ACADEMIC REGULATIONS

(CHOICE BASED CREDIT SYSTEM (CBCS))

PG PROGRAMMES

For

M.Tech. - Electrical Power Systems
Regular Two Year Post Graduate Degree Programme
(Applicable for the batches admitted from 2020 - 2021)

Giving Wings to Thoughts

St.Peter's Engineering College

(UGC - Autonomous)
Approved by AICTE, Permanently Affiliated to JNTUH & Accredited by NBA
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M.Tech. - Regular Two Year Post Graduate Degree Programme

(For batches admitted from the academic year 2020 - 21)

PREAMBLE

Institution is gearing up for several initiatives towards academic excellence, quality improvement and administrative reforms. In view of this priority and in-keeping with the Institution Vision and Mission; process was already initiated towards introduction of semester system, grading system and credit system.

The above initiatives acquired further strength with University Grants Commission (UGC) guidelines, informing all the Universities/Autonomous Colleges regarding UGC"s new initiatives, on speedy and substantive academic and administrative reforms regarding higher education. Given this background St.Peter's Engineering College has framed this REGULATION-2020. In short, it will be referred to as SR20.

Academic Programmes of the Institute are governed by rules and regulations approved by the Governing Body. The academic rules and regulations are applicable to the students admitted into Two year Postgraduate programmes offered by the college leading to Master of Technology (M.Tech) degree from the academic year 2020-21 onwards.

VISION, MISSION, QUALITY POLICY

VISION: To promote quality education accessible to all sections of the Society without any discrimination of caste, creed, color, gender and religion and help students to discover their true potential.

MISSION:

IM_1: To provide and equip stakeholders with knowledge and skills, social values and ethics, scientific attitude and orientations for lifelong learning.

IM_2 : To create an environment conductive to inhibiting their total involvement and participation

IM_3: Provide infrastructure to arm the students with the competence to be at the forefront of cutting edge technology and entrepreneurship in highly competitive global market.

QUALITY POLICY: St.Peter's Engineering College strives to establish a system of quality assurance to continuously address, monitor and evaluate the quality of education offered to students, thus promoting effective teaching-learning processes for the benefits of our students and making our institution a centre of excellence for engineering and technological studies.

1. POST GRADUATE PROGRAMS OFFERED

St.Peter's Engineering College, an autonomous college affiliated to JNTUH, offers M.Tech. - Regular 2 years (4 semesters) Post Graduate Degree Programme, under Choice Based Credit System (CBCS) with effect from the academic year 2020 - 21 onwards. The following specializations are offered at present for the M. Tech. programme of study.

S.No	Programme	Offering Department
1	Electrical Power Systems	Electrical and Electronics Engineering
2	Embedded Systems	Electronics and Communication Engineering

2. ADMISSION CRITERIA AND MEDIUM OF INSTRUCTION

2.1 Admission into first year of M.Tech. - Regular Two Year Post Graduate Degree Programme

2.1.1 Eligibility: Admission to the PGPs shall be made subject to eligibility, qualification and specializations prescribed by the University from time to time, for each specialization under each M.Tech programme.

2.1.2 Admission Procedure: Admission to the post graduate programme shall be made 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 Telangana State Government (PGECET) for M.Tech. programmes / an entrance test conducted by JNTUH/ on the basis of any other exams approved by the University, subject to reservations as laid down by the Govt. from time to time.

(a) Category A: 70% seats are filled through TSPGECET/GATE counseling.

(b) Category B: 30% seats are filled by the management.

2.2 College Transfers: There shall be no college transfers after the completion of admission process.

2.3 Medium of Instruction: The medium of instruction and examinations for the entire M.Tech. - Regular Two Year Post Graduate Degree Programme will be in **English** only.

3. M.Tech. PROGRAMME STRUCTURE

3.1 Admitted under M.Tech. - Regular Two Year Post Graduate Degree Programme:

3.1.1 The M.Tech Programmes in E & T of JNTUH are of Semester pattern, with Four Semesters consisting of Two academic years, each academic year having Two Semesters (First/Odd and Second/Even Semesters). Each Semester shall be of 22 weeks duration (inclusive of Examinations), with a minimum of 90 instructional days per Semester.

3.1.2 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.

3.2 UGC/AICTE specified definitions/ descriptions are adopted appropriately for various terms and abbreviations used in these academic regulations/ norms, which are listed below.

3.2.1 Semester Scheme:

Each Semester shall have 'Continuous Internal Evaluation (CIE)' and 'Semester End Examination (SEE)'. Choice Based Credit System (CBCS) and Credit Based Semester System (CBSS) are taken as 'references' for the present set of Regulations. The terms 'SUBJECT' and 'COURSE' imply the same meaning here and refer to 'Theory Subject', or 'Lab Course', or

'Design/Drawing Subject', or 'Mini Project with Seminar', or 'Dissertation', as the case may be.

3.2.2 Credit Courses:

All subjects/courses are to be registered by a student in a semester to earn credits. Credits shall be assigned to each subject/course in a L : P : C (Lecture Periods: Practical Periods : Credits) structure, based on the following general pattern.

i) One Credit - for One hour/Week/Semester for Theory/Lecture (L) Courses; and

ii) One Credit - for Two hours/Week/Semester for Laboratory/Practical (P) /Project/Courses

3.2.3 Subject Course Classification

All subjects/courses offered for the Post-Graduate Programme in E & T (M.Tech Degree Programme) are broadly classified as follows. The University has followed in general the guidelines issued by AICTE/UGC.

S.No.	Broad Course Classification	Course Group/ Category	Course Description
1	Core Courses (CoC)	PC- Professional Core	Includes subjects related to the parent discipline/department/ branch of Engineering
		Dissertation	M.Tech Project or PG Project or Major Project
		Mini Project with Seminar	Seminar based on core contents related to Parent Discipline/ Department/ Branch of Engineering
2	Elective Courses (EtE)	PE - Professional Electives	Includes elective subjects related to the parent discipline/department/branch of Engineering
	Mandatory Courses	OE - Open Electives	Elective subjects which include inter-disciplinary subjects or subjects in an area outside the parent discipline/department/ branch of Engineering
3	**Mandatory Courses**	---	**Non-Credit Audit Courses**

4. COURSE REGISTRATION

4.1 A 'Faculty Advisor or Counsellor' shall be assigned to a group of 15 students, who advises the student about the M.Tech. Programme, its course structure and curriculum, choice/option for subjects/courses, based on his/her competence, progress, and interest.

4.2 The Academic Section of the College invites 'Registration Forms' from students within 15 days from the commencement of class work through 'ON-LINE SUBMISSIONS', ensuring 'DATE and TIME Stamping'. The ON-LINE Registration Requests for any 'CURRENT SEMESTER' shall be completed BEFORE the commencement of SEEs (Semester End Examinations) of the 'PRECEDING SEMESTER'

4.3 A student can apply for **online** registration, **only after** obtaining the written approval from his

faculty advisor or counselor, which should be submitted to the College Academic Section through the Head of the Department. A copy of it shall be retained with the Head of the Department, the faculty advisor and the student.

4.4 If the student submits ambiguous choices or multiple options or erroneous (incorrect) entries during **online** registration for the subject(s)/course(s) under a given/specified course group/ category as listed in the course structure, only the first mentioned subject/course in that category will be taken into consideration.

4.5 Subject/course options exercised through **online** registration are final and **cannot** be changed or inter-changed; further, alternate choices will not be considered. However, if the subject/course that has already been listed for registration by the Head of the Department in a semester could not be offered due to any unforeseen or unexpected reasons, then the student shall be allowed to have alternate choice - either for a new subject (subject to offering of such a subject), or for another existing subject (subject to availability of seats). Such alternate arrangements will be made by the Head of the Department, with due notification and time-framed schedule, within the **first week** from the commencement of class-work for that semester.

4.6 **Open Electives**: Students have to choose open elective in II year I semester from the open electives list as per course structure.

4.7 **Professional Electives**: Students have to choose two professional electives (PE-I and PE-II) in I year I semester and another two professional electives (PE-III and PE-IV) in I year II semester, and one more professional elective (PE-V) in II year I semester from the professional electives list as per course structure.

5. SUBJECTS / COURSES TO BE OFFERED

A Subject/Course may be offered to the Students, **if only** a minimum of 1/3 of students register to the course.

i) More than **one faculty member** may be allotted by the department to offer the **same subject** (lab/practical's may be included with the corresponding theory subject in the same semester) in any semester. However, selection choice for students will be based on '**first come first serve** basis and CGPA criterion' (i.e. the first focus shall be on early **online entry** from the student for registration in that semester, and the second focus, if needed, will be on CGPA of the student).

ii) If more entries for registration of a subject come into picture, then the concerned Head of the Department shall take necessary decision, whether or not to offer such a subject/ course for **two (or multiple) sections**.

6. ATTENDANCE REQUIREMENTS

The programmes are offered based on a unit system with each subject being considered a unit. Attendance is calculated separately for each subject.

6.1 Attendance in all classes (Lectures/Laboratories) is compulsory. The minimum required attendance in each theory subject (**also mandatory (audit) courses**) including the attendance of mid-term examination / Laboratory etc. is 75%. Two periods of attendance for each theory subject shall be considered, if the student appears for the mid-term examination of that subject. **This attendance should also be included in the fortnightly upload of attendance to the University. The attendance of mandatory (audit) courses should be uploaded separately to the University.** A student shall not be permitted to appear for the Semester End Examinations (SEE), if his attendance is less than 75%.

6.2 A student's Seminar report and presentation on Mini Project shall be eligible for evaluation, only if he ensures a minimum of 75% of his attendance in Seminar presentation classes on Mini Project during that Semester.

6.3 **Condoning of shortage of attendance** (between 65% and 75%) up to a maximum of 10% (considering the days of attendance in sports, games, NCC, NSS activities and Medical grounds) in each subject (Theory/Lab/Mini Project with Seminar) of a semester shall be granted by the College Academic Committee on genuine reasons.

6.4 A prescribed fee per subject shall be payable for condoning shortage of attendance after getting the approval of College Academic Committee for the same. The College Academic Committee shall maintain relevant documents along with the request from the student.

6.5 Shortage of Attendance below 65% in any subject shall in **no case be condoned.**

6.6 A Student, whose shortage of attendance is not condoned in any Subject(s) (Theory/Lab/Mini Project with Seminar) in any Semester, is considered as 'Detained in that Subject(s), and is not eligible to write Semester End Examination(s) of such Subject(s), (in case of Mini Project with Seminar, his/her Mini Project with Seminar Report or Presentation are not eligible for evaluation) in that Semester; and he/she has to seek re-registration for those Subject(s) in subsequent Semesters, and attend the same as and when offered.

6.7 A student fulfills the attendance requirement in the present semester, shall not be eligible for readmission into the same class.

6.8 a) A student shall put in a minimum required attendance in at least **three theory subjects (excluding mandatory (audit) course)** in first Year I semester for promotion to first Year II Semester.

b) A student shall put in a minimum required attendance in at least **three theory subjects (excluding mandatory (audit) course)** in first Year II semester for promotion to second Year I Semester.

7. ACADEMIC REQUIREMENTS

The following academic requirements must be satisfied, in addition to the attendance requirements mentioned in item no. 5. The performance of the candidate in each semester shall be evaluated subject-wise, with a maximum of 100 marks per subject / course (theory / practical), based on Internal Evaluation and Semester End Examination.

7.1 A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course, if he secures not less than 40% of marks (30 out of 75 marks) in the End Semester Examination, and a minimum of 50% of marks in the sum total of CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together; in terms of Letter Grades and this implies securing 'B' Grade or above in a subject.

7.2 A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to Mini Project with seminar, if student secures not less than 50% marks (i.e. 50 out of 100 allotted marks). The student would be treated as failed, if student (i) does not submit a seminar report on Mini Project or does not make a presentation of the same before the evaluation committee as per schedule or (ii) secures less than 50% marks in Mini Project with seminar evaluation. The failed student shall reappear for the above evaluation when the notification for supplementary examination is issued.

7.3 A student shall register for all subjects for total of 68 credits as specified and listed in the course structure for the chosen specialization, put in the required attendance and fulfill the academic requirements for securing 68 credits obtaining a minimum of 'B' Grade or above in each subject, 6.0 (in each semester) and≥and all 68 credits securing Semester Grade Point Average (SGPA) 6.0, and shall pass≥final Cumulative Grade Point Average (CGPA) (i.e., CGPA at the end of PGP) all the mandatory(audit) courses to complete the PGP successfully.

Note: (1) The SGPA will be computed and printed on the marks memo only if the candidate passes in all the subjects offered and gets minimum B grade in all the subjects.

(2) CGPA is calculated only when the candidate passes in all the subjects offered in all the semesters.

7.4 Marks and Letter Grades obtained in all those subjects covering the above specified 68 credits alone shall be considered for the calculation of final CGPA, which will be indicated in the Grade Card /Marks Memo of second year second semester.

7.5 If a student registers for extra subject(s) (in the parent department or other departments/ branches of Engineering) other than those listed subjects totaling to 68 credits as specified in the course structure, the performance in extra subject(s) (although evaluated and graded using the same procedure as that of the required 68 credits) will not be considered while calculating the SGPA and CGPA. For such extra subject(s) registered, percentage of marks and Letter Grade alone will be indicated in the Grade Card/Marks Memo, as a performance measure, subject to completion of the attendance and academic requirements as stated in items 5 and 6.1 - 6.3.

7.6 When a student is detained due to shortage of attendance in any subject(s) in any semester, no Grade allotment will be made for such subject(s). However, he is eligible for re-registration of such subject(s) in the subsequent semester(s), as and when next offered, with the academic regulations of the batch into which he is re-registered, by paying the prescribed fees per subject. In all these re-registration cases, the student shall have to secure a fresh set of internal marks and

Semester End Examination marks for performance evaluation in such subject(s), and SGPA/CGPA calculations.

7.7 A student eligible to appear for the Semester End Examination in any subject, but absent from it or failed (failing to secure 'B' Grade or above), may reappear for that subject at the supplementary examination as and when conducted. In such cases, his Internal Marks assessed earlier for that subject will be carried over, and added to the marks secured in the supplementary examination, for the purpose of evaluating his performance in that subject.

7.8 A Student who fails to earn **68** credits as per the specified course structure, and as indicated above, within **four** academic years from the date of commencement of his first year first semester, shall forfeit his seat in M.Tech programme and his admission **shall stand cancelled.**

8. EVALUATION - DISTRIBUTION AND WEIGHTAGE OF MARKS

The performance of a student in each semester shall be evaluated subject-wise / course-wise (irrespective of credits assigned) with a maximum of 100 marks for theory. For all theory subjects/practicals, the distribution shall be 30 marks for CIE, and 70 marks for the SEE, and a letter grade corresponding to the percentage of marks obtained shall be given.

8.1 Evaluation of Theory Subjects / Courses

A) Continuous Internal Evaluation:

For the theory subjects 70 marks shall be awarded for the performance in the Semester End Examination and 30 marks shall be awarded for Continuous Internal Evaluation (CIE). The Continuous Internal Evaluation shall be made based on the average of the marks secured in the two Mid-Term Examinations conducted, first Mid-Term examinations in the middle of the Semester and second Mid-Term examinations during the last week of instruction. Each Mid-Term Examination shall be conducted for a total duration of 120 minutes with Part 'A' as compulsory consisting of 5 questions carrying 2 marks each (10 marks), and Part 'B' with 3 questions to be answered out of 5 questions, each question carrying 5 marks (15 marks). The details of the Question Paper pattern for Semester End Examination (Theory) are given below:

- The Semester End Examination will be conducted for 75 marks. It consists of two parts.

  i) Part A for 25 marks, ii) Part B for 50 marks.
- Part A is compulsory and consists of 5 questions, one from each unit and carrying 5 marks each.
- Part B consists of 5 questions carrying 10 marks each. There will be two questions from each unit and only one should be answered

i) The subjective paper shall contain two parts i.e. Part A and Part B. Part A is compulsory question carries 10 marks for which there may be a 5 sub questions carries two mark each

and Part B carries 15 marks for which there will be 3 essay questions with internal choice.

ii) The student should submit first assignment before the commencement of the first mid term examinations, and second assignment before the commencement of the second mid-term examinations.

B) Semester End Examinations: The duration of SEE is 3 hours. The details of the question paper pattern are as follows:

- The end semester examinations will be conducted for 70 marks consisting of two parts viz. i) **Part- A** for 20 marks, ii) **Part - B** for 50 marks.
- Part-A is compulsory question which consists of ten questions (two from each unit) carries 2 marks each.
- Part-B consists of five questions each carries 10 marks each. One question from each unit with internal choice (i.e., a or b).

8.2 Evaluation of Practical Subjects/Courses: In any semester, a student has to complete all exercises in each practical/laboratory course and get the record certified by the concerned Head of the Department to be eligible for Semester End Examination. For practical/laboratory Subjects, there shall be a Continuous Internal Evaluation (CIE) during the semester for 30 internal marks and 70 marks for Semester End Examination (SEE).

C) Continuous Internal Evaluation (CIE): Out of the 30 marks, 15 marks are allocated for day-to-day work evaluation and for remaining15 marks - two mid-term examinations of each 15 marks will be conducted by the concerned laboratory teacher for a duration of two hours and the better performance of the two mid-term examinations is taken into account.

D) Semester End Examination (SEE): The SEE for practical Subject / Course shall be conducted at the end of the semester by one Internal and one External Examiners appointed by the Head of the Institution as per the recommendation of the concerned Head of the Department.

8.3 There shall be Mini Project with Seminar during I year II semester for internal evaluation of 100 marks. The Departmental Academic Committee (DAC) will review the progress of the mini project during the seminar presentations and evaluate the same for 50 marks. Mini Project Viva Voce will be evaluated by the DAC for another 50 marks before the semester end examinations. Student shall carryout the mini project in consultation with the mini project supervisor which may include critically reviewing the literature, project implementation and submit it to the department in the form of a report and shall make an oral presentation before the DAC consisting of Head of the Department, Mini Project supervisor and two other senior faculty members of the department. The student has to secure a minimum of 50% of marks in i) seminar presentation and ii) mini project viva voce, to be declared successful. If he fails to obtain the minimum marks, he has to reappear for the same as and when scheduled.

8.4 Every candidate shall be required to submit a dissertation on a topic approved by the Dissertation Review Committee.

8.5 A Dissertation Review Committee (DRC) shall be constituted with the Head of the Department as Chairperson, Dissertation Supervisor and one senior faculty member of the Department offering the M. Tech. programme.

a) Registration of Dissertation Work: A candidate is permitted to register for the Dissertation Work after satisfying the attendance requirement in all the subjects, both theory and laboratory.

b) After satisfying 7.7, a candidate must present in Dissertation Work Review - I, in consultation with his Dissertation Supervisor, the title, objective and plan of action of his Dissertation work to the Dissertation Review Committee (DRC) for approval within four weeks from the commencement of Second year First Semester. Only after obtaining the approval of the DRC can the student initiate the Dissertation work.

