Hrs:

FUNDAMENTALS OF TABU SEARCH : Overview of the Tabu Search Approach, Problem Formulation, Coding and Representation, Neighborhood Structure, Characterization of the Neighborhood, 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		Lecture Hrs:

APPLICATION TO POWER SYSTEMS: 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.

Textbooks:

1. A Ravindran, K.M. Ragsdell, and G.V. Reklaitis, “Engineering optimization : Methods and applications”, Wiley India Edition.
2. Kwang Y. Lee and Mohamed A. EI- Sharkawi “Modern Heuristic Optimization Techniques Theory and Applications to Power Systems”, A John Wiley & Sons. INC. Publication, 1st edition, 2020
3. D. P. Kothari and J. S. Dhillon, “Power System Optimization”, PHI Learning Private Limited, 2nd Edition, 2011.

Reference Books:

1. Jizhong Zhu, “Optimization of power system operation”, IEEE Press, John Wiley & Sons, Inc., Publication, 2nd edition, 2015.
2. Joshua adam Taylor, “Convex optimization of power systems’’, Cambridge University Press, 1st edition, 2015.

Course Code	SOLAR & WIND ENERGY CONVERSION SYSTEM (PE-II)	L	T	P	C
C40704a		3	0	0	3
Semester		I			

Course Objectives:

- To introduce photovoltaic systems and principle of wind turbines.
- To deal with various technologies of solar PV cells.
- To understand details about manufacture, sizing and operating techniques in solar energy conversion systems.
- Understand the concepts of fixed speed and variable speed, wind energy conversion systems, knowledge of design considerations and analyze grid integration issues.

Course Outcomes (CO):

Upon completion of the course students will be able to:

- Understand the fundamentals of solar cell, Solar PV Modules from solar cells, system types, Standalone PV system configuration, Maximum Power Point tracking (MPPT) and fundamentals the concepts of fixed speed and variable speed, wind energy conversion systems. L2
- Apply the concept of various technologies of solar PV cells, manufacture, sizing and operating techniques. L3
- Analyze the concept of Effect of series and shunt resistance on efficiency, Effect of solar radiation on efficiency, Analytical techniques, Hot spots in the module, Algorithms for MPPT. L4
- Design of PV powered DC fan without battery, Standalone system with DC load using MPPT, PV powered DC pump, standalone system with battery and AC/DC load and control principles of Wind turbine. L5

UNIT - I		Lecture Hrs:

SOLAR & WIND FUNDAMENTALS: 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		Lecture Hrs:

SOLAR PHOTOVOLTAIC MODULES : 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		Lecture Hrs:

PV SYSTEM DESIGN AND APPLICATIONS : 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		Lecture Hrs:

WIND TURBINE CONTROL SYSTEMS & SITE ANALYSIS: 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		Lecture Hrs:

WIND GENERATION WITH VARIABLE SPEED TURBINES AND APPLICATIONS: 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.

Textbooks:

1. "Solar Photovoltaics Fundamentals, Technologies and Applications" by Chetan Singh Solanki, PHI publications, 3rd edition, 2015
2. S.N.Bhadra, D.Kastha, S.Banerjee, " wind electrical systems" Oxford University Press, 1st edition, 2013
3. Banshi D. Shukla, "Engineering of Wind Energy", Jain Brothers, 1st edition, 2018

Reference Books:

1. H.P. Garg, J. Prakash, Solar Energy Fundamentals and applications Tata McGraw- Hill publishers 1st edition, 2000
2. S.Rao & B.B.Parulekar, Energy Technology, Khanna publishers, 4th edition, 2005.
3. N.K.Bansal, M. Kleemann, Michael Meliss, Renewable Energy sources & Conversion Technology, Tata Mcgraw Hill Publishers & Co., 1st edition, 1990

Course Code	SMART GRID TECHNOLOGIES (PE-II)	L	T	P	C
C40704b		3	0	0	3
	Semester	I			

Course Objectives:

- To know the importance of smart grid technology functions over the present grid.
- To get the knowledge about the measurement system and communication technology of Smart grid.
- To enhance the quality, efficiency and security of power supply.
- To impart an understanding of economics, policies and technical regulations for DG integration.