8.6 If a candidate wishes to change his supervisor or topic of the Dissertation, he can do so with the approval of the DRC. However, the DRC shall examine whether or not the change of topic/supervisor leads to a major change of his initial plans of Dissertation proposal. If yes, his date of registration for the project work starts from the date of change of Supervisor or topic as the case may be.

8.7 A candidate shall submit his Dissertation progress report in two stages at least with a gap of three months between them.

8.8 The work on the Dissertation shall be initiated at the beginning of the II year and the duration of the Dissertation is two semesters. A candidate is permitted to submit Dissertation Thesis only after successful completion of all theory and practical courses with the approval of DRC not earlier than 40 weeks from the date of approval of the Dissertation work. For the approval of DRC the candidate shall submit the draft copy of thesis to the Head of the Department and make an oral presentation before the DRC.

8.9 The Dissertation Work Review - II in II Year I Sem. carries internal marks of 100. Evaluation should be done by the DRC for 50 marks and the Supervisor will evaluate the work for the other 50 marks. The Supervisor and DRC will examine the Problem Definition, Objectives, Scope of Work, Literature Survey in the same domain and progress of the Dissertation Work. A candidate has to secure a minimum of 50% of marks to be declared successful in Dissertation Work Review - II. If he fails to obtain the minimum required marks, he has to reappear for Dissertation Work Review - II as and when conducted.

8.10 The Dissertation Work Review - III in II Year II Sem. carries 100 internal marks. Evaluation should be done by the DRC for 50 marks and the Supervisor will evaluate it for the other 50 marks. The DRC will examine the overall progress of the Dissertation Work and decide whether or not the Dissertation is eligible for final submission. A candidate has to secure a minimum of 50%

of marks to be declared successful in Dissertation Work Review - III. If he fails to obtain the required minimum marks, he has to reappear for Dissertation Work Review - III as and when conducted. For Dissertation Evaluation (Viva Voce) in II Year II Sem. there are external marks of 100 and it is evaluated by the external examiner. The candidate has to secure a minimum of 50% marks in Dissertation Evaluation (VivaVoce) examination.

8.11 Dissertation Work Reviews - II and III shall be conducted in phase I (Regular) and Phase II (Supplementary). Phase II will be conducted only for unsuccessful students in Phase I. The unsuccessful students in Dissertation Work Review - II (Phase II) shall reappear for it at the time of Dissertation Work Review - III (Phase I). These students shall reappear for Dissertation Work Review - III in the next academic year at the time of Dissertation Work Review - II only after completion of Dissertation Work Review - II, and then Dissertation Work Review - III follows. The unsuccessful students in Dissertation Work Review - III (Phase II) shall reappear for Dissertation Work Review - III in the next academic year only at the time of Dissertation Work Review - II (Phase I).

8.12 After approval from the DRC, a soft copy of the thesis should be submitted for ANTI-PLAGIARISM check and the plagiarism report should be submitted to the University and be included in the final thesis. The Thesis will be accepted for submission, if the similarity index is less than 30%. If the similarity index has more than the required percentage, the student is advised to modify accordingly and re-submit the soft copy of the thesis after one month. The maximum number of re-submissions of thesis after plagiarism check is limited to TWO. The candidate has to register for the Dissertation work and work for two semesters. After three attempts, the admission is liable to be cancelled. The college authorities are advised to make plagiarism check of every soft copy of theses before submissions.

8.13 Three copies of the Dissertation Thesis certified by the supervisor shall be submitted to the College/School/Institute, after submission of a research paper related to the Dissertation work in a UGC approved journal. A copy of the submitted research paper shall be attached to thesis.

8.14 The thesis shall be adjudicated by an external examiner selected by the University. For this, the Principal of the College/School/Institute shall submit a panel of three examiners from among the list of experts in the relevant specialization as submitted by the supervisor concerned and Head of the Department.

8.15 If the report of the external examiner is unsatisfactory, the candidate shall revise and resubmit the Thesis. If the report of the examiner is unsatisfactory again, the thesis shall be summarily rejected. Subsequent actions for such dissertations may be considered, only on the specific recommendations of the external examiner and /or Dissertation Review Committee. No further correspondence in this matter will be entertained, if there is no specific recommendation for resubmission.

8.16 If the report of the examiner is satisfactory, the Head of the Department shall coordinate and make arrangements for the conduct of Dissertation Viva-Voce examination. The Dissertation

Viva-Voce examination shall be conducted by a board consisting of the Supervisor, Head of the Department and the external examiner who adjudicated the Thesis. The candidate has to secure a minimum of 50% of marks in Dissertation Evaluation (Viva-Voce) examination.

8.17 If he fails to fulfill the requirements as specified in 8.17, he will reappear for the Dissertation 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, unless he is asked to revise and resubmit his Dissertation Work by the board within a specified time period (within four years from the date of commencement of his first year first semester).

8.18 The Dissertation Viva-Voce External examination marks must be submitted to the University on the day of the examination.

8.19 **For mandatory(audit) courses, a student has to secure 40 marks out of 100 marks (i.e. 40% of the marks allotted) in the continuous internal evaluation for passing the subject/course. These marks should also be uploaded along with the internal marks of other subjects**.

8.20 **No marks or letter grades shall be allotted for mandatory(audit) courses. Only Pass/Fail shall be indicated in Grade Card.**

9. RE-ADMISSION/RE-REGISTRATION

9.1 Re-Admission for Discontinued Student

A student, who has discontinued the M.Tech. degree programme due to any reason whatsoever, may be considered for 'readmission' into the same degree programme (with the same specialization) with the academic regulations of the batch into which he gets readmitted, with prior permission from the authorities concerned, subject to item 7.6.

9.2 If a student is detained in a subject (s) due to shortage of attendance in any semester, he may be permitted to re-register for the same subject(s) in the same category (core or elective group) or equivalent subject, if the same subject is not available, as suggested by the Board of Studies of that department, as and when offered in the subsequent semester(s), with the academic regulations of the batch into which he seeks re-registration, with prior permission from the authorities concerned, subject to item 3.1.2.

9.3 A candidate shall be given one chance to re-register and attend the classes for a maximum of two subjects, if the internal marks secured by a candidate are less than 50% and failed in those subjects but fulfilled the attendance requirement. A candidate must re-register for failed subjects within four weeks of commencement of the class work and secure the required minimum attendance. In the event of the student taking this chance, his Continuous Internal Evaluation (internal) marks and Semester End Examination marks obtained in the previous attempt stand cancelled.

10. EXAMINATIONS AND ASSESSMENT - THE GRADING SYSTEM

10.1 Grades will be awarded to indicate the performance of each student in each Theory Subject, or Lab/Practicals, or Mini Project with Seminar, Dissertation, etc., based on the percentage of marks

obtained in CIE + SEE (Continuous Internal Evaluation + Semester End Examination, both taken together) as specified in Item 7 above, and a corresponding Letter Grade shall be given.

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

% of Marks Secured (Class Intervals)	Letter Grade (UGC Guidelines)	Grade Points
90% and above	O (Outstanding)	10
Below 90% but not less than 80%	A^+ (Excellent)	9
Below 80% but not less than 70%	A (Very Good)	8
Below 70% but not less than 60%	B^+ (Good)	7
Below 60% but not less than 50%	B (Average)	6
Below 50% (< 50%)	F (Fail)	0
Absent	**Ab**	**0**

10.3 A student obtaining F Grade in any Subject is deemed to have 'failed' and is required to reappear as 'Supplementary Candidate' for the Semester End Examination (SEE), as and when conducted. In such cases, his Internal Marks (CIE Marks) in those subjects will remain as obtained earlier.

10.4 If a student has not appeared for the examinations, 'Ab' Grade will be allocated to him for any subject and shall be considered 'failed' and will be required to reappear as 'Supplementary Candidate' for the Semester End Examination (SEE), as and when conducted.

10.5 A Letter Grade does not imply any specific marks percentage; it is only the range of percentage of marks.

10.6 In general, a student shall not be permitted to repeat any Subject/ Course (s) only for the sake of 'Grade Improvement' or 'SGPA/ CGPA Improvement'.

10.7 A student earns Grade Point (GP) in each Subject/ Course, on the basis of the Letter Grade obtained by him in that Subject/ Course. The corresponding 'Credit Points' (CP) are computed by multiplying the Grade Point with Credits for that particular Subject/ Course.

Credit Points (CP) = Grade Point (GP) x Credits …. For a Course

10.8 The student passes the Subject/ Course only when he gets **GP≥6(B Grade or above).**

10.9 The Semester Grade Point Average (SGPA) is calculated by dividing the Sum of Credit Points(ΣCP) secured from ALL Subjects/ Courses registered in a Semester, by the Total Number of Credits registered during that Semester. SGPA is rounded off to TWO Decimal Places. SGPA is thus computed as

$$SGPA = \sum_{i=1}^{N} Ci\ Gi \} / \{ \sum_{i=1}^{N} Ci \}$$ **… for each Semester,**

where 'i' is the subject indicator index (takes into account all Subjects in a semester), **'N'** is the no. of subjects '**registered**' for the semester (as specifically required and listed under the course structure of the parent department), C_i is the no. of credits allotted to that i^{th} subject, and G_i represents the grade points (GP) corresponding to the letter grade awarded for that i^{th} subject.

10.10 The Cumulative Grade Point Average (CGPA) is a measure of the overall cumulative

performance of a student over all semesters considered for registration. The CGPA is the ratio of the total credit Points secured by a student in **all** registered Courses in **all** semesters, and the total number of credits registered in **all** the semesters. CGPA is rounded off to **two** decimal places. CGPA is thus computed from the I year II semester onwards, at the end of each semester, as per the formula

$$CGPA = \{ \sum_{j=1}^{M} Cj\ Gj \} / \{ \sum_{j=1}^{M} Cj \}$$ **… for all S semesters registered**

(ie., upto and inclusive of S Semesters, S≥2)

where **'M'** is the total number of subjects (as specifically required and listed under the course structure of the parent department) the Student has '**registered**' from the I year I semester onwards upto and inclusive of the semester S (obviously M > N), 'j' is the subject indicator index (takes into account all Subjects from 1 to S semesters), is the no. of credits allotted to the j^{th} subject, and represents the Grade Points (GP) corresponding to the letter grade awarded for that j^{th} subject. After registration and completion of I year I semester however, the SGPA of that semester itself may be taken as the CGPA, as there are no cumulative effects.

Illustration of calculation of SGPA

Course/Subject	Credits	Letter Grade	Grade points	Credit Points
Course 1	3	A	8	3*8=24
Course 2	3	O	10	3*10=30
Course 3	3	B	6	3*6=18
Course 4	3	B	6	3*6=18
Course 5	2	A+	9	2*9=18
Course 6	2	B	6	2*6=12
Course 7	2	A	8	2*8=16
	18			136

SGPA = 136/18 = 7.55

Illustration of calculation of CGPA

Semester	Credits	SGPA	Credits * SGPA
Semester I	18	7.5	18*7.5 = 135
Semester II	18	6	18*6 = 108
Semester III	12	6.5	12*6.5 = 78

Semester IV	20	6	20*6 = 120
	68		441

CGPA = 441/68 = 6.48

11 AWARD OF DEGREE AND CLASS

11.1 If a student who registers for all the specified Subjects/ Courses as listed in the Course Structure, satisfies all the Course Requirements, and passes the examinations prescribed in the entire PG 6.0), shall be Programme (PGP), and secures the required number of 68 Credits (with CGPA declared to have 'QUALIFIED' for the award of the M.Tech. Degree in the chosen Branch of Engineering and Technology with the specialization that he was admitted into.

11.2 Award of Class

After a student has earned the requirements prescribed for the completion of the programme and is eligible for the award of M.Tech. Degree, he shall be placed in one of the following three classes based on the CGPA.

Class Awarded	CGPA
First Class with Distinction	≥ 7.75 CGPA
First Class	6.75≤ CGPA < 7.75
Second Class	6.00≤ CGPA < 6.75

12 WITHHOLDING OF RESULTS

If the student has not paid the dues, if any, to the University or if any case of indiscipline is pending against him, the result and degree of the student will be withheld and he will not be allowed into the next semester.

13 GENERAL

13.1 **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 or tutorial) or two hours of practical work/field work per week.

13.2 **Credit Point:** It is the product of grade point and number of credits for a course.

13.3 Wherever the words "he", "him", "his", occur in the regulations, they shall include "she", "her".

13.4 The academic regulation should be read as a whole for the purpose of any interpretation.

13.5 In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the University is final.

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

14. MALPRACTICE

Malpractice Rules: Disciplinary action for improper conduct in examinations

S. No.	Nature of Malpractices / Improper Conduct	Punishment
1 (a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers 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.
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 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 Principal.

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 and forfeits the seat. The performance of the original candidate who has been impersonated, shall be cancelled in all the subjects of the examination (including practical's 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 two consecutive semesters from class work and all 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 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.

6	Refuses to obey the orders of the Addl. Controller of examinations / 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 addl. Controller of examinations 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 addl. Controller of examinations, 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. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.
7	Leaves the 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 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 and all other subjects the candidate has appeared including practical examinations and project work of that semester/year examinations.

12	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the principal for further action to award suitable punishment.	

15. SCOPE

i) The academic regulations should be read as a whole, for the purpose of any interpretation.

ii) The above mentioned rules and regulations are applicable in general to M.Tech., unless and otherwise specific.

iii) In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Chairman of the Academic Council is final.

16. REVISION AND AMENDMENTS TO REGULATIONS

The Academic Council may revise or amend the academic regulations, course structure or syllabi at any time, and the changes or amendments made shall be applicable to all students with effect from the dates notified by the Academic Council Authorities.

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St. PETER'S ENGINEERING COLLEGE
UGC AUTONOMOUS
(Approved by AICTE, New Delhi, Affiliated to JNTUH)
Accredited by NAAC with 'A' grade
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
COURSE STRUCTURE

M. Tech (ELECTRICAL POWER SYSTEMS)
(WITH EFFECT FROM ACADEMIC YEAR 2020- 21 ADMITTED BATCH)

I M TECH I SEM						
COURSE CODE	**COURSE TITLE**	**COURSE AREA**	**HOURS/WEEK**			**CREDIT**
			L	T	P	
AS20-D07PC01	ADVANCED POWER SYSTEM ANALYSIS	PC-I	3	0	0	3
AS20-D07PC02	ECONOMIC OPERATION OF POWER SYSTEMS	PC-II	3	0	0	3
AS20-D07PE01	HVDC TRANSMISSION	PE-I	3	0	0	3
AS20-D07PE02	RENEWABLE ENERGY SYSTEMS					
AS20-D07PE03	SMART GRID TECHNOLOGIES					
AS20-D07PE04	MODERN CONTROL THEORY					
AS20-D07PE05	ELECTRICAL POWER DISTRIBUTION SYSTEM	PE-II	3	0	0	3
AS20-D07PE06	REACTIVE POWER COMPENSATION AND MANAGEMENT					
AS20-D07PE07	MATHEMATICAL METHODS FOR POWER ENGINEERING					
AS20-D07PE08	HYBRID ELECTRIC VEHICLES					
AS20-D07HS01	RESEARCH METHODOLOGY AND IPR	HSMC	2	0	0	2
AS20-D07AC1X	AUDIT COURSE - I	AC-I	2	0	0	0
PRACTICAL COURSES						
AS20-D07PC03	POWER SYSTEMS COMPUTATION LAB-I	PC	0	0	4	2
AS20-D07PC04	ADVANCED POWER SYSTEM ANALYSIS LAB	PC	0	0	4	2
		TOTAL	**16**	**0**	**8**	**18**
I M TECH II SEM						
S.NO	**COURSE TITLE**	**COURSE AREA**	**HOURS/WEEK**			**CREDIT**
			L	T	P	
AS20-D07PC05	DIGITAL PROTECTION OF POWER SYSTEM	PC-III	3	0	0	3
AS20-D07PC06	POWER SYSTEM DYNAMICS	PC-IV	3	0	0	3
AS20-D07PE09	RESTRUCTURED POWER SYSTEMS	PE-III	3	0	0	3
AS20-D07PE10	EHV AC TRANSMISSION					
AS20-D07PE11	SWARM INTELLIGENCE TECHNIQUES IN POWER SYSTEMS					
AS20-D07PE12	ENERGY STORAGE SYSTEMS					
AS20-D07PE13	AI TECHNIQUES IN POWER SYSTEMS	PE-IV	3	0	0	3
AS20-D07PE14	POWER QUALITY					

AS20-D07PE15	INDUSTRIAL LOAD MODELLING AND CONTROL					
AS20-D07PE16	POWER SYSTEM RELIABILITY AND PLANNING					
AS20-D07AC2X	AUDIT COURSE - II	AC-II	2	0	0	0
PRACTICAL COURSES						
AS20-D07PC07	POWER SYSTEMS COMPUTATION LAB-II	PC	0	0	4	2
AS20-D07PC08	POWER SYSTEM PROTECTION LAB	PC	0	0	4	2
AS20-D07PW01	MINI PROJECT WITH SEMINAR	PW	0	0	4	2
		TOTAL	**14**	**0**	**12**	**18**

II M TECH I SEM

S.NO	**COURSE TITLE**	**COURSE AREA**	**HOURS/WEEK**			**CREDIT**
			L	T	P	
AS20-D07PE17	POWER SYSTEM TRANSIENTS	PE-V	3	0	0	3
AS20-D07PE18	FLEXIBLE AC TRANSMISSION SYSTEMS					
AS20-D07PE19	GAS INSULATED SYSTEMS					
AS20-D07PE20	SCADA SYSTEM AND APPLICATIONS					
AS20-D07OE1X	OPEN ELECTIVE(THROUGH MOOCS)	OE	3	0	0	3
AS20-D07PW02	DISSERTATION PHASE - I	PW	0	0	20	10
	TOTAL		**6**	**0**	**20**	**16**

II M TECH II SEM

S.NO	**COURSE TITLE**	**COURSE AREA**	**HOURS/WEEK**			**CREDIT**
			L	T	P	
AS20-D07PW03	DISSERTATION PHASE - II	PW	0	0	32	16
	Total		**0**	**0**	**32**	**16**

Total credits: 68

AS20-D07AC1X- AUDIT COURSE-I(any one of the following)						
COURSE CODE	COURSE TITLE	COURSE AREA	HOURS/WEEK			CREDIT
			L	T	P	
AS20-D07AC11	ENGLISH FOR RESEARCH PAPER WRITING	AC	2	0	0	0
AS20-D07AC12	DISASTER MANAGEMENT	AC	2	0	0	0
AS20-D07AC13	SANSKRIT FOR TECHNICAL KNOWLEDGE	AC	2	0	0	0
AS20-D07AC14	VALUE EDUCATION	AC	2	0	0	0

AS20-D07AC2X- AUDIT COURSE-II(any one of the following)						
COURSE CODE	COURSE TITLE	COURSE AREA	HOURS/WEEK			CREDIT
			L	T	P	
AS20-D07AC21	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	AC	2	0	0	0
AS20-D07AC22	PEDAGOGY STUDIES	AC	2	0	0	0
AS20-D07AC23	STRESS MANAGEMENT BY YOGA	AC	2	0	0	0
AS20-D07AC24	ECONOMIC POLICIES IN INDIA	AC	2	0	0	0

AS20-D07OE1X- OPEN ELECTIVE-I (THROUGH MOOCS)(any one of the following)						
COURSE CODE	COURSE TITLE	COURSE AREA	HOURS/WEEK			CREDIT
			L	T	P	
AS20-D07OE11	AIR INSULATED ELECTRICAL SUBSTATION DESIGN	OE	2	0	0	0
AS20-D07OE12	ELECTRICAL ENGINEERING SIMULATION USING ETAP	OE	2	0	0	0
AS20-D07OE13	ELECTRICAL POWER DISTRIBUTION WITH AUTOCAD, DIALUX & ETAP	OE	2	0	0	0
AS20-D07OE14	HIGH VOLTAGE AND INSULATORS FOR POWER ENGINEERING	OE	2	0	0	0

CREDITS DISTRIBUTION

SEM	I-I	I-II	II-I	II-II	TOTAL SPEC	AICTE
PCC	10	10	3		23	23
PE	6	6	3		15	15
AC					0	0
PW		2	10	16	28	28
HS&MC	2				2	2
TOTAL	**18**	**18**	**16**	**16**	**68**	**68**
					68	

St.Peter's Engineering College- UGC-Autonomous

I M.Tech-I SEM (EPS)

Course Title: ADVANCED POWER SYSTEM ANALYSIS	**Course Code: AS20-D07PC01**
Teaching Scheme (L:T:P): 3 1 0	**Credits:3**
Type of Course: Lecture + Assignment	**Total Contact Periods:**
Continuous Internal Evaluation-30 Marks	**Semester End Exams-70 Marks**
Prerequisites: Computer Methods in Power Systems	
Programme: EEE	

Course Overview:

The continuity and quality of electricity delivered safely and economically by today's and futures electrical power networks are important for both developed and developing economies. The correct modelling of power system equipment and correct fault analysis of electrical networks are pre-requisite to ensuring safety and they play a critical role in the identification of economic network investments. Environmental and economic factors require engineers to maximize the use of existing assets which in turn require accurate modelling and analysis techniques.

Course Objectives: to prepare the students to

- Build the Nodal admittance and Nodal impedance matrices of a practical network.
- Study various methods of load flow.
- Analyze various types of faults in power system.
- Understand power system security concepts
- Understand state estimation and study simple algorithms for state estimation

Course Outcomes(s)

CO#	Course Outcomes	PO	PSO
C111.1	To build/construct Y_{BUS} and Z_{BUS} of any practical network.	1,2,3	1,3
C111.2	Calculate voltage phases at all buses, given the data using various methods of load flow	1,2,4	1,3
C111.3	Calculate fault currents in each phase.	1,2	1,3
C111.4	Rank various contingencies according to their severity.	1,2,3	1,3
C111.5	Estimate the bus voltage phasors given various quantities viz. power flow, voltages, taps , CB status etc.	1,2,5	1,3
C111.6	Deliver technological solutions in the field of power systems by assimilating advances in allied disciplines	1,2,3,5	1,3

COURSE ASSESSMENT:

COURSE CONTENT (SYLLABUS)

UNIT-I: NETWORK MATRICES

Introduction, per unit system, Bus Admittance Matrix, Network Solution, Network Reduction(KronReduction), Y_{BUS} structure and manipulation Bus Impedance matrix, Methods to determine columns of Z_{BUS}.

UNIT-II: LOAD FLOW STUDIES

Overview of Gauss-Siedel, Newton-Raphson load flow methods, fast decoupled method, convergence properties, sparsity techniques, handling Q_{max} violations in constant matrix, inclusion in frequency effects, AVR in load flow, handling of discrete variable in load flow.

UNIT-III: FAULT CALCULATIONS

Symmetrical faults-Fault calculations using Z_{BUS} - Fault calculations using Z_{BUS} equivalent circuits,Selection of circuit breakers**,** symmetrical components, unsymmetrical faults - Problems on various types of faults.

UNIT-IV: CONTINGENCY ANALYSIS

Security Analysis: Security state diagram, contingency analysis, generator shift distribution factors, line outage distribution factor, multiple line outages, overload index ranking

UNIT-V: STATE ESTIMATION

Sources of errors in measurements, Virtual and Pseudo measurements, Observabilit concepts, Tracking state Estimation, Weighted Least Square method, Bad Data detection and estimation.

TEXT BOOKS:

1. J.J. Grainger & W.D.Stevenson, "Power system analysis ", McGraw Hill ,2003.
2. A. R. Bergen & Vijay Vittal , "Power System Analysis" ,Pearson , 2000.

REFERENCES:

1. L.P. Singh , "Advanced Power System Analysis and Dynamics", New Age International, 2006.
2. G.L. Kusic, "Computer aided power system analysis" ,Prentice Hall India, 1986.
3. A.J. Wood, " Power generation, operation and control" , John Wiley, 1994.
4. P.M. Anderson, "Faulted power system analysis" , IEEE Press , 1995

Online Resources (SWAYAM/NPTEL/MOOCS/COURSERA):

1 https://www.youtube.com/playlist?list=PL36A60B630E8C7B56

2.https://www.youtube.com/playlist?list=PL-uxPiMl0_6GWFPGXgVapb1yjVAZs9YGz

I M.Tech-I SEM (EPS)

Course Title: ECONOMIC OPERATION OF POWER SYSTEMS	**Course Code: AS20-D07PC02**
Teaching Scheme (L:T:P): 3 1 0	**Credits:3**
Type of Course: Lecture + Assignment	**Total Contact Periods:**
Continuous Internal Evaluation-30 Marks	**Semester End Exams-70 Marks**
Prerequisites: Power Systems – I & II	
Programme: EEE	

Course Overview:

Understand Economic load dispatch and Unit Commitment Problems. Understand the concept of hydrothermal scheduling in large and Small Hydro Power Plants. Provides knowledge on Advance load frequency control and Optimal power control

Course Objective

- Understand economic load scheduling problem and unit commitment problem.
- Understand hydro-thermal scheduling problem.
- Understand load frequency control (LFC)
- Understand the optimal power flow (OPF) problem.

Course Outcomes(s)

CO#	Course Outcomes	POs	PSOS
C112.1	Distinguish between economic load dispatch and unit commitment problem	**1,2,3,4**	**1,2**
C112.2	Solve economic load scheduling (with and without network losses)	**1,4**	
C112.3	Solve unit commitment problem	**4,5**	**1**
C112.4	Solve hydro-thermal scheduling problem	**2,4,5**	
C112.5	Analyze the single area and two area systems for frequency deviation	**1,3**	**1**
C112.6	Solve the OPF problem using ac and dc load flow methods.	**1,4,5**	**2**

COURSE CONTENT (SYLLABUS)

UNIT-I: ECONOMIC LOAD SCHEDULING

Characteristics of Steam Turbine, Variations in steam unit characteristics, Economic dispatch with piecewise linear cost functions, Lambda Iterative method, LP method, Economic dispatch under composite generation production cost function, Base point and Participation factors, Thermal system Dispatching with Network losses.

UNIT-II: UNIT COMMITMENT

Unit Commitment – Definition – Constraints in Unit Commitment–Unit Commitment solution methods – Priority–List Methods – Dynamic Programming Solution.

UNIT-III: HYDRO THERMAL SCHEDULING

Characteristics of Hydroelectric units, Introduction to Hydrothermal coordination, Long Range and Short-Range Hydro-Scheduling, Hydroelectric plant models, Hydrothermal scheduling with storage limitations, Dynamic programming solution to hydrothermal scheduling.

UNIT-IV: LOAD FREQUENCY CONTROL

Control of generation – models of power system elements – single area and two area block diagrams – generation control with PID controllers – implementation of Automatic Generation control (AGC) – AGC features.

UNIT-V: OPTIMAL POWER FLOW

Introduction to Optimal power flow problem, OPF calculations combining economic dispatch and power flow, OPF using DC power flow, Algorithms for solution of the ACOPF, Optimal Reactive Power Dispatch.

TEXT BOOKS:

1. Olle l. Elgerd, "Electric Energy Systems Theory an Introduction", TMH, 2nd Edition, 1983
2. J.J. Grainger &W.D.Stevenson, "Power system analysis ", McGraw Hill ,2003

REFERENCES BOOKS:

1. Allen J. Wood, Bruce F. Wollenberg, Gerald B. Sheblé-Power Generation, Operation and Control-Wiley-Interscience (2013)

Online Resources (SWAYAM/NPTEL/MOOCS/COURSERA):

1. NPTEL Course, Prof. S. N. Singh, Power System Operation and Control, https://nptel.ac.in/courses/108/104/108104052/
2. NPTEL Module on Power System Operation and Control, https://nptel.ac.in/courses/108/101/108101040/

I M.Tech-I SEM (EPS)

Course Title: **HVDC TRANSMISSION (PROFESSIONAL ELECTIVE-I)**	Course Code:**AS20-D07PE01**
Teaching Scheme (L:T:P): **3:0:0**	Credits: 3
Type of Course: Lecture +Tutorial	Total Contact Periods: 48Hrs + 16Hrs
Continuous Internal Evaluation-30 Marks	Semester End Exams-70 Marks
Prerequisites: POWER SYSTEMS-II & POWER ELECTRONICS	

Course Objectives:

- To prepare the students to understand the state-of-the-art of HVDC technology.
- To enable the students to model and analyse HVDC systems

CO#	Course Outcomes	POs	PSOS
C113.1	Understand the state-of-the-art of HVDC technology	**1,5**	**3**
C113.2	Model and analye the HVDC system for inter-area power flow regulation	**2,4**	**2**
C113.3	Analyze the converter and dc grid faults and adopt methods to mitigate them	**3,5**	**3**
C113.4	Analyse the HVDC converter reactive power requirements and address the issues.	**2,3**	**2**
C113.5	Understand the AC –DC load flow	**4**	**3**
C113.6	Analysing harmonics and their characteristics	**4**	**3**

COURSE CONTENT

UNIT-I: GENERAL ASPECTS OF DC TRANSMISSION

Evolution of HVDC transmission, Comparison of HVDC and HVAC systems, Types of DC links, Components of a HVDC system, Valve characteristics, Properties of converter circuits, assumptions, single phase and Three-phase Converters, Pulse number, choice of best circuit for HVDC converters.

UNIT-II: ANALYSIS OF BRIDGE CONVERTER

Analysis of simple rectifier circuits, Required features of rectification circuits forHVDC transmission. **Analysis of HVDC converter**: Different modes of converter operation, Output voltage waveforms and DC voltage in rectification, Output voltage waveforms and DC in inverter operation, Thyristor/Valve voltages. Equivalent electrical circuit.

UNIT-III: DC LINK CONTROL

Grid control, basic means of control, power reversal, limitations of manual control, Constant current versus Constant Voltage, Desired features of control.

Actual control characteristics: Constant-minimum-ignition-angle control, Constant-current control, Constant-

extinction-angle control. Stability of control, tap-changer control**,** Power control and current limits, frequency control.

UNIT-IV: CONVERTER FAULTS & PROTECTION

Converter mal-operations, Commutation failure, Starting and shutting down the converter bridge, Converter protection.

UNIT-V: REACTIVE POWER MANAGEMENT

Smoothing reactor and DC Lines, Reactive power requirements, Harmonic analysis, Filter design

TEXT BOOKS:

1. J. Arrillaga, "High Voltage Direct Transmission", Peter Peregrinus Ltd. London, 1983.
2. K. R. Padiyar, "HVDC Power Transmission Systems", New Age International Publishers, 3rd Edition, 2015.

REFERENCES:

1. High Voltage Direct Current Transmission, NPTEL Lectures by Prof. S. N. Singh, https://www.youtube.com/playlist?list=PL4B78E9972172086A
2. E. W. Kimbark, "Direct Current Transmission", Vol. I, Wiley Interscience, 1971.
3. Erich Uhlmann, "Power Transmission by Direct Current", B.S. Publications, 2004.
4. SN Singh, "*Electric Power Generation, Transmission and Distribution*, PHI, New Delhi 2nd edition, 2008.

5. V. Kamaraju, "HVDC Transmission" Tata McGraw-Hill Education Pvt Ltd,New Delhi,2011.

Online Resources (SWAYAM/NPTEL/MOOCS/COURSERA):

1. High Voltage DC Transmission by Prof.S.N.Singh,Department of Electrical Engineering,IIT Kanpur.
   Link :http://nptel.iitm.ac.in
2. Swayam Videos on Course " DC Power Transmission" by IIT Madras
   Link: https://onlinecourses.nptel.ac.in/noc20_ee09/preview

Web Reference/E-Books:

1) https://easyengineering.net/hvdc-power-transmission-systems-by-padiyar/
2)https://www.yumpu.com/en/document/read/63406888/ebook-pdf-hvdc-transmission-power-conversion-applications-in-power-systems-full-online

I M.Tech-I SEM (EPS)

Course Title: RENEWABLE ENERGY SYSTEMS (PROFESSIONAL ELECTIVE-I)	**Course Code: AS20-D07PE02**
Teaching Scheme (L:T:P): 3 0 0	**Credits:3**
Type of Course: Lecture + Assignment	**Total Contact Periods:**
Continuous Internal Evaluation-30 Marks	**Semester End Exams-70 Marks**
Prerequisites: Power Systems and Electrical Machines	
Programme: EPS	

Course Objectives: to prepare the students to

- learn various renewable energy sources
- gain understanding of integrated operation of renewable energy sources
- understand power electronics interface with the grid

Course Outcomes(s)

CO#	Course Outcomes	POs	PSOS
C113.1	Acquire knowledge on PV Systems	**1, 3**	**1,3**
C113.2	Understand different modes in wind power generation	**2,3**	**1,3**
C113.3	Understand the operating mechanism of Bio gas Plants	**1,3**	**1,3**
C113.4	Develop skill in designing Ocean Thermal Plants	**1,3,4**	**2,3**
C113.5	Acquire knowledge on Geo-Thermal power generation and fuel cells	**1,3**	**1,3**
C113.6	Analyze the power conditioning schemes for grid connected systems.	**2,4,12**	**1,2,3**

COURSE CONTENT

UNIT- I: SOLAR ENERGY SYSTEMS:

Introduction – solar radiation - solar thermal energy conversion - Flat plate collector – concentric collectors- solar pond - central receiver system- solar pumping – Solar photovoltaic systems - characteristics of PV cell- Photo voltaic modules - Types of Photo voltaic systems.

UNIT-II: WIND ENERGY AND BIO GAS:

Basics of wind energy - classification of turbines - wind characteristics - energy extraction - Betz limit -Modes of wind power generation- Bio Mass energy conversion - Anaerobic Digestion – Aerobic Digestion - Gasification-Bio Gas Plants.

UNIT-III: OCEAN ENERGY CONVERSION:

Tidal Energy generation - characteristics of Tides - Power generation schemes - Components in Tidal power plant- Wave Energy - Principle of wave energy plant - Wave energy conversion machines - Ocean Thermal Energy conversion - Principle - cycles of operation - Types of OTEC plants - Applications.

UNIT-IV: GEO-THERMAL ENERGY, FUEL CELLS AND HYBRID ENERGY SYSTEMS:

Geothermal Energy - Structure of Earth's interior - Geothermal fields, gradient, resources – Geothermal power

generation - Fuel cells – Introduction - Principle of operation - Types of fuel cells - State of art fuel cells- energy output of a fuel cell - operating characteristics of fuel cells - thermal efficiency - Need for Hybrid systems - Types of Hybrid systems.

UNIT-V: ENERGY SYSTEMS AND GRIDS

Introduction, Energy systems, Distribution technologies, Energy storage for grid electricity, Social and environmental aspects of energy supply and storage. Electricity grids(networks), DC grids, Special challenges and opportunities for renewable electricity, Power Electronic Interface with the Grid.

TEXT BOOKS:

1.D.P.Kothari, K.C.Singal, R.Ranjan, "Renewable Energy Resources and emerging technologies"- PHI 2/e 2011.
2. John Twidell and Tony Weir ,"Renewable Energy Resources" - 2nd edition, CRC Press.
3. Rakosh Das Begamudre, "Energy conversion systems"- New Age International Publishers, New Delhi - 2000.
4. "Renewable Energy Resources" by John Twidell and Tony Weir, 2nd Edition, Fspon & Co.

REFERENCES:

1. "Understanding Renewable Energy Systems", by Volker Quaschning, 2005, UK.
2. "Renewable Energy Systems-Advanced Conversion, Technologies & Applications" by Faner Lin Luo Honer Ye, CRC press, Taylor & Francis group.

ONLINE RESOURCES:

1. NPTEL Course on Non-Conventional Energy Sources, https://www.youtube.com/playlist?list=PL3QMEfkolRFbGhXveCE7RFDBgY0_gRxkh

I M.Tech-I SEM (EPS)

Course Title: SMART GRID TECHNOLOGIES **(PROFESSIONAL ELECTIVE-I)**	**Course Code:** AS20-D07PE03
Teaching Scheme (L:T:P): 3 0 0	**Credits:3**
Type of Course: Lecture + Assignment	**Total Contact Periods:**
Continuous Internal Evaluation-30 Marks	**Semester End Exams-70 Marks**
Prerequisites: Power systems	
Programme: EEE	

Course Overview:

The **Smart Grid** is an automated, widely distributed energy delivery network characterized by a two--way flow of electricity and informaHon, capable of monitoring and responding to changes in everything from power plants to customer preferences to individual appliances

Course Objectives: to prepare the students to

- understand concept of smart grid and its advantages over conventional grid
- Know smart metering techniques
- Learn wide area measurement techniques
- understand the problems associated with integration of distributed generation & its solution through smart grid.

Course Outcomes(s)

CO#	Course Outcomes	PO	PSO
C113.1	Distinguish between conventional grid and smart grid	1,2,4	3
C113.2	Understand the various measurement technologies in smart grid Apply smart metering concepts to industrial and commercial installations	1,2,5	3
C113.3	Formulate solutions in the areas of smart substations, distributed generation and wide area measurements	1,2,3	3
C113.4	Know about battery technology and energy storage	1,2,3	3
C113.5	Brief about role of Electric Vehicles in smart grid	1,4,5	3
C113.6	Develop smart grid solutions using modern communication technologies	1,4,5	3

COURSE CONTENT (SYLLABUS)

UNIT-I: INTRODUCTION TO SMART GRID

Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Concept of Robust & Self Healing Grid Present development & International policies in Smart Grid.

UNIT-II: SMART METERS

Introduction to Smart Meters, Real Time Pricing, Automatic Meter Reading (AMR), Advanced Metering Infrastructure (AMI), Outage Management System (OMS), Plug in Hybrid Electric Vehicles (PHEV), Vehicle to Grid, Smart Sensors, Smart Appliances, Home & Building Automation, Smart Substations, Substation Automation, Feeder Automation, Wide Area Measurement System (WAMS), Phasor Measurement Unit (PMU)

UNIT-III: INFORMATION AND STORAGE SYSTEMS

Geographic Information System (GIS), Intelligent Electronic Devices (IED) & their application for monitoring & protection, Smart storage like Battery, Pumped Hydro, Compressed Air Energy Storage,fuel-cells.