Course Outcomes (CO):

- Understand the importance of smart grid technology functions over the present grid. L2
- Apply the knowledge about the measurement system and communication technology of Smart grid. L3
- Determine the quality, efficiency and security of power supply. L3
- Impart an understanding of economics, policies and technical regulations for DG integration. L2

UNIT - I		Lecture Hrs:

SMART GRIDS: 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		Lecture Hrs:

TRANSMISSION AND DISTRIBUTION MANAGEMENT : 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		Lecture Hrs:

SMART METERING AND DEMAND SIDE INTEGRATION : 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, Neighborhood 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		Lecture Hrs:

COMMUNICATION TECHNOLOGIES FOR THE SMART GRID: 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		Lecture Hrs:

INFORMATION SECURITY FOR THE SMART GRID: 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.

Textbooks:

1. Janaka Ekanayake, Kithsiri Liyanage, et.al., Smart Grid Technology and Applications, Wiley Publications, 1st edition, 2012.
2. James Momoh, Smart Grid: Fundamentals of Design and Analysis, Wiley, IEEE Press, 1st edition, 2012.
3. Bharat Modi, Anuprakash, Yogesh Kumar, Fundamentals of Smart Grid Technology, S.K Kataria& Sons, 1st edition, 2019.

Reference Books:

1. Eric D. Knapp, Raj Samani, Applied Cyber Security and the Smart Grid-Implementing Security Controls into the Modern Power Infrastructure, Syngress Publishers, 1st edition, 2013.
2. Nouredine Hadjsaid, Jean Claude Sabonnadiere, Smart Grids, Wiley Blackwell Publications, 1st edition, 2012.
3. Peter-Fox Penner, Smart Power: Climate Changes, the Smart Grid and the future of electric utilities, Island Press, 1st edition, 2010.

Course Code	E-MOBILITY (PE-II)	L	T	P	C
C40704c		3	0	0	3
	Semester	I			

Course Objectives:

- Remember and understand the differences between conventional Vehicle and Electric Vehicles, electro mobility and environmental issues of EVs.
- Analyze various EV configurations, parameters of EV systems and Electric vehicle dynamics.
- Analyze the basic construction, operation and characteristics of fuel cells and battery charging techniques in HEV systems.
- Design and analyze the various control structures for Electric vehicle

Course Outcomes (CO):

- To understand and differentiate between Conventional Vehicle and Electric Vehicles, electro mobility and environmental issues of EVs. L2
- To remember and understand various configurations in parameters of EV system and dynamic aspects of EV. L1
- To analyze fuel cell technologies in EV and HEV systems. L4
- To analyze the battery charging and controls required of EVs. L4

UNIT - I		Lecture Hrs:

INTRODUCTION TO EV SYSTEMS AND ENERGY SOURCES: 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		Lecture Hrs:

EV PROPULSION AND DYNAMICS: 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		Lecture Hrs:

FUEL CELLS: 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		Lecture Hrs:

BATTERY CHARGING AND CONTROL: Battery charging: Basic requirements, Charger architecture, Charger functions, Wireless charging, Power factor correction. Control: Introduction, Modeling of electromechanical system, Feedback controller design approach, PI controllers designing, Torque-loop, Speed control loop compensation, Acceleration of battery electric vehicle.

UNIT - V		Lecture Hrs:

ENERGY STORAGE TECHNOLOGIES: 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.