UNIT-IV: MICROGRID

Concept of microgrid, need & applications of microgrid, formation of micro-grid, Issues of interconnection, protection & control of microgrid, Plastic & Organic solar cells, Thin film solar cells, Variable speed wind generators, micro-turbines, Captive power plants, Integration of renewable energy sources

UNIT-V: POWER QUALITY

Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, power quality conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit and communication protocols in grid.

TEXT BOOKS:

1. Ali Keyhani, "Design of smart power grid renewable energy systems", Wiley IEEE, 2011
2. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response", CRC Press , 2009

REFERENCES:

1. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, "Smart Grid: Technology and Applications", Wiley 2012.
3. Stuart Borlase, "Smart Grid: Infrastructure, Technology and solutions " CRC Press.
4. A.G.Phadke, "Synchronized Phasor Measurement and their Applications", Springer
5. S. Chowdhury, S. P. Chowdhury, and P. Crossley, "Microgrids and active distribution networks", IET, 2009, http://uni-site.ir/khuelec/wp-content/uploads/Microgrids-and-ActiveDistribution-Networks.pdf
6. Prof. N. P. Padhy and Prof. Premalatha Jena, NPTEL course – Introduction to Smart Grid.

ONLINE RESOURCES (SWAYAM/NPTEL/MOOCS/COURSERA):

1 https://www.youtube.com/playlist?list=PLLy_2iUCG87D59-Bc8Jqfqt43LvPC0KgC
2. . https://onlinecourses.nptel.ac.in/noc18_ee42/preview /

I M.Tech-I SEM (EPS)

Course Title: MODERN CONTROL THEORY (PROFESSIONAL ELECTIVE-I)	**Course Code: AS20-D07PE04**
Teaching Scheme (L:T:P): 3 0 0	**Credits:3**
Type of Course: Lecture + Assignment	**Total Contact Periods:**
Continuous Internal Evaluation-30 Marks	**Semester End Exams-70 Marks**
Prerequisites: Control Systems	
Programme: EEE	

Course Overview:

A prominent characteristic of modern control theory is the adoption of a state space model, which uses a set of first-order differential equations in the description of system input–output dynamics. The states of a plant might be either its actual physical variables or some of their linear combinations.

Course Objectives:

- To explain the concepts of basics and modern control system for the real time analysis and design of control systems.
- To explain the concepts of state variables analysis.
- To study and analyze non linear systems.
- To analyze the concept of stability for nonlinear systems and their categorization.
- To apply the comprehensive knowledge of optimal theory for Control Systems.

Course Outcomes(s)

CO#	Course Outcomes	PO	PSO
C113.1	Perform state variables analysis for any real time system.	1,2,4	1
C113.2	Apply the concept of optimal control to any system.	2,4	1
C113.3	Examine a system for its stability, controllability and observability	1,2,3	1
C113.4	Implement basic principles and techniques in designing linear control systems	2,3	1
C113.5	Formulate and solve deterministic optimal control problems in terms of performance indices.	1,3,4	1
C113.6	Apply knowledge of control theory for practical implementations in engineering and network analysis.	2,3,5	1

COURSE CONTENT (SYLLABUS)

UNIT I: MATHEMATICAL PRELIMINARIES AND STATE VARIABLE ANALYSIS: Fields, Vectors and Vector Spaces – Linear combinations and Bases – Linear Transformations and Matrices – Scalar Product and Norms – Eigen values, Eigen Vectors and a Canonical form representation of Linear systems – The concept of state – State space model of Dynamic systems –Time invariance and Linearity – Non uniqueness of state model – State diagrams for Continuous-Time State models - Existence and Uniqueness of Solutions to Continuous-Time State Equations – Solutions of Linear Time Invariant Continuous-Time State Equations – State transition matrix and it's properties. Complete solution of state space model due to zero input and due to zero state.

UNIT II: CONTROLLABILITY AND OBSERVABILITY:

General concept of controllability – Controllability tests, different state transformations such as diagonalization, Jordon canonical forms and Controllability canonical forms for Continuous-TimeInvariant Systems – General concept of Observability – Observability tests for Continuous-Time Invariant Systems – Observability of different State transformation forms.

State Feedback Controllers and Observers:

State feedback controller design through Pole Assignment, using Ackkermans formula– State observers: Full order and Reduced order observers.

UNIT III: NON-LINEAR SYSTEMS:

Introduction – Non Linear Systems - Types of Non-Linearities – Saturation – Dead-Zone - Backlash –Jump Phenomenon etc; Linearization of nonlinear systems, Singular Points and its types– Describingfunction– describing function of different types of nonlinear elements, – Stability analysis of Non-Linear systems through describing functions. Introduction to phase-plane analysis, Method of Isoclines for Constructing Trajectories, Stability analysis of nonlinear systems based on phase-plane method.

UNIT IV: STABILITY ANALYSIS:

Stability in the sense of Lyapunov, Lyapunov's stability and Lypanov's instability theorems - StabilityAnalysis of the Linear continuous time invariant systems by Lyapunov second method – Generation of Lyapunov functions – Variable gradient method – Krasooviski's method.

UNIT V: CALCULUS OF VARIATIONS: ---- optimal control

TEXT BOOKS

1. M.Gopal, Modern Control System Theory, New Age International - 1984
2. Ogata. K, Modern Control Engineering, Prentice Hall - 1997

REFERENCES:

1.N K Sinha, Control Systems, New Age International – 3rd edition.
2.Donald E.Kirk, Optimal Control Theory an Introduction, Prentice - Hall Network series – First edition.

ONLINE RESOURCES (SWAYAM/NPTEL/MOOCS/COURSERA):

1 http://nptel.ac.in/courses/108103007/

I M.Tech-I SEM (EPS)

Course Title: ELECTRICAL POWER DISTRIBUTION SYSTEM (PROFESSIONAL ELECTIVE-II)	**Course Code: AS20-D07PE05**
Teaching Scheme (L:T:P): 3 0 0	**Credits:3**
Type of Course: Lecture + Assignment	**Total Contact Periods:**
Continuous Internal Evaluation-30 Marks	**Semester End Exams-70 Marks**
Prerequisites: Power Systems	
Programme: EPS	

Course Objectives: to prepare the students to

- Learn about load forecasting
- Understand power distribution system reconfiguration and restoration
- Learn control and communication systems
- Understand distribution automation

Course Outcomes:

CO#	Course Outcomes	POs	PSOS
C114.1	understand power distribution system	**1,3**	**1**
C114.2	Explore distribution automation and its application in practice	**1,2,3**	**1,3**
C114.3	Understand SCADA and applying it to distribution system	**1,3**	**1,3**
C114.4	Analyze optimality techniques for distribution systems	**3,12**	**2,3**
C114.5	Understand distribution energy management	**1,3**	**1,3**
C114.6	Analyze AI techniques for distribution system	**2,3,12**	**2,3**

UNIT-I: LOAD FORECASTING

Distribution of Power, Management, Power Loads, Load Forecasting Short-term & Long-term, Power System Loading, Technological Forecasting.

UNIT-II: DISTRIBUTION AUTOMATION

Advantages of Distribution Management System (DMS) Distribution Automation: Definition, Restoration / Reconfiguration of Distribution Network, Different Methods and Constraints, Power Factor Correction.

UNIT-III: CONTROL AND COMMUNICATION

Interconnection of Distribution, Control & Communication Systems, Remote Metering, Automatic Meter Reading and its implementation. SCADA: Introduction, Block Diagram, SCADA Applied To Distribution Automation. Common Functions of SCADA, Advantages of Distribution Automation through SCADA.

UNIT-IV: OPTIMALITY PRINCIPLES

Calculation of Optimum Number of Switches, Capacitors, Optimum Switching Device Placement in Radial, Distribution Systems, Sectionalizing Switches – Types, Benefits, Bellman's Optimality Principle, Remote Terminal Units, Energy efficiency in electrical distribution & Monitoring

UNIT-V: ENERGY MANAGEMENT

Maintenance of Automated Distribution Systems, Difficulties in Implementing Distribution. Automation in

Actual Practice, Urban/Rural Distribution, Energy Management, AI techniques applied to Distribution Automation.

TEXT BOOKS:

1. A.S. Pabla, "Electric Power Distribution", Tata McGraw Hill Publishing Co. Ltd., Fourth Edition.
2. M.K. Khedkar, G.M. Dhole, "A Text Book of Electrical power Distribution Automation", University Science Press, New Delhi.

REFERENCES:

1. Turan Gonen, "Electric Power Distribution Engineering", 3rd Edition CRC Press,
2. Anthony J Panseni, "Electrical Distribution Engineering", CRC Press
3. James Momoh, "Electric Power Distribution, automation, protection & control", CRC Press.

ONLINE RESOURCES:

1. NPTEL course, Electricial Distribution System Analysis, https://www.youtube.com/playlist?list=PLLy_2iUCG87DxrqJr3dBhSruMiRHK0rNr

I M.Tech-I SEM(EPS)

Course Title: REACTIVE POWER COMPENSATION AND MANAGEMENT (PROFESSIONAL ELECTIVE-II)	**Course Code: AS20-D07PE06**
Teaching Scheme (L:T:P): 3 0 0	**Credits:3**
Type of Course: Lecture + Assignment	**Total Contact Periods:**
Continuous Internal Evaluation-30 Marks	**Semester End Exams-70 Marks**
Prerequisites: Power Systems	
Programme: EPS	

Course Objectives:

- To identify the necessity of reactive power compensation
- To describe load compensation
- To select various types of reactive power compensation in transmission systems
- To illustrate reactive power coordination system
- To characterize distribution side and utility side reactive power management.

Course Outcomes:

CO#	Course Outcomes	POs	PSOS
C114.1	Understand objectives specifications of load compensation.	**1,3**	**1,3**
C114.2	Analyze steady state reactive power compensation in transmission system	**2,3**	**2,3**
C114.3	Understand reactive power coordination circuit analysis of balanced and unbalanced networks.	**1,3**	**1,3**
C114.4	Understand demand side management.	**1,3**	**1,3**
C114.5	Understand user side reactive power management.	**1,3**	**1,3**
C114.6	Understand electric arc furnaces, basic operations- furnaces transformer, filter requirements.	**1,5**	**1**

COURSE CONTENT

UNIT- I: LOAD COMPENSATION

Objectives and specifications – reactive power characteristics – inductive and capacitive approximate biasing – Load compensator as a voltage regulator – phase balancing and power factor correction of unsymmetrical loads- examples.

UNIT- II: STEADY–STATE AND TRANSIENT REACTIVE POWER COMPENSATION IN TRANSMISSION SYSTEM

Uncompensated line – types of compensation – Passive shunt and series and dynamic shunt compensation – examples. Characteristic time periods – passive shunt compensation – static compensations - series capacitor compensation – compensation using synchronous condensers – examples

UNIT- III: REACTIVE POWER COORDINATION

Objective – Mathematical modeling – Operation planning – transmission benefits – Basic concepts of quality of power supply – disturbances- steady –state variations – effects of under voltages – frequency –Harmonics, radio frequency and electromagnetic interferences.

UNIT- IV DISTRIBUTION SIDE REACTIVE POWER MANAGEMENT:

Load patterns, basic methods load shaping, power tariffs- KVAR based tariffs penalties for voltage flickers and Harmonic voltage levels System losses, loss reduction methods, economics planning, capacitor placement, retrofitting of capacitor banks.

UNIT- V: USER SIDE REACTIVE POWER MANAGEMENT

KVAR requirements for domestic appliances – Purpose of using capacitors – selection of capacitors – deciding factors – types of available capacitor, characteristics and Limitations

Reactive power management in electric traction systems and arc furnaces:

Typical layout of traction systems – reactive power control requirements – distribution transformers Electric arc furnaces – basic operations- furnaces transformer –filter requirements – remedial measures –power factor of an arc furnace.

TEXT BOOKS:

1. Reactive power control in Electric power systems by T.J.E.Miller, John Wiley and sons, 1982.
2. Reactive power Management by D.M.Tagare, Tata McGraw Hill, 2004.

REFERENCES:

1. Wolfgang Hofmann, Jurgen Schlabbach, Wolfgang Just "Reactive Power Compensation: A Practical Guide, April, 2012, Wiley publication.

I M.Tech-I SEM (EPS)

Course Title: MATHEMATICAL METHODS FOR POWER ENGINEERING (PROFESSIONAL ELECTIVE-II)	**Course Code AS20-D07PE07**
Teaching Scheme (L:T:P): 3 0 0	**Credits:3**
Type of Course: Lecture + Assignment	**Total Contact Periods: 3**
Continuous Internal Evaluation-30 Marks	**Semester End Exams-70 Marks**
Prerequisites: Electrical power systems	
Programme: EEE	

Course Overview:

The course covers the mathematical methods appropriate to both linear-systems theory and signal processing. The text deals with a number of topics usually found in introductory linear-systems courses, such as complex numbers and Laplace transforms, and addresses additional topics such as complex variable theory and Fourier series and transforms. Although the discussion is mathematically self-contained, it assumes that the reader has a firm background in calculus .

Course Objective

To prepare the students to

- understand the relevance of mathematical methods to solve engineering problems.
- understand how to apply these methods for a given engineering problem.

Course Outcomes(s)

CO#	Course Outcomes	POs	PSOS
C114.1	understand vector spaces, linear transformation, Eigen values and eigenvectors of linear operators	**4,5**	**1,3**
C114.2	learn about linear programming problems and understand the simplex method for solving linear programming problems in various fields of science and technology	**1,5**	**1**
C114.3	acquire knowledge about nonlinear programming and various techniques used for solving constrained and unconstrained nonlinear programming problems	**1,2,5**	**2,3**
C114.4	understand the concept of random variables, functions of random variable and their probability distribution	**2,5**	**1**
C114.5	understand stochastic processes and their classification	**1,2,12**	**1,3**
C114.6	Understand problem solutions with Lagrange method, Kuhn-Tucker conditions, Random Variables	**1,2,5,12**	**3**

COURSE CONTENT (SYLLABUS)

UNIT – I

Vector spaces, Linear transformations, Matrix representation of linear transformation, Eigen values and Eigen vectors of linear operator..

UNIT–II

Linear Programming Problems, Simplex Method, Duality, Non Linear Programming problems

UNIT–III

Unconstrained Problems, Search methods, Constrained Problems

UNIT – IV

Lagrange method, Kuhn-Tucker conditions, Random Variables, Marginal and Conditional distributions, Elements of stochastic processes

UNIT – V

Mathematical methods applied to Power Engineering, examples – economic load dispatch, optimal power flow, unit commitment.

TEXT BOOKS:

1. Kenneth Hoffman and Ray Kunze, "Linear Algebra", 2nd Edition, PHI, 1992
2. Erwin Kreyszig, "Introductory Functional Analysis with Applications", John Wiley & Sons, 2004

REFERENCES:

1. Irwin Miller and Marylees Miller, John E. Freund's "Mathematical Statistics", 6th Edn, PHI, 2002
2. J. Medhi, "Stochastic Processes", New Age International, New Delhi., 1994
3. A Papoulis, "Probability, Random Variables and Stochastic Processes", 3rd Edition, McGraw Hill, 2002
4. John B Thomas, "An Introduction to Applied Probability and Random Processes", John Wiley, 2000
5. Hillier F S and Liebermann G J, "Introduction to Operations Research", 7th Edition, McGraw Hill, 2001
6. Simmons D M, "Non Linear Programming for Operations Research", PHI, 1975
7. MIT online course, Prof. Gilbert Strang, Linear Algebra, https://www.youtube.com/playlist?list=PL49CF3715CB9EF31D
8. Matpower, Free open-source tools for electric power system simulation and optimization, https://matpower.org/

Online Resources (SWAYAM/NPTEL/MOOCS/COURSERA):

1. https://www.youtube.com/watch?v=D4RFFnzRdkk&list=PLSRCPd4kA2-S2Cu1tYUe5WGmc959y50Xf
2. https://swayam.gov.in/nd1_noc19_ee69/

I M.Tech-I SEM (EPS)

Course Title: **HYBRID ELECTRIC VEHICLES (PROFESSIONAL ELECTIVE-II)**	Course Code:AS20-D07PE08
Teaching Scheme (L:T:P): 3:0:0	Credits: 3
Type of Course: Lecture +Tutorial	Total Contact Periods: 48Hrs + 16Hrs
Continuous Internal Evaluation-30 Marks	Semester End Exams-70 Marks
Prerequisites: Nil	

Course Objective

- understand upcoming technology of hybrid system
- understand different aspects of drives application
- learn the electric Traction

Course Outcomes(s)

CO#	Course Outcomes	PO	PSO
C114.1	Acquire fundamental concepts of hybrid electric vehicles (HEV)	1,5	1
C114.2	Understand principles of hybrid electric vehicles (HEV)	12	1
C114.3	Understand the concepts of hybrid traction and fuel efficiency analysis	3,5	
C114.4	Design and analyze HEVs	3	3
C114.5	Apply electric drives in vehicles / traction	5	3
C114.6	Understand energy management in HEVs	12	

COURSE CONTENT (SYLLABUS)

UNIT-I: INTRODUCTION TO HYBRID ELECTRIC VEHICLES (HEV)

History of hybrid and electric vehicles, Social and environmental importance of hybrid and electric vehicles, Impact of modern drive-trains on energy supplies, Basics of vehicle performance, vehicle power source characterization Transmission characteristics, Mathematical models to describe vehicle performance.

UNIT-II: HYBRID TRACTION

Basic concept of hybrid traction, Introduction to various hybrid drive-train topologies, Power flow control in hybrid drive-train topologies, Fuel efficiency analysis.

UNIT-III: CONTROL OF MOTORS FOR HEV

Introduction to electric components used in hybrid and electric Vehicles, Configuration and control of DC Motor drives, Configuration and control of Introduction Motor drives configuration and control of Permanent Magnet Motor drives Configuration and control of Switch Reluctance, Motor drives, drive system efficiency.

UNIT-IV: DESIGN OF HEV

Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics Selecting the energy storage technology, Communications, supporting subsystems

UNIT-V: ENERGY MANAGEMENT IN HEV

Introduction to energy management and their strategies used in hybrid and electric vehicle, Classification of different energy management strategies Comparison of different energy management strategies Implementation issues of energy strategies

TEXT BOOKS:

1.Sira -Ramirez, R. Silva Ortigoza, "Control Design Techniques in Power Electronics Devices",Springer.

2. Siew-Chong Tan, Yuk-Ming Lai, Chi Kong Tse, "Sliding mode control of switching Power Converters"

REFERENCES:

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design fundamentals, CRC Press, 2003.

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

3. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.

Online Resources (SWAYAM/NPTEL/MOOCS/COURSERA):

1. NPTEL Videos on Course "*Electric Vehicles,* "
   Link: https://www.youtube.com/playlist?list=PLlYm0-AHZdZRLYSylFinxkspWmcgNvbtl

I M.Tech-I SEM (EPS)

Course Title: RESEARCH METHODOLOGY AND IPR(HSMC)	**Course Code AS20-D07HS01**
Teaching Scheme (L:T:P): 3 0 0	**Credits:3**
Type of Course: Lecture + Assignment	**Total Contact Periods: 3**
Continuous Internal Evaluation-30 Marks	**Semester End Exams-70 Marks**
Prerequisites: Electrical power systems	
Programme: EPS	

Course Overview:

Private rights in living objects have always been controversial. Agriculture provided the first wave in human civilization. Therefore, agriculture including plant breeding and agricultural methods pre-dated any form of IPR protection unlike industry and commerce. Traditionally, IPR was not applied to agriculture. In recent times, this position has changed and increasingly agriculture is seen as an industry that cannot survive without research and development and astute investments. This has made it necessary that IPR in all its forms be extended to agriculture..

Course Objective : to prepare the students to

- To understand the research problem
- To know the literature studies, plagiarism and ethics
- To get the knowledge about technical writing
- To analyze the nature of intellectual property rights and new developments
- To know the patent rights

Course Outcomes(s)

CO#	Course Outcomes	POs	PSOS
C115.1	Understand research problem formulation	**4,5**	**1,3**
C115.2	Analyze research related information	**1,5**	**1**
C115.3	Follow research ethics Understand that today's world is controlled by Computer, Information Technology, but tomorrow	**1,2,5,8**	**3**
C115.4	Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasise the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.	**2,5**	**3**
C115.5	Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.	**1,2,12**	**1,3**
C115.6	To emphasise the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.	**1,2,5,12**	**3**

COURSE CONTENT (SYLLABUS)

UNIT- I:

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

UNIT- II:

Effective literature studies approaches, analysis, Plagiarism, Research ethics.

UNIT- III:

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

UNIT- IV:

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development.

International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT- V:

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent nformation and databases. Geographical Indications.

New Developments in IPR: Administration of Patent System.

New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

TEXT BOOKS:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction".

REFERENCES:

1. Ranjit Kumar, 2nd Edition , "Research Methodology: A Step by Step Guide for beginners"
2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
3. Mayall , "Industrial Design", McGraw Hill, 1992.
4. Niebel , "Product Design", McGraw Hill, 1974.
5. Asimov , "Introduction to Design", Prentice Hall, 1962.
6. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
7. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008.

ONLINE RESOURCES (SWAYAM/NPTEL/MOOCS/COURSERA):

1. https://www.youtube.com/watch?v=D4RFFnzRdkk&list=PLSRCPd4kA2-S2Cu1tYUe5WGmc959y50Xf
2. https://swayam.gov.in/nd1_noc19_ee69/

I M.Tech-I SEM (EPS)

Course Title: **POWER SYSTEMS COMPUTATION LAB-I**	Course Code:AS20-D07PC03
Teaching Scheme (L:T:P): (0:0:4)	Credits: 2
Type of Course: Lecture +Tutorial	Total Contact Periods: 48Hrs + 16Hrs
Continuous Internal Evaluation-25 Marks	Semester End Exams-75 Marks
Prerequisites: Nil	

Course Objective

- Construction of Y-bus, z-bus for a n-bus system.
- Analyze various Load flow studies .
- Steady state, transient stability analysis.
- Economic load dispatch problem.
- Unit commitment problem.
- State estimation of power system.

Course Outcomes(s)

CO#	Course Outcomes	PO	PSO
C117.1	Construct Y-bus and Z-bus	1	2
C117.2	Compare the different load flow methods	2	2
C117.3	Analyze the different stability analysis of variety of power systems	3,5	3
C117.4	Understand Economic load dispatch problems.	12	1,3
C117.5	Understand Unit commitment problems	12	
C117.6	Understand State estimation of power system.	1	3

(SYLLABUS)

List of Experiments

1. Develop Program for Y-BUS formation by direct inspection method.
2. Develop Program for Y-BUS formation by Singular Transformation method.
3. Develop Program for G-S Load Flow Algorithm.
4. Develop Program for N-R Load Flow Algorithm in Polar Coordinates.
5. Develop Program for FDLF Algorithm.
6. Develop Program for DC load Flow Algorithm.
7. Develop Program for Z-BUS Building Algorithm.
8. Develop Program for Short Circuit Analysis using Z-BUS Algorithm.
9. Develop Program for Transient Stability Analysis for Single Machine connected to Infinite Bus
10. Develop Program for Economic Load dispatch Problem using Lambda Iterative Method.
11. Develop Program for Unit Commitment Problem using Forward Dynamic Programming Method.
12. Develop Program for State Estimation of Power System.

I M.Tech. I SEM (EPS)

Course Title: Advanced Power System Analysis Lab	**Course Code: AS20-D07PC04**
Teaching Scheme (L:T:P): 0:0:4	**Credits:2**
Type of Course: Lecture + Assignment	**Total Contact Periods:**
Continuous Internal Evaluation-30 Marks	**Semester End Exams-70 Marks**
Prerequisites: Power Systems and FACTS	
Programme: EPS	

Course Overview:
Course Objectives

- Determine transmission line parameters
- Determine transmission line regulation and efficiency
- Determine various fault calculations
- Perform load and line compensation

Course Outcomes(s)

CO#	Course Outcomes	POs	PSOS
C118.1	Calculation of transmission line parameters	**3,4,5**	**1,2**
C118.2	Calculation of transmission line regulation and efficiency	**1,3,5**	**1**
C118.3	Calculation of various fault parameters	**2,3,4,5**	**2,3**
C118.4	Comparison of system parameters with and without compensation	**1,2,4,5**	**2,3**
C118.5	Analysis of Transmission lines under Surge Impedance Loading.	**2,5,12**	**2,3**
C118.6	Determination of Sequence impedance of Transmission Line and SIL analysis	**1,2,5, 12**	**2,3**

COURSE CONTENT (SYLLABUS)
LIST OF EXPERIMENTS

1. Determination of Line Parameters R, L and C.
2. Determination of T/L efficiency and Regulation for a given load.
3. Analysis of Ferranti effect on Transmission Lines under light loadings.
4. Determination of ABDC parameters of a given Transmission Line Network.
5. Fault Analysis :
   Single Line to Ground fault (L-G).
   Line to Line fault (L-L).
   Double Line to Ground fault (L-L-G).
   Triple Line to Ground fault (L-L-L-G).
6. Analysis of Uncompensated lines and their voltage profiles.
7. Shunt compensation of Transmission lines (Capacitor/Reactors)
8. Load Compensation analysis
9. Line Compensation using FACTS devices.
10. Analysis of Transmission lines under Surge Impedance Loading.
11. Determination of Sequence impedance of Transmission Line and SIL analysis.

ONLINE RESOURCES (SWAYAM/NPTEL/MOOCS/COURSERA):

1. https://www.unioviedo.es/pcasielles/uploads/proyectantes/cosas_lineas.pdf
2. https://nptel.ac.in/content/storage2/courses/108105053/pdf/L-25(TB)(ET)%20((EE)NPTEL).pdf

3. www.researchgate.net/publication/324026468_Performance_Analysis_on_Transmission_Line_for_Improvement_of_Load_Flow
4. https://nptel.ac.in/content/storage2/courses/108104051/chapter_2/2_8.html

I M.Tech-II SEM (EPS)

Course Title: DIGITAL PROTECTION OF POWER SYSTEM	**Course Code: AS20-D07PC05**
Teaching Scheme (L:T:P): 3:0:0	**Credits:3**
Type of Course: Lecture + Assignment	**Total Contact Periods:**
Continuous Internal Evaluation-30 Marks	**Semester End Exams-70 Marks**
Prerequisites: Power System Protection	
Programme: EPS	

Course Overview:

Can understand the differences, advantages and disadvantages of electromechanical and static relays, need for the digital protection of power system, analyze advanced techniques of protection; describe protection schemes, explain digital protection of transformers and transmission lines.

Course Objectives

- Study numerical relays.
- Develop mathematical approach towards protection.
- Study algorithms for numerical protection.

Course Outcomes(s)

CO#	Course Outcomes	POs	PSOS
C121.1	Describe the need of digital protection - Remember	**1,3**	**1,2**
C121.2	Explain the significance of digital relay-- Understand	**1,4,12**	**1**
C121.3	Analyze Elements of digital relay-Analyze	**3,4,5**	**2,3**
C121.4	Compute different relaying algorithms- Apply	**1,2,4,5**	**2,3**
C121.5	Develop various protection schemes-Create	**1,2,12**	**2,3**
C121.6	Explain the digital protection of transformers and transmission lines	**1,2,5,12**	**2,3**

COURSE CONTENT (SYLLABUS)

UNIT-I: MATHEMATICAL BACKGROUND TO DIGITAL PROTECTION

Overview of static relays, Transmission line protection, Transformer protection, Need for Digital protection. Performance and operational characteristics of Digital protection, Basic structure of Digital relays, Finite difference techniques, Interpolation formulas, Numerical differentiation, Curve fitting and smoothing, Fourier analysis, Walsh function analysis, Relationship between Fourier and Walsh coefficients.

UNIT-II: BASIC ELEMENTS OF DIGITAL PROTECTION

Basic components of a digital relay, Signal conditioning subsystems, Conversion subsystem, Digital relay subsystem, the digital relay as a unit.

UNIT-III: DIGITAL RELAYING ALGORITHMS-I

Sinusoidal-Wave-Based algorithms: Sample and first-derivative methods, First and second-derivative methods, Two-sample technique, Three-sample technique, an early relaying scheme. **Fourier analysis based algorithms**: Full cycle window algorithm, Fractional-cycle window algorithms, Fourier-transform based algorithm. Walsh-function-based algorithms.

UNIT-IV: DIGITAL RELAYING ALGORITHMS-II

Least squares based methods: Integral LSQ fit, Power series LSQ fit, Multi-variable series LSQ technique, Determination of measured impedance estimates.

Differential equation based techniques: Representation of transmission lines with capacitance neglected, Differential equation protection with selected limits, Simultaneous differential equation techniques. **Travelling-wave based protection**: Fundamentals of Travelling-wave based protection, Bergeron's equation based protection scheme, Ultra-high-speed polarity comparison scheme, Ultra-high-speed wave differential scheme, Discrimination function based scheme, Superimposed component trajectory based scheme.

UNIT-V: DIGITAL PROTECTION OF TRANSFORMERS AND TRANSMISSION LINES

Principles of transformer protection, Digital protection of Transformer using: FIR filter based algorithm, Least squares curve fitting based algorithms, Fourier-based algorithm, Flux-restrained current differential relay. Digital Line differential protection: Current-based differential schemes, Composite voltage- and current based scheme.

TEXT BOOKS:

1. A.G. Phadke and J. S. Thorp, "Computer Relaying for Power Systems", Wiley/Research studies Press, 2009.
2. A.T. Johns and S. K. Salman, "Digital Protection of Power Systems", IEEE Press,1999.

REFERENCES:

1. Gerhard Zeigler, "Numerical Distance Protection", Siemens Publicis Corporate Publishing, 2006.
2. S.R.Bhide "Digital Power System Protection" PHI Learning Pvt.Ltd.2014.

ONLINE RESOURCES (SWAYAM/NPTEL/MOOCS/COURSERA):

1. https://nptel.ac.in/courses/108/101/108101039/
2. http://rkgitw.ac.in/nptel/108101039/Power%20System%20Protection/TOC_M6.html

I M.Tech-II SEM (EPS)

Course Title: POWER SYSTEM DYNAMICS	**Course Code: AS20-D07PC06**
Teaching Scheme (L:T:P:C): 3:0:0:3	**Credits:3**
Type of Course: Lecture + Assignment	**Total Contact Periods:**
Continuous Internal Evaluation-30 Marks	**Semester End Exams-70 Marks**
Prerequisites: Power Systems and Electrical Machines	
Programme: EPS	

Course Overview:
Understand the power system stability of Single machine and multi machine connected to infinite bus, Analyze the modelling of synchronous machine and compute the digital simulation of synchronous machine, State space representation of simplified model, explain various excitation configurations and Prime mover control.

Course Objectives

- Develop mathematical models for synchronous machine, Exciter, Governor and Prime mover.
- Study power system dynamic phenomena and the effects of exciter and governor control.
- Understand methods to improve dynamic stability.

Course Outcomes(s)

CO#	Course Outcomes	POs	PSOS
C122.1	Identify the stability analysis of single machine and multi machine system	**2,3,4**	**1,2**
C122.2	Analyze simplified models of the Synchronous Machine	**1,3,12**	**1**
C122.3	Compute the digital simulation of Synchronous machines	**3,4,5**	**2,3**
C122.4	Develop Linear model and state-space representation of simplified model	**1,2,4**	**2,3**
C122.5	Describe various excitation configurations and prime mover control	**2,12**	**2,3**
C122.6	Apply the concept of stability of dynamic systems	**1,2,5,12**	**2,3**

COURSE CONTENT (SYLLABUS)

UNIT-I: POWER SYSTEM STABILITY: A CLASSICAL APPROACH

Introduction, Requirements of a Reliable Electrical Power Service, Swing Equation, Power-Angle Curve, Stability analysis of SMIB system, Equal area criteria, Classical Model of a Multi-machine System, Shortcomings of the Classical Model, Block Diagram of One Machine infinite bus system, System Response to Small Disturbances: Types of Problems Studied, The Unregulated Synchronous Machine, Modes of Oscillation of an Unregulated Multi-machine System, Regulated Synchronous Machine.

UNIT-II: SYNCHRONOUS MACHINE MODELING-I

Introduction, Park's Transformation, Flux Linkage Equations, Voltage Equations, Formulation of State Space Equations, Current Formulation, Per Unit Conversion, Normalizing the Voltage and Torque Equations, Equivalent Circuit of a Synchronous Machine, The Flux Linkage State-Space Model, Load Equations, Sub-transient and Transient Inductances and Time Constants, Simplified Models of the Synchronous Machine, Turbine Generator Dynamic Models.

UNIT-III: SYNCHRONOUS MACHINE MODELING-II

Steady state equations and phasor diagrams, Determining steady state conditions, Evaluation of Initial conditions, Determination of machine parameters, Digital simulation of Synchronous machines, Linearization

and Simplified Linear model and state-space representation of simplified model.

UNIT-IV: EXCITATION AND PRIME MOVER CONTROL

Simplified view of excitation control, control configurations, typical excitation configurations, excitation control system definitions, voltage regulator, exciter build up, excitation system response, state-space description of the excitation system, computer representation of excitation systems, Typical system constants, and the effects of excitation on generator power limits, transient stability and dynamic stability of the power system, Prime mover control: Hydraulic turbines and governing systems, Steam turbines and governing systems.

UNIT-V: SMALL SIGNAL STABILITY ANALYSIS

Fundamental concepts of stability of dynamic systems, Eigen properties of the state matrix, Small-signal stability of a single-machine infinite bus system, Effects of excitation system, Power system stabilizer, System state matrix with amortisseurs, Characteristics of small-signalstabilityproblems.

TEXT BOOKS:

1. P. M. Anderson & A. A. Fouad "Power System Control and Stability", Galgotia , New Delhi,1981.
2. J Machowski, J Bialek & J. R W. Bumby, "Power System Dynamics and Stability", John Wiley&Sons, 1997.

REFERENCES:

1. P.Kundur, "Power System Stability and Control", McGraw Hill Inc., 1994.
2. E.W. Kimbark, "Power system stability", Vol. I & III, John Wiley & Sons, New York 2002
3. L. Leonard Grigsby (Ed.); "Power System Stability and Control", 2nd edition, CRC Press, 2007
4. NPTEL online course, Prof. A. M. Kulkarni, Power System Dynamics and Control, https://www.youtube.com/playlist?list=PLuv3GM6-gsE2WXbxLSnqKHf5gcnedXCZH

ONLINE RESOURCES (SWAYAM/NPTEL/MOOCS/COURSERA):

1. https://nptel.ac.in/courses/108/101/108101004/
2. https://www.classcentral.com/course/swayam-power-system-dynamics-control-and-monitoring-12955

I M.Tech-II SEM (EPS)

Course Title: RESTRUCTURED POWER SYSTEMS (PROFESSIONAL ELECTIVE-II)	**Course Code: AS20-D07PE09**
Teaching Scheme (L:T:P:C): 3:0:0:3	**Credits:3**
Type of Course: Lecture + Assignment	**Total Contact Periods:**
Continuous Internal Evaluation-30 Marks	**Semester End Exams-70 Marks**
Prerequisites: Power Systems	
Programme: EPS	

Course Objectives: to prepare students to

- Understand restructuring of the electricity market
- Understand deregulation of the electricity market
- Understand the money, power & information flow in a deregulated power system

Course Outcomes(s)

CO#	Course Outcomes	POs	PSOs
C123.1	Know about various types of regulations in power systems.	**1,3**	**2,3**
C123.2	Identify the need of regulation and deregulation.	**2,4,5**	**2,3**
C123.3	Understand technical and Non-technical issues in deregulated Power Industry	**1,2**	**2,3**
C123.4	Identify existing electricity markets.	**1,3,4**	**2,3**
C123.5	Classify different market mechanisms and summarize the role of various entities in the market	**2,3,4**	**2,3**
C123.6	To Apply optimal bidding and risk assessment	**2,4**	**2,3**

COURSE CONTENT (SYLLABUS)

UNIT-I: INTRODUCTION

Fundamentals of restructured system, Market architecture, Load elasticity, Social welfare maximization

UNIT-II: OPTIMAL POWER FLOW (OPF)

Optimal power flow (OPF): Role in vertically integrated systems and in restructured markets, congestion management

UNIT-III: MARKER PROCESS

Optimal bidding, Risk assessment, Hedging, Transmission pricing, Tracing of power

UNIT-IV: MARKET SYSTEM

Ancillary services, Standard market design, Distributed generation in restructured markets, renewable energy markets

UNIT-V: DEVELOPMENT OF RESTRUCTURED POWER SYSTEMS

Developments in India, IT applications in restructured markets, Working of restructured power systems, Pennsylvania-New Jersey-Maryland Interconnection (PJM) market, Recent trends in Restructuring.

TEXT BOOKS:

1. LorrinPhilipson, H. Lee Willis, "Understanding electric utilities and de-regulation", Marcel Dekker Pub.,1998.
2. Steven Stoft, "Power system economics: designing markets for electricity", John Wiley and Sons, 2002.

REFERENCES:

1. Kankar Bhattacharya, Jaap E. Daadler, Math H.J. Boolen, "Operation of restructured power systems", Kluwer Academic Pub., 2001.
2. Mohammad Shahidehpour, MuwaffaqAlomoush, "Restructured electrical power systems: operation, trading and volatility", Marcel Dekker.

M. TECH. I Year II Sem. (EPS)

Course Title: **EHV AC TRANSMISSION (PROFESSIONAL ELECTIVE-II)**	Course Code:**AS20-D07PE10**
Teaching Scheme (L:T:P): (3:0:0)	Credits: 3
Type of Course: Lecture +Tutorial	Total Contact Periods: 48Hrs + 16Hrs
Continuous Internal Evaluation-30 Marks	Semester End Exams-70 Marks
Prerequisites: Power systems	

Course objectives: to prepare the students to

- identify the different aspects of Extra High Voltage AC Transmission design and analysis
- understand the importance of modern developments of EHV and UHV transmission systems.
- demonstrate EHV AC transmission system components, protection and insulation level for over voltages.