Textbooks:

1.C.C Chan, K.T Chau: Modern Electric Vehicle Technology, Oxford University Press Inc., New York 2001,1st Edition
2.Francisco Díaz-González, Andreas Sumper, Oriol Gomis-Bellmunt," Energy Storage in Power Systems" Wiley Publication, ISBN: 978-1-118-97130-7, Mar 2016,1st Edition

Reference Books:
1.Electric and Hybrid Vehicles Design Fundamentals, Iqbal Husain, CRC Press 2021,3rd Edition. 2.Ali Emadi, Advanced Electric Drive Vehicles, CRC Press, 2015,1st Edition 3.A.G.Ter-Gazarian, “Energy Storage for Power Systems”, the Institution of Engineering and Technology (IET) Publication, UK, (ISBN – 978-1-84919-219-4), Second Edition, 2011. 3.Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, “Modern Elelctric, Hybrid Elelctric and Fuel Cell Vehicles: Fundamentals, Theory and Design”, CRC Press, 2004,1st Edition 4.James Larminie, John Lowry, “Electric Vehicle Technology Explained”, Wiley, 2003,2nd Edition.

Course Code	POWER SYSTEM ANALYSIS AND PROTECTION LAB	L	T	P	C
C40705		0	0	4	2
Semester		I			

Course Objectives:

- Understand the experiments ensuring the safety of equipment and personnel.
- Analyze the power system data fault studies.
- Interpret the experimental results and correlating them with the practical power system.
- Design the relays for power system protection purpose.

Course Outcomes (CO):

- Understand the concept of different experiments. L2
- Analyze the data for and compute the data to obtain results. L4
- Apply the computational results to solve the original power system problems. L4
- Develop advanced relays to identify various faults. L5

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

Course Code	POWER SYSTEMS SIMULATION LAB	L	T	P	C
C40706		0	0	4	2
Semester		I			

Course Objectives:

- Understand how to write the coding in simulation.
- Analyze the data related to load flows, economic dispatch problem and transient stability analysis.
- Apply the computational results in real life power system problems.
- Have the capabilities to develop new software's to optimize the results.

Course Outcomes (CO):

- Understand the coding in simulation. L2
- Analyze the power system data for load-flow and stability studies. L4
- Apply computational methods for large scale power system studies. L3
- Develop software for power system industry to solve various issues. L5

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

Course Code	AI TECHNIQUES IN ELECTRICAL ENGINEERING (SE)	L	T	P	C
C40708		2	0	0	2
	Semester	I			

Course Objectives:

- To locate soft commanding methodologies, such as artificial neural networks, Fuzzy logic and genetic Algorithms.
- To observe the concepts of feed forward neural networks and about feedback neural networks.
- To practice the concept of fuzziness involved in various systems and comprehensive knowledge of fuzzy logic control and to design the fuzzy control.
- To analyze genetic algorithm, genetic operations and genetic mutations.

Course Outcomes (CO): Student will be able to

- Understand feed forward neural networks, feedback neural networks and learning techniques. L2
- Apply selected basic AI techniques; judge applicability of more advanced techniques. L3
- Analyze &Develop fuzzy logic control for applications in electrical engineering. L4
- Develop genetic algorithm for applications in electrical engineering. L5

UNIT - I		Lecture Hrs:

ARTIFICIAL NEURAL NETWORKS: 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		Lecture Hrs:

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

UNIT - III		Lecture Hrs:

FUZZY LOGIC: 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		Lecture Hrs:

GENETIC ALGORITHMS: 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		Lecture Hrs:

APPLICATIONS OF AI TECHNIQUES: 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.

Textbooks:

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

Reference Books:

1.P.D.Wasserman, VanNostrand Reinhold," NeuralComputingTheory&Practice",NewYork,1st . Eddition ,1989
2.Bart Kosko,"Neural Network & Fuzzy System", Prentice Hall,1992.
3.G.J.Klir and T.A.Folger, "Fuzzy sets, Uncertainty and Information", Pearson, 1st edition, 2015.
4.D.E.Goldberg, "Genetic Algorithms", Pearson Education India, 1st edition, 2008