CO#	Course Outcomes	POs	PSOS
C123.1	Understand the importance of EHV AC transmission	**1,**	**1**
C123.2	Estimate choice of voltage for transmission, line losses and power handling capability of EHV Transmission	**2,3**	**2**
C123.3	Apply statistical procedures for line designs, scientific and engineering principles in power systems.	**4,5**	**2**
C123.4	Understanding corona loss, attention of traveling waves due to Corona, Audio noise due to Corona, Measurements of audio noise radio interference due to Corona	**3**	**1**
C123.5	Understand shunt and series compensation	**1**	**1**
C123.6	Design of EHV lines based on steady state and transient limits	**6**	**2**

UNIT- I: EXTRA HIGH VOLTAGE (EHV) AC TRANSMISSION LINE TRENDS

EHV AC Transmission line trends and preliminary aspect standard transmission voltages – Estimation at line and ground parameters-Bundle conductor systems-Inductance and Capacitance of EHV lines – positive, negative and zero sequence impedance – Line Parameters for Modes of Propagation.

UNIT- II: ELECTROSTATIC FIELD AND VOLTAGE GRADIENTS

Calculations of electrostatic field of AC lines – effect of high electrostatic field on biological organisms and human beings - surface voltage gradients and maximum gradients of actual transmission lines – voltage gradients on sub conductor.

UNIT- III: ELECTROSTATIC INDUCTION IN UNENERGIZED LINES

Measurement of field and voltage gradients for three phase single and double circuit lines – unenergized lines. Power Frequency Voltage control and overvoltages in EHV lines: No load voltage – charging currents at power frequency-voltage control – shunt and series compensation – static VAR compensation.

UNIT - IV: CORONA IN EHV LINES

Corona in EHV lines – Corona loss formulae- attention of traveling waves due to Corona – Audio noise due to Corona, its generation, characteristic and limits. Measurements of audio noise radio interference due to Corona - properties of radio noise – frequency spectrum of RI fields – Measurements of RI and RIV.

UNIT-V DESIGN OF EHV LINES:

Design of EHV lines based on steady state and transient limits - EHV cables and their characteristics.

TEXT BOOKS:

1. R. D. Begamudre, "EHVAC Transmission Engineering", New Age International (p) Ltd. 3rd Edition.
2. K. R. Padiyar, "HVDC Power Transmission Systems" New Age International (p) Ltd. 2nd Revised Edition, 2012.

REFERENCES:

1. S. Rao "EHVAC and HVDC Transmission Engineering. Practice" Khanna publishers.
2. Arrillaga. J "High Voltage Direct Current Transmission" 2nd Edition (London) Peter Peregrines, IEE, 1998.
3. Padiyar. K. R, "FACTS Controllers in Power Transmission and Distribution" New Age International Publishers, 2007.
4. Hingorani H G and Gyugyi. L "Understanding FACTS-Concepts and Technology of flexible AC Transmission Systems" New York, IEEE Press, 2000.
5. Advances in UHV Transmission and Distribution, online course.

ONLINE RESOURCES (SWAYAM/NPTEL/MOOCS/COURSERA):

1. https://www.youtube.com/channel/UCWKPXSjLRz-TAFgFWCfMmGg/videos
2. Link: https://onlinecourses.nptel.ac.in/noc20_ee67/preview

WEB REFERENCE/E-BOOKS:

1)http://reitakofra.gq/44eec0eb58b1671d5a3652c670a5b092KhV4V6EBcaZkml/SY/iUc2Ai-hLM3EeD0qx7y9cndcLIgw0Xj3mNwOFz?zF5=agXrfObBsp2_2JhTe

2)https://books.google.co.in/books?id=e24FNdV2AroC&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false

I M.Tech-II SEM (EPS)

Course Title: SWARM INTELLIGENCE TECHNIQUES IN POWER SYSTEMS (PROFESSIONAL ELECTIVE-III)	**Course Code:** AS20-D07PE11
Teaching Scheme (L:T:P): 3 0 0	**Credits:3**
Type of Course: Lecture + Assignment	**Total Contact Periods:**
Continuous Internal Evaluation-30 Marks	**Semester End Exams-70 Marks**
Prerequisites: Artificial Intelligence techniques in power systems	
Programme: EEE	

Course Overview: Analysis of *Swarm Intelligence*–Based Algorithms for Constrained ... These *techniques* are ant colony optimizer, particle *swarm* optimizer, *artificial* ... It is demonstrated that PSO gets better *results* in a faster, cheaper way than other *methods*

.

Course Objectives: to prepare students to:

- Understand evolutionary algorithms like GA,PSO, ANT COLONY and BEE COLONY etc.
- Apply evolutionary algorithms to solve power systems problems
- Understand solution of Multi-Objective optimization using these algorithms

Course Outcomes(s)

CO#	Course Outcomes	PO	PSO
C123.1	Discriminate the capabilities of bio-inspired system and conventional methods in solving optimization problems.	2,4,5	2,3
C123.2	Examine the importance of exploration and exploitation of swarm intelligent system to attain near global optimal solution	2,3,5	3
C123.3	Distinguish the functioning of various swarm intelligent systems	3,4,5	3
C123.4	Employ various bio-inspired algorithms for power systems engineering applications	3,5	3
C123.5	Able to know the difference between genetic algorithm and particle swarm optimization	1,2,3	3
C123.6	Able to apply BAT OPTIMIZATION ALGORITHM	3,4,5	3

COURSE CONTENT (SYLLABUS)

UNIT-I: FUNDAMENTALS OF SOFT COMPUTING TECHNIQUES

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

Genetic algorithms-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 problems.

UNIT-III: ANT COLONY OPTIMIZATION and ARTIFICIAL BEE COLONY ALGORITHMS

Biological ant colony system-Artificial ants and assumptions –Stigmergic communications-pheromone updating-local-global-pheromone evaporation-ant colony system-ACO models-Touring ant colony system-max min ant system-concept of elastic ants-Task partitioning in honey bees-Balancing foragers and receivers-Artificial bee colony (ABC) algorithms-binary ABC algorithms-ACO and ABC algorithms for solving Economic Dispatch of thermal units.

UNIT-IV: SHUFFLED FROG-LEAPING ALGORITHM and BAT OPTIMIZATION ALGORITHM

Bat algorithm-Echolocation of bats-Behaviour of micro bats-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

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 to power systems.

TEXT BOOKS:

1. Xin-She Yang, 'Recent Advances in Swarm Intelligence and Evolutionary Computation' Springer International Publishing, Switzerland, 2015.
2. Kalyanmoy Deb 'Multi-Objective Optimization using Evolutionary Algorithms', John Wiley & Sons, 2001.

REFERENCES:

1. James Kennedy and Russel E Eberheart, 'Swarm Intelligence', The Morgan Kaufmann Series in Evolutionary Computation, 2001.
2. Eric Bonabeau, Marco Dorigo and Guy Theraulaz, 'Swarm Intelligence-From natural to Artificial Systems', Oxford university Press, 1999.
3. David Goldberg, 'Genetic Algorithms in Search, Optimization and Machine Learning', Pearson Education, 2007.
4. Konstantinos E. Parsopoulos and Michael N. Vrahatis, ' Particle Swarm Optimization and Intelligence: Advances and Applications', Information Science reference, IGI Global, 2010.
5. N P Padhy, 'Artificial Intelligence and Intelligent Systems', Oxford University Press, 2005.

REFERENCE PAPERS:

1. "Shuffled frog-leaping algorithm: a memetic meta-heuristic for discrete optimization" by Muzaffar eusuff, Kevin lansey and Fayzul pasha, Engineering Optimization, Taylor & Francis, Vol. 38, No. 2, pp.129-154, March 2006.
2. "A New Metaheuristic Bat-Inspired Algorithm" by Xin-She Yang, Nature Inspired Cooperative Strategies for Optimization (NISCO 2010) (Eds. J.R. Gonzalez et al.), Studies in Computational Intelligence, Springer Berlin, 284, Springer, 65-74 (2010).
3. "Firefly Algorithms for Multimodal Optimization" Xin-She Yang, O. Watanabe and T. Zeugmann (Eds.), Springer-Verlag Berlin Heidelberg, pp. 169-178, 2009.

ONLINE RESOURCES (SWAYAM/NPTEL/MOOCS/COURSERA):

1 https://www.youtube.com/playlist?list=PL36A60B630E8C7B56
2.https://www.youtube.com/playlist?list=PL-uxPiMl0_6GWFPGXgVapb1yjVAZs9YGz

I M.Tech-II SEM (EPS)

Course Title: ENERGY STORAGE SYSTEMS (PROFESSIONAL ELECTIVE-III)	**Course Code: AS20-D07PE12**
Teaching Scheme (L:T:P:C): 3:0:0:3	**Credits:3**
Type of Course: Lecture + Assignment	**Total Contact Periods:**
Continuous Internal Evaluation-30 Marks	**Semester End Exams-70 Marks**
Prerequisites: None	
Programme: EPS	

Course Overview:
Analyze various non-electrical storage systems and their comparison, understands the general battery concepts, classification of various types of batteries, Performance characteristics and applications of Energy storage systems, Explain battery management, different charging methods and their testing safety, storage, Architecture and Efficiency improvement of Energy storage systems

Course Objectives

- To understand non electrical storage technologies available
- To Understand Electro chemical secondary batteries characteristics
- To Understand efficiency improvement techniques in storage systems
- To Appreciate various applications of storage systems

Course Outcomes(s)

CO#	Course Outcomes	POs	PSOS
C123.1	Compare various non-electrical storage systems	**1,2,3,4**	**1,2**
C123.2	Identify various types of batteries	**1,3**	**1**
C123.3	Analyze the performance characteristics Energy storage systems	**2,3,4,5**	**2,3**
C123.4	Explain discharge characteristics	**1,2,4,5**	**2,3**
C123.5	Estimate the efficiency of Energy storage systems	**2,12**	**2,3**
C123.6	Design of hybrid Energy storage systems	**1,2, 12**	**2,3**

COURSE ASSESSMENT:
COURSE CONTENT (SYLLABUS)
UNIT-I: NON-ELECTRICAL STORAGE SYSTEMS
Flywheel, Energy Relations, Flywheel System Components, Benefits of Flywheel over Battery, Superconducting Magnet Energy Storage, Compressed Air Energy storage, Overview Thermal Energy Storage. Capacitor bank storage, Comparison of storage Technologies.

UNIT-II: ELECTRO CHEMICAL STORAGE
History, General battery concepts- Types of Batteries- Primary, seconday- Battery Vs Cell, Nickel-Cadmium - Nickel-Metal Hydride, Nickel hydrogen, Lithium-Ion- Lithium-Polymer, Fuel cells.

UNIT –III:
Specifications and Characteristics: Domains of applications of Energy storage- Starter-Traction-stationary-mobile or nomadic, Review of storage requirements, Definitions of characteristics, Terminology of States, Battery Design, Battery Charging, Charge Regulators, Battery Management, General Equivalent Electrical Circuit, Performance Characteristics.

UNIT-IV: SEALED-LEAD CELLS AND BATTERIES

Discharge Characteristics, Charging-Importance-characteristics-charge acceptance-over charging, Types of charging- Constant voltage charging- Constant current charging- Taper charging-special charging- Charging power sources, storage, Testing, safety.

UNIT –V: ELECTRICAL ENERGY STORAGE SYSTEM EFFICIENCY IMPROVEMENT

Hybrid Electrical Energy storage– Design Considerations- Architecture- Charge management- components Modeling of Power Conversion, Reconfigurable EES Array Architecture, Cycle Efficiency and Capacity Utilization of EES Bank , General Bank Reconfiguration Architecture, Dynamic Reconfiguration Algorithm, Cycle Efficiency and Capacity Utilization Improvement.

TEXT BOOKS:

1. Energy Storage for Power Systems, A. Ter-Gazarian, Peter Peregrinus Ltd., 1994
2. Design and Management of Energy-Efficient Hybrid Electrical Energy Storage Systems, Younghyun Kim, Naehyuck Chang, Springer, 2014
3. Rechargeable Batteries Applications Handbook, EDN Series for Design Engineers, Elsevier

REFERENCES:

1. Lithium Batteries and Other Electrochemical Storage Systems, Christian Glaize, Sylvie Geniès
2. Wind and Solar Power Systems, Second Edition, Mukund R. Patel, CRC Press, 2006

ONLINE RESOURCES (SWAYAM/NPTEL/MOOCS/COURSERA):

1. https://www.youtube.com/watch?v=EakRe6ICM-Q
2. https://www.youtube.com/watch?v=l46GUVBisUo
3. https://www.youtube.com/watch?v=no4vRKvKxcU
4. https://nptel.ac.in/content/storage2/courses/108103009/download/M9.pdf

I M.Tech-II SEM (EPS)

Course Title: AI TECHNIQUES IN POWER SYSTEMS (PROFESSIONAL ELECTIVE-IV)	**Course Code:** AS20-D07PE13
Teaching Scheme (L:T:P): 3 0 0	**Credits:3**
Type of Course: Lecture + Assignment	**Total Contact Periods:48**
Continuous Internal Evaluation-30 Marks	**Semester End Exams-70 Marks**
Prerequisites: NIL	

Course Overview:

To understand various fuzzy logic,Artificial Neural Networks **,**genetic algorithm (GA) & Evolutionary programming (EP),for solving practical problems for various applications

Course Objective

- To study and understand about Supervisory Control and Data Acquisition System(SCADA)
- To know SCADA communication and its functions
- To get an insight into its application

Course Outcomes(s)

CO#	Course Outcomes	POs	PSOS
C124.1	To Learn the concepts of biological foundations of artificial neural networks	**1,2**	**1**
C124.2	To Learn Feedback networks and radial basis function networks and fuzzy logics.	**1,5**	**1,**
C124.3	To learn defuzzification Methods and its various applications	**2,4**	**1,2**
C124.4	To Identifications of fuzzy and neural network	**2,4,6**	**2,**
C124.5	To Acquire the knowledge of GA	**3,2**	**1,2**
C124.6	Applications of various techniques for practical problems on power Engineering	**1,2,5**	**2**

COURSE CONTENT (SYLLABUS)

UNIT-I: INTRODUCTION TO NEURAL NETWORKS

Biological foundations to intelligent Systems, Artificial Neural Networks, Single layer and MultilayerFeed Forward NN, LMS and Back Propagation Algorithm, Feedback networks and Radial Basis Function Networks

UNIT-II: FUZZY SYSTEMS

Fuzzy Logic, Knowledge Representation and Inference Mechanism, Defuzzification Methods. Fuzzy Neural Networks and their learning methods

UNIT-III: NEURO FUZZY SYSTEMS

System Identification using Fuzzy and Neural Network.

UNIT-IV: GENETIC ALGORITHM

Genetic algorithm, Reproduction cross over, mutation, Introduction to evolutionary program.

UNIT-V: APPLICATIONS OF AI TECHNIQUES TO POWER ENGINEERING

Applications of above mentioned techniques to practical problems on power engineering

TEXT BOOKS:

1. J M Zurada , "An Introduction to ANN", Jaico Publishing House
2. Simon Haykins, "Neural Networks", Prentice Hall

REFERENCES:

1. Timothy Ross, "Fuzzy Logic with Engg.Applications", McGraw. Hill
2. Driankov, Dimitra, "An Introduction to Fuzzy Control", Narosa Publication
3. Golding, "Genetic Algorithms", Addison-Wesley Publishing Co.

ONLINE RESOURCES (SWAYAM/NPTEL/MOOCS/COURSERA):

1.NPTEL Course on "Introduction to Soft Computing" by Prof. Debasis Samanta,
https://www.youtube.com/playlist?list=PLJ5C_6qdAvBFqAYS0P9INAogIMklG8E-9
2. NPTEL Course on Neural Networks and Applications,
https://www.youtube.com/playlist?list=PL53BE265CE4A6C056

Web Reference/E-Books:

1.Artificial neural netwoks by Kevin.L.peter https://www.spiedigitallibrary.org/ebooks/TT/Artificial-Neural-Networks-An-Introduction/eISBN-9780819478726/10.1117/3.633187?SSO=1

I M.Tech-II SEM (EPS)

Course Title: **POWER QUALITY (PROFESSIONAL ELECTIVE-IV)**	Course Code:AS20-D07PE14
Teaching Scheme (L:T:P): (3:0:0)	Credits: 3
Type of Course: Lecture +Tutorial	Total Contact Periods: 48Hrs + 16Hrs
Continuous Internal Evaluation-30 Marks	Semester End Exams-70 Marks
Prerequisites: Nil	

Course Objective

- Know different terms of power quality.
- Illustrate power quality issues for short and long interruptions.
- Construct study of characterization of voltage sag magnitude and three phase unbalanced voltage sag.
- know the behavior of power electronics loads, induction motors, synchronous motor etc. by the power quality issues
- Know mitigation of power quality problems by using VSI converters.

Course Outcomes(s)

CO#	Course Outcomes	PO	PSO
C124.1	Know about the different terms of power quality.	12	1
C124.2	Understand the severity of power quality problems in power system	5,12	1,3
C124.3	Describe power quality issues for short and long interruptions.	5,12	1
C124.4	Understand the concept of voltage sag transformation	3	1
C124.5	Know the considerations of power quality in industrial power systems	6	2
C124.6	Compute the power quality improvement by using various mitigating power devices.	5,12	1

COURSE CONTENT (SYLLABUS)

UNIT- I: INTRODUCTION

Introduction of the Power Quality (PQ) problem: Terms used in PQ - Voltage, Sag, Swell, Surges, Harmonics, over voltages, spikes, Voltage fluctuations, Transients, Interruption, overview of power quality phenomenon, Remedies to improve power quality, power quality monitoring.

UNIT- II: LONG & SHORT INTERRUPTIONS

Interruptions – Definition – Difference between failures, outage, Interruptions – causes of Long Interruptions – Origin of Interruptions – Limits for the Interruption frequency – Limits for the interruption duration – costs of Interruption – Overview of Reliability evaluation to power quality, comparison of observations and reliability evaluation.

Short interruptions: definition, origin of short interruptions, basic principle, fuse saving, voltage magnitude events due to re-closing, voltage during the interruption, monitoring of short interruptions, difference between

medium and low voltage systems. Multiple events, single phase tripping –voltage and current during fault period, voltage and current at post fault period, stochastic prediction of short interruptions.

UNIT - III: SINGLE-PHASE & THREE-PHASE VOLTAGE SAG CHARACTERIZATION

Voltage sag – definition, causes of voltage sag, voltage sag magnitude, and monitoring,
Theoretical calculation of voltage sag magnitude, voltage sag calculation in non-radial systems, meshed systems, and voltage sag duration.
Three phase faults, phase angle jumps, magnitude and phase angle jumps for three phase unbalanced sags, load influence on voltage sags.

UNIT-IV: POWER QUALITY CONSIDERATIONS IN INDUSTRIAL POWER SYSTEMS

Voltage sag – equipment behavior of Power electronic loads, induction motors, synchronous motors,computers, consumer electronics, adjustable speed AC drives and its operation. Mitigation of AC Drives, adjustable speed DC drives and its operation, mitigation methods of DC drives.

UNIT-V: MITIGATION OF INTERRUPTIONS & VOLTAGE SAGS

Overview of mitigation methods – from fault to trip, reducing the number of faults, reducing the fault clearing time changing the power system, installing mitigation equipment, improving equipment immunity, different events and mitigation methods. System equipment interface – voltage sourceconverter, series voltage controller, shunt controller, combined shunt and series controller.
Power Quality and EMC Standards: Introduction to standardization, IEC Electromagnetic compatibility standards, European voltage characteristics standards, PQ surveys.

TEXT BOOKS:

1.Math H J Bollen "Understanding Power Quality Problems", IEEE Press.
2.R.C. Dugan, M.F. McGranaghan and H.W. Beaty, "Electric Power Systems Quality." New York: McGraw-Hill.1996

REFERENCES:

1.G.T. Heydt, 'Electric Power Quality', 2nd Edition. (West Lafayette, IN, Stars in a Circle Publications, 1994).
2.Power Quality VAR Compensation in Power Systems, R. Sastry Vedam Mulukutla S.Sarma,CRC Press.
3.A Ghosh, G. Ledwich, Power Quality Enhancement Using Custom Power Devices. Kluwer Academic, 2002.

ONLINE RESOURCES (SWAYAM/NPTEL/MOOCS/COURSERA):

3. NPTEL Videos on Course "*power quality improvement* " Co-ordinated by IIT Roorkee
   Link: https://nptel.ac.in/courses/108/107/108107157/
4. Swayam Videos on Course " *power quality*" Co-ordinated by IIT Roorkee
   Link: https://www.classcentral.com/course/swayam-power-quality-improvement-technique-17736

WEB REFERENCE/E-BOOKS:

1) power quality By Roger C.Dugan
   http://www.gcebargur.ac.in/sites/gcebargur.ac.in/files/lectures_desk/electrical_power_systems_quality.pdf
2) power quality By Dr Ranjan Kumar Jena
   https://www.cet.edu.in/noticefiles/227_Electrical_Power_Quality-PEEL5403-8th_Sem-Electrical.pdf

I M.Tech-II SEM(EPS)

Course Title: **INDUSTRIAL LOAD MODELLING AND CONTROL** **(PROFESSIONAL ELECTIVE-IV)**	**Course Code AS20-D07PE15**
Teaching Scheme (L:T:P): 3 0 0	**Credits:3**
Type of Course: Lecture + Assignment	**Total Contact Periods: 3**
Continuous Internal Evaluation-30 Marks	**Semester End Exams-70 Marks**
Prerequisites: Electrical power systems	
Programme: EEE	

Course Overview:

Increasingly, there is a focus on utilising renewable energy resources in a bid to fulfil increasing energy requirements and mitigate the climate change impacts of fossil fuels. While most renewable resources are free, the technology used to usefully convert such resources is not and there is an increasing focus on improving the conversion economy and efficiency. To this end, advanced control technology can have a significant impact and is already a relatively mature technology for wind turbines. Though wave energy systems are still in their infancy, significant benefits have been shown to accrue from the appropriate use of control technology. To date, the application communities connected with wind and wave energy have had little communication, resulting in little cross fertilisation of control ideas and experience, particularly from the more mature wind area to wave.

Course Objective : to prepare the students to

- understand the energy demand scenario
- model the industrial loads and study load demand
- Study reactive power management in Industries
- To know the literature studies, plagiarism and ethics
- To get the knowledge about technical writing
- To analyze the nature of intellectual property rights and new developments
- To know the patent rights

Course Outcomes(s)

CO#	**Course Outcomes**	**POs**	**PSOS**
C124.1	Students will be able to gain knowledge about load control techniques in industries and its application	**4,5**	**1,3**
C124.2	understand different types of industrial processes and optimize the process	**1,5**	**1**
C124.3	apply load management to reduce demand of electricity during peak time	**1,2,5**	**1**
C124.4	apply different energy saving opportunities in industries.	**2,5**	**2**
C124.5	Intelligent nonlinear fes modelling for hemeplegic quadricpes muscle.	**1,2,12**	**1,3**
C124.6	Intelligent nonlinear fes modelling for hemeplegic quadricpes muscle.	**1,2,5,12**	**3**

COURSE ASSESSMENT:

COURSE CONTENT (SYLLABUS)

UNIT-I: INTRODUCTION TO INDUSTRIAL LOAD MODELING

Electric Energy Scenario-Demand Side Management-Industrial Load Management. Load Curves-Load Sharing Objectives-Methodologies. Barriers; Classification of Industrial Loads- Continuous and Batch processes -Load Modelling.

UNIT-II: LOAD CONTROL METHODS

Direct load control- Interruptible load control. Bottom up approach- scheduling- Formulation of load models-Optimization and control algorithms - Case studies. Reactive power management in industries controls-power quality impacts, application of filters, Energy saving in industries.

UNIT-III: COOLING AND HEATING

load profiling- Modelling. Cool storage-Types- Control strategies. Optimal operation-Problem formulation-Case studies.

UNIT-IV: CAPTIVE POWER MANAGEMENT

Captive power units- Operating and control strategies- Power Pooling- Operation models. Energy banking-Industrial Cogeneration.

UNIT-V: OPTIMAL OPERATING STRATEGIES

Selection of Schemes Optimal Operating Strategies. Peak load saving-Constraints-Problem formulation Case study. Integrated Load management for Industries.

TEXT BOOKS:

1. C.O. Bjork "Industrial Load Management - Theory, Practice and Simulations", Elsevier, the Netherlands,1989.
2. C.W. Gellings and S.N. Talukdar, "Load management concepts," IEEE Press, New York, 1986, pp. 3-28.

REFERENCES:

1. Y. Manichaikul and F.C. Schweppe ," Physically based Industrial load", IEEE Trans. on PAS, April 1981.
2. H. G. Stoll, "Least cost Electricity Utility Planning", Wiley Interscience Publication, USA, 1989.
3. I.J.Nagarath and D.P.Kothari, .Modern Power System Engineering., Tata McGraw Hill publishers, New Delhi, 1995.
4. IEEE Bronze Book- "Recommended Practice for Energy Conservation and cost effective planningin Industrial facilities", IEEE Inc, USA.

Online Resources (SWAYAM/NPTEL/MOOCS/COURSERA):

1. https://www.youtube.com/watch?v=D4RFFnzRdkk&list=PLSRCPd4kA2-S2Cu1tYUe5WGmc959y50Xf
2. https://swayam.gov.in/nd1_noc19_ee69/

I M.Tech-II SEM (EPS)

Course Title: **POWER SYSTEM RELIABILITY AND PLANNING (PROFESSIONAL ELECTIVE-IV)**	Course Code:AS20-D07PE12
Teaching Scheme (L:T:P): (3:0:0)	Credits: 3
Type of Course: Lecture +Tutorial	Total Contact Periods: 48Hrs + 16Hrs
Continuous Internal Evaluation-30 Marks	Semester End Exams-70 Marks
Prerequisites: Reliability Engineering	

Course Objectives: to prepare the students to:

- describe the generation system model and recursive relation for capacitive model building
- explain the equivalent transitional rates, cumulative probability and cumulative frequency
- develop the understanding of risk, system and load point reliability indices
- explain the basic and performance reliability indices

CO#	Course Outcomes	POs	PSOS
C124.1	Understand the importance of maintaining reliability of power system components.	**1,4**	**3**
C124.2	Apply the probabilistic methods for evaluating the reliability of generation and transmission systems	**2,3,4**	**3**
C124.3	Assess the different models of system components in reliability studies	**5**	**3**
C124.4	Assess the reliability of single area and multi area systems.	**4,5**	**1**
C124.5	Differentiate economic assessment of individual generation projects – Investigation and simulation	**2,3**	**3**
C124.6	Auditing reliability calculations for single area and multi–area power systems	**1,4,5**	**3**

UNIT-I: BASIC RELIABILITY CONCEPTS:

The general reliability function, exponential distribution – Mean time to failures – series and parallel systems. Markov process – continuous Markov process – Recursive techniques – Simple series and parallel system models.

UNIT-II: GENERATING CAPACITY – BASIC PROBABILITY METHODS:

The generation system model – Loss of load indices – Capacity expansion analysis – scheduled outages. Load forecast uncertainty Loss of energy indices. The frequency and duration method.

UNIT-III: TRANSMISSION SYSTEMS RELIABILITY EVALUATION:

Radial configuration – Conditional probability approach – Network configurations – State selection.

UNIT-IV: GENERATION PLANNING:

Comparative economic assessment of individual generation projects – Investigation and simulation models – Heuristic and linear programming models – Probabilistic generator and load models.

UNIT-V: TRANSMISSION AND DISTRIBUTION PLANNING:

Deterministic contingency analysis – Probabilistic transmission system – reliability analysis. Reliability calculations for single area and multi–area power systems. Network configuration design–consisting of schemes – security criteria configuration synthesis.

TEXT BOOKS:

1. Roy Billinton and Ronald Allan Pitam: Reliability Evaluation of Power Systems,1996.
2. R.L. Sullivan: Power System Planning, McGraw Hill International, 1977.

REFERENCES:

1. Wheel Wright and Makridakis: Forecasting methods and Applications, John Wiley, 1992.
2. J. Endremyl: Reliability Modelling in Electric Power Systems, John Wiley, 2005.
3. International Renewable Energy Agency , Bonn Lecture Series: Planning for the Transformationof Power Systems

.

Online Resources (SWAYAM/NPTEL/MOOCS/COURSERA):

1. https://www.youtube.com/watch?v=sbZ2sY_E4QU
2. https://www.youtube.com/watch?v=dpgN8fl3IvY&list=PLm_MSClsnwm8Cfe2XX4pT7OZeWdtlp-TR
3. https://www.youtube.com/watch?v=tb3gCr9m0LU&list=PLtcRcIUOKppXWUMEVXGwwULXgzEBygOK-

Web Reference/E-Books:

1)https://books.google.co.in/books/about/Power_System_Planning_and_Reliability.html?id=EsQpHQAACAAJ&redir_esc=y

2) https://www.nrel.gov/docs/fy08osti/42297.pdf

I M.Tech-II SEM (EPS)

Course Title: POWER SYSTEMS COMPUTATION LAB – II	**Course Code: AS20-D07PC07**
Teaching Scheme (L:T:P): 0 0 4	**Credits:2**
Type of Course: Practical	**Total Contact Periods:**
Continuous Internal Evaluation-30 Marks	**Semester End Exams-70 Marks**
Prerequisites: Power Systems computation lab – 1	
Programme: EEE	

Course Objective

- Known Neural network tool box.
- Know the various Evolutionary Algorithms.
- Apply various Evolutionary Algorithms to power system problems.

Course Outcomes(s)

CO#	Course Outcomes	POs	PSOS
C126.1	Understood Neural network.	**4,5**	**1,3**
C126.2	Understood fuzzy logic tool box.	**1,5**	**1**
C126.3	Understood various Evolutionary Algorithms	**1,2,5**	**1**
C126.4	Solved power system problems by applying various Evolutionary Algorithms	**2,5**	**2**
C126.5	Understood various Artificial intelligence techniques.	**1,5**	**1,3**
C126.6	Understood swarm technologies	**3,5**	**3**

COURSE ASSESSMENT:

COURSE CONTENT (SYLLABUS)

LIST OF EXPERIMENTS (Any ten of the following experiments)

1. Load Flow analysis using Neural Network
2. State Estimations using Neural Network
3. Contingency Analysis using Neural Network
4. Power system Security using Neural Network
5. Fuzzy Logic based AGC – Single area system – Two area system
6. Fuzzy Logic based small signal stability analysis
7. Economic Dispatch of Thermal Units using ANN
8. Economic Dispatch of Thermal Units using GA
9. Unit commitment problem by using GA
10. Unit commitment problem by using PSO
11. Optimal location and sizing of capacitor in distribution system using PSO
12. Security constrained optimal power dispatch using GA
13. Optimal Reactive power dispatch using PSO

I M.Tech-II SEM (EPS)

Course Title: POWER SYSTEM PROTECTION LAB	Course Code:AS20-D07PC08
Teaching Scheme (L:T:P): (0:0:4)	Credits: 2
Type of Course: Lecture +Tutorial	Total Contact Periods: 48Hrs + 16Hrs
Continuous Internal Evaluation-25 Marks	Semester End Exams-75 Marks
Prerequisites: Nil	

Course Objective

- Different types of Faults occurring in power systems
- Characteristics of different types of relays
- Protection schemes

Course Outcomes(s)

CO	Course Outcomes	PO	PSO
C127.1	Understand about Different types of Faults occurring in power systems	1	1,3
C127.2	Calculation of different parameters for various faults	1,5,12	1
C127.3	Analyze the various time-current characteristics of protective relays	5	1
C127.4	Analyze the protection characteristics of distance relay	5	1
C127.5	Understand about differential protection on single phase transformer	5,12	1
C127.6	understand the Performance and Testing of various electrical models and systems	5	1

(SYLLABUS)

List of Experiments

1.Characteristics of Electromechanical Non-Directional over current relay
2. Characteristics of Electromechanical Directional Over Current Relay
3. Characteristics of Electromechanical differential protection relay
4. Characteristics of Numerical Distance relay
5. Characteristics of Integrated Numerical under Voltage Relay
6. Characteristics of Numerical over current Relay
7. Zones protection characteristics of distance Relay
8. Differential protection on Single Phase Transformer
9. Performance and Testing of Feeder Protection System
10. Performance and Testing of Generator Protection System.

II M.Tech-I SEM (EPS)

Course Title:POWER SYSTEM TRANSIENTS (PROFESSIONAL ELECTIVE - V)	**Course Code:AS20-D07PE17**
Teaching Scheme (L:T:P):3 0 0	**Credits:3**
Type of Course: Lecture + Assignment	**Total Contact Periods:**
Continuous Internal Evaluation-30 Marks	**Semester End Exams-70 Marks**
Prerequisites:Power Systems	
Programme: EEE	

Course Overview:

Studythe fundamental circuit analysis of electrical transients, Laplace Transform method of solving simpleSwitching transients,damping circuits -Abnormal switching transients and various methods of digital computation and understand the Interaction between lightning and power system and study of Travelling waves on transmission line and Protection of system against over voltages**,** lightning arresters, substation earthling

Course Objectives: To prepare the students to

- Learn the reasons for occurrence of transients in a power system.
- Understand the change in parameters like voltage & frequency during transients.
- Know about the lightning phenomenon and its effect on power system.

Course Outcomes(s)

CO#	Course Outcomes	POs	PSOS
C211.1	Compute power system transients of fundamental circuits and three phase circuits	**1,2,3,4**	**1,2**
C211.2	Understand the principle of digital computation and various methods of computation	**1,2,3**	
C211.3	Elaborate the influence of tower footing resistance and EarthResistance on power system trips	**1,6,7**	**2,3**
C211.4	Discuss about over voltages induced by faults	**1**	**2,3**
C211.5	Study the behaviour of Travelling waves at the line Terminations, Lattice Diagrams, Attenuation and Distortion factors	**1,2,3,5**	**2**
C211.6	Understand insulation co-ordination in Air Insulated substation and Gas Insulated Substation	**1,6,12**	**2**

COURSE CONTENT (SYLLABUS)

UNIT-I: SOURCES OF TRANSIENTS

Fundamental circuit analysis of electrical transients, Laplace Transform method of solving simple Switching transients, Damping circuits -Abnormal switching transients, Three-phase circuits and transients, Computation of power system transients.

UNIT-II: COMPUTATION OF TRANSIENTS

Principle of digital computation – Matrix method of solution, Modal analysis- Z transform- Computation using EMTP, Lightning, switching and temporary over voltages, Lightning, Physical phenomena of lightning.

UNIT-III: LIGHTNING AND SWITCHING TRANSIENTS

Interaction between lightning and power system, Influence of tower footing resistance and Earth Resistance, **Switching:** Short line or kilometric fault, Energizing transients - closing and re-closing of lines, line dropping, load rejection – over voltages induced by faults.

UNIT-IV: TRAVELLING WAVES

Switching HVDC line, Travelling waves on transmission line, Circuits with distributed Parameters, Wave Equation, Reflection, Refraction, Behaviour of Travelling waves at the line Terminations, Lattice Diagrams, Attenuation and Distortion factors, Multi-conductor system and Velocity wave.

UNIT-V: INSULATION CO-ORDINATION

Principle of insulation co-ordination in Air Insulated substation (AIS) and Gas Insulated Substation (GIS) Coordination between insulation and protection level, Statistical approach. Protective devices**,** Protection of system against over voltages**,** lightning arresters, substation earthing.

TEXT BOOKS:

1. Allan Greenwood, "Electrical Transients in Power System", Wiley & Sons Inc. New York, 1991
2. Harold A Peterson: Transient in Power Systems, McGraw Hill, 1966.

REFERENCES:

1. Kuffel and Abdullah: High Voltage Engineering, PHI, 2000.
2. Rakesh D. Begamudre: EHV AC Transmission Engineering, PHI, 2006.

ONLINE RESOURCES (SWAYAM/NPTEL/MOOCS/COURSERA):

1. http://www.nitc.ac.in/electrical/highvoltage/pdf/syllabus_PG_HVE.pdf
2. https://www.eolss.net/Sample-Chapters/C05/E6-39-59-02.pdf
3. https://www.ipstconf.org/papers/Proc_IPST2007/07IPST110.pdf
4. https://electricalbaba.com/travelling-wave-transmission-line/
5. https://go-pdf.online/insulation-coordination-for-ais-and-gis.pdf

II M.Tech-I SEM (EPS)

Course Title: FLEXIBLE AC TRANSMISSION SYSTEMS ((PROFESSIONAL ELECTIVE - V)	**Course Code:AS20-D07PE18**
Teaching Scheme (L:T:P):3 0 0	**Credits:3**
Type of Course: Lecture + Assignment	**Total Contact Periods:**
Continuous Internal Evaluation-30 Marks	**Semester End Exams-70 Marks**
Prerequisites: Power Electronics and Power Systems	
Programme: EEE	

Course Objectives: to prepare the students to

- Identify the limitations of uncompensated lines under various loading conditions.
- Understand the concept and importance of compensation through FACTS devices
- Explore shunt compensation, and basic operation of SVC, STATCOM and UPFC.
- Analyze the functioning of series controllers like GCSC, TSSC, TCSC and SSSC

Course Outcomes:

CO	Course Outcomes	PO	PSO
C212.1	Understand real and reactive power flow control in ac systems and various control issues, for the purpose of identifying the scope and for selection of specific FACTS controllers.	1,2	2
C212.2	Apply different current sourced and voltage sourced converters for solving problems of simple power systems with FACTS controllers.	1,2,3	2,3
C212.3	Understand and apply the concepts of different static shunt compensators.	1,2	2
C212.4	Apply the concepts of different static shunt compensators.	1,2,3	1,2,3
C212.5	Understand the concepts of different static series compensators.	1,2	1,2
C212.6	Apply the concepts of different static series compensators.	1,4,5	3

COURSE CONTENT (SYLLABUS)

UNIT-I: CONCEPT OF FACTS

Transmission interconnections power flow in an AC system, loading capability limits, Dynamic stability considerations, importance of controllable parameters basic types of FACTS controllers, benefits from FACTS controllers.

UNIT-II: VOLTAGE & CURRENT SOURCE CONVERTERS

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-III: STATIC SHUNT COMPENSATION

Objectives of shunt compensation, mid-point voltage regulation, voltage instability prevention,improvement of transient stability, Power oscillation damping, Methods of controllable VAR generation, variable impedance type static VAR generators switching converter type VAR generators, hybrid VAR generators.

UNIT-IV: STATIC SERIES COMPENSATION

Concept of series capacitive compensation, improvement of transient stability, power oscillation damping, and functional requirements of GTO thyristor controlled series capacitor (GSC), thyristor switched series capacitor (TSSC), and thyristor controlled series capacitor (TCSC),static synchronousseries compensator (SSSC), control schemes for GSC, TSSC, TCSC and SSSC.

UNIT-V: SVC & UPFC

The regulation and slope transfer function and dynamic performance, transient stability enhancement and power oscillation damping operating point control and summary of compensator control., basic concept of unified power flow controller (UPFC).

TEXT BOOKS:

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

REFERENCES:

1. Prof. Avik Bhattacharya , IIT Roorkee, NPTEL Course on Flexible AC Transmission Systems (FACTS), July 2018, https://www.youtube.com/playlist?list=PLLy_2iUCG87AVyRAN4QwVQrC8vSg1vWa6
2. Zhang, Xiao-Ping, Rehtanz, Christian, Pal, Bikash "Flexible AC Transmission Systems: Modeling and Control", Springer, 2012.
3. Yong-Hua Song, Allan Johns, "Flexible AC Transmission Systems", IET, 1999.

II M.Tech-I SEM (EPS)

Course Title GAS INSULATED SYSTEMS (PROFESSIONAL ELECTIVE - V)	**Course Code AS20-D07PE07**
Teaching Scheme (L:T:P): 3 0 0	**Credits:3**
Type of Course: Lecture + Assignment	**Total Contact Periods: 3**
Continuous Internal Evaluation-30 Marks	**Semester End Exams-70 Marks**
Prerequisites: Switch Gear and Protection	
Programme: EPS	

Course Overview:

Direct current gas-insulated switchgear assemblies
DC GIS
Direct current gas-insulated transmission lines
DC GIL
Modular design
Underground installation
Containerized installation
Offshore platform installation
Transition station

Course Objective

To prepare the students to

- understand the GIS concepts and principles
- distinguish Air Insulated and Gas insulated Substations demonstrate the design and constructional aspects of GIS
- analyze transient phenomenon, problems and diagnostic methods in GIS

Course Outcomes(s)

CO#	Course Outcomes	POs	PSOS
C211.1	Upon the completion of this course, the student will be able to Know the advantages of GIS systems over air insulated systems	**4,5**	**1,3**
C211.2	Observe constructional design features of GIS design	**1,5**	**1**
C211.3	Discriminate the problems and design diagnostic methods of GIS	**1,2,5**	
C211.4	understand the concept of random variables, functions of random variable and their probability distribution	**2,5**	**1**
C211.5	understand stochastic processes and their classification	**1,2,12**	**1,3**
C21.6	Characteristics of imperfections in insulation Insulation Diagnostic methods PD Measurement and UHF Method.	**1,2,5,12**	**3**

COURSE CONTENT (SYLLABUS)

UNIT–I: INTRODUCTION TO GIS AND PROPERTIES OF SF6

Characteristics of GIS- Introduction to SF6 - Physical properties-Chemical properties - Electrical properties-Specification of SF6 gas for GIS application - Handling of SF6 gas before use - Safe handling of Sf6 gas in electrical equipment - Equipment for handling the SF6 Gas - SF6 and environment.

UNIT–II: LAYOUT OF GIS STATIONS

Advancement of GIS station - Comparison with Air Insulated Substation - Economics of GIS – User Requirements for GIS - Main Features for GIS - Planning and Installation components of a GIS station.

UNIT–III: DESIGN AND CONSTRUCTION OF GIS STATION

Introduction - Rating of GIS components - Design Features - Estimation of different types of Electrical Stresses -Design Aspects of GIS components - Insulation Design for Components - Insulation Design for GIS - Thermal Considerations in the Design of GIS - Effect of very Fast Transient Over-voltages (VFTO) on the GIS design - Insulation Coordination systems - Gas handling and Monitoring System Design.

UNIT-IV: FAST TRANSIENT PHENOMENA IN GIS

Introduction - Disconnector Switching in Relation to Very fast Transients-Origin of VFTO-Propagation and Mechanism of VFTO-VFTO Characteristics- Effects of VFTO-Testing of GIS for VFTO.

UNIT–V: SPECIAL PROBLEMS IN GIS AND GIS DIAGNOSTICS

Introduction - particles their effects and their control- Insulating Spacers and their Reliability - SF6 Gas Decomposition - Characteristics of imperfections in insulation - Insulation Diagnostic methods – PD Measurement and UHF Method.

TEXT BOOKS:

1. M. S. Naidu," Gas Insulated Substations"- IK International Publishing House.
2. Hermann J. Koch, "Gas Insulated Substations", June 2014, Wiley - IEEE Press.

REFERENCES:

1. Olivier Gallot-Lavellee, "Dielectric materials and Electrostatics" , Wiley - IEEE Press.
2. Jaun Martinez, "Dielectric Materials for Electrical Engineering", Wiley - IEEE Press.

ONLINE RESOURCES (SWAYAM/NPTEL/MOOCS/COURSERA):

1. https://www.youtube.com/watch?v=D4RFFnzRdkk&list=PLSRCPd4kA2-S2Cu1tYUe5WGmc959y50Xf
2. https://swayam.gov.in/nd1_noc19_ee69/

II M. TECH. I Sem. (EPS)

Course Title: SCADA SYSTEM AND APPLICATIONS (PROFESSIONAL ELECTIVE - V)	**Course Code:** AS20-D07PE20
Teaching Scheme (L:T:P): 3 0 0	**Credits:3**
Type of Course: Lecture + Assignment	**Total Contact Periods:48**
Continuous Internal Evaluation-30 Marks	**Semester End Exams-70 Marks**
Prerequisites: NIL	

Course Overview:
To understand about SCADA and learn about its components used in various industries. To study how SCADA systems is applied in transmission and distribution sectors and various SCADA architectures, advantages and disadvantages of each System, single unified standard architectures to understand.

Course Objective
- To study and understand about Supervisory Control and Data Acquisition System(SCADA)
- To know SCADA communication and its functions
- To get an insight into its application

Course Outcomes(s)

CO#	Course Outcomes	POs	PSOS
C211.1	Describe the basic tasks of SCADA	**1,5**	**1**
C211.2	Acquire knowledge about SCADA architecture, various advantages and disadvantages of each System.	**1,4,**	**1,2**
C211.3	To understand about single unified standard architecture IEC 61850.	**3,4**	**2,3**
C211.4	To learn about SCADA system components: remote terminal units, PLCs, intelligent electronic devices, HMI systems, SCADA server.arry out different testing methods to predetermine the efficiency of DC machines	**1,2,6**	**2,3**
C211.5	To Apply SCADA systems in transmission and distribution sectors.	**1,2**	**1,2**
C21.6	To understand various industrial communication technologies used.	**1,2,5,4**	**2**

COURSE CONTENT (SYLLABUS)
UNIT–I: INTRODUCTION TO SCADA,
Data acquisition systems, Evolution of SCADA, Communication technologies.
Monitoring and supervisory functions, SCADA applications in Utility Automation, Industries SCADA.

UNIT–II: SCADA COMPONENTS
Industries SCADA System Components, Schemes- Remote Terminal Unit (RTU), Intelligent Electronic Devices(IED), Programmable Logic Controller (PLC), Communication Network, SCADA Server, SCADA/HMI Systems.

UNIT–III: SCADA ARCHITECTURE

Various SCADA architectures, advantages and disadvantages of each System, single unified standard architecture -IEC 61850.

UNIT–IV: SCADA COMMUNICATION

various industrial communication technologies, wired and wireless methods and fiber optics, Openstandard communication protocols.

UNIT–V: SCADA APPLICATIONS:

Utility applications**,** Transmission and Distribution sector operations, monitoring, analysis and improvement**,** Industries - oil, gas and water, Case studies, Implementation, Simulation Exercises.

TEXT BOOKS:

1. Stuart A. Boyer: "SCADA-Supervisory Control and Data Acquisition", Instrument Society of America Publications, USA, 2004.
2. Gordon Clarke, Deon Reynders: "Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems", Newnes Publications, Oxford, UK, 2004.

REFERENCES:

1. William T. Shaw, "Cybersecurity for SCADA systems", PennWell Books, 2006.
2. David Bailey, Edwin Wright, "Practical SCADA for industry", Newnes, 2003.
3. Michael Wiebe, "A guide to utility automation: AMR, SCADA, and IT systems for electric power", PennWell 1999.

ONLINE RESOURCES (SWAYAM/NPTEL/MOOCS/COURSERA):

1. NPTEL Videos on Course "*Energy management system and SCADA* " Co-ordinated by IIT MADRAS
   Link: https://nptel.ac.in/courses/108/106/108106022/#

WEB REFERENCE/E-BOOKS:

1) SCADA By Ronald Reagan

https://www.pdfdrive.com/page-1-page-2-scada-supervisory-control-and-data-acquisition-e10705382.html

2) SCADAForbegineers by Kindle Edition.
http://studioangelart.com/prokla/?q=Scada+beginners+guide.html

I M. TECH. I Sem. (EPS)

Course Title: ENGLISH FOR RESEARCH PAPER WRITING (Audit Course - I)	**Course Code:** AS20-D07AC11
Teaching Scheme (L:T:P): 2 0 0	**Credits:0**
Type of Course: Lecture + Assignment	**Total Contact Periods:32**
Prerequisites: NIL	

Course objectives: Students will be able to:

- Understand that how to improve your writing skills and level of readability
- Learn about what to write in each section
- Understand the skills needed when writing a Title Ensure the good quality of paper at very first time submission

UNIT-I:

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

UNIT-II:

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction.

UNIT-III:

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

UNIT-IV:

key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.

UNIT-V:

skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions. useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

TEXT BOOKS/ REFERENCES:

1. Goldbort R (2006) Writing for Science, Yale University Press.
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press.
3.Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.
4.Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

I M. TECH. I Sem. (EPS)

Course Title: DISASTER MANAGEMENT (Audit Course - I)	**Course Code:** AS20-D07AC12
Teaching Scheme (L:T:P): 2 0 0	**Credits:0**
Type of Course: Lecture + Assignment	**Total Contact Periods:32**
Prerequisites: NIL	

Course Objectives: Students will be able to

- learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- critically understand the strengths and weaknesses of disaster management approaches,
- planning and programming in different countries, particularly their home country or the countries they work in

UNIT-I:INTRODUCTION

Disaster: Definition, Factors and Significance; Difference Between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

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

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

UNIT-III: DISASTER PREPAREDNESS AND MANAGEMENT

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 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 in Risk Assessment. Strategies for Survival.

UNIT-V: DISASTER MITIGATION

Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation

and Non-Structural Mitigation, Programs of Disaster Mitigation in India.

TEXT BOOKS/ REFERENCES:

1.R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.

2.Sahni, Pardeep Et. Al. (Eds.)," Disaster Mitigation Experiences and Reflections", Prentice Hall of India, New Delhi.

3.Goel S. L., Disaster Administration and Management Text and Case Studies", Deep &Deep Publication Pvt. Ltd., New Delhi.

I M. TECH. I Sem. (EPS)

Course Title SANSKRIT FOR TECHNICAL KNOWLEDGE (Audit Course - I)	**Course Code:** AS20-D07AC13
Teaching Scheme (L:T:P): 2 0 0	**Credits:0**
Type of Course: Lecture + Assignment	**Total Contact Periods:32**
Prerequisites: NIL	

Course Objectives:

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- Learning of Sanskrit to improve brain functioning
- Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
- The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

Course Outcomes: Students will be able to

- Understanding basic Sanskrit language
- Ancient Sanskrit literature about science & technology can be understood
- Being a logical language will help to develop logic in students

UNIT-I:
Alphabets in Sanskrit

UNIT-II:
Past/Present/Future Tense, Simple Sentences

UNIT-III:
Order, Introduction of roots,

UNIT-IV:
Technical information about Sanskrit Literature

UNIT-V:
Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

TEXT BOOKS/ REFERENCES:

1. "Abhyaspustakam" – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

I M. TECH. I Sem. (EPS)

Course Title : VALUE EDUCATION (Audit Course - I)	**Course Code:** AS20-D07AC14
Teaching Scheme (L:T:P): 2 0 0	**Credits:0**
Type of Course: Lecture + Assignment	**Total Contact Periods:32**
Prerequisites: NIL	

Course Objectives: Students will be able to

- Understand value of education and self- development
- Imbibe good values in students
- Let the should know about the importance of character

Course outcomes: Students will be able to

- Knowledge of self-development
- Learn the importance of Human values
- Developing the overall personality

UNIT-I:

Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgements.

UNIT-II:

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration.Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline.

UNIT-III:

Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline, Punctuality, Love and Kindness.

UNIT-IV:

Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature.

UNIT-V:

Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation, Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively.

TEXT BOOKS/ REFERENCES:

1. Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press, New De

I M. TECH. II Sem. (EPS)

Course Title : PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS (Audit Course - II)	**Course Code:** AS20-D07AC21
Teaching Scheme (L:T:P): 2 0 0	**Credits:0**
Type of Course: Lecture + Assignment	**Total Contact Periods:32**
Prerequisites: NIL	

Course Objectives:

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

Course Outcomes: Students will be able to

- Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and mankind to peace and prosperity
- Study of Neetishatakam will help in developing versatile personality of students

UNIT-I:

Neetisatakam-Holistic development of personality

- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)

UNIT-II:

Neetisatakam-Holistic development of personality

- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)

UNIT-III:

Approach to day to day work and duties.

- Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

UNIT-IV:

Statements of basic knowledge.

- Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68
- Chapter 12 -Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad Bhagwad Geeta:

UNIT-V:

- Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4-Verses 18, 38,39
- Chapter18 – Verses 37,38,63

TEXT BOOKS/ REFERENCES:

1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata.
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

I M. TECH. II Sem. (EPS)

Course Title : PEDAGOGY STUDIES (Audit Course - II)	**Course Code:** AS20-D07AC22
Teaching Scheme (L:T:P): 2 0 0	**Credits:0**
Type of Course: Lecture + Assignment	**Total Contact Periods:32**
Prerequisites: NIL	

Course Objectives: Students will be able to:

- Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

Course Outcomes: Students will be able to understand:

- What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

UNIT-I: INTRODUCTION AND METHODOLOGY

Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions**.** Overview of methodology and Searching.

UNIT-II: THEMATIC OVERVIEW

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

UNIT-III: PEDAGOGICAL PRACTICES

Evidence on the effectiveness of pedagogical practices, Methodology for the indepth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the scho curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT-IV: PROFESSIONAL DEVELOPMENT

Professional development: alignment with classroom practices and follow-up support, Peer support, Support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes.

UNIT-V: RESEARCH GAPS AND FUTURE DIRECTIONS

Research gaps and future directions: Research design**,** Contexts**,** Pedagogy**,** Teacher education**,** Curriculum

and assessment**,** Dissemination and research impact.

TEXT BOOKS/ REFERENCES:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher Education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

I M. TECH. II Sem. (EPS)

Course Title : STRESS MANAGEMENT BY YOGA (Audit Course - II)	**Course Code:** AS20-D07AC23
Teaching Scheme (L:T:P): 2 0 0	**Credits:0**
Type of Course: Lecture + Assignment	**Total Contact Periods:32**
Prerequisites: NIL	

Course Objectives:

- To achieve overall health of body and mind
- To overcome stress

Course Outcomes: Students will be able to:

- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

UNIT-I:

Definitions of Eight parts of yog. (Ashtanga)

UNIT-II:

Yam and Niyam.

UNIT-III:

Do`s and Don't's in life.

i) Ahinsa, satya, astheya, bramhacharya and aparigraha

ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

UNIT-IV:

Asan and Pranayam

UNIT-V:

i) Various yog poses and their benefits for mind & body

ii) Regularization of breathing techniques and its effects-Types of pranayam

TEXT BOOKS/ REFERENCES:

1. 'Yogic Asanas for Group Tarining-Part-I": Janardan Swami Yogabhyasi Mandal, Nagpur

2."Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

I M. TECH. II Sem. (EPS)

Course Title: ECONOMIC POLICIES IN INDIA (Audit Course - II)	**Course Code:** AS20-D07AC24
Teaching Scheme (L:T:P): 2 0 0	**Credits:0**
Type of Course: Lecture + Assignment	**Total Contact Periods:32**
Prerequisites: NIL	

COURSE OBJECTIVES:

1.To analyze the overall business environment and evaluate its various components in business decision making.
2. To Provide an analysis and examination of significant contemporary ethical issues and challenges.
3.To Emphases the manager's social and environmental responsibilities to a wide variety of stakeholders.
4. To know the various Government policies governing industry.
5. To know economic terms and its scope.

COURSE OUTCOMES:

1. Familiarize with the nature of business environment and its components.
2.The students will be able to demonstrate and develop conceptual framework of business environment.
3. Understand the definition of ethics and the importance and role of ethical behaviour in the business world today.
4. Explain the effects of government policy on the economic environment. 5. Outline how an entity operates in a business environment.

UNIT 1: BUSINESS ENVIRONMENT

Factors effecting Business Environment-need for industrial policies-Overview of Indian Economy, Trends towards market economy, problems of underdevelopment – meaning, Main problems, reasons, of underdevelopment.

UNIT :2 DEVELOPMENT AND ITS MEASUREMENT

Meaning of Economic development, National income, Per capital income, Quality of life, Capital Formation – Savings, Investment.

UNIT 3: PLANNING IN INDIA

Meaning, Importance, Main reasons of adopting, planning in India, Objectives of planning, Economic development, moderation, stability, self-sufficiency, employment etc, foreign aid, Employment. Allocation of Resources,

UNIT 4: PRIVATE AND PUBLIC SECTOR

Public Sector – role and growth, Achievements of the public sector, Private Sector – Importance Problems, New foreign Trade Policy.

UNIT 5: PRESENT ECONOMIC POLICY

Main features, Globalization, Expansion of Private sector, more market orient approach. Public distribution

system, Industrial policy – 1948, 1956, 1977, 1980, 1990, 1991, 2000-2001, Industrial Licensing, Monetary and Fiscal Policy.

REFERENCES:

1.Indian Economy- A. N. Agarwal
2.Indian Economy – Mishra &Puri
3. Indian Development and planning – M. L. Jhingan
4. Indian Economy – R. S. Rastogi Yozna and Kurukshetra Magazines